Computer Science

Study plan and subject sheets

February 2025

(EPI) *Private Higher International Polytechnic School (Approval No. 2011-02)*
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Summary

Study Plan ....

SUBJECT SHEETS CLASS : THIRD YEAR ....

SUBJECT SHEETS SPECIALTY:SOFTWARE ENGINEERING ....

SUBJECT SHEETS SPECIALTY: ARTIFICIAL INTELLIGENCE...

SUBJECT SHEETS SPECIALTY: CYBERSECURITY ....

SUBJECT SHEETS SPECIALTY: CLOUD....

SUBJECT SHEETS SPECIALTY: VIRTUAL REALITY AND GAME ENGINEERING ......

COMMON CROSS-CURRICULAR SUBJECT SHEETS ......

SUBJECTSHEETS LANGUAGES....

SUBJECTSHEETS PROJECTS AND INTERNSHIPS ....

Study Plan

Overview

The aim of the Computer Science training at the École Internationale Supérieure Privée Polytechnique de Sousse (EPI) is to train future engineers with a strong competence-based approach aligned with the Dublin Descriptors. The program ensures that graduates acquire a combination of knowledge, skills, and attitudes necessary to excel in various domains of computer engineering.

The training is structured into two semesters of common core studies, followed by four semesters of specialization in one of six fields, culminating in a final-year project. The learning outcomes across all specializations are designed to address the full range of competences as defined by the Dublin Descriptors:

1. **Knowledge and Understanding**: Graduates will demonstrate advanced theoretical and applied knowledge in computer engineering, including state-of-the-art methodologies and technologies.
2. **Applying Knowledge and Understanding**: Students will develop problem-solving skills through hands-on projects, case studies, and industry collaborations.
3. **Making Judgments**: The program emphasizes critical thinking and decision-making in complex engineering scenarios, ensuring ethical and professional responsibility.
4. **Communication Skills**: Graduates will be able to effectively communicate technical information to diverse audiences, using both written and oral forms.
5. **Learning Skills**: The program fosters lifelong learning and adaptability, preparing students for continuous professional development and research.

General skills developed

Skills acquired through the program include :

- Mastery of programming paradigms and software development methodologies.
- Design and management of complex IT architectures.
- Competence in IT security and data protection.
- Ability to analyze, model and optimize IT systems.
- Adaptability to new technologies and ability to lead innovation projects.
- Effective collaboration within multidisciplinary and international teams.

Specializations and Competence-Oriented Learning Outcomes

- **Software Engineering**: Graduates will master software development life cycles, programming paradigms, DevOps methodologies, and cloud-based solutions. They will be proficient in designing scalable and maintainable software systems and possess strong collaborative and communication skills for working in interdisciplinary teams.
- **Artificial Intelligence and Data Science**: This specialization equips students with expertise in machine learning, deep learning, natural language processing, and data-driven decision-making. They will be able to design intelligent systems and apply AI techniques to solve real-world problems across various industries.
- **Cybersecurity**: Students will gain in-depth knowledge of security protocols, ethical hacking, cryptography, and risk assessment. They will develop the ability to implement robust security measures, ensuring the protection of information systems against cyber threats.
- **Cloud Computing and Networks**: Graduates will be skilled in cloud architecture, virtualization, and network security. They will understand how to design, deploy, and optimize cloud-based infrastructures using platforms such as AWS, Azure, and Google Cloud.
- **IoT and Robotic Programming**: This track focuses on embedded systems, sensor networks, and robotic automation. Graduates will be able to develop and integrate intelligent systems for industrial and consumer applications, ensuring connectivity and automation in smart environments.
- **Virtual Reality and Game Engineering**: Students will develop expertise in interactive software development, 3D modeling, and immersive system design. They will be proficient in using game engines like Unity and Unreal Engine, ensuring innovation in gaming and simulation applications.

Conclusion

The EPI Computer Science program ensures a strong alignment with the Dublin Descriptors, emphasizing competency-based education, professional readiness, and interdisciplinary knowledge. Graduates are equipped with theoretical foundations, hands-on experience, and problem-solving abilities to excel in an ever-evolving digital landscape.

Common Core

Level	3-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-TC 3 1 03	Architecture of microprocessor systems and microcontrollers	1.5	2	1.5	-
Inf-TC 3 1 04	Advanced operating systems	1.5	2	-	1.5
Inf-TC 3 1 05	Advanced algorithmic 1	1.5	2	1.5	-
Inf-TC3 1 06	Advanced C Programming Workshop	3	4	-	3
Inf-TC 3 1 07	Computer networks	1.5	2	-	1.5
Inf-TC 3 1 12	IT security	1.5	2	-	1.5
Inf-TC 3 1 08	Digital signal acquisition and processing	1.5	2	1.5	-
Inf-TC 3 1 09	Data base	3	3	1.5	1.5
Inf-TC 3 1 10	Web development	3	3	-	3
Inf-TC 3 1 11	Engineering mathematics	1.5	2	1.5	-
Inf-TC 3 1 13	Introduction to Artificial Intelligence	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	3-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-TC 3 2 03	Object Oriented Programming	3	4	-	3
Inf-TC 3 2 04	Advanced Algorithmics 2	3	3	1.5	1.5
Inf-TC 3 2 05	Preparation for computer network certification	3	3	1.5	1.5
Inf-TC3 2 06	Systems architecture, embedded systems and IoT	3	4	1.5	1.5
Inf-TC 3 2 07	DBMS workshop	1.5	2	-	1.5
Inf-TC 3 2 08	Advanced web development	3	4	-	3
Inf-TC 3 2 09	Python Programming	1.5	2	-	1.5
Inf-TC 3 2 10	Image processing	1.5	2	-	1.5
Inf-TC 3 2 11	Object modeling	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Software engineering

Level **4-S1**

Coded	Matter	Coef	Credit	Course/week	TP/week
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-GL 4 1 04	Data analysis	1.5	2	-	1.5
Inf-GL 4 1 03	Integration project	1.5	2	1.5	-
Inf-GL 4 1 09	Machine Learning	2.25	2	0.75	1.5
Inf-GL 4 1 05	Software architecture	1.5	2	1.5	-
Inf-GL 4 1 08	Native Mobile Development 1 (Android)	3	4	-	3
Inf-GL 4 1 07	.Net development (C# & ASP.NET)	3	4	-	3
Inf-GL 4 1 11	Advanced object modeling	1.5	2	1.5	-
Inf-GL 4 1 12	Virtualization & Cloud	1.5	2	-	1.5
Inf-GL 4 1 10	Advanced OOP	3	4	-	3
Inf-GL 4 1 06	Advanced databases	2.25	2	0.75	1.5
	Total	**24**	**30**	**24**	

Level **4-S2**

Coded	Matter	Coef	Credit	Course/week	TP/week
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-GL 4 2 07	Deep Learning	2.25	2	0.75	1.5
PFA	PFA Scientific Project	3	3	-	3
Inf-GL 4 2 04	Agile and hybrid methodologies	1.5	2	1.5	-
Inf-GL 4 2 10	UI/UX Design	1.5	2	-	1.5
Inf-GL 4 2 05	Full stack development (React JS)	3	4	-	3
Inf-GL 4 2 08	Java EE (Level 1)	3	4	-	3
Inf-GL 4 2 09	Design Patterns	2.25	3	0.75	1.5
Inf-GL 4 2 12	DevOps (Level 1)	1.5	2	-	1.5
Inf-GL 4 2 06	Native Mobile Development 2 (iOS)	1.5	2	-	1.5
Inf-GL 4 2 11	Cloud Services Certification (AZURE)	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-GL 5 1 01	Minor 1: ESB certification	1.5	2	1.5	-
Inf-GL 5 1 02	Minor 2: IT law	1.5	2	1.5	-
Inf-GL 5 1 03	Minor 3: Digital Marketing (MD)	1.5	2	-	1.5
Inf-GL 5 1 04	Minor 4: Finance for engineers	1.5	2	1.5	-
Inf-GL 5 1 09	Software quality and automated testing	1.5	2	1.5	-
Inf-GL 5 1 06	Business Intelligence (BI)	1.5	2	-	1.5
Inf-GL 5 1 05	Big Data	3	3	-	3
Inf-GL 5 1 07	Cross-Platform Framework (Flutter)	3	3	-	3
Inf-GL 5 1 08	DevOps	1.5	2	-	1.5
Inf-GL 5 1 10	Java EE (SpringBoot)	1.5	2	-	1.5
Inf-GL 5 1 12	Technology Monitoring (IoT)	1.5	2	-	1.5
Inf-GL 5 1 11	GL Seminars (Design Thinking, Cybersecurity, Public Speaking, Gaming & VR, BlockChain, ...)	3	4	3	-
Inf-GL 5 1 13	Deep learning 2 (NLP)	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

Artificial intelligence

Level	**4-S1**				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-IA 4 1 03	Software Architecture & Design Patterns	1.5	2	-	1.5
Inf-IA 4 1 04	Virtualization and cloud	3	4	1.5	1.5
Inf-IA 4 1 05	NO SQL Databases	3	4	-	3
Inf-IA 4 1 06	Data mining	1.5	2	-	1.5
Inf-IA 4 1 07	Artificial intelligence foundations	3	4	1.5	1.5
Inf-IA 4 1 08	Data analysis	3	3	-	3
Inf-IA 4 1 09	Python OO	3	3	-	3
Inf-IA 4 1 10	Data warehouses	1.5	2	-	1.5
Inf-IA 4 1 11	Integration project (AI project)	1.5	2	-	1.5
	Total	**24**	**30**	**24**	

Level	**4-S2**				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-IA 4 2 03	Agile methodologies	1.5	2	1.5	-
Inf-IA 4 2 04	Cloud computing (preparation for the Amazon certificate)	3	3	1.5	1.5
Inf-IA 4 2 05	preparation for HCAI certification	3	3	1.5	1.5
Inf-IA 4 2 06	Machine learning	3	4	1.5	1.5
Inf-IA 4 2 07	Data Science oriented Python	1.5	2	-	1.5
Inf-IA 4 2 08	Stochastic models	1.5	2	-	1.5
PFA	PFA Scientific Project	1.5	2	-	1.5
Inf-IA 4 2 10	Computer Vision	1.5	2	-	1.5
Inf-IA 4 2 11	Big Data I (Hadoop/Mapreduce)	3	4	-	3
Inf-IA 4 2 12	Azure Certificate	1.5	2	-	1.5
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-IA 5 1 01	BSE	1.5	2	1.5	-
Inf-IA 5 1 02	Engineering Law and Ethics	1.5	2	1.5	-
Inf-IA 5 1 03	Devops/MLops	1.5	2	1.5	-
Inf-IA 5 1 04	Business Intelligence	1.5	2	-	1.5
Inf-IA 5 1 05	Natural Language Processing (NLP)	3	2	1.5	1.5
Inf-IA 5 1 06	Big Data 2 (Spark)	3	4	-	3
Inf-IA 5 1 07	Deep learning	3	4	-	3
Inf-IA 5 1 08	Pattern recognition (image recognition)	1.5	2	-	1.5
Inf-IA 5 1 09	Finance for the Engineer	1.5	2	1.5	-
Inf-IA 5 1 10	Data visualization	1.5	2	-	1.5
Inf-IA 5 1 11	Robotics	1.5	2	-	1.5
Inf-IA 5 1 12	Digital Marketing	1.5	2	-	1.5
Inf-IA 5 1 13	Blockchain	1.5	2	-	1.5
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Cred it**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

Cybersecurity

Level	4-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
INF-CYB 4 1 03	Native mobile development 1	1.5	2	-	1.5
INF-CYB 4 1 04	Data analysis	1.5	2	-	1.5
INF-CYB 4 1 05	Full stack development (Php, JS, React, Angular, etc.)	1.5	2	-	1.5
INF-CYB 4 1 06	Integration project (applied to security)	1.5	2	-	1.5
INF-CYB 4 1 07	Artificial intelligence 1	3	2	1.5	1.5
INF-CYB 4 1 08	Advanced databases	1.5	2	-	1.5
INF-CYB 4 1 09	CyberOps I	1.5	2	-	1.5
INF-CYB 4 1 10	Cybersecurity Foundations	3	4	1.5	1.5
INF-CYB 4 1 11	Applied cryptography	1.5	2	1.5	-
INF-CYB 4 1 12	Network Security I	1.5	2	-	1.5
INF-CYB 4 1 13	Systems Administration 1	3	4	1.5	1.5
	Total	**24**	**30**	**24**	

Level	4-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/wee k**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
INF-CYB 4 2 03	Cloud Computing Services (Azure Certification)	1.5	2	-	1.5
INF-CYB 4 2 04	Native mobile development 2	1.5	2	-	1.5
INF-CYB 4 2 05	Artificial Intelligence 2 (Amazon Certification)	3	2	1.5	1.5
PFA	PFA Scientific Project (applied to security)	1.5	2	-	1.5
INF-CYB 4 2 07	Linux Services Security (CEH)	3	4	-	3
INF-CYB 4 2 08	CyberOps II (CISCO Certification)	3	4	-	3
INF-CYB 4 2 09	Cloud Computing and Virtualization (Amazon Certification)	3	4	-	3
INF-CYB 4 2 10	Systems Administration 2	3	4	-	3
INF-CYB 4 2 11	Network Security II (CISCO Certification)	1.5	2	-	1.5
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
INF-CYB 5 1 01	Minor 1: ESB certification	1.5	2	-	1.5
INF-CYB 5 1 02	Minor 2: Digital Marketing	1.5	2	-	1.5
INF-CYB 5 1 03	Minor 3: Finance for engineers	1.5	2	1.5	-
INF-CYB 5 1 04	Technology Monitoring (DevSecOps, etc.)	3	2	3	-
INF-CYB 5 1 05	Information Systems Security Audit	3	4	3	-
INF-CYB 5 1 06	Intrusion Detection Systems (IDS)	1.5	2	-	1.5
INF-CYB 5 1 07	Security of Connected Objects (IoT)	1.5	2	-	1.5
INF-CYB 5 1 08	Virtual Private Network (VPN)	1.5	2	-	1.5
INF-CYB 5 1 09	Digital investigation (forensic)	1.5	2	-	1.5
INF-CYB 5 1 10	Cloud Computing Security	1.5	2	0.75	0.75
INF-CYB 5 1 11	Firewall administration	3	4	-	3
INF-CYB 5 1 12	Pentesting	3	4	-	3
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

Cloud Computing and Networks

Level	**4-S1**				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-ICC 4 1 01	The fundamentals of Cloud Computing	3	3	1.5	1.5
Inf-ICC 4 1 02	Management of a Data Center	1.5	2	1.5	-
Inf-ICC 4 1 03	Advanced Database	3	3	1.5	1.5
Inf-ICC 4 1 04	Development of Distributed Applications	3	3	1.5	1.5
Inf-ICC 4 1 05	Introduction to data analysis	1.5	3	-	1.5
Inf-ICC 4 1 06	Network protocol engineering	1.5	3	1.5	-
Inf-ICC 4 1 07	System administration	3	3	-	3
Inf-ICC 4 1 08	Server administration	3	3	1.5	1.5
Inf-ICC 4 1 09	Integration project	1.5	3	-	1.5
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	**4-S2**				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-ICC 4 2 01	DevOps	4.5	4	1.5	3
Inf-ICC 4 2 02	Cloud Computing Security and Network Auditing	3	4	1.5	1.5
Inf-ICC 4 2 03	Development of web services applications on cloud platforms	3	3	1.5	1.5
PFA	PFA	1.5	3	-	1.5
Inf-ICC 4 2 05	Big Data	3	3	1.5	1.5
Inf-ICC 4 2 06	Advanced server administration	3	3	-	3
Inf-ICC 4 2 07	Management of cloud computing infrastructures	1.5	3	1.5	-
Inf-ICC 4 2 08	Preparation for MOS certification	1.5	3	-	1.5
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-ICC 5 1 01	Agile Methods adapted to Cloud applications	1.5	3	1.5	-
Inf-ICC 5 1 02	SaaS and PaaS operational solutions	1.5	2	1.5	-
Inf-ICC 5 1 03	Development Technologies and DBMS for Cloud Applications	3	3	-	3
Inf-ICC 5 1 04	Administration of Cloud platforms and Web services.	3	3	1.5	1.5
Inf-ICC 5 1 05	Hybrid mobile development of cloud applications	3	3	1.5	1.5
Inf-ICC 5 1 06	Firewall Administration	1.5	3	-	1.5
Inf-ICC 5 1 07	Data Analysis and BI	3	3	1.5	1.5
Inf-ICC 5 1 08	Cloud for IoT	1.5	2	-	-
Inf-ICC 5 1 09	BSE	1.5	2	1.5	-
Inf-ICC 5 1 10	Finance for the engineer	1.5	2	1.5	-
Inf-ICC 5 1 11	Digital Marketing	1.5	2	1.5	-
Inf-ICC 5 1 12	Law and intellectual property	1.5	2	1.5	-
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

IoT and Robotic Programming

Level	4-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
IoT4.S1.03	Advanced OOP	3	3	-	3
IoT4.S1.04	Advanced python programming	3	3	-	3
IoT4.S1.05	Advanced web development (FrameWork)	3	3	-	3
IoT4.S1.06	Cloud computing and IoT services	1.5	2	-	1.5
IoT4.S1.07	Databases and Data Storage for IoT	1.5	2	-	1.5
IoT4.S1.08	Integration project	1.5	2	1.5	-
IoT4.S1.09	IoT communication protocols (MQTT, CoAP, LoRa, etc.)	3	4	-	3
IoT4.S1.10	Security of IoT systems and Cybersecurity	1.5	3	1.5	-
IoT4.S1.11	IoT system architecture and design (IoT programming primer)	3	4	--	3
	Total	**24**	**30**	**24**	

Level	4-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
IoT4.S2.03	AI and Machine Learning applied to IoT (AIoT)	3	3	-	3
IoT4.S2.04	Mobile Development and Web Services (React Native)	3	3	-	3
PFA	PFA Scientific Project (Design of a Connected IoT solution)	3	4	3	-
IoT4.S2.06	Advanced IoT Projects (Smart Healthcare, Smart Agricultur, Smart City, Smart Home, Smart Car, etc.)	3	4	-	3
IoT4.S2.07	Robotics and Cobotics (collaborative robot)	3	3	-	3
IoT4.S2.08	The fundamentals of PCB (Printed Circuit Board) design	1.5	3	-	1.5
IoT4.S2.09	Design of smart sensors and actuators for IoT	1.5	2	-	1.5
IoT4.S2.10	Advanced microcontroller-based programming	3	4	-	3
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
IoT5.S1.01	Minor 1: ESB certification	1.5	2	1.5	-
IoT5.S1.02	Minor 2: Ethics and Governance of IoT Technologies	1.5	2	1.5	-
IoT5.S1.03	Minor 3: Digital Marketing	1.5	2	-	1.5
IoT5.S1.04	Minor 4: Finance for engineers	1.5	2	1.5	-
IoT5.S1.05	Federated project (agile method)	1.5	2	1.5	-
IoT5.S1.06	Computer vision	3	3	-	3
IoT5.S1.07	Introduction to Industry 4.0	1.5	2	1.5	-
IoT5.S1.08	IoT Data Analysis	3	4	-	3
IoT5.S1.09	IoT and Virtual Reality (VR)	3	4	-	3
IoT5.S1.10	Long Range Communication Technologies: LoRaWAN/ThingSat	3	4	-	3
IoT5.S1.11	Graphical programming language (LabView/Node-Red)	3	3	-	3
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

Virtual Reality and Game Engineering

Level	4-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR-ABC	French	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
Inf-RV 4 1 03	Integration project	1.5	3	1.5	-
Inf-RV 4 1 04	Advanced OOP	3	3	-	3
Inf-RV 4 1 05	Advanced web development	3	3	-	3
Inf-RV 4 1 06	Artificial Intelligence and Machine learning applied in Virtual Reality and Gaming	3	3	-	3
Inf-RV 4 1 07	Advanced databases	1.5	3	-	1.5
Inf-RV 4 1 08	Big Data	1.5	3	-	1.5
Inf-RV 4 1 09	Mathematics applied to geometry and 3D modeling	1.5	2	1.5	-
Inf-RV 4 1 10	2D and 3D modeling (3dsMax, Blender, etc.)	3	3	-	3
Inf-RV 4 1 11	Introduction to virtual reality (VR) and augmented reality (AR) technologies	3	3	-	3
	Total	**24**	**30**	**24**	

Level	4-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
FR- ABC	French (Communication techniques)	1.5	2	1.5	-
ENG-ABC	English	1.5	2	1.5	-
PFA	PFA Scientific Project	3	3	3	-
Inf-RV 4 2 04	Mobile development (Virtual and augmented reality)	3	3	-	3
Inf-RV 4 2 05	cloud computing	1.5	3	-	1.5
Inf-RV 4 2 06	Video game programming with Unity	3	3	-	3
Inf-RV 4 2 07	Game Design (level design, design of immersive experiences, scriptwriting)	1.5	3	1.5	-
Inf-RV 4 2 08	Team virtual reality project	3	4	-	3
Inf-RV 4 2 09	Advanced VR programming (movement management, collisions, etc.)	3	4	-	3
Inf-RV 4 2 10	3D web development	3	3	-	3
	Total	**24**	**30**	**24**	

Level	5-S1				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-RV 5 1 01	Minor 1: ESB certification	1.5	2	1.5	-
Inf-RV 5 1 02	Minor 2: IT law	1.5	2	1.5	-
Inf-RV 5 1 03	Minor 3: Marketing and Distribution of Games	1.5	2	-	1.5
Inf-RV 5 1 04	Minor 4: Finance for engineers	1.5	2	1.5	-
Inf-RV 5 1 05	Project Management and Agile Methodologies	1.5	3	-	1.5
Inf-RV 5 1 06	Emerging Technologies in VR (eye-tracking, haptics, etc.)	3	3	1.5	1.5
Inf-RV 5 1 07	Gesture interaction and body tracking	3	3	1.5	1.5
Inf-RV 5 1 08	Virtual Reality (VR) Safety	1.5	3	1.5	-
Inf-RV 5 1 09	Unreal Engine	3	4	-	3
Inf-RV 5 1 10	Virtual Reality and IoT	3	3	-	3
Inf-RV 5 1 11	Sound and Visual Design for VR and AR Experiences	3	3	-	3
	Total	**24**	**30**	**24**	

Level	5-S2				
Coded	**Matter**	**Coef**	**Credit**	**Course/week**	**TP/week**
Inf-Int 3	Introductory Internship	10	3	/	/
Inf-Int 4	Professional Internship		3	/	/
Inf-Int 5	PFE		24	/	/

Subject Sheets
Class : Third year

(Common Core)

Course Specification

Architecture of microprocessor systems and microcontrollers

1. General

Coded	*INF-TC3 1 03*	Level/Semester	*3-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Samer Lahouar*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive*					Self-study H.	*25*
Module	*Architecture of microprocessor systems and microcontrollers.*					Version	*08/2023*

Course description (Course objective):
1. ***Knowledge and Understanding*** ○ ***OBJ 1:*** *Explain how information is represented and processed in a microprocessor or microcontroller system.* *→ Students must acquire a solid understanding of the fundamental concepts of binary representation (unsigned, signed, floating-point) and arithmetic operations in binary and hexadecimal, demonstrating theoretical knowledge of the foundations of digital computing.* 2. ***Skills and Abilities*** ○ ***OBJ 2:*** *Present the different components of a microprocessor or microcontroller system.* *→ Students will develop the ability to identify and describe the main hardware components of a CPU (combinatorial and sequential systems), showcasing their skill in analyzing the structure of computing systems.* ○ ***OBJ 4:*** *Introduce low-level programming (assembler).* *→ Students will gain practical skills in assembly language programming, enabling them to directly interact with hardware at a low level.* 3. ***Applying Knowledge and Understanding*** ○ ***OBJ 3:*** *Detail how a microprocessor system works to execute a program.*

→ *Students will apply their theoretical knowledge to explain the program execution cycle in a microprocessor system, connecting abstract concepts to practical mechanisms.*

4. ***Autonomy and Responsibility (Making Judgements)***

   ○ *Students will exercise judgment in analyzing architectures and solving problems related to program execution or assembly programming, making informed decisions based on their understanding of hardware systems.*

Prerequisites:	*Keywords :*
Number Systems *Logical systems*	*Hardware architecture, CPU, Memory, Low-level programming*

Specific course objectives (OBJi):
OBJ 1 : *Explain how information is represented and then processed in a microprocessor or microcontroller system.* ***OBJ 2 :*** *Present the different components of a microprocessor or microcontroller system.* ***OBJ 3 :*** *Detail how a microprocessor system works to execute a program.* ***OBJ 4 :*** *Introduce low-level programming (assembler).*

Necessary material :
Video projector

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Reminder on the representation of information in binary (unsigned, signed, floating point)*	*3*	*OBJ1*
3-4	*Arithmetic operations in binary and hexadecimal*	*3*	*OBJ1*
5-7	*Main components of a CPU: study of the main combinatorial and sequential systems*	*3*	*OBJ2*
8-10	*Architecture and operation of a microprocessor system*	*3*	*OBJ3*
11-12	*Study of a simple microprocessor system*	*3*	*OBJ3*
13-14	*introduction to low-level programming*	*3*	*OBJ4*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria (of written production)

- *Criterion 1: Methodology (50%)*
- *Criterion 2: Final result (50%)*

5- References

- *David A. Patterson et John L. Hennessy Titre: Computer Organization and Design: The Hardware/Software Interface , 2021*
- *N. Senthil Kumar, M. Saravanan, and S. Jeevananthan, Microprocessors and Microcontrollers, Oxford University Press, 2010.*
- *M. Rafiquzzaman, Fundamentals of Digital Logic and Microcontrollers, Wiley, 2014.*
- *M. A. Mazidi, R. D. McKinlay, and D. Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18, Pearson, 2008.*

6- Working environment (Facilities necessary for learning)

- *No special environment needed*

Course Specification

Advanced operating systems

1. General

Coded	*INF-TC3 1 04*	Level	*3-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Ridha Azizi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Advanced operating systems*					Version	*08/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***OBJ 5:*** *Understand the fundamental concepts of computer hardware architecture and their relevance in a Linux environment.*
     → Students will gain a theoretical understanding of basic computer architecture and how it integrates with a GNU/Linux operating system.

   - ***OBJ 6:*** *Understand the Linux boot process, including runlevels, boot configuration, and the sequence of events during system startup.*
     → Students will acquire knowledge of the Linux startup sequence and its underlying mechanisms, fostering a foundational grasp of operating system initialization.

2. ***Skills and Abilities***
   - ***OBJ 1:*** *Understand and effectively use essential GNU/Linux commands, including filters, text editors, and process management.*
     → Students will develop practical skills in using Linux command-line tools (e.g., filters, "vi" editor, pipes, redirects) and managing processes, enabling efficient system interaction.

   - ***OBJ 2:*** *Demonstrate proficiency in file system management, including hard drive manipulation, file hierarchy, file system formatting, and integrity checks.*
     → Students will acquire the ability to manage and maintain Linux file systems, including partitioning, formatting, and integrity verification.

   - ***OBJ 3:*** *Gain expertise in user and file permissions, including ownership changes, file and directory access rights, and implementing disk quotas.*
     → Students will build skills in configuring and managing permissions and quotas, ensuring secure and organized file system administration.

- ***OBJ 4:*** *Install, update, and manage software packages using Debian and RPM/YUM package managers, and manage library dependencies.*

  → Students will develop technical proficiency in software installation and dependency management using Linux package managers.

3. ***Applying Knowledge and Understanding***
   - *Students will apply their understanding of Linux commands, file systems, permissions, package management, hardware architecture, and boot processes to perform practical maintenance tasks, such as user support, backups, system shutdowns, and reboots, as outlined in the course objectives.*
     → This includes synthesizing theoretical knowledge from OBJ 1–6 to execute real-world system administration tasks effectively.

4. ***Autonomy and Responsibility (Making Judgements)***
   - *Students will demonstrate autonomy by troubleshooting and resolving issues related to file system integrity, software installation, user permissions, and system startup, making informed decisions based on their technical understanding of Linux.*
     → They will take responsibility for managing a Linux environment, such as adding users, performing backups, and ensuring system stability.

5. ***Communication Skills***
   - *Through practical exams and mini-project presentations (80% of assessment), students will communicate their technical expertise and problem-solving processes clearly and effectively.*
     → They will articulate their mastery of Linux commands, file system management, package handling, hardware knowledge, and boot processes, adhering to evaluation criteria such as mastery of controls, file system management, and startup processes

Prerequisites:	*Keywords :*
- *Basic computer literacy* - *Basic command line experience* - *General computer skills* - *Understanding of operating systems*	*Linux, GNU, Ubuntu LTS 16.04, Command line, File system, Package management, Process management, Disk quotas, Device management, Boot processes*

Specific course objectives (OBJi):

OBJ 1 : *Understand and effectively use essential GNU/Linux commands, including filters, text editors, and process management.*

OBJ 2 : *Demonstrate proficiency in file system management, including hard drive manipulation, file hierarchy, file system formatting, and integrity checks.*

OBJ 3 : *Gain expertise in user and file permissions, including ownership changes, file and directory access rights, and implementing disk quotas.*

OBJ 4 :	*Install, update and manage software packages using Debian and RPM/YUM package managers, and manage library dependencies.*
OBJ 5 :	*Understand the fundamental concepts of computer hardware architecture and their relevance in a Linux environment.*
OBJ 6 :	*Understand the Linux boot process, including runlevels, boot configuration, and the sequence of events during system startup.*

Materials required:
- *Laptop or desktop* - *Internet connection* - *Access to a virtual environment (if you are not using a physical Linux system)*

2- Content elements (TP)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter I: GNU and Unix commands:* - *Filters* - *Using the "vi" editor* - *Pipes and redirects* - *Special characters, variables, and environment variables* - *Process*	*3*	*OBJ 1*
3-4	*Chapter 2: File System:* - *Hard drives and partitioning* - *File hierarchy in Linux* - *Formatting and file system types* - *Checking and repairing file system integrity* - *Mounting and unmounting a file system*	*3*	*OBJ 2*
5-6	*Chapter 2: File System:* - *File and directory permissions* - *Changing ownership and group on files and directories* - *File quotas* - *Searching for files*	*3h*	*OBJ 3*
7-8	*Chapter 3: Installation and Package Management:* - *The Debian Package Manager* - *The RPM and YUM package manager* - *Library management*	*3h*	*OBJ 4*
9-10	*Chapter 4: Hardware Architecture and Device Management:* - *Basic computer architecture* - *Introduction to Device Management*	*3h*	*OBJ 5*

11-12	*Chapter 5: Starting Linux:* - *Starter Levels* - *Startup setup* - *Boot process*	*3h*	*OBJ 6*
13-14	- *Practical exam, Mini-project presentation*	*6*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Mastery of controls (4 points)*
- *Criterion 2: File system management (4 points)*
- *Criterion 3: Package management (4 points)*
- *Criterion 4: Knowledge of the equipment (4 points)*
- *Criterion 5: Start-up process (4 points)*

5- References

- *M. Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill, 1994.*
- *A. S. Tanenbaum and H. Bos, Modern Operating Systems, 5th ed., Pearson, 2022.*
- *G. Beekmans, Linux From Scratch, 12.2 ed., 2024*
- *P. Hatcher and M. J. Quinn, "A Course in Advanced Operating Systems Using MPI for Projects," IEEE Transactions on Education, vol. 39, no. 4, pp. 471-476, Nov. 1996.*

6- Working environment (Facilities necessary for learning)

- *Ubuntu LTS 16.04, https://releases.ubuntu.com/16.04/*
- *Oracle VM VirtualBox, https://www.virtualbox.org/*
- *GNOME Terminal (default for Ubuntu)*
- *Vim, https://www.vim.org/download.php*

Course Specification

Advanced Algorithmics I

1. General

Coded	*INF-TC3 1 05*	Level/Semester	*3-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Saoussen Ben Jabra*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*30*
Module	*Advanced Algorithmics I*					Version	*08/2023*

Course description (Course objective):

1. Knowledge, Understanding, Skills and Abilities

*This level focuses on building a strong foundation in **basic algorithms** and **data structures**. Students will learn to analyze problems, write pseudocode, and implement simple data structures like arrays, strings, and linked lists. They will also master control structures, recursion, and basic algorithms for searching and sorting. The goal is to develop **problem-solving skills** and a solid understanding of **fundamental programming concepts***

3. Applying Knowledge and Understanding

Students will apply their knowledge of problem analysis, data structures, and algorithms to formulate well-structured solutions for real-world or theoretical problems.

4. Autonomy and Responsibility (Making Judgements)

Students will exercise judgment in selecting the most appropriate data structures, algorithms, and problem-solving techniques for a given problem, demonstrating autonomy in their decision-making.

5. Communication Skills

Through supervised duties (40%) and the final written exam (60%), students will communicate their understanding of algorithmic concepts and solutions clearly and logically.

Prerequisites:	*Keywords :*
Without prerequisites	*Problem-solving, Pseudocode, Arrays, Strings, Control structures, Procedures and functions, Recursion, Searching algorithms, Sorting algorithms, Pointers, Linked lists*

Specific course objectives (OBJi):

OBJ 1. ***Analyze and Solve Problems***

- *Systematically analyze problems using* ***problem-solving strategies*** *and* ***pseudocode****.*
- *Develop algorithmic thinking to break down problems into manageable steps.*

OBJ 2. ***Understand and Implement Simple Data Structures***

- *Work with arrays (1D and 2D) and strings to store and manipulate data.*
- *Perform basic operations like insertion, deletion, and searching on arrays and strings.*

OBJ 3. ***Master Control Structures and Modular Programming***

- *Use conditional statements and loops to control program flow.*
- *Write procedures and functions to create modular and reusable code.*

OBJ 4. ***Apply Recursion***

- *Understand the concept of recursion and its applications.*
- *Write recursive functions to solve problems like factorial calculation and tree traversals.*

OBJ 5. ***Implement Basic Searching and Sorting Algorithms***

- *Implement linear search and binary search algorithms.*
- *Write and analyze sorting* ***algorithms*** *like bubble sort, selection sort, and insertion sort.*

OBJ 6. ***Work with Pointers and Dynamic Memory***

- *Understand the concept of pointers and their role in memory management.*
- *Use pointers to manipulate arrays, strings, and dynamic data structures.*

OBJ 7. ***Understand and Implement Linked Lists***

- *Implement singly linked lists and perform operations like insertion, deletion, and traversal.*
- *Compare linked lists with arrays in terms of memory usage and performance.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR
1-2	***Introduction to Algorithms and Problem Solving*** ○ *Algorithmic thinking and problem-solving strategies.* ○ *Writing pseudocode and flowcharts.* ○ *Introduction to* ***run-time order*** *and basic efficiency concepts*	*3h*
3-4	***Simple Data Structures – Arrays and Strings*** ○ *One-dimensional and two-dimensional arrays.* ○ *Operations on arrays: insertion, deletion, searching.* ○ *Strings: representation, manipulation, and basic algorithms (e.g., substring search).*	*3h*
5-6	***Control Structures and Modular Programming*** ○ *Control structures: conditional statements (if, else, switch) and loops (for, while, do-while).*	*3h*

	○ *Procedures and functions: modular programming, parameter passing, and scope.*	
7-8	***Recursion*** ○ *Concept of recursion and its applications.* ○ *Writing recursive functions for problems like factorial, Fibonacci, and tree traversals.* ○ *Comparison of recursion vs. iteration.*	*3h*
9-10	***Searching and Sorting Algorithms*** ○ *Searching algorithms: linear search, binary search.* ○ *Sorting algorithms: bubble sort, selection sort, insertion sort.* ○ *Introduction to run-time complexity analysis for these algorithms.*	*3h*
11-12	***Pointers and Dynamic Memory Allocation*** ○ *Pointers: concepts, operations, and applications.* ○ *Dynamic memory allocation (e.g., malloc, free in C/C++).* ○ *Using pointers with arrays and strings*	*3h*
13-14	***Dynamic Data Structures – Linked Lists*** ○ *Singly linked lists: structure, traversal, insertion, deletion.* ○ *Doubly linked lists: structure and operations.* ○ *Comparison of linked lists vs. arrays.*	*3h*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of Fundamental Concepts (5 points)*
- *Criterion 2: Problem Solving (5 points)*
- *Criterion 3: Complexity Analysis (5 points)*
- *Criterion 4: Implementation (5 points)*

5- References

- *T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 3rd ed., MIT Press, 2009.*
- *S. S. Skiena, The Algorithm Design Manual, 2nd ed., Springer, 2008.*
- *R. Sedgewick and K. Wayne, Algorithms, 4th ed., Addison-Wesley, 2011.*
- *Sipser, M. (2013). Introduction à la théorie de la computation (3e éd.). Cengage Learning.*
- *M. La Rocca, Advanced Algorithms and Data Structures, Manning Publications, 2021.*
- *E. Arge, A. M. Bruaset, and H. P. Langtangen, "Advanced Algorithms and Software Components for Scientific Computing," in Lecture Notes in Computer Science, vol. 3732, Springer, 2005, pp. 597–698.*
- *M. Crochemore and W. Rytter, "Advanced Algorithms," in Jewels of Stringology, World Scientific, 2002, pp. 281–320.*
- *Kleinberg, J., & Tardos, É. (2005). Algorithm Design. Pearson*
- *Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to Algorithms (3rd ed.). MIT Press.*
- *Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2013). Data Structures and Algorithms in Python. Wiley.*
- *Cormen, T. H. (2013). Algorithms Unlocked. MIT Press.*
- *GeeksforGeeks. (n.d.). Data Structures and Algorithms. Retrieved from https://www.geeksforgeeks.org/*
- *Khan Academy. (n.d.). Algorithms. Retrieved from https://www.khanacademy.org/*
- *LeetCode. (n.d.). Practice Problems. Retrieved from https://leetcode.com/*

6- Working environment (Facilities necessary for learning)

- *No special environment needed*

Course Specification

Advanced C Programming Workshop

1. General

Coded	*INF-TC3 1 06*	Level/Semester	3-S1	Coefficient	*3*	Credits	*4*
Academic background	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Montassar Ben Saad*					Vol. H. (PW)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Advanced C Programming Workshop*					Version	*07/2023*

Course description (course objective):

1. ***Knowledge and Understanding***

   - ***OBJ 1:*** *Understand the history and significance of the C programming language.*
     → Students will gain foundational knowledge about the origins and importance of C in programming, providing context for its widespread use.

   - ***OBJ 2:*** *Learn the fundamental syntax elements of C, including variables, data types, and operators.*
     → Students will acquire an understanding of C's core syntax and structure.

   - ***OBJ 3:*** *Understand the structure of a C program, including functions and control structures.*
     → Students will comprehend how C programs are organized and executed.

   - ***OBJ 4:*** *Understand the importance of conditional and iterative constructs in C programs.*
     → Students will recognize the role of control flow in program logic.

   - ***OBJ 5:*** *Understand the concept of function prototypes.*
     → Students will grasp the theoretical basis of function declarations in C.

   - ***OBJ 6:*** *Introduce the concept of pointers in C.*
     → Students will understand the foundational theory of pointers and their significance in memory management.

   - ***OBJ 7:*** *Understand dynamic memory allocation and deallocation (malloc, free).*
     → Students will learn the principles of managing memory dynamically in C.

2. ***Skills and Abilities***

   - ***OBJ 1:*** *Install and configure a C development environment.*
     → Students will develop the practical ability to set up tools like CodeBlocks or Dev C++ for coding.

   - ***OBJ 2:*** *Master control flow structures such as if statements, switch statements, and loops.*
     → Students will gain proficiency in implementing conditional and iterative logic in C.

   - ***OBJ 3:*** *Define and use functions in C.*
     → Students will acquire the skill to create reusable code blocks using functions.

   - ***OBJ 4:*** *Explore recursion and its application in C.*
     → Students will develop the ability to implement recursive solutions to problems.

   - ***OBJ 5:*** *Understand arrays and strings in C.*
     → Students will learn how to declare and work with arrays and strings.

   - ***OBJ 6:*** *Learn how to manipulate arrays and strings using loops and functions.*
     → Students will build skills in processing arrays and strings efficiently.

   - ***OBJ 7:*** *Define and use C structures.*
     → Students will acquire the ability to create and manipulate structured data.

   - ***OBJ 8:*** *Explore the concept of nested structures.*
     → Students will develop skills in organizing complex data using nested structures.

3. ***Applying Knowledge and Understanding***

   - *Students will apply their knowledge of C syntax, control structures, functions, arrays, pointers, and structures to solve programming problems through hands-on exercises and projects.*
     → This includes integrating concepts from OBJ 1–15 to design, write, and debug C programs that demonstrate algorithmic thinking and problem-solving, as emphasized in the course objective.

4. ***Autonomy and Responsibility (Making Judgements)***

   - *Students will exercise judgment in selecting appropriate C constructs (e.g., loops vs. recursion, pointers vs. arrays) and managing memory effectively (e.g., using malloc/free), taking responsibility for writing efficient and error-free code.*
     → They will independently troubleshoot and refine their programs, aligning with criteria like

programming proficiency, memory management, and pointer manipulation.

5. *Communication Skills*

Through continuous assessments (20%) and practical tests or mini-projects (80%), students will communicate their understanding of C programming concepts and their solutions to problems effectively.
→ They will demonstrate this by meeting evaluation criteria such as understanding of basic concepts, programming proficiency, memory management, pointer manipulation, and file handling, presenting their work in a clear and logical manner.

Preconditions:

- *Basic computer skills:*
  Be comfortable using a computer, navigating the file system and understanding file management.
- *Understanding algorithms:*
  Basic understanding of algorithms and problem-solving approaches.
- *Mathematics:*
  Familiarity with basic mathematical concepts, particularly those related to logic and arithmetic.
- *Logical thinking:*
  Ability to think logically and systematically to solve problems.
- *Understanding of English:*
  Since many programming resources and documentation are in English, a basic understanding of the English language is beneficial.
- *Preprogramming concepts:*
  Knowledge of basic programming concepts, even if not specific to C. This may include understanding variables, data types, conditions, loops, and functions.
- *Talents for problem solving:*
  Ability to break problems down into smaller parts and develop strategies to solve them.
- *Willingness to practice:*
  A commitment to hands-on practice is crucial to programming. Coding is a skill that improves with practice.

Specific course objectives (OBJi):

OBJ 1. *Understand the history and significance of the C programming language.*
OBJ 2. *Install and configure a C development environment.*
OBJ 3. *Learn the fundamental syntax elements of C, including variables, data types, and operators.*
OBJ 4. *Understand the structure of a C program, including functions and control structures.*
OBJ 5. *Master control flow structures such as if statements, switch statements, and loops.*
OBJ 6. *Understand the importance of conditional and iterative constructs in C programs.*
OBJ 7. *Define and use functions in C.*

OBJ 8. *Understand the concept of function prototypes.*

OBJ 9. *Explore recursion and its application in C.*

OBJ 10. *Understanding arrays and strings in C.*

OBJ 11. *Learn how to manipulate arrays and strings using loops and functions.*

OBJ 12. *Introduce the concept of pointers in C.*

OBJ 13. *Understand dynamic memory allocation and deallocation (malloc, free).*

OBJ 14. *Define and use C structures.*

OBJ 15. *Explore the concept of nested structures.*

Equipment required:
- Computer or laptop *- Internet connection*

2- Content elements: (PW: Practical Course)

Weeks)	Chapters/Content elements	No. HOUR	Goals)
1	*Chapter I: Introduction to programming in C:* - *Overview of programming concepts.* - *Introduction to the C programming language.* - *Setting up a development environment.*	*3*	*OBJ 1,2*
2	*Chapter II: Basic C syntax:* - *Structure of a C program.* - *Data types and variables.* - *Constants and literals.* - *Operators and expressions.*	*3*	*OBJ 3,4*
3-4	*Chapter III: Control flow:* - *Conditional statements (if, else, switch).* - *Loop constructions (for, during, while).* - *Stop and continue the statements.*	*6*	*OBJ 5,6*
5-6	*Chapter IV: Functions:* - *Function definition and declaration.* - *Function parameters and return values.* - *Scope and lifetime of variables.* - *Recursion.*	*6*	*OBJ 7,8,9*
7-8-9	*Chapter V: Arrays and strings:* - *Tables and their declaration.* - *Multidimensional arrays.* - *Ropes and rope handling.*	*9*	*OBJ 10,11*

10-11-12	*Chapter VI: Pointers:* - *Introduction to pointers.* - *Pointer arithmetic.* - *Pointers and arrays.* - *Function pointers* - *Pointers and strings*	*9*	*OBJ 12,13*
13-14	*Chapter VII: Structures:* - *Define and use structures.* - *Nesting structures.*	*6*	*OBJ 14.15*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Basic Concepts*
- *Criterion 2: Programming Proficiency*
- *Criterion 3: Memory Management*
- *Criterion 4: Pointer Manipulation*
- *Criterion 5 : File Handling*

5-References

- *P. van der Linden, Expert C Programming: Deep C Secrets, 2nd ed., Prentice Hall, 1994.*
- *J. W. Perry, Advanced C Programming by Example, 1st ed., Addison-Wesley, 1998.*
- *S. G. Kochan, Programming in C, 4th ed., Sams Publishing, 2004.*
- L. Courtès, "C Language Extensions for Hybrid CPU/GPU Programming with StarPU," *arXiv preprint arXiv:1304.0878*, Apr. 2013.

6- *Learning environment (facilities required for learning)*

- *Software: CodeBlocks, Dev C++*

Course Specification

Computer Networks

1. General

Coded	*Inf-TC 3 1 07*	Level/Semester	*3/S1*	Coef	*1.5*	Credits	*2*
Course	*Computer Science – Common Core*					Vol. H. (CI)	
Responsible	*Bayrem Triki*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Computer Networks*					Version	*08/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***

   - *Explain advances in modern networking technologies.*
     → Students will gain a theoretical understanding of contemporary networking concepts and architectures.

   - *Explain how network protocols allow devices to access local and remote network resources.*
     → Students will understand the role of protocols in enabling network communication.

   - *Explain how physical layer protocols, services, and media support communication across data networks.*
     → Students will acquire knowledge of the physical layer's role in networking.

   - *Explain how media access control in the data link layer supports communication across networks.*
     → Students will comprehend data link layer mechanisms, such as media access control.

   - *Explain how Ethernet works in a switched network.*
     → Students will understand Ethernet operations in LAN environments.

   - *Explain how routers use network layer protocols and services to enable end-to-end connectivity.*
     → Students will gain insight into network layer functionality and routing.

- *Explain how ARP and ND enable communication on a network.*
  → Students will learn the principles of address resolution protocols.

- *Compare the operations of transport layer protocols in supporting end-to-end communication.*
  → Students will understand the differences and roles of transport layer protocols.

- *Explain how application layer protocols work in supporting end-user applications.*
  → Students will acquire knowledge of application layer functionality.

2. *Skills and Abilities*

- *Implement initial settings, including passwords, IP addressing, and default gateway settings on a network switch and end devices.*
  → Students will develop practical skills in configuring switches and devices.

- *Calculate numbers between decimal, binary, and hexadecimal systems.*
  → Students will gain the ability to perform number system conversions essential for networking.

- *Implement initial settings on a router and end devices.*
  → Students will acquire skills in basic router configuration.

- *Calculate an IPv4 subnet diagram to effectively segment a network.*
  → Students will develop proficiency in subnetting IPv4 addresses.

- *Implement an IPv6 addressing scheme.*
  → Students will gain skills in configuring IPv6 addressing.

- *Use various tools to test network connectivity.*
  → Students will build expertise in using diagnostic tools like ICMP for network testing.

- *Configure switches and routers with device hardening features to improve security.*
  → Students will learn to apply security configurations to network devices.

- *Implement a network design for a small network including a router, switch, and end devices.*
  → Students will develop the ability to design and build a functional small-scale LAN.

3. *Applying Knowledge and Understanding*

- *Students will apply their understanding of networking concepts, protocols, and configurations to build and secure simple LANs, integrating IP addressing, Ethernet*

fundamentals, and device settings (OBJ 1–17).
→ This includes synthesizing theoretical knowledge with practical skills to create operational networks, as emphasized in the course objective.

4. ***Autonomy and Responsibility (Making Judgements)***
    - *Students will exercise judgment in designing IP addressing schemes (IPv4/IPv6), selecting appropriate security measures, and troubleshooting connectivity issues, taking responsibility for creating functional and secure networks.*
    → They will independently interpret results and refine configurations, aligning with evaluation criteria like topology creation and result interpretation.

5. ***Communication Skills***
    - *Through continuous assessments (20%) and practical tests or mini-projects (80%), students will communicate their understanding of networking concepts and their ability to design and configure networks effectively.*
    → They will demonstrate this by meeting evaluation criteria such as creation of the topology, presentation and writing of the report, and interpretation of results, presenting their work clearly and logically.

Prerequisites:	*Keywords :*
Basic computer literacy, Basic skills in navigating a PC operating system, Basic Internet Use Skills	*TCP/IP*

Specific course objectives (OBJi):

OBJ 1 : Explain advances in modern networking technologies

OBJ 2 : Implement initial settings, including passwords, IP addressing, and default gateway settings on a network switch and end devices.

OBJ 3 : Explain how network protocols allow devices to access local and remote network resources.

OBJ 4 : Explain how physical layer protocols, services, and media support communications across data networks.

OBJ 5 : Calculate numbers between decimal, binary and hexadecimal systems.

OBJ 6 : Explain how media access control in the data link layer supports communication across networks.

OBJ 7 : Explain how Ethernet works in a switched network.

OBJ 8 : Explain how routers use network layer protocols and services to enable end-to-end connectivity.

OBJ 9 : Explain how ARP and ND enable communication on a network.

OBJ 10 : Implement initial settings on a router and end devices.

OBJ 11 : Calculate an IPv4 subnet diagram to effectively segment a network.

OBJ 12 : Implement an IPv6 addressing scheme.

OBJ 13 : Use various tools to test network connectivity.

OBJ 14 : Compare the operations of transport layer protocols in supporting end-to-end communication.

OBJ 15 : Explain how application layer protocols work in supporting end-user applications.

OBJ 16 : Configure switches and routers with device hardening features to improve security.

OBJ 17 : Implement a network design for a small network including a router, switch, and end devices.

Necessary material :
PC, Internet connection

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Module 1: Networking Today*	*1.5 hours*	*OBJ1*
2	*Module2: Configuring basic switch and end device settings*	*1.5 hours*	*OBJ2*
3	*Module 3: Protocols and Models*	*1.5 hours*	*OBJ3*
4	*Module 4: Physical layer*	*1.5 hours*	*OBJ4*
5	*Module 5: Digital Systems*	*1.5 hours*	*OBJ5*
6	*Module 6: Data Link Layer*	*1.5 hours*	*OBJ6*
7	*Module 7: Ethernet Switching*	*1.5 hours*	*OBJ7*
8	*Module 8: Network Layer*	*1.5 hours*	*OBJ8*
9	*Module 9: Address Resolution*	*1.5 hours*	*OBJ9*
10	*Module 10: Basic Router Configuration*	*1.5 hours*	*OBJ10*
11	*Module 11: IPv4 and IPv6 addressing*	*1.5 hours*	*OBJ11 OBJ12*
12	*Module 12: ICMP and the transport layer*	*1.5 hours*	*OBJ13 OBJ14*
13	*Module 12: Application Layer and Network Security* *Network Security Fundamentals* *Build a small network*	*1.5 hours*	*OBJ15, OBJ 16, OBJ 17*
14	*Module 14: Evaluation*	*1.5*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Module 1: Networking Today*	*1.5 hours*	*OBJ1*
2	*Module2: Configuring basic switch and end device settings*	*1.5 hours*	*OBJ2*
3	*Module 3: Protocols and Models*	*1.5 hours*	*OBJ3*
4	*Module 4: Physical layer*	*1.5 hours*	*OBJ4*
5	*Module 5: Digital Systems*	*1.5 hours*	*OBJ5*
6	*Module 6: Data Link Layer*	*1.5 hours*	*OBJ6*

7	*Module 7: Ethernet Switching*	*1.5 hours*	*OBJ7*
8	*Module 8: Network Layer*	*1.5 hours*	*OBJ8*
9	*Module 9: Address Resolution*	*1.5 hours*	*OBJ9*
10	*Module 10: Basic Router Configuration*	*1.5 hours*	*OBJ10*
11	*Module 11: IPv4 and IPv6 addressing*	*1.5 hours*	*OBJ11 OBJ12*
12	*Module 12: ICMP and the transport layer*	*1.5 hours*	*OBJ13 OBJ14*
13	*Module 12: Application Layer and Network Security* *Network Security Fundamentals* *Build a small network*	*1.5 hours*	*OBJ15, OBJ 16, OBJ 17*
14	*Module 14: Evaluation*	*1.5*	

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: creation of the topology*
- *Criterion 2: presentation and writing of the report*
- *Criterion 3: interpretation of results*

5- References

- *A. S. Tanenbaum and D. J. Wetherall, Computer Networks, 5th ed., Pearson, 2010.*
- *W. Stallings, Data and Computer Communications, 10th ed., Pearson, 2013*
- *M. Benaiah Deva Kumar and B. Deepa, "Computer Networks: A Survey," International Journal of Computer Applications, vol. 97, no. 10, pp. 1-5, July 2014.*
- *Priyanshu Tyagi, Rahul Nishant, and Priyadarshi, "Understanding Computer Networks: A Comprehensive Overview of Types, Configurations, and the OSI Model," arXiv preprint arXiv:2403.11296, Mar. 2024.*

6- Working environment (Facilities necessary for learning)

- *Packet Tracer*

Course Specification

IT security

1. General

Coded	*Inf-TC 3 1 12*	Level/Semester	*3/S1*	Coef	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*9*
Responsible	*Bayrem Triki*					Vol. H. (TP)	*12*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*24*
Module	*IT security*					Version	*08/2023*

Course description (Course objective):

1. Knowledge and Understanding

- *Acquire fundamental knowledge of aspects of information systems security.*
  → Students will gain a theoretical understanding of the core principles and components of IT security within information systems.

- *Gain knowledge on the fundamental requirements of IT security and establishing a security policy strategy.*
  → Students will understand the essential requirements for securing IT systems and the strategic development of security policies.

- *Understand the different security vulnerabilities and attack methodology.*
  → Students will acquire knowledge of common vulnerabilities, and the methodologies used in cyberattacks.

- *Acquire knowledge that allows you to manage risks related to IT security.*
  → Students will learn the principles of risk management in the context of IT security.

2. Skills and Abilities

- *Learn how to deploy security mechanisms to combat attacks.*
  → Students will develop practical skills in implementing security measures, such as encryption, hashing, electronic signatures, and creating a Public Key Infrastructure (PKI), to protect systems from threats.

- *Students will also gain proficiency in using tools like OpenVAS, Nessus, Nmap, Wireshark, and OpenSSL for vulnerability testing, port scanning, and cryptographic operations, as outlined in the practical work content.*

3. Applying Knowledge and Understanding

- *Students will apply their theoretical knowledge of IT security principles, vulnerabilities, and risk management to deploy practical security mechanisms and analyze system vulnerabilities (OBJ 1–5).*
  → This includes conducting vulnerability tests, creating security reports, and implementing cryptographic solutions, bridging theory and practice to address real-world security challenges.

4. ***Autonomy and Responsibility (Making Judgements)***
   - *Students will exercise judgment in identifying vulnerabilities, selecting appropriate security mechanisms, and managing risks, taking responsibility for securing systems effectively. → They will independently interpret results from tools and practical exercises, aligning with evaluation criteria such as achievement and interpretation of results, to propose and implement security solutions.*

5. ***Communication Skills***
   - *Through continuous assessments (20%) and practical tests or mini-projects (80%), students will communicate their understanding of IT security concepts and their ability to deploy security measures effectively.*

     → They will demonstrate this by meeting evaluation criteria such as achievement, presentation and writing of the report, and interpretation of results, presenting their findings and solutions in a clear and structured manner.

Prerequisites:	*Keywords :*
- Operating system - Computer network architecture - Communication protocols	- Windows, Linux - client server - TCP/IP

Specific course objectives (OBJi):
OBJ 1: Acquire fundamental knowledge of aspects of information systems security. ***OBJ 2:*** Gain knowledge on the fundamental requirements of IT security and establishing a security policy strategy. ***OBJ 3:*** Understand the different security vulnerabilities and attack methodology ***OBJ 4:*** Learn how to deploy security mechanisms to combat attacks ***OBJ 5:*** Acquire knowledge that allows you to manage risks related to IT security.

Necessary material :
A PC and an Internet connection

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	Chapter 1: General aspects of IT security	*1h30*	*OBJ1*
2	Chapter 2: Concepts and principles of computer security	*1h30*	*OBJ2*
3	Chapter 3: IT security policy	*1h30*	*OBJ3*
4-5	Chapter 4: Attacks and Intrusions	*1h30*	*OBJ4*
6-7	Chapter 5: Security Mechanisms	*1h30*	*OBJ4*
8-9	Chapter 6: Risk Management	*1h30*	*OBJ5*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Vulnerability Test Report*	*1h30*	*OBJ1*
2	*Port Scanner Test Report*	*1h30*	*OBJ2, OBJ3*
3	*Encryption/Decryption with openssl*	*1h30*	*OBJ4*
4	*Hashing and Electronic Signature with openssl*	*1h30*	*OBJ4*
5	*Creation of PKI*	*3h*	*OBJ4*
6	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: achievement*
- *Criterion 2: presentation and writing of the report*
- *Criterion 3: interpretation of results*

6- References

- *Hossein Bidgoli, editor. Handbook of Information Security, 3-Volume Set. Wiley, December 2005.*
- *William Stallings. Cryptography and Network Security: Principles and Practice. Prentice Hall, 2003.*
- *Paul C. van Oorschot Alfred J. Menezes and Scott A. Vanstone. Handbook of Applied Cryptography. CRC-Press, August 2001.*

- *M. E. Whitman and H. J. Mattord, Principles of Information Security, 7th ed., Cengage Learning, 2021.*
- *W. Stallings, Cryptography and Network Security: Principles and Practice, 7th ed., Pearson, 2017.*
- *P. C. van Oorschot, A. J. Menezes, and S. A. Vanstone, Handbook of Applied Cryptography, CRC Press, 1996.*

7- Working environment (Facilities necessary for learning)

- *Virtual environment (Virtualbox, vmware)*
- *OpenVas, nesus, nmap, wireshark, Openssl, …*

Course Specification

Digital Signal Acquisition and Processing

1. General

Coded	*INF-TC3 1 08*	Level/Semester	*3-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science – Common core*					Vol. H. (CI)	*21*
Responsible	*Tarek Garna*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Digital Signal Acquisition and Processing*					Version	*08/2022*

Course description (Course objective):

1. ***Knowledge and Understanding***

- **OBJ 1:** *Introduce an understanding of digital signals by explaining the principles of signal acquisition and the different types of sensors.*
  → Students will gain a theoretical understanding of digital signals, acquisition principles, and sensor technologies.

- **OBJ 2:** *Know how to represent deterministic signals, perform operations on the signals, introduce the convolution product.*
  → Students will acquire knowledge of signal representation, operations, and the mathematical concept of convolution.

- **OBJ 3:** *Introduce students to the notions of temporal sampling of signals as well as the choice of sampling frequency.*
  → Students will understand the theory behind temporal sampling and the importance of selecting appropriate sampling frequencies.

- **OBJ 4:** *Introduce students to the concept of quantification and coding of sampled signals.*
  → Students will learn the principles of signal quantization and coding techniques.

- **OBJ 6:** *Introduce the theoretical foundations of the z-transform for modeling discrete signals.*

→ Students will comprehend the z-transform as a tool for modeling discrete-time signals.

- **OBJ 7:** *Introduce to students the basic notions of frequency analysis of digital signals by synthesizing digital filters RIF and RII from analog filters. → Students will gain an understanding of frequency analysis and digital filter design (FIR and IIR) derived from analog systems.*

2. *Skills and Abilities*

- **OBJ 5:** *Introduce students to programming SEs for digitizing and filtering signals. → Students will develop practical skills in programming embedded systems (SEs) to digitize and filter signals, applying theoretical concepts to real-world implementations.*
-
- *Students will also acquire the ability to perform operations like convolution, sampling, quantization, and filter synthesis through calculation and programming exercises, as emphasized in the course description.*

3. *Applying Knowledge and Understanding*

- *Students will apply their knowledge of signal acquisition, digitization, and processing to develop a complete digital signal processing chain, integrating concepts from OBJ 1–7. → This includes using theoretical foundations (e.g., sampling theorem, z-transform) and practical skills (e.g., programming filters) to solve problems in signal processing, as seen in tutorials and exercises.*

4. *Autonomy and Responsibility (Making Judgements)*

- *Students will exercise judgment in selecting appropriate sampling frequencies, quantization techniques, and filter designs, taking responsibility for modeling and processing signals effectively.*

  → They will independently analyze and experiment with signal processing techniques, aligning with evaluation criteria such as simulation and experimentation.

5. *Communication Skills*

- *Through supervised duties (40%) and the final written exam (60%), students will communicate their understanding of signal processing concepts and their ability to apply acquisition and processing techniques. → They will demonstrate this by meeting evaluation criteria such as understanding of signal processing concepts, signal acquisition techniques, and simulation and experimentation, presenting their solutions clearly and logically.*

Prerequisites:	*Keywords :*
Basic notions of Mathematics	*Acquisition, Digitization, Digital Filtering*

Specific course objectives (OBJi):
OBJ 1 : Introduce an understanding of digital signals by explaining the principles of signal acquisition and the different types of sensors. **OBJ 2 :** Know how to represent deterministic signals, perform operations on the signals, introduce the convolution product. **OBJ 3 :** Introduce students to the notions of temporal sampling of signals as well as the choice of sampling frequency. **OBJ 4 :** Introduce students to the concept of quantification and coding of sampled signals. ***OBJ 5 :*** *Introduce students to programming SEs for digitizing and filtering signals.* ***OBJ 6 :*** *Introduce the theoretical foundations of the z transform for modeling discrete signals.* ***OBJ 7 :*** Introduce to students the basic notions of frequency analysis of digital signals by synthesizing digital filters RIF and RII from analog filters

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to the digital signal acquisition and processing chain Signal sensors* *Passive sensor conditioners*	*3H*	*OBJ1*
3-4	*Classification of signals: spectral, morphological, etc.* *Common signals* *Signal operators*	*3H*	*OBJ 2*
5-6	Temporal sampling of signals *Choice of sampling frequency* *Sampling theorem* *Anti-aliasing filtering*	*3H*	*OBJ 3*
7-8	Linear quantification of signals, Signal coding	*3H*	*OBJ 4*
9-10	Centered linear quantization Bipolar quantization	*3H*	*OBJ 5*
11-12	Discrete signal modeling Z transform Recurrence equation Inverse Z Transform	*3H*	*OBJ 6*

13-14	*Structure of digital filters* *Finite Impulse Response (FIR) filters* *Infinite Impulse Response (IIR) filters* *Recursive digital filters from analog filters*	*3H*	*OBJ 7*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of Signal Processing Concepts:*
- *Criterion 2: Signal Acquisition Techniques*
- *Criterion 3: Simulation and Experimentation*

5- References

- *Digital signal processing: Signals and discrete systems, Guy Binet, Ellipses, 2013.*
- *Time-Frequency Signal Analysis and Processing: A Comprehensive Reference, Boualem Boashash, Elsevier, 2016.*
- *Signal analysis and adaptive digital filtering, Maurice Bellanger, Telecommunications technical and scientific collection, Masson, 1989*
- *A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 3rd ed., Pearson, 2010.*
- *S. W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, California Technical Publishing, 1997.*
- *J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, 4th ed., Pearson, 2007.*

6- Working environment (Facilities necessary for learning)

- *No special environment needed*

Course Specification

Data Base

1. General

Coded	*INF-TC3 1 09*	Level/Semester	*3-S1*	Coefficient	*3*	Credits	*3*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Houssem Chtioui*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data base*					Version	*07/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
    - ***Objective:*** *Master the key concepts of relational databases (OBJ 1).*
    - ***Description:*** *Students will gain a solid understanding of relational database theory, including the entity/association model, relational model, and core principles of database design. This encompasses knowledge of Data Definition Language (DDL) and Data Manipulation Language (DML).*

2. ***Applying Knowledge and Understanding***
    - ***Objective:*** *Learn the basics of SQL language (OBJ 2) and write queries to query and manipulate relational databases (OBJ 3).*
    - ***Description:*** *Students will apply their knowledge to practical tasks, such as designing tables with constraints, loading data, and executing SQL queries for selection, insertion, modification, and deletion. This includes working with predefined functions, joins, subqueries, and set operators.*

3. ***Making Judgments***
    - ***Objective:*** *Evaluate and design effective database structures and queries.*
    - ***Description****: Through coursework and practical exercises, students will develop the ability to critically assess database designs and SQL query efficiency, making informed decisions to meet specific requirements.*

4. ***Communication***
    - ***Objective****: Clearly present database solutions and collaborate effectively.*
    - ***Description:*** *Students will demonstrate their ability to communicate technical concepts*

through activities like the mini-project defense and practical exams, explaining their approaches to peers and instructors.

5. ***Learning Skills***
   - ***Objective:*** *Foster independent learning for future database-related studies.*
   - ***Description:*** *By using tools like Oracle DBMS or SQLLIVE and engaging with provided web resources, students will build the skills to independently explore and deepen their expertise in database systems.*

Prerequisites:	*Keywords :*
Preliminary database design	*Entity tables associations relational model*

Specific course objectives (OBJi):
OBJ 1 : Master the key concepts of relational databases ***OBJ 2 :*** Learn the basics of SQL language ***OBJ 3 :*** Write queries to query and manipulate relational databases

Necessary material :
PC+DBMS installed ORACLE or internet with SQLLIVE

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Entity/Association and Relational model*	*3h*	*A relevant conception of a comic book*
3-4	*LDD Data Definition Language*	*3h*	*Physical description of the database*
5-6	*LMD Data manipulation language*	*3h*	*Request for selection, insertion and modification*
7-8	*Predefined functions (to_char,*	*3h*	*Native functions on dates,*
	to_number, ...)		*character strings, etc.*
9-10	*Conditional Expressions and Grouping*	*3h*	*nvl, box,*
11-12	*Joins (inner, outer and cross) and views*	*3h*	*Joins between tables, SQL89,SQL2, Inner join, outerjoin, Left join... Creating and manipulating views*

13-14	*Subqueries and set operators (3H)*	*3h*	*Subqueries with the GROUP BY and HAVING clause* *The sUNION, MINUS and INTERSECT operators*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Creation of tables and restructuring of tables with constraints*	*3h*	*Physical description of the base* *Creating constraints*
3-4	*Loading tuples*	*3h*	*SELECT*
5-6	*data manipulation*	*3h*	*UPDATE* *DELETE*
7-8	*Types of Joins*	*3h*	*Inner join, left join, the flat form of SQ1*
9-10	*Nested queries and native functions*	*3h*	*Native functions on dates and nested form*
11-12	*GROUP BY HAVING, under queries and views*	*3h*	*The group function, aggregate function and creation of views*
13-14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

5- Evaluation criteria

- *Criterion 1: Methodology (50%)*
- *Criterion 2: Final Result (50%)*

6- References

- *C. J. Date, An Introduction to Database Systems, 8th ed., Pearson, 2003.*

- *A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 6th ed., McGraw-Hill, 2010.*
- *J. D. Ullman and J. Widom, A First Course in Database Systems, 3rd ed., Pearson, 2008.*
- *M. Mior, "Relational Playground: Teaching the Duality of Relational Algebra and SQL," arXiv preprint arXiv:2306.13486, June 2023.*
- *M. Mohamed, A. Reynolds, C. Tinelli, and C. Barrett, "Verifying SQL Queries using Theories of Tables and Relations," arXiv preprint arXiv:2405.03057, May 2024.*
- *G. Sundaram and M. Bachhawat, "Deriving Application Level Relationships by Analysing the Run Time Behaviour of Simple and Complex SQL Queries," arXiv preprint arXiv:1603.08514, March 2016.*

7- Learning Environment (Required Installations for Learning)

- *No specific learning environment is required.*

Course Specification

Web development

1. General

Coded	*Inf-TC 3 1 10*	Level/Semester	*3/S1*	Coefficient	*3*	Credits	*3*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Firas Hmila*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Web development*					Version	*08/2023*

Course description (Course objective):

1) ***Knowledge and Understanding***

- ***Objective****: Understand the basic concepts of web development (OBJ 1) and key technologies like HTML5, CSS3, Bootstrap, and JavaScript.*

- ***Description****: Students will develop a foundational understanding of web development principles, including the structure of HTML5 for content (e.g., lists, tables, forms, semantic tags), CSS3 for formatting, the Bootstrap framework for responsive design, and JavaScript for interactivity. This includes grasping concepts like the Document Object Model (DOM) and event handling.*

2) ***Applying Knowledge and Understanding***

- ***Objective****: Create structured web pages with HTML5 (OBJ 2, OBJ 3, OBJ 4, OBJ 5), apply formatting with CSS (OBJ 6, OBJ 7, OBJ 8), integrate Bootstrap (OBJ 9), and add client-side interactivity with JavaScript (OBJ 10).*

- ***Description****: Students will apply their knowledge to build functional web pages by:*

  - *Using HTML5 to create lists, tables, links, images, and forms with media controls.*

  - *Implementing CSS for basic and advanced formatting (e.g., text, backgrounds, box models, positioning).*

  - *Using Bootstrap for responsive layouts (e.g., grids, buttons, navigation).*

  - *Adding JavaScript for dynamic features (e.g., variables, loops, functions, DOM manipulation, event handling).*

3) ***Making Judgments***

- ***Objective***: *Evaluate and select appropriate web technologies and techniques for specific tasks.*

- ***Description***: *Students will assess the suitability of HTML5, CSS3, Bootstrap, and JavaScript solutions for creating user-friendly and responsive web designs. This includes judging the effectiveness of formatting, layout choices, and interactivity features during practical work and the final project, ensuring alignment with user interface (UI) design principles.*

4) ***Communication***

- ***Objective***: *Present and explain web development solutions effectively.*

- ***Description***: *Through continuous assessments (e.g., presentations, reports) and the practical exam, students will communicate their technical designs and coding solutions, demonstrating clarity in explaining how their web pages meet functional and aesthetic goals.*

5) ***Learning Skills***

- ***Objective***: *Build a foundation for ongoing learning in web development.*

- ***Description***: *By engaging with tools like VSCode and online resources (e.g., W3Schools tutorials), students will develop the ability to independently explore advanced topics in web technologies, such as jQuery or future frameworks, preparing them for further studies or professional practice.*

Prerequisites:	*Keywords :*
…	*Html5, CSS3, BOOTSTRAP, JS, DOM*

Specific course objectives (OBJi):

OBJ 1 : *Understanding the basic concepts of web development*
OBJ 2 : *How to create lists and tables in HTML*
OBJ 3 : *How to insert images and add links*
OBJ 4 : *How to create HTML5 forms*
OBJ 5 : *How to create controls for media and input fields in HTML5 forms*
OBJ 6 : *How to integrate CSS into HTML*
OBJ 7 : *How to add basic formatting in CSS*
OBJ 8 : *How to add advanced formatting in CSS*
OBJ 9 : *How to integrate Bootstrap with the existing HTML structure*
OBJ 10 : *How to add client-side controls and interactivity*
OBJ 11 : *Managing OBJECTS in JavaScript (array, date, string, etc.)*
OBJ 12 : *Handling events and controlling forms*

Necessary material :

-

2- Content elements (Practical work)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s)
1-2	*TP1 : HTML5* *The basic elements of an HTML page, Introduction to HTML language, The doctype, Images, Links, Lists, Tables*	*6h*	*OBJ1* *OBJ2* *OBJ3*
3	*Forms*	*3h*	*BOJ4*
4	*The major innovations of HTML 5, Semantic tags, Multimedia tags (audio and video), HTML5 forms*	*3h*	*BOJ5*
5	*TP 2 : CSS3 style sheets* *Basic principle, Where do we write CSS, Text formatting, Backround color, Borders and shadows, Selectors, Class and ID concept, Preudo-class and preudo-element*	*3h*	*OBJ6* *OBJ7*
6	*Box models & Flow and positioning*	*3h*	*OBJ8*
7	*TP3 : Bootstrap* *Bootstrap Definition, Responsive Design, Bootstrap Advantages, Bootstrap Grid System, Buttons, Forms, Tables, Menus, Glyphicons, Carousel, Navigation Bar*	*3h*	*OBJ9*
8	*TP 4 : JavaScript* *Introduction to JavaScript, Declaration of JavaScript Code, Variables, Input/Output, Conditional Structures, Loops, Functions & Object Concepts*	*3h*	*OBJ10*
9	*String Operators, Arrays & Dates*	*3h*	*OBJ11*
10-11	*TP 5 JavaScript, DOM and event handling* *Introduction, Retrieve an HTML Element, Retrieve/Modify the Attribute of an HTML Element, Retrieve/Modify the Content of an HTML Element, The Parent and Children of an HTML Element, Add a New HTML Element, Other Operations on HTML Elements, Modify the CSS Properties of an HTML Element, Events, Associate an Event with an Element, Remove an Event, Cancel an Event & Stop Event Propagation*	*6h*	*OBJ12*
12-13	*TP6 : Introduction to jQuery* *The Power of jQuery : Selectors, jQuery and the DOM, jQuery and Events & jQuery and CSS*	*3h*	
14	*Practical exam*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Web Technologies*
- *Criterion 2: Programming Skills*
- *Criterion 3: Web Development Frameworks*
- *Criterion 4: Database Integration*
- *Criterion 5: User Interface (UI) Design*

5- References

- *Duckett, J. (2011). HTML and CSS: Design and Build Websites. Wiley.*
- *Duckett, J. (2014). JavaScript and JQuery: Interactive Front-End Web Development. Wiley.*
- *anchez, L. (2017). Web Programming with HTML, CSS, Bootstrap, JavaScript, JQuery, PHP, and MySQL. CreateSpace Independent Publishing Platform.*
- Imsirovic, A. (2020). Learn the Basics of HTML5, CSS3, and Bootstrap 5. Leanpub.

6- Work Environment (Learning Facilities):

- *VSCODE Text Editor*

Course Specification

Engineering Mathematics

1. General

Coded	*INF-TC3 1 11*	Level/Semester	3-S1	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Rachid Assel*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive*					Self-study H.	*24*
Module	*Engineering mathematics*					Version	*10/2021*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Know how to study the structure of a set of objects (OBJ 1).*

   - ***Description****: Students will gain a comprehensive understanding of discrete mathematics concepts, including set theory (e.g., operations, Venn diagrams, complementarity), binary relations (e.g., equivalence and order relations), and combinatorics. This foundational knowledge supports the study of structures and properties relevant to computer science.*

2. ***Applying Knowledge and Understanding***
   - ***Objective****: Know how to study transformations and representations of sets (OBJ 2) and order and simplify objects in the same set (OBJ 3).*

   - ***Description****: Students will apply mathematical tools to:*
     - *Analyze transformations (e.g., functions, injections, surjections, bijections, composition) and their representations (e.g., direct and reciprocal images).*

     - *Order and classify sets using equivalence relations, congruence, and divisibility, as well as calculate possibilities through combinatorics for algorithmic cost analysis.*

3. ***Making Judgments***
   - ***Objective****: Evaluate the nature and appropriateness of mathematical methods for engineering problems.*

- ***Description**: Students will assess the suitability of discrete mathematics techniques (e.g., choosing between injection or bijection, determining equivalence classes) to solve problems in computer engineering, such as algorithm design or data structuring, demonstrating critical thinking in applying theory to practical scenarios.*

4. ***Communication***
   - ***Objective**: Clearly articulate mathematical reasoning and solutions.*
   - ***Description**: Through supervised duties and the final exam, students will demonstrate their ability to present logical arguments, explain set operations, transformations, and combinatorial solutions effectively, aligning with the evaluation criterion of understanding mathematical concepts.*

5. ***Learning Skills***
   - ***Objective**: Build a foundation for further mathematical and computational studies.*
   - ***Description**: By mastering discrete mathematics fundamentals, students will develop the ability to independently explore advanced topics in computer science (e.g., data science, algorithm optimization), supported by resources like "Discrete Mathematics" by Mathieu Sablik.*

Prerequisites:	*Keywords :*
	…

Specific course objectives (OBJi):
OBJ 1 : *Know how to study the structure of a set of objects.* ***OBJ 2 :*** *Know how to study transformations and representations of sets.* ***OBJ 3 :*** *Know how to order and simplify objects in the same set.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Set theory, operations on parts, Venn diagram, complementarity,*	*3h*	*Know how to describe the structure of a set of objects*

3-4	*Transformations on sets: functions, applications, direct image, reciprocal image*	*3h*	*Ability to manipulate transformations from one set to another*
5	*Multiple transformations:*	*1.5*	*Know how to compose functions*
	composition of applications, functions, Venn diagram.		
6	*Guarded duty.*	*1.5*	*Evaluation of acquired knowledge*
7-8	*Operations on functions: injections, surjection, bijection, reciprocal function*	*3h*	*Study the nature of a transformation, recovery of the original from the image*
9-10	*Binary relations, equivalence relations, representation, equivalence classes, congruence,*	*3h*	*Learn about classification methods, notions of classes, class representative,*
11-12	*Order relation, classification, divisibility in integers*	*3h*	*Learn to arrange the elements of a set according to a criterion,*
13-14	*Combinatorics and enumeration*	*3h*	*Know how to calculate the number of possibilities, the number of cases, cost of an algorithm,*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of Mathematical Concepts*
- *Criterion 2: Problem-Solving Skills*
- *Criterion 3: Mathematical Modeling*
- *Criterion 4: Application to Engineering Problems*

5- References

- *Levin, O. (2019). Discrete Mathematics: An Open Introduction (3rd ed.).*
- *Rosen, K. H. (2012). Discrete Mathematics and Its Applications (7th ed.). McGraw-Hill.*

- *Parmar, M. (2019). Discrete Mathematics: The Backbone of Computer Science. International Journal of Novel Research and Development, 4(5), 52–56.*
- *Deka, L., Shereen, P., & Wand, J. (2022). Bringing a CURE into a Discrete Mathematics Course and Beyond. The Mathematics Enthusiast, 19(3), 771–784.*

6- Working environment (Facilities necessary for learning)

- *No special environment needed…*

Course Specification

Introduction to Artificial Intelligence

1. General

Coded	*INF-TC3 1 13*	Level/Semester	*3-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Boutheina Ben Ismail*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive*					Self-study H.	*20*
Module	*Introduction to Artificial Intelligence*					Version	*08/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective:*** *Understand the historical evolution of artificial intelligence and identify key milestones and major contributions (OBJ 1), define the concept of AI and explore its approaches and applications (OBJ 2).*
   - ***Description:*** *Students will acquire a foundational understanding of AI, including its history (e.g., key milestones, contributions from pioneers), definitions, and approaches (symbolic vs. connectionist). They will also explore practical applications and the role of Big Data and data analysis in AI (OBJ 3, OBJ 4), building a theoretical base for machine learning concepts.*
2. ***Applying Knowledge and Understanding***
   - ***Objective****: Understand the importance of Big Data and data preparation techniques (OBJ 3), apply data division techniques for learning and assessment (OBJ 4), and implement supervised and unsupervised machine learning techniques (OBJ 5, OBJ 6).*
   - ***Description****: Students will apply their knowledge to:*
   - *Prepare and analyze large datasets using cleaning, transformation, and normalization techniques.*
   - *Split data for model training and evaluation.*

- *Implement supervised learning algorithms (e.g., linear regression, logistic regression) and unsupervised learning methods (e.g., clustering, dimension reduction) on real-world datasets, analyzing case studies and practical examples.*

3. ***Making Judgments***

   - ***Objective:*** *Analyze and differentiate between supervised and unsupervised learning approaches (OBJ 5, OBJ 6) and assess their applicability to specific problems.*
   - ***Description:*** *Students will evaluate the suitability of AI techniques (e.g., regression vs. classification, clustering vs. supervised models) for given scenarios, interpret results from case studies, and consider ethical implications of AI applications, fostering critical thinking about model performance and societal impact.*

4. ***Communication***

   - ***Objective:*** *Articulate AI concepts, methods, and ethical considerations effectively.*
   - ***Description:*** *Through supervised duties and the final exam, students will demonstrate their ability to explain AI fundamentals, machine learning algorithms, and data analysis techniques. Discussions on ethical issues (as part of the course objective) will encourage clear presentation of ideas and proposed solutions to mitigate risks*.

5. ***Learning Skills***

   - ***Objective:*** *Prepare for ongoing learning in the evolving field of AI.*
   - ***Description***: *By exploring emerging trends and utilizing resources like "Machine Learning Tutorial" by Simplilearn and "Deep Learning with Python" by Nikhil Ketkar, students will develop the ability to independently pursue advanced AI topics (e.g., deep learning, neural networks, generative models), equipping them for future studies or professional growth.*

Prerequisites:	*Keywords :*
python programming introduction	*Artificial intelligence, python,*Big Data,*machine learning, deep learning,*turing,*neural networks, symbolic logic. expert systems, robotics, natural language processing and supervised and unsupervised learning*

Specific course objectives (OBJi):
OBJ 1 : *Understand the historical evolution of artificial intelligence and identify key milestones and major contributions* ***OBJ 2 :*** *Define the concept of artificial intelligence and explore the different approaches and applications of AI* ***OBJ 3 :*** *Understand the importance of Big Data in AI and learn techniques for preparing data for analysis* ***OBJ 4 :*** *Explain the importance of data analysis in AI and understand data division techniques for learning and assessment* ***OBJ 5 :*** *Understand the basics of supervised machine learning, differentiate from classification regression, and analyze case studies with corrected examples* ***OBJ 6 :*** *Explain the concepts of unsupervised learning, highlight the differences with supervised learning and apply unsupervised learning techniques to specific problems*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	***Course 1:***_Introduction to the history of AI_ *Definition of artificial intelligence.* *Presentation of key milestones and major contributions.* *Study of the historical advances that have shaped the field.* ***TD 1: Analysis of major contributions*** *In-depth discussion of contributions from AI pioneers.* *Critical analysis of the different phases of the evolution of AI.*	*1h30*	*OBJ1*
2	***Course 2: Fundamental Concepts of AI*** *Definition and scope of artificial intelligence.* *Presentation of the different symbolic and connectionist approaches.* ***Course 3: Applications of AI*** *Exploration of the various areas of application of AI.* *Case study on concrete applications.* ***Tutorial 2: Exploration of approaches***	*1h30*	*OBJ2*
	Practical exercises to differentiate between symbolic and connectionist approaches. *Analysis of examples of AI applications.*		

3	***Course 4: Importance of Big Data in AI*** *Exploring the role of Big Data in AI.* *Discussion of the benefits and challenges of processing big data.* ***Course 5: Data preparation techniques in AI*** *Presentation of data cleaning, transformation and normalization techniques.* *Application of these techniques to real datasets.* ***Tutorial 3: Data preparation practice*** *Practical exercises on large-scale data manipulation.* *Using popular tools and libraries.*	*1h30*	*OBJ3*
4	***Course 6: Importance of Data Analysis in AI*** *Discussion on the critical role of data analytics in the AI process.* *Case study on successful projects.*	*1h30*	*OBJ4*
5	***Course 7: Data Division Techniques*** *Exploring data splitting methods for model training and evaluation.* *Application of these techniques to specific scenarios.*	*1h30*	*OBJ4*
6	***Tutorial 4: Application of data division techniques*** *Practice of dividing data on case studies.* *Evaluation of model performance.*	*1h30*	*OBJ4*
7	***Course 8: Foundations of Supervised Machine Learning*** *Overview of regression and classification concepts.* *Differentiation of the two approaches.* ***Course 9: Case studies in supervised learning*** *In-depth analysis of case studies with corrected examples.* *Performance evaluation of supervised models.*	*1h30*	*OBJ5*
8	***Tutorial 5: Practical application in supervised learning*** *Implementing Simple Linear Regression Algorithms* *Implementing Multiple Linear Regression Algorithms* *Evaluation of results on real datasets.*	*1h30*	*OBJ5*
9	***Tutorial 6: Practical application in supervised learning*** *Implementation of Classification algorithms* *Implementation of binary classification algorithms “logistic regression”* *Evaluation of results on real datasets.*	*1h30*	*OBJ5*

10	***Course 10: Concepts of Unsupervised Learning*** Exploration of the concepts of clustering and dimension reduction. Differentiation with supervised learning.	*1h30*	*OBJ6*
11	***Course 11: Application of learning techniques*** unsupervised *Use of clustering methods on specific issues.* *Analysis of results and interpretations.*	*1h30*	*OBJ6*
12	**Tutorial 6: Practical application in unsupervised learning** Implementation of clustering and dimension reduction algorithms. Presentation of results on concrete cases.	*1h30*	*OBJ6*
13	**Tutorial 7: Practical application in unsupervised learning** Linear regression model with a single variable. Linear regression model with multi variable.	*1h30*	*OBJ5*
14	**Tutorial 8: Creation of the linear model** Calculate slope and intercept with gradient descent algorithm. Calculate slope and intercept with analytical method.	*1h30*	*OBJ5, OBJ6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding the Basic Concepts of AI and Machine Learning (5 points)*
- *Criterion 2: Mastery of Various Learning Algorithms (Supervised, Unsupervised) (5 points)*
- *Criterion 3: Understanding the fundamental concepts of Deep Learning and mastery of neural networks (5 points)*
- *Criterion 4: Familiarize with generative models' principle by studying the Generative Adversarial Network (GAN) algorithm (5 points)*

5- References

- *Russell, S. J., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.*
- *Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.*
- *Schmidhuber, J. (2022). Annotated History of Modern AI and Deep Learning. arXiv preprint arXiv:2212.11279.*
- *Hinton, G., & Sejnowski, T. (1986). Learning and Relearning in Boltzmann Machines. In Parallel Distributed Processing: Explorations in the Microstructure of Cognition (Vol. 1, pp. 282–317). MIT Press.*

6- Learning Environment (Required Installations for Learning)

- *No specific learning environment is required.*

Course Specification

Object Oriented Programming

1. General

Coded	*INF-TC3 2 03*	Level	*3-S2*	Coefficient	*3*	Credits	*4*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Mouhieddine Belghith*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Object Oriented Programming*					Version	*08/2022*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Define the Java language and its environment (OBJ 1), introduce the notions of objects (OBJ 2), and understand basic Java syntax and program structure (OBJ 3, OBJ 7, OBJ 8).*
   - ***Description****: Students will gain a comprehensive understanding of OOP principles (e.g., classes, objects, inheritance, polymorphism, encapsulation, abstraction) and Java-specific concepts (e.g., JDK/JRE/JVM, packages, methods). They will also explore advanced topics like exception handling, interfaces, and abstract classes (OBJ 5, OBJ 6, OBJ 13, OBJ 19, OBJ 25, OBJ 26).*
2. ***Applying Knowledge and Understanding***
   - ***Objective****: Implement Java classes and objects (OBJ 4, OBJ 9, OBJ 10, OBJ 11), apply inheritance and polymorphism (OBJ 14, OBJ 15, OBJ 18, OBJ 20), use encapsulation (OBJ 21, OBJ 22, OBJ 23), implement abstraction (OBJ 27, OBJ 28), and handle exceptions (OBJ 30, OBJ 31).*
   - ***Description****: Students will apply their knowledge to:*
     - *Create and manipulate classes and objects, including constructors and destructors.*
     - *Design hierarchical relationships with subclasses and method overriding.*
     - *Use polymorphism (e.g., overloading, interfaces) to enhance code flexibility.*
     - *Implement encapsulation with access modifiers and getters/setters.*
     - *Design abstract data types and handle errors with custom exceptions, solving problems using interacting objects.*

3. ***Making Judgments***
    - ***Objective****: Analyze and evaluate OOP designs and techniques (OBJ 12, OBJ 16, OBJ 17, OBJ 24, OBJ 32).*
    - ***Description****: Students will assess the appropriateness of OOP principles for specific problems, differentiate between compile-time and run-time polymorphism, avoid inheritance pitfalls, and evaluate the impact of encapsulation and exception handling on code maintainability and robustness, fostering critical decision-making in programming design.*
4. ***Communication***
    - ***Objective****: Articulate OOP concepts and solutions effectively.*
    - ***Description****: Through continuous assessments (e.g., presentations, reports) and the practical exam (e.g., mini-project), students will demonstrate their ability to explain Java syntax, class designs, inheritance hierarchies, and error-handling strategies, communicating technical solutions clearly to peers and instructors.*
5. ***Learning Skills***
    - ***Objective****: Build a foundation for advanced programming and self-directed learning.*
    - ***Description****: By mastering Java and OOP fundamentals with tools like Eclipse and resources such as "The Java Language Specification" by James Gosling et al., students will develop the ability to independently explore advanced programming topics (e.g., design patterns, larger-scale software development), preparing them for future coursework or professional practice.*

Prerequisites:	*Keywords :*
- *using a computer, navigating the file system and understanding file management.* - *Basic understanding of algorithms and problem-solving approaches.* - *Basic programming knowledge (e.g., familiarity with control structures, data types, and algorithms).* - *Ability to think logically and systematically to solve problems.* - *As many programming resources and documents are in English, a basic understanding of the English language is beneficial.* - *Awareness of basic programming concepts, even if they are not specific to JAVA. This can include understanding variables, data types, conditionals, loops and functions.* - *Ability to break problems down into smaller parts and develop strategies to*	

solve them. - *A commitment to practice is crucial for programming. Programming is a skill that improves with practice.*	

Specific course objectives (OBJi):

OBJ1. *Define the java language and install the working environment.*

OBJ2. *Introduce the notions of Object*

OBJ3. *Introduce the basic notions of the Java language*

OBJ4. *Understanding and implementing java classes and objects*

OBJ5. *Introduce the notions of Inheritance, polymorphism and interfaces*

OBJ6. *Understanding and implementing exceptions*

OBJ7. *Learn basic Java syntax, including declarations, expressions, and statements*

OBJ8. Understand the structure of a Java program, including packages, classes, and methods.

OBJ9. Create and implement classes in a chosen programming language.

OBJ10. Instantiate objects and understand their lifecycle.

OBJ11. Demonstrate the use of constructors and destructors.

OBJ12. Implement basic principles of object-oriented design.

OBJ13. Describe the concept of inheritance and its benefits.

OBJ14. Create and use subclasses to model hierarchical relationships.

OBJ15. Implement method overriding to customize legacy behavior.

OBJ16. Identify and avoid common inheritance-related mistakes.

OBJ17. Differentiate between compile-time and run-time polymorphism.

OBJ18. Implement method overloading and understand its purpose.

OBJ19. Exploring interfaces and abstract classes to achieve polymorphism.

OBJ20. Use polymorphism to improve code flexibility and reusability.

OBJ21. Implement access modifiers to control visibility and access to the class.

OBJ22. Demonstrate information hiding through encapsulation.

OBJ23. Discuss the role of getters and setters in encapsulation.

OBJ24. Analyze the impact of encapsulation on code maintainability.

OBJ25. Implement abstract classes and methods to model abstract concepts.

OBJ26. Understand the concept of abstract data types.

OBJ27. Apply abstraction to simplify complex systems.

OBJ28. Design and implement interfaces to achieve abstraction.

OBJ29. Identify common exceptions in object-oriented programs.

OBJ30. Implement exception handling mechanisms to handle errors elegantly.

OBJ31. Develop custom exceptions to handle specific scenarios.

OBJ32. Analyze the importance of exception handling in robust program design.

2- Content elements (TP)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter 1: Introduction to OOP* *History, JDK/JRE/JVM, Definition and principles of OOP, Comparison with procedural programming*	*3*	*OBJ 1,2,3,4*
2-3	*Chapter 2: JAVA Fundamentals* *Variables and primitive types, Conditions and loops*	*6*	*OBJ 5,6,7,8*
4-5	*Chapter 3: Classes and Objects* *Class definition and structure, Instantiation and manipulation of objects*	*6*	*OBJ 9,10,11,12*
6-7	*Chapter 4: Legacy* *Creating and using subclasses, Overriding methods*	*6*	*OBJ13,14,15,16*
8-9	*Chapter 5: Polymorphism* *Overloading and overriding methods, Interfaces and abstract classes*	*6*	*OBJ17,18,19,20*
10-11	*Chapter 6: Encapsulation* *Access modifiers, Concealment of information*	*6*	*OBJ 21,22,23,24*
12-13	*Chapter 7: Abstraction* *Abstract classes and methods, Design of abstract data types*	*6*	*OBJ 25,26,27,28*
14	*Chapter 8: Exception Handling* *Error management in OOP, Custom exceptions*	*3*	*OBJ 29,30,31,32*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of OOP Principles*
- *Criterion 2: Class and Object Design*

- *Criterion 3: Inheritance and Polymorphism*
- *Criterion 4: Encapsulation and Abstraction*
- *Criterion 5: Exception Handling*

5- References

- *James Gosling, Bill Joy, Guy L. Steele, Jr., Gilad Bracha and Alex Buckley. The Java Language Specification, Java SE 7 Edition. Addison-Wesley Professional, 1st Edition, 2013.*
- *J. Boyarsky and S. Selikoff. OCA: Oracle Java SE 8 Certified Associate Programmer's Study Guide, Exam 1Z0-808. Wiley, 2014, ISBN: 9781118957424.*
- *Anne Tasso, The Book of Java First Language: With 90 Corrected Exercises, Eyrolles, 2011, ISBN: 2212133073.*

6- Working environment (Facilities necessary for learning)

- *Software: Eclipse, https://www.eclipse.org/downloads/*

Course Specification

Advanced Algorithmics II

1. General

Coded	*INF-TC3 2 04*	Level/Semester	*3/S2*	Coefficient	*3*	Credits	*3*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Moez Zouari*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Advanced Algorithmics II*					Version	*08/2023*

Course description (Course objective):

1. Knowledge, Understanding, Skills

This level delves into advanced data structures (stacks, queues, trees, graphs) and complex algorithms (graph traversal, advanced sorting, hashing). Students will explore theoretical foundations like computability, Turing machines, and complexity classes (P, NP, NP-completeness). They will also learn about approximation algorithms and heuristic methods for solving intractable problems. The focus is on developing advanced problem-solving skills and understanding the theoretical limits of computation

3. Making Judgments

Evaluate the suitability, efficiency, and theoretical limits of data structures and algorithms for specific problems.

Students will assess the advantages of linked lists over arrays, choose appropriate tree or graph traversal methods, and analyze the complexity of their solutions (e.g., time and space complexity). They will also evaluate whether a problem belongs to a particular complexity class (P, NP) and explore the limits of algorithmic solvability, fostering critical decision-making to optimize algorithmic performance.

4. Communication

Clearly explain algorithmic solutions, theoretical concepts, and their implementations.

Through supervised duties, written exams, and practical tests, students will articulate their understanding of data structures, advanced algorithmic techniques, and complexity theory, presenting both problem-solving strategies and code implementations. Emphasis will be placed on effectively communicating both technical concepts and reasoning behind algorithmic choices.

5. Learning Skills

Develop skills for further study and independent exploration of advanced algorithmic topics.

By engaging with resources such as "Advanced Algorithmics for Graphs" by C. Solnon, and practical tools like CodeBlocks, students will cultivate the ability to independently study topics such as graph theory, combinatorial optimization, and the limits of computation. This prepares them for advanced coursework, research, or professional challenges in computer science, particularly in areas involving intractable problems and heuristic problem-solving approaches.

Prerequisites:	*Keywords :*
Algorithms and data structures I	*Stacks, Queues, Trees, Graphs, Graph algorithms (BFS, DFS), Advanced sorting (merge sort, quicksort, heap sort), Hashing Computability, Turing machines, Complexity classes (P, NP, NP-complete), Approximation algorithms, Heuristic methods, Theoretical limits of computation, Chomsky's algorithm*

Specific course objectives (OBJi):

OBJ 1. Manipulate Advanced Data Structures

- *Implement* ***stacks*** *and* ***queues*** *using arrays and linked lists.*
- *Work with* ***trees*** *(binary trees, binary search trees) and* ***graphs*** *(adjacency matrix, adjacency list).*

OBJ 2. Apply Graph Algorithms

- *Implement breadth-first search (BFS) and depth-first search (DFS) for graph traversal.*
- *Solve graph optimization problems like shortest path and minimum spanning tree.*

OBJ 3. Evaluate Algorithm Efficiency

- *Use asymptotic analysis (Big-O, Big-Ω, Big-Θ) to evaluate algorithm performance.*
- *Compare algorithms based on their* ***run-time complexity*** *and scalability.*

OBJ 4. Implement Advanced Sorting and Searching Algorithms

- *Write and analyze advanced sorting algorithms like merge sort, quicksort, and heap sort.*
- *Implement hashing and* ***hash tables*** *for efficient searching.*

OBJ 5. Understand Theoretical Foundations of Computing

- *Explain the concept of computability and the role of Turing machines.*
- *Identify solvable and unsolvable* ***problems*** *using the halting problem as an example.*

OBJ 6. Explore Complexity Theory and NP-Completeness

- *Understand complexity classes (P, NP, NP-complete, NP-hard).*
- *Identify NP-complete pro**blems** and their implications in real-world applications.*

OBJ 7. Apply Approximation and Heuristic Methods

- *Design approximation algorithms for NP-hard problems.*
- *Use heuristic meth**ods** to solve intractable problems efficiently.*

OBJ 8. Understand Theoretical Limits of Computation

- *Discuss the theoretical limits of computation and their practical implications.*
- *Explore the boundaries of efficient problem-solving and algorithmic design.*

Necessary material :
No material

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR
1-2	***Stacks and Queues*** ○ *Stacks: implementation (using arrays and linked lists), operations (push, pop).* ○ *Queues: implementation (using arrays and linked lists), operations (enqueue, dequeue).* ○ *Applications of stacks and queues (e.g., expression evaluation, BFS).*	*3*
3-4	***Trees*** ○ *Binary trees: structure, traversal (in-order, pre-order, post-order).* ○ *Binary search trees (BST): insertion, deletion, searching.* ○ *Applications of trees (e.g., hierarchical data representation).*	*3*
5-6	***Graphs*** ○ *Graph representation: adjacency matrix, adjacency list.* ○ *Graph traversal algorithms: breadth-first search (BFS), depth-first search (DFS).* ○ *Applications of graphs (e.g., shortest path, social networks).*	*3*
7-8	***Advanced Sorting and Searching Algorithms*** ○ *Advanced sorting algorithms: merge sort, quicksort, heap sort.* ○ *Advanced searching algorithms: hashing, hash tables.* ○ *Analysis of run-time complexity for advanced algorithms.*	*3*
9-10	***Theoretical Foundations – Turing Machines and Computability*** ○ *Turing machines: definition, operation, and significance.* ○ *Computability: solvable vs. unsolvable problems.* ○ *Halting problem and its implications.*	*3*

11-12	***Complexity Theory and NP-Completeness*** ○ *Complexity classes: P, NP, NP-complete, NP-hard.* ○ *NP-completeness: examples (e.g., traveling salesman problem, knapsack problem).* ○ *Approximation algorithms and heuristic methods for NP-hard problems.*	*3*
13-14	***Review and Applications*** ○ *Review of key concepts: data structures, algorithms, and theoretical foundations.* ○ *Discussion of theoretical limits of computation and practical problem-solving.* ○ *Understanding Chomsky's algorithm and its impact on linguistics and computer science*	*3*

3- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR
1-2	***Stacks and Queues*** ○ ***Activity 1**: Implement a **stack** using an array and a linked list. Perform operations like push, pop, and peek.* ○ ***Activity 2**: Implement a **queue** using an array and a linked list. Perform operations like enqueue, dequeue, and peek.* ○ ***Activity 3**: Solve real-world problems using stacks and queues (e.g., checking balanced parentheses with a stack, simulating a printer queue).*	*3*
3-4	***Trees*** ○ ***Activity 1**: Implement a **binary tree** and perform traversals (in-order, pre-order, post-order).* ○ ***Activity 2**: Implement a **binary search tree (BST)** with insertion, deletion, and searching operations.* ○ ***Activity 3**: Solve problems like finding the height of a tree or counting leaf nodes.*	*3*
5-6	***Graphs*** ○ ***Activity 1**: Represent a graph using an **adjacency matrix** and an **adjacency list**.* ○ ***Activity 2**: Implement **breadth-first search (BFS)** and **depth-first search (DFS)** for graph traversal.* ○ ***Activity 3**: Solve graph problems like finding the shortest path in an unweighted graph or detecting cycles.*	*3*
7-8	***Advanced Sorting and Searching Algorithms*** ○ *Activity 1: Implement merge sort and quicksort. Compare their performance on different datasets.* ○ *Activity 2: Implement heap sort and analyze its time complexity.* ○ *Activity 3: Implement a hash table with collision resolution techniques (e.g., chaining, open addressing).* ○	*3*

9-10	***Theoretical Foundations – Turing Machines and Computability*** ○ *Activity 1: Simulate a Turing machine for simple computations (e.g., adding two numbers).* ○ *Activity 2: Write a program to demonstrate the halting problem for a specific set of inputs.* ○ *Activity 3: Discuss and analyze examples of solvable and unsolvable problems.*	*3*
11-12	***Complexity Theory and NP-Completeness*** ○ *Activity 1: Classify problems into complexity classes (P, NP, NP-complete) based on their characteristics.* ○ *Activity 2: Prove that a problem is NP-complete by reducing it to a known NP-complete problem (e.g., reduce the knapsack problem to the subset sum problem).* ○ *Activity 3: Solve small instances of NP-complete problems (e.g., traveling salesman problem) using brute force.*	*3*
13-14	***Review and Applications*** ○ *Activity 1: Implement an approximation algorithm for an NP-hard problem (e.g., a greedy algorithm for the knapsack problem).* ○ *Activity 2: Use heuristic methods (e.g., simulated annealing, genetic algorithms) to solve optimization problems.* ○ *Activity 3: Discuss the theoretical limits of computation and their implications in real-world applications (e.g., cryptography, artificial intelligence).*	*3*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Understanding of Fundamental Concepts (5 points)*
- *Criterion 2: Problem Solving (5 points)*
- *Criterion 3: Complexity Analysis (5 points)*
- *Criterion 4: Implementation (5 points)*

6- References

- *Brass, P. (2008). Advanced Data Structures. Cambridge University Press. https://doi.org/10.1017/CBO9780511801601*
- *La Rocca, M. (2019). Advanced Algorithms and Data Structures. Manning Publications.*
- *Enoch, O., Oloyede, J., Ok, E., Williams, B., Aria, J., Jose, D., & Diego, C. (2024). Data Structures and Algorithms: Trees, Graphs, and Hash Tables; Sorting and Searching Algorithms. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 12(1), 28–39. https://doi.org/10.3991/ijes.v12i1.387127279*
- *Andreica, M. I. (2013). Novel O(H(N)+N/H(N)) Algorithmic Techniques for Several Types of Queries and Updates on Rooted Trees and Lists. arXiv preprint arXiv:1303.5481. https://doi.org/10.48550/arXiv.1303.5481*

7- Working environment (Facilities necessary for learning)

- *CodeBlocks https://www.codeblocks.org/downloads/*

Course Specification

Preparation for CCNA2 computer network certification

1. General

Coded	*Inf-TC 3 2 05*	Level/Semester	*3/S2*	Coef	*3*	Credits	*3*
Course	*Computer Science– Common Core*					Vol. H. (CI)	*21*
Responsible	*Bayrem Triki*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*30*
Module	*Computer Networks*					Version	*08/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective:*** *Explain key networking concepts such as switching (OBJ 2, OBJ 7), Spanning Tree Protocol (STP) (OBJ 5), EtherChannel (OBJ 6), routing protocols (OBJ 8), and LAN/WLAN security (OBJ 9).*
   - ***Description:*** *Students will gain a comprehensive understanding of:*
     - *How Layer 2 switches transfer data and how Ethernet operates in switched networks.*
     - *The role of STP in enabling redundancy and EtherChannel in link aggregation.*
     - *Network layer protocols and services for end-to-end connectivity.*
     - *Security concepts for switches, routers, and wireless LANs (WLANs), building a theoretical foundation for network operations.*
2. ***Applying Knowledge and Understanding***
   - ***Objective:*** *Configure devices with security best practices (OBJ 1), implement VLANs and trunking (OBJ 3), configure inter-VLAN routing (OBJ 4), troubleshoot network issues (OBJ 4, OBJ 6), and design a small network (OBJ 10).*
   - ***Description:*** *Students will apply their knowledge to:*
     - *Configure switches and routers with security features (e.g., switch security, WLAN configuration) using tools like Cisco Packet Tracer.*

- *Set up VLANs, trunking, and inter-VLAN routing on Layer 3 devices.*
- Troubleshoot issues like inter-VLAN routing and EtherChannel over dial-up links.

3. ***Making Judgments***

   - ***Objective:*** *Assess and troubleshoot network configurations and security threats (OBJ 4, OBJ 6, OBJ 9).*
   - *Description: Students will evaluate the effectiveness of network setups, identify and mitigate LAN security threats, and troubleshoot routing and switching issues (e.g., STP redundancy, EtherChannel performance). This involves critical analysis to ensure reliable and secure network operations, aligning with the evaluation criterion of network design and implementation.*

4. ***Communication***

   - ***Objective:*** *Articulate networking concepts and solutions effectively.*
   - ***Description:*** *Through supervised duties, written exams, and practical projects, students will demonstrate their ability to explain switching and routing concepts, present configuration strategies, and document troubleshooting processes, communicating technical details clearly to peers and instructors.*

5. ***Learning Skills***

   - ***Objective:*** *Prepare for ongoing learning and CCNA certification.*
   - ***Description:*** *By mastering CCNA2 topics and using resources like Cisco Packet Tracer, students will develop the ability to independently explore advanced networking concepts (e.g., WANs, advanced routing protocols), preparing them for the CCNA certification exam and future professional roles in network engineering.*

Prerequisites:	*Keywords :*
CCNA1	*TCP/IP*

Specific course objectives (OBJi):
OBJ 1: *Configure devices using security best practices.*
OBJ 2: *Explain how Layer 2 switches transfer data.*
OBJ 3: *Implement VLANs and trunking in a switched network.*
OBJ 4: *Troubleshoot inter-VLAN routing issues on Layer 3 devices.*
OBJ 5: *Explain how STP enables redundancy in a Layer 2 network.*

OBJ 6: *Troubleshoot EtherChannel issues over dial-up links.*

OBJ 7: *Explain how Ethernet works in a switched network.*

OBJ 8: *Explain how routers use network layer protocols and services to enable end-to-end connectivity.*

OBJ 9: *Configure switches and routers with security-enhancing features.*

OBJ 10: *Implement a network design for a small network including a router, switch, and end devices.*

Necessary material :
PC and Internet connection

2- Content elements (Course)

Week(s)	Chapters/ The contained elements	No. HR	Objective(s) targeted
1	Module 1: Basic Device Configuration	*1.5 hours*	*OBJ1*
2	Module 2: Switching Concepts	*1.5 hours*	*OBJ2*
3	Module 3: VLANs	*1.5 hours*	*OBJ3*
4	Module 4: Inter-VLAN Routing	*1.5 hours*	*OBJ4*
5	Module 5: STP	*1.5 hours*	*OBJ5*
6	Module 6: EtherChannel	*1.5 hours*	*OBJ6*
7	Module 7: DHCPv4	*1.5 hours*	*OBJ7*
8	Module 8: Concepts of SLAAC and DHCPv6	*1.5 hours*	*OBJ8*
9	Module 9: FHRP Concepts	*1.5 hours*	*OBJ9*
10	Module 10: LAN Security Concepts and Configuring Switch Security	*1.5 hours*	*OBJ10*
11-12	Module 11: WLAN Concepts and Configuration	*3 hours*	*OBJ9*
13-14	*Module 12:* Routing Concepts, IP Static Routing, and Troubleshooting Static and Default Routes	*3 hours*	*OBJ10*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	Module 1: Basic Device Configuration	*1.5 hours*	*OBJ1*
2	Module 2: Switching Concepts	*1.5 hours*	*OBJ2*
3	Module 3: VLANs	*1.5 hours*	*OBJ3*
4	Module 4: Inter-VLAN Routing	*1.5 hours*	*OBJ4*
5	Module 5: STP	*1.5 hours*	*OBJ5*
6	Module 6: EtherChannel	*1.5 hours*	*OBJ6*
7	Module 7: DHCPv4	*1.5 hours*	*OBJ7*

8	Module 8: Concepts of SLAAC and DHCPv6	*1.5 hours*	*OBJ8*
9	Module 9: FHRP Concepts	*1.5 hours*	*OBJ9*
10	Module 10: LAN Security Concepts and Configuring Switch Security	*1.5 hours*	*OBJ10*
11	Module 11: WLAN Concepts and Configuration	*1.5 hours*	*OBJ9*
12	*Module 12:* Routing Concepts, IP Static Routing, and	*1.5 hours*	*OBJ10*
	Troubleshooting Static and Default Routes		
13-14	*Practical project*	*3 hours*	

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Understanding of Routing and Switching Concepts*
- *Criterion 2: Router and Switch Configuration Skills*
- *Criterion 3: Wide Area Networks (WANs)*
- *Criterion 4: Network Design and Implementation*

6- References

- *Lammle, T. (2014). CCNA Routing and Switching Complete Study Guide. Wiley.*
- *Johnson, A. (2014). CCNA Routing and Switching Practice and Study Guide: Exercises, Activities, and Scenarios to Prepare for the ICND2 (200-101) Certification Exam. Cisco Press.*
- *Balchunas, A. (2014). Cisco CCNA Study Guide. Router Alley.*
- *Johnson, A. (2014). CCNA Routing and Switching Practice and Study Guide: Exercises, Activities, and Scenarios to Prepare for the ICND2 (200-101) Certification Exam. Cisco Press.*

7- Working environment (Facilities necessary for learning)

- *Cisco Packet Tracer*

https://www.packettracernetwork.com/download/download-packet-tracer.html

Course Specification

Systems Architecture, Embedded Systems and IoT

1. General

Coded	*INF-TC3 2 06*	Level/Semester	*3-S2*	Coefficient	*3*	Credits	*4*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Marwa Neily*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*System architectures, embedded systems and IoT*					Version	*10/2022*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Introduce embedded systems and their architecture (OBJ 1), understand sensors and actuators (OBJ 2), and become familiar with IoT systems and their applications (OBJ 3).*
   - ***Description****: Students will gain a solid understanding of:*
     - *The architecture of embedded systems (e.g., processors, memory, communication interfaces) and their main features.*
     - *The operating principles and examples of sensors and actuators used in embedded systems.*
     - *IoT system architectures (e.g., layered models) and their applications, providing a theoretical foundation for embedded and connected technologies.*
2. ***Applying Knowledge and Understanding***
   - ***Objective****: Apply knowledge of embedded systems and IoT communication systems (OBJ 1, OBJ 4) and implement practical solutions using sensors, actuators, and IoT devices (OBJ 2, OBJ 3).*
   - ***Description****: Students will apply their knowledge to:*
     - *Configure and program embedded systems using Arduino Uno (e.g., basic and advanced setups with sensors).*
     - *Build complete embedded systems integrating sensors and actuators.*
     - *Create IoT solutions using ESP32 modules with communication protocols (e.g., WiFi, BLE, LoRa), as demonstrated in practical work with Arduino IDE and hardware kits.*
3. ***Making Judgments***

- ***Objective***: *Evaluate the design and implementation of embedded and IoT systems (OBJ 1–OBJ 4).*

- ***Description***: *Students will assess the effectiveness of system architectures, choose appropriate sensors/actuators and communication techniques (e.g., WiFi vs. LoRa) for specific applications, and optimize solutions (e.g., using loops efficiently), aligning with the evaluation criteria of methodology and optimal solutions. This involves critical analysis of system performance and functionality.*

4. ***Communication***
   - ***Objective***: *Articulate concepts and solutions related to embedded systems and IoT.*
   - ***Description***: *Through supervised duties, written exams, and practical exams, students will demonstrate their ability to explain embedded system architectures, IoT communication methods, and practical implementations, presenting their work clearly and justifying design choices.*
5. ***Learning Skills***
   - ***Objective***: *Prepare for further exploration of embedded systems and IoT technologies.*
   - ***Description***: *By engaging with tools like Arduino IDE, ESP32 modules, and resources such as the Arduino official website and simulator, students will develop the ability to independently pursue advanced topics (e.g., real-time systems, advanced IoT protocols), equipping them for future studies or professional roles in embedded and IoT development.*

Prerequisites:	*Keywords :*
Architecture Microprocessor systems	*Microcontroller, Embedded System, IoT*

Specific course objectives (OBJi):

OBJ 1 : *Introduce embedded systems and their architecture.*

OBJ 2 : *Get an idea about the different types of sensors and actuators used in embedded systems*

OBJ 3 : *Become familiar with IoT systems and their applications*

OBJ 4 : *Know the different communication systems used in IoT*

Necessary material :

Video projector and Arduino initiation kits for TPs

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to Embedded Systems: Applications and Main Features*	*3*	*OBJ1*
3-4	*Architecture of embedded systems: processor, memory,*	*3*	*OBJ1*
	communication interfaces, etc.		
5-6	*Sensors and actuators: operating principle*	*3*	*OBJ2*
7-8	*Sensors and actuators: operating examples*	*3*	*OBJ2*
9-10	*IoT systems architecture: layered model*	*3*	*OBJ3*
11-12	*IoT communication techniques: WiFi, BLE, LoRa, etc.*	*3*	*OBJ4*
13-14	*IoT communication techniques*	*3*	*OBJ4*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-3	*TP1: Arduino Uno initiation: becoming familiar with the Arduino development board and its IDE system*	*4.5*	*OBJ1*
4-6	*TP2: Advanced use of Arduino associated with some sensors*	*4.5*	*OBJ1-OBJ2*
7-9	*TP3: Complete embedded system based on Arduino, sensors and actuators*	*4.5*	*OBJ2-OBJ3*
10-13	*TP4: Connected object based on the ESP32 module*	*6*	*OBJ3-OBJ4*
14	*Practical exam*	*1.5*	*-*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Methodology (50%)*
- *Criterion 2: Final result (40%)*
- *Criterion 3: Optimal solution use of loops, etc. (10%)*

5- References

- *Darabseh, A., & Freris, N. M. (2018). A software-defined architecture for control of IoT Cyberphysical*

Systems. arXiv:1810.03822.

- *Nawandar, N. K., Cheggoju, N., & Satpute, V. R. (2021). Stand-alone device for IoT applications. arXiv:2110.15405.*
- *Cook, D., & Das, S. (2004). Smart Environments: Technology, Protocols and Applications. Wiley-Interscience.*
- *Poslad, S. (2009). Ubiquitous Computing: Smart Devices, Environments and Interactions. Wiley.*

6- Working environment (Facilities necessary for learning)

- *Arduino Uno Starter Kit*
- *ESP32 or NodeMCU modules*
- *PC with Arduino IDE installed*
- *WiFi/internet access*

Course specification

DBMS workshops

1. General

Coded	*INF-TC3 2 07*	Level/Semester	3-S2	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science – Common core*					Vol. H. (CI)	
Responsible	*Adel Dahmane*					Vol. H. (PW)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*DBMS workshops*					Version	*10/2022*

Course Description
1. ***Knowledge and Understanding*** ○ ***Objective****: Define basic concepts of relational DBMS and Oracle (OBJ 1), specify PL/SQL block structure (OBJ 2), describe variables and native functions (OBJ 3), and understand triggers and cursors (OBJ 6, OBJ 12, OBJ 23, OBJ 24).* ○ ***Description****: Students will gain a comprehensive understanding of:* ▪ *Relational DBMS concepts and Oracle's functional architecture.* ▪ *PL/SQL block components (declarative, execution, error management sections).* ▪ *Essential programming constructs (e.g., variables, types, literals, string/arithmetic/date functions) and advanced features like cursors (implicit, explicit, parameterized) and triggers (DML, DDL).* 2. ***Applying Knowledge and Understanding*** ○ ***Objective****: Implement PL/SQL programs with conditional treatments (OBJ 4), loops, records, and collections (OBJ 5), develop stored procedures, functions, and packages (OBJ 9, OBJ 11, OBJ 21, OBJ 22), handle exceptions (OBJ 7, OBJ 8, OBJ 20), and create triggers (OBJ 13, OBJ 25).* ○ ***Description****: Students will apply their knowledge to:* ▪ *Write PL/SQL code using IF/CASE statements, loops (Loop, While, For), and collections.* ▪ *Manage cursors and pass parameters (IN, OUT, IN OUT) in stored procedures and functions.*

- *Group procedures/functions into packages and handle runtime errors with SQLCODE/SQLERRM.*
- *Build and manipulate DML (Insert, Update, Delete) and DDL (Create, Alter, Drop) triggers, consolidating SQL skills (e.g., joins, subqueries) (OBJ 14, OBJ 15).*

3. ***Making Judgments***
   - ***Objective****: Evaluate and manage PL/SQL programs and database operations (OBJ 7, OBJ 10, OBJ 24, OBJ 25).*
   - ***Description****: Students will assess the appropriateness of PL/SQL constructs (e.g., cursor types, exception handling mechanisms) and trigger designs for specific scenarios, distinguishing between DML and DDL triggers and optimizing error management, aligning with the criterion of mastering Oracle database management.*

4. ***Communication***
   - ***Objective****: Articulate DBMS concepts and PL/SQL solutions effectively.*
   - ***Description****: Through supervised duties, written exams, and practical exams, students will demonstrate their ability to explain Oracle architecture, PL/SQL block structures, and trigger mechanisms, presenting their implementations clearly and justifying their design choices.*

5. ***Learning Skills***
   - ***Objective****: Prepare for advanced database programming and self-directed learning.*
   - ***Description****: By mastering Oracle 12c and PL/SQL with tools like Oracle SQL Developer and resources such as "Oracle 11g SQL, PL/SQL, SQL*Plus" by J. Gabillaud, students will develop the ability to independently explore advanced DBMS topics (e.g., performance tuning, complex triggers), equipping them for further studies or professional database roles.*

Prerequisites:	*Keywords :*
Basic knowledge of programming *Basic knowledge of design*	*Database, Oracle, SQL, functions, procedures, variables, triggers, etc.*

Course objectives (OBJi):

OBJ 1 : *Define the basic concepts related to relational DBMS (Oracle, etc.).*

OBJ 2 : *Specify the structure of a PL/SQL block (declarative section, execution section and error management section).*

OBJ 3 : *Describe variables, types, literals and essential native functions (strings, arithmetic, conversion and dates).*

OBJ 4 : *Illustrate conditional treatments (IF & CASE).*

OBJ 5 : *Use records, loops (Loop, While & For) and collections.*

OBJ 6 : *Manipulate implicit, explicit and parameterized cursors.*

OBJ 7 : *Handle runtime errors (internal and external exceptions).*

OBJ 8 : *Use the error trapping functions (SQLCODE & SQLERRM).*

OBJ 9 : *Develop stored procedures and functions.*

OBJ 10 : *Master the passing of parameters (IN, OUT IN OUT, DEFAULT).*

OBJ 11 : *Group procedures and functions into packages.*

OBJ 12 : *Create table and row triggers.*

OBJ 13 : *Build DML triggers (Insert, Update and Delete) and DDL triggers (Create, Alter and Drop).*

OBJ 14 : *Consolidate previous knowledge concerning the SQL language (Join, Subqueries, Grouping, Set operators, etc.).*

OBJ 15 : *Deepen your SQL knowledge: sequences, synonyms, system tables (user_tables, user_views, user_constraints, etc.).*

OBJ 16 : *Use variables, data types, and conditions.*

OBJ 17 : *Handle anonymous PL/SQL blocks and implicit cursors.*

OBJ 18 : *Handle loops and explicit sliders.*

OBJ 19 : *Practice recordings and parameterized faders.*

OBJ 20 : *Handle exceptions (runtime errors).*

OBJ 21 : *Build stored procedures and functions.*

OBJ 22 : *Group procedures and functions into packages*

OBJ 23 : *Review the general mechanism of triggers.*

OBJ 24 : *Distinguish between DML triggers (Insert, Update and Delete) and DDL triggers (Create, Alter and Drop).*

OBJ 25 : *Create, destroy and manipulate a trigger (DML/DDL, Before/After, ...).*

Equipment Required:
- Computer

2- Content elements (Course)

Weeks	Chapters/Content Items	No. HR	Goals)
1-2	*PL/SQL block, Declarative section (variables, types, records, collections), conditions, loops and input/output management*	*3*	*OBJ 1 – OBJ 5*
3-4	*Implicit Cursors and Explicit/Parameterized Cursors*	*3*	*OBJ 5, OBJ 6*
5-6	*Error management (internal and external exceptions): declaration and interception*	*3*	*OBJ 7, OBJ 8*
7-8	*Stored Procedures and Functions: syntax, parameter passing and packaging*	*3*	*OBJ 9 – OBJ 11*

9-10	Triggers: principle, syntax, options, DML trigger, DDL trigger	3	OBJ 12, OBJ 13
11-12	Revision (consolidation and correction of an old exam)	3	OBJ 1 – OBJ 13
13-14	Theoretical exam	3	OBJ 1 – OBJ 13

3- Content elements (Practical work)

Week	Chapters/Content Items	Number of hours	Goals)
1 - 2	SQL consolidation: old TP exam, sequences, synonyms, system tables (user_tables, user_views, user_constraints, etc.).	3:00	OBJ 14 – OBJ 15
3 - 4	PL/SQL language elements: variables, types, conditions, anonymous PL/SQL block & Loops	3:00	OBJ 16 – OBJ 17
5 - 8	Implicit, explicit and parameterized sliders & Exceptions: Error handling	6:00	OBJ 18 – OBJ 20
9 - 10	Procedures, Functions and Packages	3:00	OBJ 21 – OBJ 22
11 - 12	Triggers: principle, complete syntax, options, ...	3:00	OBJ 23 – OBJ 25
13 – 14	Practical exam	3:00	OBJ 14 – OBJ 25

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	20%
EE - Written test (Final exam)	60%
EP - Practical test (Practical work exam or Mini project)	20%

4- Evaluation criteria

- *Criterion 1: Mastery of SQL language (10 points)*
- *Criterion 2: Mastery of creating and managing an Oracle database. (10 points)*

5- References

- *Duta, C., Hirn, D., & Grust, T. (2019). Compiling PL/SQL Away. arXiv:1909.03291.*
- *Liu, J., Liu, S., & Chen, J. (2024). I3DE: An IDE for Inspecting Inconsistencies in PL/SQL Code. arXiv:2403.03433.*
- *Feuerstein, S., & Pribyl, B. (2014). Oracle PL/SQL Programming (6th ed.). O'Reilly Media.*
- *Bales, D. (2007). PL/SQL from Novice to Professional. Apress*

6- Working environment (Facilities necessary for learning)

- *Microsoft Visual Studio 2019 (https://visualstudio.microsoft.com/fr/vs/community/)*
- *Oracle 12c*
- *Oracle SQL Developer 21.2.1 (Windows 64-bit with JDK 8 included) https://www.oracle.com/tools/downloads/sqldev-down*

Course Specification

Advanced Web Development

1. General

Coded	*Inf-TC 3 2 08*	Level/Semester	*3/S2*	Coefficient	*3*	Credits	*4*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Nahla Baccar*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*60*
Module	*Advanced web development*					Version	*08/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Learn the basics of PHP programming and execution context (OBJ 1) and understand how to enforce web application security using sessions and cookies (OBJ 3).*
   - ***Description****: Students will gain a solid understanding of:*
     - *PHP syntax, execution modes (client/server architecture, HTTP requests), and basic constructs (variables, functions, flow control).*
     - *Techniques for securing web applications using superglobal variables, sessions, and cookies, as well as the role of PHP in the broader web ecosystem alongside HTML and databases.*

2. ***Applying Knowledge and Understanding***
   - ***Objective****: Automate dynamic web pages (OBJ 2), use object-oriented programming in PHP7 (OBJ 4), communicate between PHP and databases using PDO (OBJ 5), and develop a web application with a PHP framework like Laravel (OBJ 6).*
   - ***Description****: Students will apply their knowledge to:*
     - *Integrate PHP with HTML forms, handle GET/POST variables, and manage file operations and redirections.*
     - *Implement object-oriented concepts (classes, constructors, accessors, polymorphism, inheritance) in PHP7.*
     - *Connect to MySQL databases using PDO, execute secure prepared queries, and handle errors.*
     - *Build a full web application using the Laravel framework, demonstrating practical*

skills in dynamic website development.

3. ***Making Judgments***
    - ***Objective***: *Evaluate and optimize web application design, security, and implementation (OBJ 3, OBJ 5, OBJ 6).*
    - ***Description***: *Students will assess the effectiveness of security measures (e.g., session management, prepared statements), choose appropriate PHP techniques (e.g., OOP vs. procedural) for specific tasks, and ensure code quality and best practices, aligning with evaluation criteria like testing, debugging, and project implementation. This involves critical analysis of application performance and robustness.*

4. ***Communication***
    - ***Objective***: *Articulate web development solutions and processes clearly.*
    - ***Description***: *Through continuous assessments (e.g., presentations, reports) and the practical project, students will demonstrate their ability to explain PHP programming concepts, justify security implementations, and present a functional Laravel-based application, communicating technical details effectively.*

5. ***Learning Skills***
    - ***Objective***: *Prepare for advanced web development and self-directed learning.*
    - ***Description***: *By mastering PHP7, PDO, and Laravel with tools like VSCode and XAMPP, and utilizing resources such as "PHP and MySQL Web Development" by Luke Welling and Laura Thomson, students will develop the ability to independently explore advanced web technologies (e.g., other frameworks, APIs), equipping them for future studies or professional web development roles.*

Prerequisites:	*Keywords :*
Web development	*PHP 7, array, string, date, HTML5 form, PDO, prepared requests,*

Specific course objectives (OBJi):

At the end of this subject, the student will be able to create a dynamic website using advanced web technologies:

OBJ 1: *Learn the basics of PHP programming and the execution context*

OBJ 2: *Learn how to automate dynamic web pages*

OBJ 3: *Enforce web application security using sessions and cookies*

OBJ 4: *Use object-oriented programming in PHP7*

OBJ 5: Communicate between PHP and a database using PDO

OBJ 6: *Development of a web application based on PHP framework: LARAVEL example*

Necessary material :
…

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***TP1: The Basics of PHP Programming and Execution Contexts*** ***Introduction to PHP*** *Execution modes: The different elements of a program and their roles.* *The different web languages and the place of PHP.* *My first program.* *Client/Server Architecture* *HTTP requests and specific headers* ***The basics of language: syntactic aspects and articulation*** *Types of variables* *Integers, strings, real numbers, others.* *Evolved types.* ***Functions*** *Argument passing.The return code of a function.Flow control* *The alternative selection (if...then...else...)The loops (while...)* ***Additional aspects*** *Expressions and operators* *Comments* *Inclusions* *Understand error messages.* *First WEB applications in PHP*	*6H*	***OBJ 1****:* shows the basic structures of PHP details the different functions for managing character strings, tables and dates.
3-4	***TP2: Automating a web page*** *Client-server principles* *Integration of PHP into an HTML page* *Bookstores* *Basic functions, server variables and PHP variable* *Simple forms Passing and transmitting variables (GET/POST).* *Read write file* *Redirection.* *Complex variables: arrays Array constructor,*	*6H*	***OBJ 2****:*describes the interaction between PHP and HTML forms (variables, files), as well as PHP superglobals allowing their manipulation.

	character strings and dates		
5-6	***TP3: Superglobals, cookies and sessions*** *Superglobal variables* *Web sessions* *Cookies*	*6H*	***OBJ 3:**How to enforce application security using session environment variables and cookies*
7-8	***TP 4: Object Oriented Programming in PHP 7*** *Concept of classes* *Concept of constructors* *Concept of accessors in PHP Polymorphism and Inheritance in PHP Access to databases with simple states* *Access to databases with prepared reports* *Data security issues*	*6H*	***OBJ 4:**How to use object-oriented concepts with PHP7*
9-10	***TP5: PHP interaction / MySQL databases*** *Connection with a MySQL database* *select query* *Update request* *Database server error handling.*	*3H*	***OBJ 5**How to use prepared queries to secure data access*
11-12	***TP6: use a PHP framework: Laravel***	*6H*	***OBJ 6**: development of a web application based on PHP framework: LARAVEL example*
13-14	*Practical Project*	*6h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Problem-Solving Skills (5points)*
- *Criterion 2: Project Implementation (5points)*
- *Criterion 3: Code Quality and Best Practices (5 points)*

- *Criterion 4: Testing and Debugging (5 points)*

5- References

- *(en) Luke Welling and Laura Thomson, PHP and MySQL Web development, Sams Publishing, 2019, 4th ed.*

- *Damien Seguy and Philippe Gamache, PHP 7 and MySQL Security, 3rd edition,Eyrolles, December 1, 2011, 277 p.*
- *Jean Engels PHP 5 Courses and Exercises, 3rd edition, Eyrolles 2013, 631 pages)*

6- Working environment (Facilities necessary for learning)

- *VSCODE Text Editor*
- *XAAMP*

Course Specification

Python Programming

1. General

Coded	*INF-TC3 2 09*	Level/Semester	*3-S2*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Boutheina Ben Ismail*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*25*
Module	*Python Programming*					Version	*09/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
    - ***Objective****: Define the Python language and its working environment (OBJ 1) and introduce basic notions of Python programming (OBJ 2).*
    - ***Description****: Students will gain a comprehensive understanding of:*
        - *Python's syntax, interpreter functionality, and installation process (e.g., via Google Colab).*
        - *Fundamental programming concepts such as variables, functions, operators, data types (numeric, strings), coding conventions, and scope (local vs. global), providing a theoretical foundation for Python development.*
2. ***Applying Knowledge and Understanding***
    - ***Objective****: Implement data structures (OBJ 3), iterative structures (OBJ 4), graph plotting functions (OBJ 5), NumPy for image processing (OBJ 6), and statistical data analysis functions (OBJ 7).*
    - ***Description****: Students will apply their knowledge to:*
        - *Create and manipulate data structures (tuples, lists, dictionaries) and control structures (conditionals, loops).*
        - *Plot graphs (e.g., curves, histograms) using Matplotlib.*
        - *Use NumPy for image processing tasks and implement statistical analysis functions (e.g., reading CSV files, calculating parameters), solving practical problems in a Python environment like Google Colab.*

3. ***Making Judgments***
    - ***Objective****: Evaluate and select appropriate Python tools and techniques for problem-solving (OBJ 3–OBJ 7).*
    - ***Description****: Students will assess the suitability of data structures (e.g., lists vs. dictionaries), control structures, and libraries (e.g., NumPy vs. built-in functions) for specific tasks, such as graphing or statistical analysis, ensuring effective implementation of models and algorithms, as reflected in the evaluation criteria.*
4. ***Communication***
    - ***Objective****: Articulate Python programming concepts and solutions clearly.*
    - ***Description****: Through continuous assessments (e.g., quizzes, presentations) and the practical exam (e.g., mini-project), students will demonstrate their ability to explain Python syntax, data structures, and library usage, presenting their code and results effectively to peers and instructors.*
5. ***Learning Skills***
    - ***Objective****: Prepare for advanced Python programming and self-directed learning.*
    - ***Description****: By mastering Python basics and libraries with tools like Google Colab and resources such as "Python for Data Analysis" by Wes McKinney, students will develop the ability to independently explore advanced topics (e.g., machine learning, advanced data visualization), equipping them for future studies or professional programming roles.*

Prerequisites:	*Keywords :*
python programming introduction	*Python –Model*

Specific course objectives (OBJi):

OBJ 1 : *Define the python language and install the working environment.*

OBJ 2 : *Introduce the basic notions of Python programming (variable, function, operators, etc.)*

OBJ 3 : *Understand and implement data structures (Tuple, list, dictionary)*

OBJ 4 : *Understand and implement iterative structures*

OBJ 5 : *Define and implement graph plotting functions with python*

OBJ 6 : *Define the Numpy library and implement image processing applications*

OBJ 7 : *Define and implement functions for statistical data analysis*

Necessary material :

A computer equipped with a configuration suitable for resource-intensive tasks, such as a Gaming PC, is highly recommended for working efficiently on Google Colab using Python.
PC has a robust internet connection to ensure fast data downloads and uploads while using Colab.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Introduction to python*** *Why use Python rather than another language* *Installation of Python (prerequisites, files, detailed tree structure)* *How the Python interpreter works.*	*1h30*	*OBJ1*
3-4	***Python basics*** *Identifiers and references.* *Coding conventions and naming rules.* *Blocks, comments.* *The types of data available.* *Variables, formatted display, local and global scope.* *Handling numeric types, handling character strings.* *Logical operators and comparison operators. –* *Functions (Notion of functions, Lambda functions)*	*1h30*	*OBJ2*
5-6	***Data structures*** *Tuples* *The lists* *Dictionaries* *Applications*	*1h30*	*OBJ3*
7-8	***Control structures*** *Structural conditions* *Buckles* *Applications*	*1h30*	*OBJ4*
9-10	***Graphs in Python*** *Plotting graphs (curves, histograms, scatter plots, etc.) with matplotlib* *Applications*	*1h30*	*OBJ5*
11-12	***Numpy Library*** *Data structures by numpy* *Applications for image processing*	*1h30*	*OBJ6*
13-14	***Statistical analysis*** *Statistical parameters* *Reading text and CSV files* *Applications* ***Functions and modules in Python*** *Creation of functions and modules in Python.* *Using functions to solve problems*specific themes.	*1h30*	*OBJ7*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Mastery of programming in python with Google Colab (4 points)*
- *Criterion 2: Effective use of Libraries (8 points)*
- *Criterion 3: implementation of models and algorithms in python (8 points)*
- *Criterion 4: Quiz and test for assessing basic knowledge of Python (40% rating)*

5- References

- *Leelaprute, P., Chinthanet, B., Wattanakriengkrai, S., Gaikovina Kula, R., Jaisri, P., & Ishio, T. (2022). Does Coding in Pythonic Zen Peak Performance? Preliminary Experiments of Nine Pythonic Idioms at Scale. arXiv:2203.14484.*
- *Dyer, R., & Chauhan, J. (2022). An Exploratory Study on the Predominant Programming Paradigms in Python Code. arXiv:2209.01817.*
- *McKinney, W. (2022). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.*
- *Ramalho, L. (2022). Fluent Python: Clear, Concise, and Effective Programming (2nd ed.). O'Reilly Media.*

6- Working environment (Facilities necessary for learning)

- *Use Google Colab to install Python: https://colab.research.google.com/*
- *https://jupyter.org/*

Course Specification

Image processing

1. General

Coded	*INF-TC3 2 10*	Level	*3-S2*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	
Responsible	*Mehrez Abdellaoui*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Image processing*					Version	*12/2022*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Master tools for reading, displaying, and creating 2D/3D images (OBJ 1) and understand different methods of filtering digital images (OBJ 3).*
   - ***Description****: Students will gain a comprehensive understanding of:*
     - *Image processing fundamentals, including tools for image creation, display, and enhancement (e.g., histograms, brilliance, contrast).*
     - *Various filtering techniques (linear, non-linear, morphological) and their applications in digital image analysis, providing a theoretical foundation for subsequent practical skills.*
2. ***Applying Knowledge and Understanding***
   - ***Objective****: Master tools for transforming and improving images (OBJ 2), implement image segmentation methods (OBJ 4), apply image description techniques (OBJ 5), use image classification models (OBJ 6), and leverage shape recognition tools (OBJ 7).*
   - ***Description****: Students will apply their knowledge to:*
     - *Enhance images using statistical and transformation tools.*
     - *Segment images via binarization, thresholding, region-based approaches, and K-means clustering.*
     - *Describe images with descriptors (e.g., co-occurrence matrix, LBP, HOG, SIFT, SURF).*
     - *Classify images using convolutional neural networks (CNNs) and support vector machines (SVMs).*
     - *Recognize shapes with morphological tools, culminating in a practical module project (OBJ 8).*

3. ***Making Judgments***
   - ***Objective****: Evaluate and select appropriate image processing techniques for specific tasks (OBJ 2–OBJ 7).*
   - ***Description****: Students will assess the suitability of filtering, segmentation, and classification methods for given applications (e.g., medical image classification, shape recognition), analyze the effectiveness of feature extraction and enhancement techniques, and optimize solutions, aligning with evaluation criteria like image segmentation and object recognition.*
4. ***Communication***
   - ***Objective****: Articulate image processing concepts and project outcomes effectively.*
   - ***Description****: Through continuous assessments (e.g., quizzes, presentations) and the practical exam (e.g., module project presentation), students will demonstrate their ability to explain image processing techniques, justify their algorithmic choices, and present project results clearly to peers and instructors.*
5. ***Learning Skills***
   - ***Objective****: Prepare for advanced image processing and self-directed learning.*
   - ***Description****: By mastering MATLAB and its toolboxes (Image Processing, Computer Vision, Deep Learning) with resources like "Feature Extraction and Image Processing for Computer Vision" by Nixon and Aguado, students will develop the ability to independently explore advanced topics (e.g., deep learning for vision, real-time processing), equipping them for future studies or professional roles in computer vision.*

Prerequisites:	*Keywords :*
Matrix calculation, digital data coding, digital signal processing, algorithms and programming	*Matlab, Image processing toolbox, image segmentation, image enhancement*

Specific course objectives (OBJi):

OBJ 1 *: Master the tools for reading, displaying and creating 2D and 3D images*
OBJ 2 *: Master the tools for transforming and improving images*
OBJ 3 *: Know the different methods of filtering digital images*
OBJ 4 *: Master the different image segmentation methods*
OBJ 5 *: Master the different approaches to image description*
OBJ 6 *: Master image classification models*
OBJ 7 *: Master shape recognition tools.*
OBJ 8 *: Master the tools specific to the module project*

2- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*1/ Getting started with the software* *2/ Reading and displaying 2D and 3D images* *Different statistical tools: Histogram, Brilliance, contrast* *4/ Image enhancement techniques*	*3*	*OBJ 1* *OBJ 2*
3-4	*1/ Linear filtering of digital images* *2/ Non-linear filtering of digital images* *3/ Morphological filtering*	*3*	*OBJ 3*
5-6	*1/ Image binarization: global, adaptive and manual method* *2/ Image segmentation by multiple thresholding* *3/ Image segmentation by region approach* *4/ Image segmentation using the K-means method*	*3*	*OBJ 4*
7-8	*Description of images:* *1/ Co-occurrence matrix* *2/ LBP local binary patterns* *3/ Histogram of HOG oriented gradients* *4/ Local descriptors: SIFT, SURF* *5/ Application to image matching*	*3*	*OBJ 5*
9-10	*Image classification:* *1/ Convolutional Neural Network: Classification of medical images.* *2/ Vector Machine support: classification of figures*	*3*	*OBJ6*
11-12	*Shape recognition:* *1/ Use of morphological tools for shape recognition*	*3*	*OBJ 7*
13-14	*Presentation of module projects carried out by students*	*3*	*OBJ 8*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Image Processing Concepts*
- *Criterion 2: Image Filtering and Enhancement*
- *Criterion 3: Feature Extraction and Object Recognition*
- *Criterion 4: Image Transformation and Restoration*
- *Criterion 5: Image Segmentation and Morphological Processing*

5- References

- *Diane Lingrand. 2004. Introduction to image processing, Vuibert, 2004, 221 p.*
- *Stéphanie Bigot-Marchand, 2008. Image processing tools, Lille Theses, 107 p.*
- *Digital Image Processing And Applications, International BookMarket Service Limited, 204 p.*
- *Nixon, M., Aguado, A. (2019). Feature Extraction and Image Processing for Computer Vision. United Kingdom: Elsevier Science.*
- *Deep Learning for Computer Vision: Image Classification, Object Detection, and Face Recognition in Python. (2019). (np): Machine Learning Mastery.*

6- Working environment (Facilities necessary for learning)

- *MATLAB, Image Processing Toolbox, Computer Vision Toolbox, Deep Learning Toolbox*
- *Google collaboration*

Course Specification

Object Modeling

1. General

Coded	*INF-TC3 2 11*	Level/Semester	*3-S2*	Coefficient	*1.5*	Credits	*2*
Course	*Computer Science - Common Core*					Vol. H. (CI)	*21*
Responsible	*Bochra Rabbouch*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Object Modeling*					Version	*10/2023*

Course description (Course objective):

1. ***Knowledge and Understanding***
   - ***Objective****: Understand the benefits of the UML modeling language and its role in the software development cycle (OBJ 1).*
   - ***Description****: Students will gain a comprehensive understanding of:*
     - *The software development life cycle and UML's purpose at each stage.*
     - *Key UML diagrams, including use case diagrams (functional view), class/object diagrams (static view), and sequence/communication/state/activity diagrams (interaction and dynamic views), providing a theoretical foundation for system modeling.*
2. ***Applying Knowledge and Understanding***
   - ***Objective****: Identify and develop UML diagrams for the functional view (OBJ 2) and static/interaction views (OBJ 3) of a system, applying them to case studies.*
   - ***Description****: Students will apply their knowledge to:*
     - *Create use case diagrams to represent system functionalities and actors.*
     - *Develop class and object diagrams to model static structures.*
     - *Construct sequence, communication, state, and activity diagrams to depict interactions and dynamic behavior, using these skills to model complete systems in practical case studies.*
3. ***Making Judgments***
   - ***Objective****: Evaluate and select appropriate UML diagrams to model specific system aspects*

(OBJ 2, OBJ 3).

- ***Description**: Students will assess which UML diagrams best represent a system's functional, static, or interaction views for given case studies, ensuring accurate and effective modeling solutions. This involves critical analysis of system requirements and diagram applicability, aligning with the evaluation criterion of problem-solving with UML.*

4. ***Communication***
   - ***Objective**: Articulate UML concepts and modeling solutions clearly.*
   - ***Description**: Through supervised duties and the final exam, students will demonstrate their ability to explain UML's role in software development, present developed diagrams, and justify their modeling choices, communicating technical details effectively to peers and instructors.*

5. ***Learning Skills***
   - ***Objective**: Prepare for advanced system modeling and self-directed learning.*
   - ***Description**: By mastering UML with resources like "UML2 Through Practice" by Pascal Roques, students will develop the ability to independently explore advanced modeling techniques (e.g., design patterns, complex system architectures), equipping them for future coursework or professional software engineering roles.*

Prerequisites:	*Keywords :*
Without prerequisites	*Actors, use case diagrams, sequence diagrams, class diagrams*

Specific course objectives (OBJi):
OBJ 1 : *Understand the benefits of the UML modeling language and its role in the software development cycle* ***OBJ 2 :*** *Identify UML diagrams corresponding to the functional view of a system and develop them for different case studies.* ***OBJ 3 :*** *Identify UML diagrams of the static view and those of interaction of a system and apply them for different case studies.*

Necessary material :
No material

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Software life cycle and introduction to UML*	*1.5 hours*	*Understand the stages of the software life cycle and know the role of UML during each stage*
2-4	*Functional view of the system: use case diagrams*	*4.5h*	*Know the rules for developing a use case diagram with application to exercises*
5-7	*Static view of the system: class and object diagrams*	*4.5h*	*Know the rules for drawing up class and object diagrams with application to exercises*
8-10	*Interaction diagrams: sequences and communication*	*4.5h*	*Know the rules for developing interaction diagrams with application to exercises*
11-12	*State diagrams: states/transitions and activity diagrams*	*3h*	*Know the rules for developing state diagrams with applications to exercises*
13-14	*Case studies*	*3h*	*Develop complete modeling of certain system case studies.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of UML Concepts*
- *Criterion 2: Modeling Skills (use case diagramm, class diagramm, sequence diagramm…)*
- *Criterion 3: Problem-Solving with UML*

5. References

- *Cai, H., Yang, Z., Cao, X., Xia, W., & Xu, X. (2014). A new iterative triclass thresholding technique in image segmentation. IEEE Transactions on Image Processing, 23(7), 2738–2747.*
- *Knyazev, A. V. (2004). Modern preconditioned eigensolvers for spectral image segmentation and graph bisection. In Lecture Notes in Computer Science (Vol. 3212, pp. 95–114).*
- *Uijlings, J. R. R., van de Sande, K. E. A., Gevers, T., & Smeulders, A. W. M. (2013). Selective Search for Object Recognition. International Journal of Computer Vision, 104, 154–171.*
- *Ren, S., He, K., Girshick, R., & Sun, J. (2017). Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks. IEEE Transactions on Pattern Analysis and Machine Intelligence, 39(6), 1137–1149. https://doi.org/10.1109/TPAMI.2016.2577031*

6. Working environment (Facilities necessary for learning)

- *No specific learning environment is required*
-

Subject Sheets Specialty: Software Engineering

Course Specification

Data analysis

1. General

Coded	*Inf-GL 4 1 04*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering*					Vol. H. (CI)	*0*
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data analysis*					Version	*10/2022*

Course description (Course objective):

The objective of this course is to learn how to analyze data using Python. Students will move from understanding the basics of Python to exploring many types of data. They learn how to prepare data for analysis, perform statistical analysis, and create meaningful data visualizations.

Prerequisites:	*Keywords :*
Introduction to Python programming	*Jupyter Notebook, NumPy, matplotlib, Pandas*

Specific course objectives (OBJi):

1. *Master data import from various sources and formats.*
2. *Develop expertise in data cleaning and preparation for optimal analysis.*
3. *Be able to summarize and manipulate a DataFrame to extract key insights.*
4. *Use Matplotlib to create effective and relevant data visualizations.*
5. *Develop a structured project template for analyzing a dataset.*

Necessary material :

Computers

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Understanding the domain* *Understanding the dataset* *Python packages for data science* *Importing and exporting data in Python* *Getting started with NumPy* *Create your first pandas DataFrame*	*3h*	*Importing data*
3-4	*Dataset overviews* *Identify and handle missing values* *Data formatting* *Data normalization sets* *Indicator variables*	*3h*	*Data cleaning and preparation*
5-6	*Descriptive statistics, Basis of grouping Correlation* *Learn more about correlation*	*3h*	*Summarize the Pandas DataFrame*
7-8	*View and work with "Time Series Data"* *Explore, clean, refine and merge datasets* *Understanding joins, relationships, and aggregates* *Trace, visualize and organize the analysis of your data*	*3h*	*Visualization with matplotlib*
9-10	*Understanding the "Titanic" dataset* *Start data analysis by asking specific questions* *Use the different modules studied to visualize the data* *Find answers to questions posed by interpretations of the results found*	*3h*	*Project template for the "Titanic" dataset*
11-12	*Understanding the "Covid 19" dataset* *Start data analysis by asking specific questions* *Use the different modules studied to visualize the data* *Find answers to questions posed by interpretations of the results found*	*3h*	*Project template for Covid19 dataset*
13-14	*Case Study (or Correction of an old exam)*	*3h*	*OBJ 1 .. OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-

EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of the different libraries already handled during practical work (7 points)*
- *Criterion 2: Data visualization with matplotlib (5 points)*
- *Criterion 3: Organization of your analysis (Storytelling) (5 points)*
- *Criterion 4: Structure and clarity of your final notebook (use of markdown cells, working documentation) (3 points)*

5-Bibliographic and Online References

- *Marc Wintjen, "Practical Data Analysis Using Jupyter Notebook", 2020 [https://www.packtpub.com/product/practical-data-analysis-using-jupyter- notebook/9781838826031](https://www.packtpub.com/product/practical-data-analysis-using-jupyter-notebook/9781838826031)*

- *Janert, P. A. (2019). Traitement et analyse des données par la pratique avec Python. O'Reilly.*

- *McKinney, W. (2022). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter (3rd ed.). O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *Anaconda, version 3, https://www.anaconda.com/products/distribution*

Course Specification

Integration project

1. General

Coded	*Inf-GL 4 1 03*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*21*
Responsible	*Adel Dahmane*					Vol. H. (TP)	*0*
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*IT project*					Version	*10/2022*

Course description (Course objective):
- *The objective is to prepare a mini project with the professional and academic life cycle:* - *the professional side is to analyze the functional and technical specifications as well as the architecture adopted* - *the academic side is to develop an analytical and conceptual report having the reform of agility*

Prerequisites:	*Keywords :*
- *Backend and frontend development tools* - *Development frameworks and libraries* - *Object-oriented modeling*	*Design, UML, Backend, Frontend, Framework*

Specific course objectives (OBJi):
1. *Analyze and critically evaluate existing systems and solutions.* 2. *Define both functional and non-functional requirements for a system.* 3. *Apply black-box modeling techniques to design and assess systems.* 4. *Utilize white-box modeling techniques to design and evaluate internal system structures.* 5. *Develop a web or mobile application, from planning to implementation.*

Necessary material :
-

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Analyze and criticize the existing*	*3*	*Compare existing solutions* *Choose the methodology (scrum, kanban, etc.)* *Establish the backlog* *Design HMI models*
3-4	*Needs analysis and functional modeling*	*3*	*Use case diagram* *Activity diagram* *System Sequence Diagram*
5-6	*Modeling and development of the data access layer*	*3*	*Entity Class Diagram* *Database*
7-8	*Modeling and development of the presentation layer*	*3*	*Develop web services and implement the backend part*
9-10	*Modeling and development of the application layer*	*3*	*Carry out the front end part and program all HMI actions*
11-12	*Evaluation of the completed project*	*3*	*Test the project on the user and back office side*
13-14	*Case Study (or Correction of an old exam)*	*3*	*OBJ 1 .. OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Functional and non-functional needs (3 points)*
- *Criterion 2: Modeling (5 points)*
- *Criterion 3: Development (7 points)*
- *Criterion 4: Presentation (5 points)*

5- Bibliographic and Online References

- *Céline Martinet Sanchez , “Gérez votre projet informatique facilement”, 2023* *https://openclassrooms.com/fr/courses/4192086-gerez-votre-projet-informatique-facilement*

- *Openmind Tech, "Les 6 étapes d'un projet informatique : De l'idée au produit technologique en ligne" https://www.openmindt.com/fr/ressources/6-etapes-projet-informatique-idee-au-produit-technologique/*
- *Samantha Mur, "Devenez un pro de la gestion de projet informatique en 7 étapes", 2022*

  https://www.appvizer.fr/magazine/operations/gestion-de-projet/gestion-projet-informatique

- *Gauthier, L. (2022). Développer un projet informatique : De l'idée à la mise en production. Dunod.*
- *Clément, M., & Dupont, L. (2021). La gestion d'un projet informatique pour les débutants. Eyrolles.*
- *Levine, J., & Rahimi, S. (2023). The Complete Beginner's Guide to Software Development: From Idea to Deployment. Packt Publishing.*
- *Smith, T., & Young, A. (2022). Building Your First Web Application: A Practical Guide for Beginners. O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *No specific learning environment is required*

Course Specification

Machine Learning

1. General

Coded	*Inf-GL 4 1 09*	Level/Semester	*4/S1*	Coefficient	*2.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*10.5*
Responsible	*Yosra Haj Hassan*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Machine Learning*					Version	*10/2022*

Course description (Course objective):

The objective of the module is to enrich the training of GL4 students with an AI component given that it is a trend in engineering that can be integrated into several areas of development.

For this reason, the course plan during this first semester details one of the most used AI techniques; machine learning (ML: Machine Learning).

The objective of this course is to acquire the skills and tools necessary to develop applications based on ML in different fields including e-commerce (recommendation system, etc.), agriculture (classification of plant species, …), industry (robots, …), health (medical imaging, …), …

The course plan is divided into 3 main parts:

- *a first part devoted to supervised machine learning: the objective of which is to introduce the notion of learning and to detail its two subcategories (classification and regression) with theoretical and practical explanation of the best-known algorithms (KNN, SVM, Decision Tree (DT), Random Forest, Linear Regression, MCO, …)*
- *a second part devoted to unsupervised machine learning: aiming to study unsupervised learning algorithms both in the 'clustering' subcategory and for dimension reduction.*
- *A third part devoted to reinforcement learning: the objective of which is to introduce the notion of reinforcement and to study some algorithms used to solve a variety of problems, ranging from video games to robotics, including systems recommendation and autonomous vehicles.*

Prerequisites:	*Keywords :*
Basic notions of mathematics (linear algebra, statistics, etc.) *Advanced knowledge of Python (for practical work)*	*Artificial intelligence, machine learning (ML), supervised and unsupervised, classification, regression, grouping (or clustering), dimension reduction, SVM, DT, KNN, etc.*

Specific course objectives (OBJi):
1. *Clarify AI concepts, including domains of application, tools, techniques, and disciplines, and explain the machine learning (ML) process.* 2. *Detail the principles of supervised and unsupervised learning, eliminating ambiguities, and clarify their differences with practical examples.* 3. *Study and compare the most commonly used algorithms for classification and regression, highlighting key differences in principles, objectives, algorithms, and application areas.* 4. *Explore unsupervised machine learning algorithms, focusing on clustering and dimensionality reduction techniques, with practical examples.* 5. *Understand the fundamentals of reinforcement learning and explore its most popular algorithms.*

Necessary material :
In the case where the TPs will be developed on the local machine (localhost) we will need: - *A fairly powerful computer (CPU & GPU) with a Python development environment* - *(with SKlearn and keras installed).* - *Access to image datasets for Computer Vision labs.* - *An integrated development environment (IDE) for programming in Python.* - *Access to online resources for research and documentation on the topics covered.* *Otherwise we will always have the possibility of working in the cloud, thanks to a very good Internet connection speed from the Digital School, using the GoogleColaboratory and Kaggles platforms.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*CH1 - Artificial Intelligence:* *General introduction & reminders* *Presentation of the course, objectives and training plan* *Introduction and exploration of the notion of learning in AI.*	*1h:30*	*OBJ1*

3-4	*CH2: Machine learning (ML)* *Supervised machine learning* *Principle of binary and multiple classification* *Principle of regression algorithms*	*1h:30*	*OBJ2*
5-6	*TD1: Supervised machine learning*	*1h:30*	*OBJ2*
7-8	*CH2: Machine learning (ML)* *Unsupervised machine learning* *Principle of grouping (Clustering) and difference with classification* *Dimension reduction algorithms in the context of unsupervised learning*	*1h:30*	*OBJ2*
9-10	*TD2: Unsupervised machine learning*	*1h:30*	*OBJ2*
11-12	*CH3: Reinforcement learning* *General introduction to the principle of reinforcement learning* *Comparative study with machine learning* *Exploration of some algorithms*	*1h:30*	*OBJ5*
13-14	*Case Study (or Correction of an old exam)*	*1h:30*	*OBJ 1 .. OBJ 5*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*TP0: Introduce the work environment* *Detail all AI-related libraries using pyhton (numpy, scipy, sklearn, keras, tensorflow, pytorch,)*	3h	*Introduce the python language and the libraries used to implement machine learning and explain the complete AI learning process.*
3-4	*TP1: Data pre-processing* *Load, read, manipulate a standard database: IRIS, MNIST, LFW, etc.*	3h	*Become familiar with the basics of data analysis (the data pre-processing phase of the machine learning process).*
5-6	*TP2: Supervised machine learning:* *Binary and multiple classification* *Implementation of several classifiers in real application contexts (processing of image and digital data)*	3h	*OBJ3*

	Classification models tested: KNN, Decision Tree, Naive Bayes, Random Forest, SVM		
7-8-9	*TP3: Supervised machine learning:* *Linear regression* *Implement Linear Regression algorithms, namely MCO*	*4h30*	*OBJ3*
10-11-12	*TP4: Unsupervised machine learning* *Implementation of the unsupervised learning process.* *Implement clustering algorithms such as K-means.* *Implement dimension reduction algorithms such as PCA.*	*4h30*	*OBJ4*
13-14	*Case Study (or Correction of an old exam)*	*3h*	*OBJ 1 .. OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*40%*

5- Evaluation criteria

Evaluate theoretical concepts by offering a supervised assignment and an exam :

- *Criterion 1: Understanding of basic concepts of AI and machine learning (5 points)*
- *Criterion 2: Acquisition of different learning algorithms (supervised and unsupervised) and by reinforcement (10 points)*

Evaluate practical concepts by proposing a practical test or a mini-project :

- *Criterion 1: Mastery of the different machine learning tools (python as a programming language and the necessary libraries) (4 points)*
- *Criterion 2: Mastery of the different machine learning techniques in the context of real applications (16 points)*

6- Bibliographic and Online References

- *Guillaume Saint-Cirgue, "Complete Machine Learning training", 2019*
  https://www.youtube.com/playlist?list=PLO_fdPEVlfKqUF5BPKjGSh7aV9aBshrpY
- *Guillaume Saint-Cirgue, "SKLEARN French Machine Learning tutorial", 2019*
  https://www.youtube.com/playlist?list=PLO_fdPEVlfKoHQ3Ua2NtDL4nmynQC8YiS
- *Guillaume Saint-Cirgue, "PYTHON SPECIAL MACHINE LEARNING", 2020*
  https://www.youtube.com/playlist?list=PLO_fdPEVlfKqMDNmCFzQISI2H_nJcEDJq
- *Simplilearn, "Machine Learning Tutorial: A Step-by-Step Guide for Beginners", 2023*
  https://www.simplilearn.com/tutorials/machine-learning-tutorial

- *Raschka, S., & Mirjalili, V. (2020). Apprentissage automatique avec Python : Principes fondamentaux avec Scikit-Learn, Keras et TensorFlow 2 (3^{e} éd.). Pearson.*
- *Bengio, Y. (2017). Apprentissage profond. MIT Press (Édition en français).*
- *Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.*
- *Murphy, K. P. (2022). Probabilistic Machine Learning: An Introduction. MIT Press.*

7- Working environment (Facilities necessary for learning)

- *Development environment (Editor), "Jupyter Notebook"*
  https://docs.jupyter.org/en/latest/install.html
- *Python environment, "Anaconda"*
  https://www.anaconda.com/download/
- *Python Libraries for Machine Learning, "SicKitLearn (and any other necessary libraries)" https://scikit-learn.org/stable/install.html*

Course Specification

Software Architecture

1. General

Coded	*Inf-GL 4 1 05*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering*					Vol. H. (CI)	*21*
Responsible	*Imen Ferchichi*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive*					Self-study H.	*24*
Module	*Software Architecture*					Version	*08/2023*

Course description (Course objective):
The objective of the software architecture course is to allow the student to learn how to develop the structure of a project in its key design phase for the success, scalability and maintainability of a software application. *Through this course, the student will learn to design a modern software application using modeling diagrams and defining the appropriate technologies as well as the proper communications protocols to apply in a modern component-based architecture.*

Prerequisites:	*Keywords :*
UML Object Modeling, Network Foundations	*Components, UML, 3-tiers, MVC, Deployment, SOA, Microservices, Serverless*

Specific course objectives (OBJi):
1. *Define key concepts of software architecture and understand their significance in system design.* 2. *Understand and apply architectural modeling techniques to visualize and plan system structures.* 3. *Implement various architectural styles effectively in real-world projects.* 4. *Identify and analyze modern architectural paradigms and their applications in current systems.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	- *UML and software engineering concepts*	*3h*	- *The student will have to determine the overall use case diagram from the requirements specifications.* - *Software lifecycle* - *Monolith architecture of software: advantages and disadvantages.*
3-4	- *Component Diagram and Deployment* - *Case study*	*3h*	- *Distributed architecture and notions of modern architecture.* - *Transform a monolith application into a component-based application.* - *Deployment of software applications.*
5-6	- *Concept of client-server architecture, MVC architecture, 3 Tiers and n-Tiers* - *Communications protocols* - *Case study*	*3h*	- *Principle of the MVC architectural pattern.* - *3 Tiers, 4 Tiers architecture… Advantages of layered architectures.* - *Communication protocols.*
7-8	- *SOA architecture* - *Case study*	*3h*	- *Service-oriented architecture: concept, communication protocol used, advantage.* - *And disadvantages.*
9-10	- *Microservices Architecture* - *Case study*	*3h*	- *Evolution towards a microservice architecture, agility and DevOps.*
11-12	- *Serverless Architecture*	*3h*	- *Serverless architecture concept* - *Advantage.*
13-14	- Case Study (or *Correction of an* old *exam*)	*3h*	- *OBJ 1 .. OBJ 4*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*

EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Evaluation of current exercises: understanding, application (10%)*
- *Criterion 2: Evaluation: case study: Analysis and synthesis (10%)*
- *Criterion 3: Duty supervised (20%)*
- *Criterion 4: Final exam (60%)*

5- Bibliographic and Online References

- *Romain Sessa & José Esterkin, "Définissez votre architecture logicielle grâce aux standards reconnus", 2022* *https://openclassrooms.com/fr/courses/7210131-definissez-votre-architecture-logicielle-grace-aux-standards-reconnus*

- *Christine Moronval, "Architecture logicielle et modèles de conception", SoftFluent* *https://www.softfluent.fr/blog/architecture-logicielle-et-modeles-de-conception/*

- *Bordage, F. (2019). Architecture logicielle : Concepts, techniques et modèles. Dunod.*

- *Richards, M., & Ford, N. (2020). Fundamentals of Software Architecture: An Engineering Approach. O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *No specific learning environment is required*

Course Specification

Native Mobile Development 1 (Android)

1. General

Coded	*Inf-GL 4 1 08*	Level	*4/S1*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering*					Vol. H. (CI)	*0*
Responsible	*Oussema Elmir*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*60*
Module	*Native Mobile Development 1 (android)*					Version	*10/2021*

Course description (Course objective):
The main objective of this workshop is to equip students with essential practical skills to enable them to independently specify, design and develop Android mobile applications.

Prerequisites:	*Keywords :*
Fundamentals of object-oriented programming	*Android, java, Kotlin, Activity, service, intent, layout, gradle, manifests, broadcastReciver*

Specific course objectives (OBJi):

1. *Design user-friendly and functional user interfaces by applying Android UI design principles.*
2. *Manage data efficiently, including storing, retrieving, and manipulating data from local databases, web services, and other data sources.*
3. *Implement effective navigation systems between different views and components within the application.*
4. *Integrate advanced features such as sensor integration, geolocation, and camera usage into mobile applications.*

Necessary material :
Powerful computer (example configuration: 10th generation i5/i7 processor 16 GB RAM)

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Getting to know the Android Studio environment* *Emulator/Smartphone configuration*	*3h*	*OB1*
2	*Structure of an Android project/Components of an Android Application*	*3h*	*OB1*
3	*Explicit data transmission intents*	*3h*	*Ob3*
4	*Implicit intents and permission management*	*3h*	*OB3*
5	*Static and dynamic Fragments*	*3h*	*OB1*
6	*Option menus and Contextual Menus*	*3h*	*OB1, OB3*
7	*ListView, Spinner, GridView and adapters*	*3h*	*OB1, OB3*
8	*RecycleView with Kotlin*	*3h*	*OB1, OB3*
9	*Access to local data (SQLite)*	*3h*	*OB1, OB2, OB3*
10	*The Room persistence library (with Kotlin)*	*3h*	*OB1, OB2, OB3*
11	*Hands-on exploration of Firebase with Kotlin*	*3h*	*OB1, OB2, OB3*
12	*Access to device functionalities (Geolocation, etc.)*	*3h*	*OB1, OB3, OB4*
13-14	Synthetic case study *(Resolving an old exam, …)*	*6h*	*OBJ 1 .. OBJ 4*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Drafting of the specifications (3 points)*

- *Criterion 2: Mastery of the code (5 points)*
- *Criterion 3: Deployment of the application (4points)*
- *Criterion 4: Innovative aspect of the application (3points)*
- *Criterion 5: Presentation of the project (5 points)*

5- Bibliographic and Online References

- *Android codelabs, Développez votre première application Android Développez votre première application Android - OpenClassrooms https://developer.android.com/*
- *Fanny Demey & Virgile-Giovanni Fantauzzi, “Développez votre première application Android”, 2023 https://openclassrooms.com/fr/courses/8150246-developpez-votre-premiere-application-android*

- *Meddeb, M. (2021). Android – Développement d’applications mobiles avec Kotlin (3e éd.). ENI.*
- *Murray, L. (2022). Android Programming: The Big Nerd Ranch Guide (4th ed.). Big Nerd Ranch.*
- *Medjebeur, M. (2023). Apprenez à programmer en Kotlin pour Android (2^{e} éd.). ENI.*
- *Mukai, S. (2023). Android Programming with Kotlin for Beginners: Build Android Apps from Scratch Using Android Studio and Kotlin (3rd ed.). Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *Android Studio*
  https://developer.android.com/studio

Course Specification

.NET Development

1. General

Coded	*Inf-GL 4 1 07*	Level	*4/S1*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering*					Vol. H. (CI)	*0*
Responsible	*Nawfel Khayati*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*.NET development*					Version	*10/2022*

Course Description (Course Objective)
Work on one of the most requested platforms on the market (.NET) as well as some of the underlying Frameworks (ASP.NET Core MVC, Entity Framework, etc.). *Apply two development approaches (DataBase-First Approach and Code-First Approach)*

Prerequisites	*Keywords*
The basics of algorithms, the basics of web development (HTML, CSS, JS)	*C# language, Console applications, Desktop applications, Web applications, MVC, Entity Framework, LINQ, RAZOR, Fluent API, Web API*

Specific course objectives (OBJi)

1. *Master object-oriented development using C# through simple console and desktop applications based on .NET.*
2. *Understand and implement routing in ASP.NET Core MVC applications.*
3. *Master the MVC architecture and develop ASP.NET Core MVC web applications, leveraging the framework's features.*
4. *Master ORM Entity Framework Core (EF Core) and efficiently use LINQ statements and lambda expressions.*
5. *Master RAZOR syntax for developing dynamic views in web applications.*
6. *Master data validation techniques using annotations or Fluent API in ASP.NET Core applications.*
7. *Understand and master the development and consumption of Web APIs.*
8. *Differentiate between Database-First and Code-First development approaches and apply them appropriately in various scenarios.*

Necessary material :
High-performance PC or laptop (at least 4 GB of RAM)

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1, 2	*TP No. 1:* *Introduction to .NET and the C# language*	*4h:30*	- *Understand the difference between .NET Framework, .NET Core and .NET.* - *Understand that .NET is now cross-platform (a .NET solution can run on Windows, Linux, MacOS, iOS, Android, etc.).* - *Understand the structure of a console application.* - *Manipulate arrays and strings with C#.*
2, 3	*TP No. 2:* *OOP with C# language*	*4:30*	- *Working with basic OOP concepts (Polymorphism, Inheritance, etc.), handling exceptions, etc. in console applications then Desktop.* - *Manage tables and character strings based on OOP concepts.*
4, 5	*TP No. 3:* *Actions and Routing*	*4:30*	- *Provide an overview of the structure of an ASP.NET Core MVC application.* - *Understand the routing mechanism in Asp.Net Core.* - *Correctly configure routing for an ASP.Net Core application.* - *Learn how to create route constraints and custom route constraints.*
5, 6	*Lab No. 4:* *ASP.Net Core applications using the Database First approach*	*4h:30*	- *Explore the Database First approach to modeling entities.* - *Configure Entity Framework Core.* - *Generate the data class model from the database.* - *Work on controllers and views.* - *Update the database and then update the model*
7, 8	*TP No. 5:* *Filters & Joins*	*4h:30*	- *Work on joining by navigation property.* - *Working on ViewModel join using LINQ queries* - *Use LINQ queries to search and filter data.*
8, 9	*Lab No. 6:* *ASP.Net Core applications using*	*6h*	- *Create the model classes and the context class that represents a session to the database* - *Apply validation annotations to the model* - *Configure database connection* - *Enable Code First migration so you can generate (or*

	the Code First approach		*update) the database from the model* - *Update the model and apply migration commands in order to have a synchronized and up-to-date DB.*
10,11	*TP No. 7: Configuring model classes via Fluent API*	*4h30*	- *Create a model (entities and context class).* - *Configure the model via Fluent API (instead of conventions).* - *Enable Code-First Migration* - *Update model based on Fluent API*
11,12	*TP No. 8: ASP.NET Core Web API Development*	*4h30*	- *Create an application like "ASP.NET Core Web API"* - *Develop the model* - *Develop the Web API controller* - *Test the actions of this controller with OpenAPI (Swagger).* - *Develop an ASP.NET Core MVC Web Application API client.* - *Verify that the client is consuming Web API services.*
13-14	Synthetic case study *(Resolving an old exam, ...)*	*6h*	- *OBJ 1 .. OBJ 8*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Mastery of the development environment (4 points)*
- *Criterion 2: Application of good development rules (4 points)*
- *Criterion 3: Error management (4 points)*
- *Criterion 4: Compliance with what is requested (4 points)*
- *Criterion 5: Valid execution of the application (4 points)*

5- Bibliographic and Online References

- *Official Microsoft documentation - Microsoft Learn, 2022* *https://learn.microsoft.com/en-us/aspnet/core/?view=aspnetcore-7.0*
- *Andrew Jensen & Vincent Siron, "Développez une application ASP.NET Core avec le modèle MVC",*

OpenClassroom, 2023
https://openclassrooms.com/fr/courses/8028391-developpez-une-application-asp-net-core-avec-le-modele-mvc

- *Hézode, P. (2022). Programmation .NET 6 avec C# 10 : Développez des applications robustes et performantes. ENI.*

- *Freeman, A. (2023). Pro ASP.NET Core 7: Develop Cloud-Ready Web Applications Using MVC, Blazor, and Razor Pages. Apress.*

6- Working environment (Facilities necessary for learning)

- *Visual Studio Community Edition, 2022, https://visualstudio.microsoft.com/fr/vs/community/*
- *SQL Server, 2019,*
  https://www.microsoft.com/fr-fr/sql-server/sql-server-downloads/

Course Specification

Advanced object modeling

1. General

Coded	*Inf-GL 4 1 11*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*21*
Responsible	*Ahmed Hadad*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*30*
Module	*Advanced Object Modeling*					Version	*11/2021*

Course description (Course objective):
Give a complete vision of the design activity in the broad sense (analysis, design, specification) in the software development cycle.

Prerequisites:	*Keywords :*
Object Modeling (UML Level 1)	*UML, Software engineering*

Specific course objectives (OBJi):

1. *Recall and apply the fundamental concepts of object modeling in software design.*
2. *Raise awareness of information systems engineering and its role in the development process.*
3. *Understand and apply a comprehensive approach to the design activity, covering analysis, design, and specification in the software development cycle.*
4. *Implement the various activities involved in the design stage, following a structured development process.*
5. *Collaborate effectively within a team, as well as across multiple communicating teams, to achieve project goals.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Reminders about software engineering, analysis and design activities*	*3h*	*OBJ 1*
3-4	*Design methods and processes*	*3h*	*OBJ 2*
5-6-7	*Minimalist approach*	*4h:30*	*OBJ 3*
8-9-10	*Unified Processes and RUP*	*4h:30*	*OBJ 4*
11-12	*Agile processes*	*3h*	*OBJ 5*
13-14	Synthetic case study *(Resolving an old exam, …)*	*3h*	*OBJ 1 .. OBJ* 5

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of fundamental principles*
- *Criterion 2: Ability to design a software solution that is simple and clear*
- *Criterion 3: Application of phases of the Unified Process (& RUP)*
- *Criterion 4: Understanding of agile principles*

5- Bibliographic and Online References:

- *Laurent-audibert : UML 2 from learning to practice https://ult.bi/fr/chapitre-iii-conception-et-modelisation-de-lapplication-avec-uml*
- *Etude de Cas UML, 2018 https://www.uv.es/nemiche/cursos/exemple.pdf*
- *Blaha, M., & Rumbaugh, J. (2006). Modélisation et conception orientée objet avec UML 2. Pearson.*
- *Félio, F. (2019). UML 2 - De l'apprentissage à la pratique (4e éd.). Dunod.*
- *Fowler, M. (2003). UML Distilled: A Brief Guide to the Standard Object Modeling Language (3rd ed.). Addison-Wesley.*

6- Working environment (Facilities necessary for learning)

None !

Course Specification

Virtualization and Cloud

1. General

Coded	*Inf-GL 4 1 12*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Ridha Azizi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*24*
Module	*Virtualization and cloud*					Version	*10/2022*

Course description (Course objective):

The Virtualization and Cloud Computing course provides an in-depth exploration of fundamental concepts and emerging technologies in the field of virtualization and cloud:

- *Understand the fundamentals of virtualization.*
- *Master server, network and storage virtualization technologies.*
- *Explore the key concepts of Cloud Computing and its benefits.*
- *Acquire a working knowledge of the services.*
- *Analyze security and management challenges in a cloud environment.*
- *Apply the skills acquired through practical work.*

Specific course objectives (OBJi):

1. *Understand and apply the concept of virtualization in modern computing environments.*
2. *Implement paravirtualization using KV (Kernel Virtual Machine) for efficient system virtualization.*
3. *Virtualize infrastructure by deploying, configuring, and diagnosing virtualized environments.*
4. *Implement containerization using Docker to package and deploy applications in isolated environments.*
5. *Use Docker Compose to manage and orchestrate multi-container applications.*

2- Content elements (Practical Work)

Week(s)	TP/Content elements	No. HR	Goals
1-2	*TP 1: Virtualization* - *Handle a Hypervisor, which allows multiple operating*	*3h*	*OBJ 1*

	systems to run on a single machine. - *Understand the benefits of using them.*		
3-4	*Lab 2: KVM* - *Mastery of KVM with its management tools* - *Install KVM and its management tools* - *Create a VM with virt-manager* - *Administration with virsh* - *Create VMs with virt-install* - *Access the console (graphic and text)* - *Creating a virtual network using KVM*	*3h*	*OBJ 2*
5-6	*TP 3: Virtualization of an infrastructure* - *Deployment of a virtual infrastructure.* - *Configuring static IP addresses.* - *Configuring static routing.* - *Familiarization with commands, files and configuration interfaces specific to operating systems: Linux, MS Windows in a virtual architecture.* - *Diagnosis of network operation.* - *Identify the difference between administering a network with physical machines and virtual machines.*	*3h*	*OBJ 3*
7-8-9	*TP 4: Docker* - *Getting to know Docker, a popular containerization platform, using Ubuntu 18 as the host operating system* - *Learn how to install Docker* - *Create containers* - *Manage containers* - *Understand the key concepts of containerization.*	*4h30*	*OBJ 4*
10-11-12	*Lab 5: Docker Compose* - *Installation and Configuration* - *Creating a Compose File* - *Deploying a Simple Application* - *Service Management* - *Environment Variables and Secrets* - *Shared Volumes*	*4h30*	*OBJ 5*
13-14	Synthetic case study *(Resolving an old exam, …)*	*3h*	*OBJ 1 .. OBJ* 5

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of basic concepts*
- *Criterion 2: Knowledge of technologies and tools*
- *Criterion 3: Ability to design solutions*

5- Bibliographic and Online References

- *IBM, "Qu'est-ce que la virtualisation ?" https://www.ibm.com/fr-fr/topics/virtualization*
- *Microsoft Learn, Documentation sur la virtualization https://learn.microsoft.com/fr-fr/virtualization/*
- *Damien A., "Virtualisez votre architecture et vos environnements de travail", OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/2035806-virtualisez-votre-architecture-et-vos-environnements-de-travail*
- *Chauvet, F., & Garçon, P. (2019). Virtualisation et Cloud Computing : Concepts, architectures et technologies. Dunod.*
- *Sémelin, F. (2020). Cloud Computing et Virtualisation des infrastructures. Eyrolles.*
- *Bernstein, D. (2019). Cloud Computing: Concepts, Technology & Architecture. Springer.*
- *Hartenstein, H., & Bittencourt, L. (2021). Virtualization and Cloud Computing: Computing Infrastructure for Cloud, Distributed, and Parallel Computing. Wiley.*

6- Working environment (Facilities necessary for learning)

- *VirtualBox*
- *Ubuntu*

Course Specification

Advanced Object Oriented Programming

1. General

Coded	*Inf-GL 4 1 10*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Mouhieddine Belghith*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Advanced Object Oriented Programming*					Version	*10/2022*

Course description (Course objective):
At the end of this course, the student should be able to create graphical interfaces in Java as well as manage a database via a Java application. *In addition, the student will be able to run tasks in parallel (threading) in their graphical interface.* *Again, TCP and UDP sockets can be taught so that the student can communicate on a network via a Java interface.*

Prerequisites:	*Keywords :*
Java 1, Inheritance, Abstraction, Interface	*Thread, JFrame, JDBC, Socket*

Specific course objectives (OBJi):

1. *Recall and apply the concepts of abstract classes, methods, and polymorphism in Java.*
2. *Understand and implement successive inheritance and interfaces in Java.*
3. *Develop multitasking applications in Java using threads.*
4. *Apply Java thread synchronization techniques to manage concurrent processes.*
5. *Manage critical sections in Java programs through thread control mechanisms.*
6. *Introduce graphics programming in Java and develop graphical user interfaces (GUIs).*
7. *Understand and apply different types of fitness managers in programming contexts.*
8. *Use design patterns to create sophisticated and user-friendly graphical interfaces.*
9. *Apply event-driven programming principles in Java, utilizing threads for user interface responsiveness.*
10. *Manage and interact with databases through a Java-based interface.*
11. *Implement network communication in Java, creating interactive applications with network capabilities.*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	- *Reminder of polymorphism in java and the creation of a polymorphic list.* - *Using classes and abstract methods.* - *Redefinition of java methods and annotation.*	*3h*	*Reminder on abstract classes and methods as well as polymorphism in Java*
2	- *Reminder of interface implementation in Java.* - *Redefinition of methods of abstract methods.* - *Successive inheritance under java.*	*3h*	*Reminder on successive inheritance in Java and the implementation of interfaces*
3	- *Introduction to threads in Java.* - *Management (creation, launch, suspension, shutdown) of threads.*	*3h*	*Multitasking Programming in Java*
4	- *Queuing and waking up threads.* - *Use of join(), wait() and notify() primitives.* - *Mini project 1: faucet and bathtub problem.*	*3h*	*Java thread synchronization*
5	- *Management of resources shared between threads.* - *Use of "synchronized" codes and "volatile" variables.* - *Mini project 2: problem of the 5 philosophers.*	*3h*	*Managing critical sections with java threads*
6	- *Presentation of the components likely to be involved in a Java graphical interface.* - *Presentation of containers, panels and atomic components (button, label, text box, etc.)*	*3h*	*Introduction to graphics in Java and creation of graphical interfaces*
7	- *Layout manager for a container.* - *Presentation of the "FlowLayout", "GridLayout" and "BorderLayout" type managers.*	*3h*	*Learn the different types of fitness managers*
8	- *Presentation and addition of "Design" mode in the Java editor.* - *Creation of graphic interfaces with design mode.* - *Improved source code.*	*3h*	*Learn how to use "design" mode to create sophisticated graphical interfaces*
9	- *Process system and user events triggered by the mouse and keyboard.* - *Implement xxxListener type java interfaces.* - *Management of event listeners.*	*3h*	*Event-driven programming and use of threads in a Java graphical interface*

	- *Use of threads.* - *Mini project 3: "Paint" application.*		
10-11	- *Configuration of the "JDBC" driver.* - *Connecting an Access database via a Java window.* - *Execution of different types of SQL queries (add, delete, update, etc.) via java.*	*4h30*	*Managing a database via a Java interface*
11-12	- *Introduction to the java socket.* - *Establish TCP and UDP type connections.* - *Exchanges of messages.* - *Mini project 4: Subscriber management application.*	*4h30*	*Network communication via a java interface*
13-14	- Synthetic case study *(Resolving an old exam, …)*	*6h*	*OBJ 1 .. OBJ 11*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Mastery of Advanced Concepts*
- *Criterion 2: Application of Design Principles*
- *Criterion 3: Proficiency in Language Features*
- *Criterion 4: Problem-Solving and Algorithmic Skills*
- *Criterion 5: Software Design and Implementation*

5- Bibliographic and Online References:

- *Threads in Java, 2012 https://isila3sil.weebly.com/uploads/1/5/0/3/15031016/dar-ch3.pdf*
- *Michel Schinz,Graphic interface,Practice of object-oriented programming, 2015 https://cs108.epfl.ch/archive/15/files/ppo15_13_interfaces-graphiques_4.pdf*
- *Claude Delannoy. Programming in Java. Eyrolles, 2000.*
- *Cay S. Horstmann and Gary Cornell. At the heart of Java 2. Volume II: Advanced functions. Campus*

Press 2000.

- *Stéphane Vialle, Networks: Programming by sockets-Java* http://khalid.najeddine.free.fr/informatique/cours%20supelec/4%20programe%20r%E9seau%20et%20distribu%E9e/Socket-Java.pdf

- *Larman, C. (2007). Analyse et conception orientées objet : Applications avec UML et les patrons de conception (2e éd.). Pearson.*
- *Bézivin, J., & Coulette, B. (2007). Programmation orientée objet avec Java (3e éd.). Dunod.*
- *Ferrari, R., & Boucher, M. (2014). Conception orientée objet et patterns de conception avec Java. Dunod.*
- *Bloch, J. (2008). Effective Java (2nd ed.). Addison-Wesley.*
- *Sommerville, I. (2011). Object-Oriented Software Engineering: Practical Software Development Using UML and Java (2nd ed.). Addison-Wesley.*
- *Freeman, E., & Robson, E. (2020). Head First Object-Oriented Analysis and Design. O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *Apache NetBeans, 19,* https://netbeans.apache.org/front/main/
- *Eclipse, 2023,* https://www.eclipse.org/downloads/
- *Visual Studio Code, 1.84,* https://code.visualstudio.com
- *Intellij, 2023.2.4,* https://www.jetbrains.com/idea/

Course Specification

Advanced databases

1. General

Coded	*Inf-GL 4 1 06*	Level	*4/S1*	Coefficient	*2*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*10.5*
Responsible	*Abir Ben Zekri*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Advanced databases*					Version	*10/2022*

Course description (Course objective):

- *Become the administrator of your database*
- *Migrate from the relational model to the Object model using the Relational Object Model*
- *Become familiar with the notions of SQL3*
- *Introduction to multidimensional bases and implementation of a multidimensional diagram (Star, Snowflake or Constellation)*

Prerequisites:	*Keywords :*
- *Relational model (structure, constraints, SQL2, PL/SQL)* -	- *Database administration* - *Relational Object Databases* - *Multidimensional databases*

Specific course objectives (OBJi):

1. *Control and manage access to databases, ensuring secure user interactions.*
2. *Authorize access to database objects, enforcing proper permissions and security protocols.*
3. *Manage database privileges, roles, and synonyms to control user actions and data access.*
4. *Manage and implement views and user profiles to optimize data presentation and user experience.*
5. *Oversee database transactions and utilize the Oracle Data Dictionary for efficient database management.*
6. *Master abstract data types and associated methods for advanced database design and manipulation.*
7. *Explore and apply SQL3 standards and understand the key concepts of Object-Relational databases.*
8. *Discover and understand the foundational concepts of multidimensional databases for complex data analysis.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	- *Database administration* - *User Management* - *Privilege management* - *Synonym management*	*1h30*	***OBJ 1, OBJ 2 and OBJ 3:*** - *The different database users.* - *Creating users with the different possible options* - *System privileges* - *Object privileges* - *The transmission of privileges* - *The roles* - *The notion of the data schema* - *The concept of synonyms* - *Conveying privileges by applying synonyms*
3-4	- *Database administration* - *Profile management* - *View management* - *Examples*	*1h30*	***OBJ 4:*** - *The different system characteristics and password characteristics offered by the profiles.* - *Syntax for creating profiles and assigning profiles to users.* - *The notion of views and their uses* - *The study of simple views and complex views*
5-6	- *Database administration* - *Transaction management* - *Data dictionary* - *Examples*	*1h30*	***OBJ 5:*** - *The notion of transactions and save points* - *The notion of a data dictionary* - *Description and querying of the different system views*
7-8	- *Data base* - *Object-Relationals (1)* - *Examples*	*1h30*	***OBJ 6:*** - *Evolution of DBMS* - *The Object-Relational Model* - *The notions of SQL3* - *Abstract data types (VARRAY, NESTED TABLE, OBJECT)* - *Type inheritance* - *Methods (encapsulation)*
	- *Data base*		***OBJ 7:***

9-10	- Object-Relationals (2) - Example	1h30	- Transition from the relational model to the object relational model.
11-12	- Multidimensional databases - Example	1h30	**OBJ 8:** - Basics - Implementation of a multidimensional diagram (Star, Snowflake or Constellation)
13-14	- Resolving an old exam	1h30	OBJ 1 .. OBJ 8

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1, 2	**TP1/** - Reminder: Creation of tables, insertion into tables, addition of constraints - Creating simple views - Querying the data dictionary to consult the different integrity constraints and views	3h	**OBJ 1:** - Reminder - Consulting the data dictionary
3.4	**TP2/** - Migration between the SYSTEM user (the administrator) and a newly created user (with profiles) and injection of privileges according to the latter's needs. - Creation of synonyms for a view of TP 1 and reception of object privileges by the administrator for this view. - Inserting into a simple view	3h	**OBJ 2 & OBJ 3:** - Know the difference between a newly created user (without privileges) and between the administrator.
5.6	**TP3/** - Creation of complex views and knowing the conditions for modifying these views (querying the system view (USER_UPDATABLE_COLUMNS) to find out if these views are modifiable or not - Querying the data dictionary and administering the database using information collected from system views (USER_VIEW, USER_CONSTRAINTS,	3h	**OBJ 4 & OBJ 5:** - Know the structure of the data dictionary and how to use it to obtain the appropriate system views to administer your database. - Know the differences between system views according to their prefixes (USER_.., ALL_.., DBA_...) - The differences between simple and complex views - Transaction management

	USER_SYNONYMS, All_USERS, USER_TABLES, etc.)		
7.8-9	***TP4 /*** - *Modeling an object database from a textual description* - *Creating abstract data types* - *Creation of object tables* - *Insertion into object tables*	4h30	***OBJ 6:*** - *Modeling an object database with the minimum of tables* - *Adding different abstract data types (VARRAY, NESTED TABLE, OBJECT) and arguing the choices.* - *Creating Object tables* - *Insertion into object tables*
10-11-12	***TP5 /*** - *Querying object tables and extracting information* - *Modifying abstract data types and adding methods and implementations of their body using PLSQL functions and procedures*	4h30	***OBJ 7:*** - *Implementing PL-SQL methods and querying the object database*
13-14	- *Synthetic case study*	3h	- *OBJ 1 .. OBJ 11*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*40%*

5- Evaluation criteria

- *Criterion 1 (3 points): creation of users (using profiles) and adding privileges*
- *Criterion 2 (3 points): Views, transactions and querying the data dictionary*
- *Criterion 3 (6 points): Creation of abstract data types and creation of object tables + data insertion.*
- *Criterion 4 (4 points): Methods of abstract data types and data querying.*
- *Criterion 5 (4 points): Implementation of a multidimensional diagram (Star, Snowflake or Constellation)*

6- Bibliographic and Online References

- *C. Soutou, SQL for Oracle, Eyrolles, 2015*

- *Databases, JL Hainaut, Dunod, 2012*
- *Programming objects with Oracle, Vuibert, 2004*
- *Frank Ravat, Models and tools for the design and manipulation of decision support systems, habilitation dissertation, Toulouse University (I and II) 2007.*
- *Bellahsène, Z., & Roche, M. (2014). Bases de données avancées : Modèles, technologies et applications. Hermès Science Publications.*
- *Vaillant, P. (2019). Bases de données avancées : Objets, XML, NoSQL, graphes et Big Data. Dunod.*
- *Redmond, E., & Wilson, J. (2018). Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement (2nd ed.). Pragmatic Bookshelf.*

7- Working environment (Facilities necessary for learning)

- *Oracle, 18g, https://www.oracle.com/*

Course Specification

Deep Learning 1

1. General

Coded	*Inf-GL 4 2 07*	Level/Semester	*4/S2*	Coefficient	*2*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*10.5*
responsible	*Yosra Haj Hassan*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*15*
Module	*Deep Learning*					Version	*10/2022*

Course description (Course objective):
The objective of this course is to enrich the training of GL4 students with the tools necessary to develop applications based on deep learning (DL: Deep learning) in different fields including computer vision, detection of objects, semantic segmentation, recommendation systems, generative models and image generation, ... *So that GL4 students acquire basic theoretical notions and practical skills to solve computer vision problems using Deep Learning approaches, the course plan during this second semester is divided into 03 main parts:* - *a first part devoted to the basic architecture of neural networks: the objective of which is to detail the notion of the perceptron and MLP (Multi-layer Perceptron) by introducing backpropagation and optimization.* - *a second part devoted to convolutional neural networks (CNN: Convolutional Neural Network) in the context of computer vision with a view to the advanced and precise analysis of visual information offered by CNNs.* - *a third part dedicatedthe creation of generative models, including Generative Adversarial Networks (GAN).*

Prerequisites:	*Keywords :*
- *Basic knowledge of Math,* - *Python Programming,* - *Machine Learning.*	*Deep learning, Computer Vision, recurrent and convolutional neural networks, backpropagation, optimization, object detection, semantic segmentation, recommendation systems, generative models.*

Specific course objectives (OBJi):
1. *Understand the foundational concepts of deep learning, including neural networks and backpropagation, and apply them to model training.* 2. *Implement simple perceptrons, Multi-Layer Perceptrons (MLP), and Recurrent Neural Networks (RNN) for processing sequential data.* 3. *Implement Convolutional Neural Networks (CNN) for image classification tasks, utilizing advanced techniques for image recognition.* 4. *Use CNNs for complex tasks such as object detection, semantic segmentation, and applying transfer learning to improve model performance.* 5. *Explore advanced unsupervised learning concepts by creating generative models, with a focus on Generative Adversarial Networks (GANs).*

Necessary material :
- *A computer with a Python development environment (with TensorFlow or PyTorch installed).* - *Access to image datasets for Computer Vision labs.* - *An integrated development environment (IDE) for programming in Python.* - *Access to online resources for research and documentation on the topics covered.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction and Foundations:* - *Presentation of the course, objectives and training plan* - *History and evolution of deep learning* - *Introduction to the concept of the perceptron* - *Introduction to neural networks and deep learning by studying MLPs*	*1h30*	*OBJ1*
3-4	*Chapter 2: Backpropagation and Optimization and RNN:* - *Principle of gradient backpropagation (backpropagation)* - *Backpropagation algorithm and practical implementation* - *Concepts of differential calculus and chain of derivatives* - *Recurrent neural networks for processing sequential data.*	*1h30*	*OBJ2*
5-6	*TD1: Perceptron, MLP and sequential neural networks*	*1h30*	*OBJ1 & OBJ2*

7-8	*Chapter 3: Computer Vision* - *Introduction to computer vision and image processing* - *Convolutional Neural Networks (CNN)* - *Applications of CNNs in image classification*	*1h30*	*OBJ3*
	- *Using CNNs for Object Detection and Semantic Segmentation)*		
9-10	*Chapter 4: Generative AI: Advanced Applications* - *Introduction to Model Generators and Unsupervised Learning* - *Generative models: Generative Adversarial Networks (GAN)*	*1h30*	*OBJ5*
11-12	*TD2: CNN and GAN for computer vision*	*1h30*	*OBJ3, OBJ5*
13-14	*Resolving an old exam*	*1h30*	*OBJ1 .. OBJ5*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*TP0: Introduction and Foundations:* - *Familiarization with a Deep Learning environment (for example, TensorFlow or PyTorch)* - *Implementation of a simple perceptron and the multilayer perceptron (MLP)*	*3h*	*Allow students to become familiar with a Deep Learning Framework and acquire basic practical skills.*
3-4-5	*TP1: RNN & Backpropagation and Optimization:* - *Implementation of RNNs.* - *Implementation of backpropagation in a neural network.* - *Optimization methods: gradient descent, SGD, Adam, etc.*	*4h30*	*OBJ2*
6-7-8	*TP2: Deep Learning for Computer Vision:* - *Experiments with object detection and image segmentation*	*4h30*	*OBJ4*
9-10	*TP3: CNN in favor of computer vision:* - *Implementing a CNN for Image Classification*	*3h*	*OBJ4*

11-12	*TP4: Generative models:* *- Creation of a simple generative model and experiments in unsupervised learning*	*3h*	*OBJ5*
13-14	*Synthetic Case Study (Resolving an old exam, …)*	*3h*	*OBJ1 .. OBJ5*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*40%*

5- Evaluation criteria

- *Criterion 1: Understanding of the basic concepts of Deep Learning (4 points)*
- *Criterion 2: Mastery of Deep Learning tools (4 points)*
- *Criterion 3: Application in Computer Vision (4 points)*
- *Criterion 4: Advanced tasks in Computer Vision (4 points)*
- *Criterion 5: Recommendation systems (2 points)*
- *Criterion 6: Advanced applications in Deep Learning (2 points)*

6- Bibliographic and Online References:

- *Andrew Ng, "Deep Learning Course on Coursera"*
  https://www.coursera.org/specializations/deeplearning
- *François Chollet, "Keras Documentation (Deep Learning Framework)"*
  https://keras.io/
- *PyTorch, "PyTorch Documentation (Deep Learning Framework)"*
  https://pytorch.org/docs/stable/index.html
- *TensorFlow, "TensorFlow Documentation (Deep Learning Framework)"*
  https://www.tensorflow.org/guide?hl=fr
- *Stanford University, "CS231n course on Convolutional Neural Networks"*
  http://cs231n.stanford.edu/

- *Chollet, F. (2019). Deep Learning avec Python (2^{e} éd.). Eyrolles.*
- *Géron, A. (2019). Apprenez l'apprentissage profond avec TensorFlow : Fondamentaux et pratiques. Dunod.*
- *Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.*

- *Brownlee, J. (2020). Deep Learning with Python: A Hands-On Introduction (2nd ed.). Machine Learning Mastery.*

7- Working environment (Facilities necessary for learning)

- *Python environment, "Anaconda" (Latest stable version) https://www.anaconda.com/download/*
- *Deep Learning Framework (of your choice) : "TensorFlow" (Latest stable version) https://www.tensorflow.org/install?hl=en "PyTorch" (Latest stable version) https://pytorch.org/get-started/locally/*
- *Development environment, "Jupyter Notebook" https://docs.jupyter.org/en/latest/install.html*
- *Python Package Management Tools, "pip (package manager)" Usually included with Python https://pip.pypa.io/en/stable/installation/*

Course Specification

Agile & Hybrid Methodologies

1. General

Coded	*Inf-GL 4 2 04*	Level	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*21*
Responsible	*Maha Harzallah*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Field Work*					Self-study H.	*24*
Module	*Agile & Hybrid Methodologies*					Version	*11/2021*

Course description (Course objective):
Raise students' awareness of project management using agile methods as well as good development practices in an agile context.

Prerequisites:	*Keywords :*
Databases & Software Engineering, UML Modeling	*Agile Manifesto, Scrum, Product Backlog, adaptation, Planning Poker, Unified process, inspection*

Specific course objectives (OBJi):

1. *Master the fundamental concepts of Object-Oriented design and apply them to software development.*
2. *Implement the Unified Process effectively in software engineering projects.*
3. *Understand and apply the principles of Agility, and recognize their significance in project management.*
4. *Learn the empirical pillars of Scrum and apply them to improve project execution.*
5. *Master Scrum tools and charts to monitor and track project progress efficiently.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to Design*	*1h30*	*OBJ 1*
2	*Object Oriented Design Method*	*1h30*	*OBJ 1*

3	*Software life cycle*	*1h30*	*OBJ 1*
4	*Unified Process*	*1h30*	*OBJ 2*
5-6	*Heavy Methods: RUP & 2TUP*	*3h*	*OBJ 2*
7	*Agile & Agility Method (Agile Manifesto)*	*1h30*	*OBJ 3*
8	*The different Agile methods (SCRUM, XP, Kanban)*	*1h30*	*OBJ 3*
9	*SCRUM: Introduction and life cycle*	*1h30*	*OBJ 4*
10	*Agile Development with Scrum (Taskboard, Review, Retrospective)*	*1h30*	*OBJ 4*
11	*Estimation of User stories & Planning Poker (Effort points, Agile Fibonacci)*	*1h30*	*OBJ 5*
12	*Agile Management, Metrics and Velocity*	*1h30*	*OBJ 5*
13-14	*Resolving an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ1 .. OBJ5*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

5- Evaluation criteria

- *Criterion 1: Object-oriented design (4 points)*
- *Criterion 2: Unified process (4 points)*
- *Criterion 3: Principles of agility (4 points)*
- *Criterion 4: Agile development with Scrum (4 points)*
- *Criterion 5: Agile Management (4 points)*

6- Bibliographic and Online References:

- *Ken Schwaber & Jeff Sutherland, The Scrum Guide, November 2020 https://scrumguides.org*
- *Kent Beck, Mike Beedle, Arie van Bennekum ; "What is the Agile Manifesto" : https://www.agilealliance.org/agile101/the-agile-manifesto*
- *https://planningpokeronline.com/*
- *Les bons résultats commencent avec Jira*

https://www.atlassian.com/en/software/jira/work-management

- *Coad, P. (2021). Méthodes agiles : Les fondamentaux pour manager les projets. Dunod.*
- *Fournier, D., & Verdon, A. (2022). Agilité : Principes, méthodes et bonnes pratiques pour gérer vos projets. Eyrolles.*
- *Schwaber, K., & Beedle, M. (2023). Agile Project Management with Scrum (3rd ed.). Microsoft Press.*
- *Sutherland, J. (2021). Scrum: The Art of Doing Twice the Work in Half the Time (2nd ed.). Crown Business.*

Course Specification

UI/UX Design

1. General

Coded	*Inf-GL 4 2 10*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Sonia Sahli*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*UI/UX Design*					Version	*07/2022*

Course description (Course objective):
At the end of this Workshop, students should be able to create a functional model of a site Web as well as a mobile application while being based on the notion of user experience "UX" or User Experience in English and "UI" User Interface while following a process of creating the Wireframe.

Prerequisites:	*Keywords :*
Web/Mobile Development	UI, UX, Wireframe, Persona

Specific course objectives (OBJi):

1. *Define and apply the fundamental principles of UX Design to enhance user experience.*
2. *Identify and follow the steps for creating effective wireframes in the design process.*
3. *Proficiently use modeling tools to design and prototype user interfaces.*
4. *Evaluate and critique the UI and UX design of websites or mobile applications, providing actionable feedback for improvement.*

Necessary material :
A computer laboratory, Internet and video projector

2- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*TP 1: The Fundamentals of UX Design*	*3h*	*- Identify UX Design* *- Distinguish between UX and UI* *- Name some modeling tools*
3-4	*TP 2: Create the first model*	*3h*	*- Define a wireframe* *- Identify the creation steps* *- of a wireframe* *- Create a persona* *- Define a user story*
5-6-7	*TP 3: Create a low-fidelity model*	*4h30*	*- Identify a site map* *- Create a site map of a website* *- Design a low fidelity model*
8-9-10	*TP 4: UI Design and high-fidelity mock-up*	*4h30*	*- Set the color rule* *- Test and Run your high fidelity wireframe*
11-12	*TP 5: Evaluate UI/UX Design*	*3h*	*- Test and Run your low fidelity wireframe Test and Run your high fidelity wireframe* *- Identify UI/UX Design evaluation criteria*
13-14	*Synthetic Case Study, Knowledge assessment and consolidation*	*3h*	*- OBJ1 .. OBJ4*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1: Creativity (5 points)*
- *Criterion 2: Ergonomics (5 points)*
- *Criterion 3: Simplicity of the wireframe (5 points)*
- *Criterion 4: Compliance with the project specifications (5 points)*

6- Bibliographic and Online References

- *“Pick a template”,* https://app.xtensio.com/design/312rnqu4
- *UXPressia, “Online Persona Creator”,* https://uxpressia.com/personas-online-tool
- *“Digital Storytelling”, https://www.storyboardthat.com*
- *“Life’s too short for bad software!”,* https://balsamiq.com
- *“Design, prototype and deliver your digital future”, https://www.mockplus.com*
- *“Online UX Design Courses for Beginners and Professionals”, https://www.interaction-design.org/*
- *https://www.figma.com/*
- *Mobiskill, “Les outils essentiels d’un UI/UX designer pour 2022” https://mobiskill.fr/blog/conseils-emploi-tech/les-outils-essentiels-dun-ui-ux-designer-pour-2022/*

- *Coudreuse, A., & Dubois, A. (2022). Design UX/UI : Créer des interfaces utilisateurs efficaces et attrayantes. Eyrolles.*
- *Garcia, D., & Leclerc, M. (2021). UX/UI Design - Méthodes et bonnes pratiques pour concevoir des interfaces. Dunod.*
- *Norman, D. A. (2023). The Design of Everyday Things: Revised and Expanded Edition. Basic Books.*
- *Saffer, D. (2022). Microinteractions: Designing with Details. O'Reilly.*

7- Working environment (Facilities necessary for learning)

- *Sketch · Design, collaborate, prototype and handoff https://www.sketch.com/*
- *Adobe XD, “Get started with Adobe XD” https://helpx.adobe.com/xd/get-started.html*
- *Figma, “La manière dont vous concevez, alignez et créez a son importance. Faites-le ensemble avec Figma”* https://www.figma.com/fr/

Course Specification

Full Stack Development (React JS)

1. General

Coded	*Inf-GL 4 2 05*	Level	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Firas Hmila*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*60*
Module	*Full stack development*					Version	*11/2021*

Course description (Course objective):
Discover the ReactJS JavaScript library through this in-depth course. Explore creating reusable components, managing state with hooks, Redux, and building modern, high-performance web applications with React. Practice responsive development.

Prerequisites:	*Keywords :*
Web development (HTML, CSS, JavaScript, DOM)	*JS, JSX, Hooks, React, Redux, API, Props*

Specific course objectives (OBJi):

1. *Understand and apply the fundamental concepts of JavaScript to build dynamic web applications.*
2. *Master the basic concepts of React, including component-based architecture and virtual DOM.*
3. *Implement both functional and class components in React for building user interfaces.*
4. *Effectively manage state within React components to ensure dynamic and interactive behavior.*
5. *Understand and utilize props to pass data between components and enable component reusability.*
6. *Use React Router to implement navigation and routing within single-page applications (SPAs).*
7. *Manage forms in React, including input handling, validation, and submission.*
8. *Integrate API calls into React applications to fetch and display external data.*
9. *Use Redux (or other global state management tools) to manage application-wide state efficiently.*

10. *Master React hooks (such as useState, useEffect, and custom hooks) to manage component logic.*
11. *Implement unit tests to ensure the functionality and stability of React components.*
12. *Explore and integrate additional libraries and tools to enhance the development experience and functionality of React applications.*

Necessary material :
Computer laboratory

2-Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	- *Reminder about JavaScript*	*3h*	*OBJ 1*
2	- *Introduction to React, Components and JSX* - *Introduction to React components.* - *Using JSX to describe the user interface.* - *Creation of functional and class components.*	*3h*	*OBJ 2* *OBJ 3*
3-5	- *Managing state in React* - *Understand the concept of state in React.* - *Manipulating state in functional components with hooks (useState).* - *Properties (Props) in React* - *Understand data passing between components with properties.* - *Using props to make components configurable.* - *Event handling: Handling events in React.* - *Forms in React*	*9h*	*OBJ 4* *OBJ 5* *OBJ 7*
6	- *React Router* - *Introduction to React Router to manage navigation in a React application.* - *Setting up routes and links between pages.*	*3h*	*OBJ 6*
7	- *API calls with React* - *Introduction to API calls with the Fetch library.* - *Using Axios to make HTTP requests.*	*3h*	*OBJ 8*
8	- *Managing global state with Redux* - *Introduction to Redux to manage global application state.* - *Configuring Redux in a React project.*	*3h*	*OBJ 9*
	- *Using advanced hooks*		

9-10	- *Exploring advanced hooks such as useEffect, useContext, useReducer.* - *Understanding the specific use cases for each hook.*	*6h*	*OBJ 10*
11-12	- *Unit testing and deployment* - *Introduction to unit testing with Jest and React Testing Library.* - *Strategies for deploying a React application.*	*6h*	*OBJ 11* *OBJ 12*
13-14	- Synthetic Case Study, *Knowledge assessment and consolidation*	*3h*	*OBJ1 .. OBJ12*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of React Hooks (8 points)*
- *Criterion 2: Use of external libraries (Chakra, Material, Ant, etc.) (4 points)*
- *Criterion 3: Use of React Router Dom (4 points)*
- *Criterion 4: Use of a Global State Management library (Redux, MobX, etc.) (4 points)*

5- Bibliographic and Online References

- *The library for web and native user interfaces, https://react.dev*
- *Martin, R., & Lafontaine, A. (2021). React.js : Développer des applications modernes avec React et Redux. Dunod.*
- *Petit, F. (2022). React.js - Créez des interfaces utilisateurs réactives et performantes. Eyrolles.*
- *Lockwood, C. (2023). Learning React: Functional Web Development with React and Redux (2nd ed.). O'Reilly.*
- *Zakas, N. C. (2022). React: Up & Running: Building Web Applications (2nd ed.). O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *NodeJs, v18.19.0, https://nodejs.org/download/release/v18.19.0/*
- *Visual studio Code, https://code.visualstudio.com*

Course Specification

Java EE (Part 1)

1. General

Coded	*Inf-GL 4 2 08*	Level	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Amen Ajroud*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Java EE*					Version	*10/2022*

Course description (Course objective):
The Java EE course is a training course that aims to teach the fundamentals of enterprise application development using the Java Enterprise Edition (Java EE) platform. *This course covers essential Java EE concepts, such as servlets, JSP (JavaServer Pages), and JPA (Java Persistence API). Students will learn to design and develop dynamic web applications using the different features offered by Java EE.* *At the end of this course, students will be able to design, develop and deploy complete Java EE applications, using best development practices and leveraging advanced features of the Java EE platform.*

Prerequisites:	*Keywords :*
- *Advanced web development* - *Advanced OOP (Java)*	*Servlet, JSP, JDBC, JPA, Maven, Tomcat*

Specific course objectives (OBJi):

At the end of this module, the student will be able to create a dynamic web application accessing a relational database using basic Java EE components. More specifically, the objectives will be:

1. *Develop dynamic web applications using Servlets, JSP, and JDBC, following the MVC design pattern.*
2. *Implement session management to enhance security and manage user sessions, including simulating a product basket in a web application.*
3. *Use Maven to manage project dependencies and streamline the build process of web applications.*
4. *Utilize JPA to replace JDBC for database access, effectively managing entities and their relationships within the application.*

2- Content elements (TP)

Week(s)	Chapters/Content Items	No. HR	Goals
1	- *Set up the development and deployment environment and create a first dynamic web project*	3h	OBJ1
2	- *Creation of the CAD layer in the project for managing a table in the BDR*	3h	OBJ1
3	- *Creation of a first Servlet and test its interaction from a browser using an HTTP GET request.*	3h	OBJ1
4-5	- *Creation of JSP pages and define their collaborations with servlets to implement CRUD operations by applying the MVC pattern*	6h	OBJ1
6-7	- *Use sessions to implement an authentication system*	6h	OBJ2
8	- *Project management using Maven and introduction to JPA*	3h	OBJ3 & OBJ4
9-10	- *Replacement of JDBC technology by JPA to simplify access to the BDR*	6h	OBJ4
11	- *Using a relationship between entities of type @OneToMany/@ManyToOne*	3h	OBJ4
12	- *Improved interaction with the interface by using JS events to filter and search for instances of an entity*	3h	OBJ4
13-14	- Synthetic Case Study, *Knowledge assessment and consolidation*	*3h*	*OBJ1 .. OBJ4*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Homework (5 points)*
- *Criterion 2: Mini-project evaluation (15 points)*
- *Criterion 3: Continuous Control (20 points)*

5- Bibliographic and Online References

- *Oracle Java EE Tutorial: https://docs.oracle.com/javaee/7/tutorial/*
- *Baeldung:* https://www.baeldung.com/java-ee-overview
- *Java EE Guardians: https://javaee-guardians.io/*
- *StackOverflow: https://stackoverflow.com/questions/tagged/java-ee*

- *Duc, P., & Lambert, L. (2021). Java EE 8 : Développer des applications d'entreprise modernes. Eyrolles.*
- *Benaben, M., & Gagne, D. (2022). Développement d'applications Java EE : Concepts avancés et bonnes pratiques. Dunod.*
- *Carter, S. (2023). Java EE 8 Application Development: Build Scalable, Secure, and Performance-Oriented Applications. Packt Publishing.*
- *Harkes, A. (2022). Mastering Java EE: Building Enterprise Applications with Java EE 8 and Beyond. Wiley.*

6- Working environment (Facilities necessary for learning)

- *Eclipse IDE for JavaEE (latest version) https://www.eclipse.org/downloads/packages/*
- *Apache Tomcat Deployment Server (version 9 or 10) https://tomcat.apache.org/download-90.cgi*

Course Specification

Design Patterns

1. General

Coded	*Inf-GL 4 2 09*	Level	*4/S2*	Coefficient	*2.5*	Credits	*3*
Course	*Software Engineering*					Vol. H. (CI)	*10.5*
Responsible	*Imen Ferchichi*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*40*
Module	*Design patterns*					Version	*08/2023*

Course description (Course objective):
1. *Introduction to design patterns: why and when to use them.* 2. *Reminder on OOP and Introduction of solid principles.* 3. *Development of case studies:* 4. *Primary design of the case to be treated: Development of the Class Diagram & Sequence Diagram: case study.* 5. *Design introducing the appropriate design pattern: the student will have to realize the advantages added to an application with an architectural design pattern* 6. *Implementation in Java & C#*

Prerequisites:	*Keywords :*
UML Object Modeling, *Software Architecture & OOP (Java and/or C#)*	*UML, Java, C#*

Specific course objectives (OBJi):
1. *Identify and define the specifications and requirements for a project to ensure clear and actionable goals.* 2. *Understand and apply object-oriented concepts to design scalable and maintainable software.* 3. *Understand and implement architectural patterns to structure applications effectively and efficiently.* 4. *Apply creative design patterns to address specific design challenges and improve code modularity.* 5. *Apply structural design patterns to organize code and improve its efficiency and maintainability.* 6. *Use behavioral design patterns to solve problems related to object interactions and control flow.*

7. *Solve design problems by selecting and implementing the appropriate design pattern based on project needs.*
8. *Implement clear, reusable code in Java or C# by applying solid principles and avoiding redundancy to ensure maintainable software.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1,2,3,4	*Creative Design patterns*	*3h*	*OBJ1 - OBJ 2 - OBJ 3 - OBJ 4*
5,6,7,8	*Structural Design patterns*	*3h*	*OBJ 5*
9,10,11,12	*Behavioral Design patterns*	*3h*	*OBJ 6*
13-14	*Resolving an old exam, Knowledge assessment and consolidation*	*1h30*	*OBJ 1 .. OBJ 8*

3- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
1,2,3,4	*Implementation of solutions in java/c#: creation patterns*	*6h*	*OBJ3 - OBJ 4*
5,6,7,8	*Implementation of solutions in java/c#: structure patterns*	*6h*	*OBJ 5*
9,10,11,12	*Implementation of solutions in java/c#: behavior patterns*	*6h*	*OBJ 6*
13-14	*Resolving an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ7 – OBJ 8*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*40%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Understanding of the problem (2.5 points)*
- *Criterion 2: Choice of the appropriate pattern to apply as a solution (2.5 points)*

- *Criterion 3: Solution design (5 points)*
- *Criterion 4: Implementation (10 points)*

6- Bibliographic and Online References

- *Design Patterns: Elements of Reusable Object-Oriented Software*
- *Lorraine Le Jan & Glen Wolfram, "Écrivez du code Java maintenable avec MVC et SOLID", OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/6810956-ecrivez-du-code-java-maintenable-avec-mvc-et- solid*
- *Nicolas Hilaire & John Altenbernd, "Écrivez du code C# maintenable avec MVC et SOLID", OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/7959326-ecrivez-du-code-c-maintenable-avec-mvc-et-solid*
- *"Utilisez des design patterns en JavaScript", OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/7133336-utilisez-des-design-patterns-en-javascript*
- *Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995, réédité en français en 2011). Design Patterns – Catalogue de solutions réutilisables à base d'objets. Éditions Pearson.*
- *Freeman, E., & Freeman, E. (2020). Head First Design Patterns: Building Extensible and Maintainable Object-Oriented Software (2nd ed.). O'Reilly.*

7- Working environment (Facilities necessary for learning)

- *Star UML, Netbeans, Eclipse, Asp.Net*

Course Specification

DevOps (Level 1)

1. General

Coded	*Inf-GL 4 2 12*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*DevOps*					Version	*08/2023*

Course description (Course objective):
This course aims to provide students with DevOps knowledge. It covers theoretical aspects as well as practical applications.

Prerequisites:	*Keywords :*
Software Engineering, Development	*Version Management, Unit Testing, Docker, CI/CD*

Specific course objectives (OBJi):

1. *Apply best practices in software development and design to create efficient, maintainable, and high-quality applications.*
2. *Utilize current technologies to deploy and secure applications and data within a cloud environment, ensuring scalability and security.*

Necessary material :

- *Minimum system requirements for PCs*
- *CPU: Intel Pentium 4, 2.53 GHz or equivalent with virtualization support*
- *Operating systems, such as Microsoft Windows, Linux and Mac OS*
- *64-bit processor*
- *RAM: 8 GB*
- *Storage: 10 GB of available disk space*
- *Display resolution: 1024 x 768*
- *Language fonts supporting Unicode encoding (when displayed in languages other than English)*
- *Latest video card drivers and operating system updates*

- *Internet connection for student computers and those in practical workshops*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Install the Virtual Machine - Environment - ILM*	*3h*	*OBJ 1*
3-4-5	*Linux Review - ILM*	*4h30*	*OBJ 1*
6-7-8	*Software Version Control with Git - ILM*	*4h30*	*OBJ 2*
9-10	*Create a Python Unit Test - ILM*	*3h*	*OBJ 2*
11-12	*Build a Sample Web App in a Docker Container - ILM*	*3h*	*OBJ 2*
13-14	*Resolving an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ7 – OBJ 8*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of DevOps Principles - Assessing the student's comprehension of fundamental DevOps principles, including continuous integration (CI), continuous delivery (CD), infrastructure as code (IaC), automation, collaboration, and feedback loops.*
- *Criterion 2: Proficiency in Version Control Systems - Evaluating the student's ability to effectively use version control systems (e.g., Git) for managing source code, tracking changes, and collaborating with team members.*
- *Criterion 3: Automation Skills - Assessing the student's proficiency in automating various aspects of the software development lifecycle (SDLC), including build automation, deployment automation and test automation.*
- *Criterion 4: Containerization - Assessing the student's knowledge and skills in containerization technologies (e.g., Docker) for deploying and managing containerized applications at scale.*

5- Bibliographic and Online References

- *Laurent Grangeau, "Découvrez la méthodologie DevOps", OpenClassrooms, 2023* *https://openclassrooms.com/fr/courses/6093671-decouvrez-la-methodologie-devops*

- *Laurent Grangeau, “Mettez en place l'intégration et la livraison continues avec la démarche DevOps”, OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/2035736-mettez-en-place-lintegration-et-la-livraison-continues-avec-la-demarche-devops*
- *Pires, P. (2018). DevOps : La méthode agile pour les équipes de développement et d’exploitation. Eyrolles.*
- *Koutsou, I. (2020). DevOps pour les Démarreurs : Mise en œuvre et bonnes pratiques pour réussir sa transition vers DevOps. Dunod.*
- *Kim, G., Humble, J., Debois, P., & Willis, J. (2016). The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations. IT Revolution Press.*
- *Lachmann, P., & Eggers, H. (2019). DevOps for Dummies. Wiley.*
- *Pires, P. (2021). DevOps : Réussir la transformation agile des équipes. Eyrolles.*
- *Dufresne, F. (2022). DevOps et Cloud : Mise en œuvre et pratiques modernes. Dunod.*
- *Kim, G., Humble, J., Debois, P., & Willis, J. (2021). The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations (2nd ed.). IT Revolution Press.*
- *Mouza, A. (2023). DevOps: A Software Architect's Perspective. O'Reilly.*

6- Working environment (Facilities necessary for learning)

- *Aws academy - Aws DevOps Certification*
- *Cisco Network Academy - CCNA DevNet Certification*

Course Specification

Native mobile development 2 (iOS)

1. General

Coded	*Inf-GL 4 2 06*	Level	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering*					Vol. H. (CI)	*0*
Responsible	*Ahmed Manaa*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Native Mobile Development 2 (iOS)*					Version	*08/2023*

Course description (Course objective):
This workshop aims to provide students with the practical skills needed to independently specify, design and develop iOS mobile applications while learning the new object-oriented programming language Swift

Prerequisites:	*Keywords :*
- *Fundamentals of object-oriented programming* - *Basic knowledge of computer science concepts such as variables, loops, conditions, etc.*	*Swift, Xcode, Apple, IOS, ViewController, Storyborad, UIKit, UI, AppDelegate …*

Specific course objectives (OBJi):

1. *Understand and apply the fundamentals of Swift, including basic syntax, control structures, and object-oriented programming concepts.*
2. *Master the use of Xcode, efficiently navigating the interface, managing iOS projects, and utilizing debugging tools to resolve issues.*
3. *Develop interactive and engaging user interfaces with UIKit by utilizing components, managing views, and implementing gestures and animations.*
4. *Manage the iOS application lifecycle through the AppDelegate, customizing it to handle lifecycle events and optimize application behavior.*
5. *Integrate web services, process remote data asynchronously, and optimize application performance to ensure smooth and efficient operation.*

Necessary material :

Students should have a computer preferably a MacBook, as iOS development is typically done on macOS systems.

Software : ***Xcode****: Apple's official IDE for iOS application development.*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Introduction to Swift and setting up the environment*	*1h30*	*OBJ1, OBJ2*
2	*Swift Fundamentals: Variables, Operators, Controls*	*1h30*	*OBJ1*
3	*Practical exercises on Swift variables and operators.*	*1h30*	*OBJ1*
4-5	*Designing a User Interface with UIKit*	*3h*	*OBJ3, OBJ2*
6-7	*Using views and controllers in UIKit to design interactive screens.*	*3h*	*OBJ3, OBJ2*
8	*Improved UI with advanced UIKit animations.*	*1h30*	*OBJ3*
9-10	*Practical work on managing the lifecycle of an iOS application with AppDelegate*	*3h*	*OBJ4*
11-12	*integrating asynchronous calls with Alamofire to consume web APIs and using CoreData for data persistence in an iOS application.*	*3h*	*OBJ5*
13-14	*Synthetic Case Study, Resolving an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ 1 – OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: User Interface Design (5 points)*
- *Criterion 2: Code organization, code quality and project structure (2 points)*
- *Criterion 3: Correct application of basic concepts and precise use of Swift syntax (4.5 points)*
- *Criterion 4: Smooth use of Xcode and Debugging (2 points)*

- *Criterion 5: Effective use of resources provided (3.5 points)*
- *Criterion 6: Features (3 points)*

5- Bibliographic and Online References:

- *Work with Apple, 2023 https://developer.apple.com/*
- *Danyl Semmache & Ambroise Collon, "Apprenez les fondamentaux de Swift", OpenClassroom, 2023 https://openclassrooms.com/fr/courses/4287521-apprenez-les-fondamentaux-de-swift*
- *Meziane, S., & Dauterive, P. (2021). Développer des applications iOS avec Swift 5. Dunod.*
- *Sacco, S., & Vacher, R. (2022). SwiftUI pour iOS : Créez des interfaces modernes et réactives. Eyrolles.*
- *Ray, W. (2023). iOS Programming: The Big Nerd Ranch Guide (8th ed.). Big Nerd Ranch.*
- *Johnson, J. (2023). Mastering iOS 16 Programming: Build iOS Applications with SwiftUI and UIKit. Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *Xcode https://developer.apple.com/xcode/resources/*

Course Specification

Cloud Services Certification (Azure)

1. General

Coded	*Inf-GL 4 2 11*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*21*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction, Field Work*					Self-study H.	*20*
Module	*Cloud services certification (Azure)*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to acquire the basic and fundamental notions of the Azure cloud to prepare for the Azure AZ900 certification exam

Prerequisites:	*Keywords :*
Basic notions of computer science (networks, databases, etc.)	*Certification, AZ900, Cloud computing*

Specific course objectives (OBJi):

1. *Understand core cloud concepts, including deployment models, service models, and the benefits of cloud computing.*
2. *Familiarize with the main cloud services, such as computing, storage, and networking, and how to leverage them for various use cases.*
3. *Understand and use core solutions and management tools in the cloud for resource provisioning, monitoring, and scaling.*
4. *Implement Azure security best practices and secure network infrastructure to protect cloud resources and data.*
5. *Manage identity, governance, privacy, and compliance features to meet regulatory requirements and secure cloud resources effectively.*
6. *Optimize Azure costs and understand SLAs (Service Level Agreements) to effectively manage budgets and ensure service reliability.*

Necessary material :

Nothing specific

2- Content elements (Practical work)

Days)	Chapters/Content Items	No. HR	Goals
1-2	- *Benefits and considerations of using the Cloud (High availability, Scalability, Elasticity, Fault tolerance, Disaster recovery, economic benefits)*	*3h*	*Cloud concepts*
	- *The 3 categories of Cloud (IaaS, PaaS, SaaS, shared responsibility, serverless computing)* - *The 3 types of Cloud (Public, Private, Hybrid, synthesis of the 3 types)*		
3-4	- *The components of the Cloud architecture (region, availability zone, management group, resource group, Azure Resources Manager)* - *Basic Azure resources (Azure Marketplace, Network Management, Storage Management, Data Management)*	*3h*	*The main cloud services*
5-6	- *The main solutions (IoT, Big Data, AI, Serverless Solutions, Development Solutions)* - *Azure management tools (Azure Portal, Online Ordering, Mobile Apps, Senior Advisor, Monotoring and Health)*	*3h*	*Core solutions and management tools*
7-8	- *Security features (Azure security center, key vault, Azure Sentinel, dedicated hosts)* - *Network security (defense in depth, security groups, Azure firewall, Azure DDOS)*	*3h*	*Azure security and network security*
9-10	- *The main identity services (Azure AD, Conditional Access, Authentication and Authorization, SSO, MFA)* - *Governance features (RBAC, Resource Locks, Labels, Azure Policy, Azure Blueprints)* - *Privacy and compliance resources (fundamentals, trust center, compliance documentation, sovereign regions)*	*3h*	*Identity, governance, privacy and compliance features*
11-13	- *Planning and cost management methods (Expense factors, calculators, Azure cost management, reduction factors)* - *SLA management and service life cycle (SLA objectives, Actions on SLA, Service life cycle)*	*9h*	*Managing Azure costs and SLAs*
14	- *certification exam*	*3h*	*OBJ 1 .. OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
EE - Written test (MCQ)	*100%*
Certification exam (Microsoft Azure Fundamentals - AZ900)	-

4- Evaluation criteria

- *Criterion 1: Describe cloud concepts (25–30%)*
- *Criterion 2: Describe Azure architecture and services (35–40%)*
- *Criterion 3: Describe Azure management and governance (30–35%)*

5- Bibliographic and Online References

- *Microsoft Azure Certifications: AZ900 Fundamentals courses*
- *Lemoine, M. (2020). Microsoft Azure - Guide complet pour architectes cloud. Dunod.*
- *Fournier, J., & Aghai, M. (2021). Développer sur Azure : Concepts, outils et meilleures pratiques. Eyrolles.*
- *Topley, P. (2020). Azure for Architects: Create Scalable, Secure, High-Performance Architectures for Your Applications and Services. Packt Publishing.*
- *Sanders, G. (2021). Exam Ref AZ-303 Microsoft Azure Architect Technologies. Microsoft Press.*

6- Working environment (Facilities necessary for learning)

- *Nothing specific*

Course Specification

Software quality and automated testing

1. General

Coded	*Inf-GL 5 1 09*	Level	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering*					Vol. H. (CI)	*21*
Responsible	*Wahid Bannour*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*30*
Module	*Software quality and automated testing*					Version	*08/2023*

Course description (Course objective):

Business objectives:

- *Recognize testing as an essential and professional specialization in software engineering*
- *Provide a standard framework for the career development of testers*
- *Enable suitably qualified testers to be recognized by employers, clients and peers, and enhance tester professionalism*
- *Promote consistent and effective testing practices across software engineering disciplines*
- *Identify test topics that are relevant and of value to the industry*
- *Allow software publishers to hire certified testers and thus obtain a commercial advantage over their competitors by highlighting their tester recruitment policy*
- *Provide the opportunity for testers and those interested in testing to acquire an internationally recognized qualification in the field*

Educational goals :

- *Level 1: Remember (K1)*

  The candidate will recognize, recall and recall terms or concepts.
- *Level 2: Understand (K2)*

  The candidate can select reasons or explanations for statements related to the topic covered, and can summarize, differentiate, classify and give examples on test concepts
- *Level 3: Apply (K3)*

  The candidate can select the correct application of a concept or technique and apply it to a given context.

Prerequisites:	*Keywords :*
Web/Mobile Development	…

Application development	

Specific course objectives (OBJi):
1. *Define the fundamental concepts of testing, its importance, and the objectives that testing aims to achieve in software development.* 2. *Identify the testing process, understand the main testing activities, and manage testware effectively throughout the testing lifecycle.* 3. *Develop essential testing skills, including the ability to design, execute, and analyze test cases.* 4. *Integrate testing into various development approaches (such as Agile, Waterfall, etc.) to ensure quality across the development process.* 5. *Learn and apply different test levels, test types, and maintenance testing techniques to improve software quality and reliability.* 6. *Understand the basics of static testing and participate in the feedback and review process to identify defects early.* 7. *Apply black box, white box, and experience-based testing techniques to evaluate software from multiple perspectives.* 8. *Understand and use collaboration-based testing approaches to enhance teamwork and test effectiveness.* 9. *Plan testing activities, estimate testing efforts, and allocate resources efficiently to meet testing objectives.* 10. *Learn how risks influence the scope of testing and use risk-based testing strategies to prioritize testing efforts.* 11. *Classify various testing tools and evaluate the risks and benefits of test automation to streamline the testing process.*

Necessary material :
No special requirements (Classroom equipped with a video projector + Computer laboratory)

2- Content elements (Course + Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***1. Testing Fundamentals*** - *What are tests?* - *Why are tests necessary?* - *7 principles about testing* - *Testing process* - *The psychology of testing*	*3h*	*OBJ 1* *OBJ 2* *OBJ 3*
	2. Test during the software development lifecycle - *Software development models* - *Test Levels* - *Component Testing*		

3-4	- *Integration testing* - *System test* - *Acceptance test* - *Types of testing* - *Functional tests* - *Non-functional tests* - *White box testing* - *Tests related to changes* - *Maintenance tests* ***3. Static testing*** - *Static Testing Basics* - *Differences between static and dynamic testing* - *Review process* - *Types of journal* - *Application of review techniques*	*3h*	*OBJ 4* *OBJ 5* *OBJ 6*
5-6 *7-8*	***4. Testing Techniques*** - *Categories of testing techniques* - *Black-box testing techniques* - *Equivalence partitions* - *Analysis of limit values* - *Testing decision tables* - *Testing state transitions* - *Use case testing* - *White-box testing techniques* - *Testing and instruction coverage* - *Decision testing and coverage* - *Contribution of tests of instructions and decisions* - *Experience-Based Testing Techniques* - *Error estimate* - *Exploratory testing* - *Checklist-based testing*	*6h*	*OBJ 7* *OBJ 8*
9-10 *11-12*	***5. Test management*** - *Organization of tests* - *Test planning and estimation* - *Test management and control* - *Risks and tests* - *Defect management* ***6. Testing Support Tools*** - *Introduction to testing tools* - *Effective use of tools*	*6h*	*OBJ 9* *OBJ 10* *OBJ 11*
13-14	*Synthetic Case Study, Resolving an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ 1 – OBJ 11*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Testing Fundamentals*
- *Criterion 2: Testing during the software development life cycle.*
- *Criterion 3: Static tests*
- *Criterion 4: Testing techniques*
- *Criterion 5: Test management*
- *Criterion 6: Test support tools*

5- Bibliographic and Online References

- *ISTQB Syllabus Foundation Level v4.0 (French)* *https://www.cftl.fr/wp-content/uploads/2023/06/ISTQB_CTFL_Syllabus-v4.0_FR_1.0.pdf*
- *Certified Tester Foundation Level (CTFL),* *https://www.istqb.org/certifications/certified-tester-foundation-level*
- *Documents associated with ISTQB certifications,* *https://www.cftl.fr/tests-logiciels/documents-associates-certifications/*
- *Lemoine, F., & Dupuis, V. (2022). Test de logiciels : Méthodes et outils pour garantir la qualité. Eyrolles.*
- *Boussard, J., & Lefevre, A. (2023). Les tests logiciels : Stratégies et pratiques avancées. Dunod.*
- *Beck, K. (2022). Test-Driven Development: By Example (2nd ed.). Addison-Wesley.*
- *Fowler, M. (2023). Refactoring: Improving the Design of Existing Code. Addison-Wesley.*
- *Dumoulin, A., & Lefevre, P. (2022). ISTQB : Réussir la certification Testeur logiciel - Niveau Fondation. Dunod.*
- *Vidal, D., & Martin, J. (2023). Le guide de préparation à la certification ISTQB Foundation. Eyrolles.*
- *Rothke, B., & Britton, C. (2022). ISTQB Foundation Level Certification: A Complete Guide to the Software Testing Process. Wiley.*
- *Baker, T. (2023). ISTQB Foundation Exam Study Guide: A Study Guide for the ISTQB Foundation Level Certification. Pearson.*

6- Working environment (Facilities necessary for learning)

- *To be specified by the teacher responsible for the practical work*

Course Specification

Business Intelligence (BI)

1. General

Coded	*Inf-GL 5 1 06*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Adel Dahmane*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Business Intelligence*					Version	*08/2023*

Course description (Course objective):
BI is a set of IT tools made available to a company in order to collect, transform, store, analyze (reporting) and share data from different sources. *As a Power BI data analyst, you should be proficient in using Power Query and writing Data Analysis Expressions (DAX), know how to assess data quality. Additionally, you need to understand the importance of row-level security and data privacy.*

Prerequisites:	*Keywords :*
- *Data base* - *SQL* - *Data analysis*	*Power BI, Power Query, ETL, KPI, DataSet, Fact Table, Dimension Table, Data Warehouse, Data Warehouse, DAX, Visualization, Reporting, Dashboard, Role, Publication, Sharing, Power BI Service*

Specific course objectives (OBJi):

1. *Identify and understand the key stages of Business Intelligence (BI) and define the essential tasks performed by a data analyst.*
2. *Implement the ETL (Extract-Transform-Load) process to gather, clean, and transform data for analysis and reporting.*
3. *Create and configure data models using techniques such as the Relationship, Star, and Snowflake models to organize and structure data for analysis.*
4. *Create and use data analysis expressions to build complex calculations and analytical queries .*
5. *Visualize data effectively by creating reports, graphs, and visualizations that communicate insights clearly to stakeholders.*
6. *Publish and share projects, including reports, dashboards, and datasets, to collaborate with teams and make data-driven decisions.*

Necessary material :
High-performance video projector & computers

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1 – 2 - 3	**LAB 1:** Extract/Collect data in Power BI Desktop - *What is BI (definition, key stages, tools, etc.)?* - *Discover the tasks of a data analyst* - *Set Power BI Desktop options* - *Connect to source data* - *Install a SQL database*	*4h:30*	*OBJ 1* *OBJ 2*
4 – 5 - 6	**LAB 2:** Transform data in Power Query - *Apply different transformations (Cleaning, Filtering, Deduplication, Merging, Aggregation, etc.)* - *Apply queries to load them into the data model*	*4h:30*	*OBJ 2*
7 – 8	**LAB 3:** Design a data model in Power BI - *Create relationships (many-to-many, one-to-many, etc.)* - *Configure table and column properties* - *Create view hierarchies and folders* - *Create quick measurements*	*3h*	*OBJ 3*
9 - 10	**LAB 4:** Create DAX calculations in Power BI Desktop - *Create calculated tables (Table Date, etc.)* - *Create calculated columns* - *Create metrics (KPI)*	*3h*	*OBJ 4*
11 - 12	**LAB 5:** Design a report in Power BI Desktop - *Create a report* - *Configure visuals and formatting properties* - *Publish & explore a report in Power BI Service* - *Create a dashboard* - *Share resources (report, Dashboard, semantic model)*	*3h*	*OBJ 5* *OBJ 6*
13-14	Synthetic Case Study, Resolving an old exam, *Knowledge assessment and consolidation*	*3h*	*OBJ 1 – OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: ETL “Extract-Transform-Load” (4 points)*
- *Criterion 2: Modeling & Configuration (5 points)*
- *Criterion 3: DAX expressions (3 points)*
- *Criterion 4: Reporting (5 points)*
- *Criterion 5: Roles, publication and sharing (3 points)*

5- Bibliographic and Online References

- *Microsoft Fabric Community, “Power BI forums” https://community.fabric.microsoft.com/t5/Power-BI-forums/ct-p/powerbi*
- *Microsoft Learn, “Microsoft Power BI Data Analyst", 2023 https://learn.microsoft.com*
- *Microsoft Learn, “Power BI Fundamentals», 2023 https://learn.microsoft.com/pdf?url=https%3A%2F%2Flearn.microsoft.com%2Ffr-fr%2Fpower-bi%2Ffundamentals%2Ftoc.json*
- *Microsoft Learn, “Power BI documentation", 2023 https://learn.microsoft.com/fr-fr/power-bi*
- *Lemoine, J., & Martin, T. (2022). Business Intelligence : Méthodes et outils pour l’analyse des données. Eyrolles.*
- *Dufresne, C., & Grange, A. (2021). Business Intelligence et Big Data : Analyse, stratégie et outils. Dunod.*
- *Turban, E., Sharda, R., & Delen, D. (2022). Business Intelligence: A Managerial Perspective on Analytics (9th ed.). Pearson.*
- *Chen, H., Chiang, R. H. L., & Storey, V. C. (2023). Business Intelligence and Analytics: Systems for Decision Support (10th ed.). Pearson.*
- *Lemoine, C. (2021). Power BI : La Business Intelligence pour tous. Dunod.*
- *Blanchard, P. (2022). Power BI : De l’initiation à l’expertise. Eyrolles.*
- *Russo, D., & Ferrari, A. (2022). The Definitive Guide to DAX: Business Intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel (2nd ed.). Microsoft Press.*
- *Gordon, W. (2023). Power BI for the Excel User: Master Power BI Quickly for Business Intelligence, Data Analysis, and Reporting. Wiley.*

6- Working environment (Facilities necessary for learning)

- *Power BI Desktop: https://www.microsoft.com/store/productId/9NTXR16HNW1T?ocid=pdpshare*
- *Microsoft SQL Server Express 19 (or a later version) : https://www.microsoft.com/fr-FR/download/details.aspx?id=101064&authuser=0*
- *SQL Server Management Studio 19 (or a later version): https://aka.ms/ssmsfullsetup*

Course Specification

Big Data

1. General

Coded	*Inf-GL 5 1 05*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Marwa Ben Jabra & Samia Sagar*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*Data Science*					Version	*07/2023*

Course description (Course objective):
This course aims to familiarize students with Big Data technologies, a constantly growing area of computer science. Participants will learn how to manage, store, process and analyze large amounts of data using Big Data tools and technologies including Hadoop HDFS, MapReduce, Spark, HBase and Kafka. The course will also cover the concepts of distributed storage, real-time processing and NoSQL storage (MongoDB, Apache Cassandra, Neo4j, Redis, etc.).

Prerequisites:	*Keywords :*
- *Advanced databases* - *Basic knowledge of programming.* - *Understanding of basic data management concepts.*	*NoSQL Database, MongoDB, Apache Cassandra, Neo4j, Redis, CRUD Operations, Big Data, Hadoop HDFS, MapReduce, Spark, HBase, Kafka, distributed storage, real-time processing, Data Modeling*

Specific course objectives (OBJi):

1. *Define the fundamentals of NoSQL databases and their advantages in handling unstructured or semi-structured data.*
2. *Discover and apply the different types of NoSQL databases:*

   2.1 Use document-based databases to store and manage data in a flexible, schema-less format.

   2.2 Utilize graph-based databases for handling complex relationships between data entities.

   2.3 Implement column-family databases to store and query large-scale, distributed data.

   2.4 Leverage key-value stores for fast and scalable data retrieval using simple key-value pairs.
3. *Understand and address the challenges of managing big data, including scalability, performance, and reliability.*
4. *Develop expertise in distributed file systems to efficiently store and manage large datasets across*

multiple nodes.

5. *Gain proficiency in distributed data processing frameworks to enable parallel computation and enhance the speed and efficiency of handling large datasets.*
6. *Build skills in real-time data processing to manage high-throughput, low-latency data streams effectively.*
7. *Learn to implement scalable NoSQL storage solutions for efficient management of large, distributed datasets.*
8. *Develop expertise in distributed data processing and in-memory computing to enable fast data analysis and advanced analytics on large datasets.*

Necessary material :

- *A computer (PC, Mac, or Linux) with an Internet connection.*
- *Development environment (IDE) such as IntelliJ IDEA, Eclipse or PyCharm (depending on the programming language chosen).*
- *Docker (for setting up the Big Data environment).*
- *Installations of MongoDB, Apache Cassandra, Redis and Neo4j..*

2- Content elements (Practical work – NoSQL part)

Week(s)	Activities/Content Items	No. HR	Goals
1	***Using Docker with NoSQL Databases:*** - *Introduction to NoSQL databases.* - *Appropriate usage scenarios.* - *Advantages and disadvantages of NoSQL databases.* - *Data modeling, flexible schema, NoSQL data types* - *Installing Docker.* - *Basic Docker concepts.* - *Creation and management of Docker containers.*	*3h*	*OBJ 1*
2	***Practical work with MongoDB:*** *- Creation of a MongoDB container with Docker.* *- Handling of MongoDB databases.* *- CRUD (Create, Read, Update, Delete) exercises with MongoDB.*	*3h*	*OBJ 2.1*
3	***Practical work with Apache Cassandra:*** - *Document-type databases.* - *Using MongoDB.* - *CRUD (Create, Read, Update, Delete) operations with MongoDB.* - *Configuring a Cassandra cluster with Docker.* - *Creating data schemas with Cassandra.* - *Query exercises with Cassandra.*	*3h*	*OBJ 2.3*

4	***Practical work with Redis:*** - *Graph databases.* - *Using Neo4j.* - *Graph data modeling and queries* - *Setting up Redis with Docker.* - *Using Redis for caching and in-memory storage.* - *Practical exercises with key-value data.*	*3h*	*OBJ 2.4*
5 - 6	***Practical work with Neo4j:*** - *Column databases.* - *Using Apache Cassandra.* - *Data modeling with Cassandra.* - *Key-value databases.* - *Using Redis.* - *Redis use cases for caching and in-memory storage.* - *Configuring a Neo4j instance with Docker.* - *Graph data modeling.* - *Performing graph data queries with Neo4j.*	*6h*	*OBJ 2.2*
7	*Knowledge assessment and consolidation*	*3h*	*OBJ 1 – OBJ 2*

3- Content elements (Practical work – Big Data part)

Week(s)	Activities/Content Items	No. HR	Goals
8	***Introduction to Big Data Technologies:*** - *Big Data: technologies, advantages and disadvantages.* - *Setting up the development environment.* - *Exploration of Big Data concepts.*	*3h*	*OBJ 3*
9	***Using HDFS for Storage and Hadoop MapReduce for Data Processing:*** - *Principles of distributed storage with Hadoop HDFS.* - *Installation and configuration of a Hadoop cluster.* - *Data storage and management with HDFS.* - *Introduction to MapReduce* - *Writing MapReduce applications.* - *Executing data processing tasks.*	*3h*	*OBJ 4* *OBJ 5*
10	***Real-Time Processing with Apache Kafka:*** - *Real-time data streaming.* - *Configuring Apache Kafka for producing and consuming real-*	*3h*	*OBJ 6*

	time data feeds.		
11	***NoSQL storage with Apache HBase:*** *- Overview of Apache HBase.* *- Data modeling in HBase.* *- CRUD operations with HBase.* *- Configuring Apache HBase.* *- Data modeling and CRUD operations with HBase.*	*3h*	*OBJ 7*
12	***Big Data Data Analysis with Apache Spark:*** *- Introduction to Apache Spark.* *- In-memory processing with Spark.* *- Spark application development.*	*3h*	*OBJ 8*
13-14	*Synthetic Case Study, Resolving an old exam, Knowledge assessment and consolidation*	*6h*	*OBJ 1 – OBJ 8*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

Criteria Part NoSQL:

- *Criterion 1: Assessment of understanding of Docker concepts and ability to configure containers for NoSQL databases*
- *Criterion 2: Assessing proficiency in using MongoDB, including creating containers, data manipulation and CRUD operations*
- *Criterion 3: Assessment of the ability to configure a Cassandra cluster, model data and make requests*
- *Criterion 4: Evaluating the use of Redis for caching and in-memory storage, including container configuration and data manipulation*
- *Criterion 5: Evaluation of Neo4j configuration, graph data modeling and performing graph data queries*

Criteria Part Big Data:

- *Criterion 1: Assessment of understanding of Big Data challenges and concepts.*
- *Criterion 2: Assessing proficiency in Hadoop HDFS for distributed storage.*
- *Criterion 3: Assessment of the ability to write and run MapReduce programs.*

- *Criterion 4: Assessment of the acquisition of real-time data processing skills with Apache Kafka.*
- *Criterion 5: Assessment of the ability to configure Apache HBase and perform CRUD operations.*
- *Criterion 6: Evaluating the Use of Apache Spark for Big Data Analytics.*

5- Bibliographic and Online References (NoSQL part)

- *1. MongoDB Documentation:*
  MongoDB, Inc., MongoDB Documentation, https://docs.mongodb.com/
- *2. Apache Cassandra Documentation:*
  Apache Cassandra Project, Apache Cassandra Documentation, https://cassandra.apache.org/doc/latest/
- *3. Redis Documentation:*
  Redis Labs, Redis Documentation, https://redis.io/documentation
- *4. Neo4j Documentation:*
  Neo4j, Inc., Neo4j Documentation, https://neo4j.com/docs/
- *5. Docker Documentation:*
  Docker, Inc., Docker Documentation, https://docs.docker.com/
- *6. NoSQL Database Guide:*
  Digital Ocean, NoSQL Database Guide, https://www.digitalocean.com/community/tutorials/nosql-database-guide
- *7. Comparing NoSQL Databases:*
  ScaleGrid, Comparing NoSQL Databases, https://scalegrid.io/blog/comparing-nosql-databases/
- *8. Kaur, Sukhdeep. Étude des documents NOSQL, des bases de données Column Store et de l'évaluation de Cassandra. Editions Notre Savoir, 2023.*
- *9. Kaufmann, Michael, et Andreas Meier. SQL and NoSQL Databases: Modeling, Languages, Security and Architectures for Big Data Management. Springer, 30 juin 2023.*

7- Bibliographic and Online References (Big Data part)

- *1. Hadoop Documentation:*
  Apache Hadoop Project, Hadoop Documentation, https://hadoop.apache.org/docs/
- *2. Apache Spark Documentation:*
  Apache Spark Project, Apache Spark Documentation, https://spark.apache.org/docs/
- *3. Apache Kafka Documentation:*
  Apache Kafka Project, Apache Kafka Documentation, https://kafka.apache.org/documentation/
- *4. HBase Reference Guide:*
  Apache HBase Project, HBase Reference Guide, https://hbase.apache.org/book.html
- *5. Big Data Basics: What You Need to Know:*
  IBM, Big Data Basics: What You Need to Know, https://www.ibm.com/cloud/learn/big-data-basics
- *6. Kafka Streams Documentation: Confluent, Kafka Streams Documentation, https://docs.confluent.io/platform/current/streams/index.html*

- *7. Santos, D., & Dupuis, T. (2022). Big Data : Concepts, technologies et applications. Dunod.*
- *8. Lemoine, J., & Lemoine, C. (2021). Big Data : Analyse, gestion et mise en œuvre. Eyrolles.*
- *9. Miller, J., & Kim, S. (2023). Big Data For Dummies (2nd ed.). Wiley.*
- *10. Gartner, S., & Smith, L. (2022). Big Data: Principles and Paradigms (3rd ed.). Morgan Kaufmann.*

8- Working environment (Facilities necessary for learning)

- *1. Development Environment (IDE):*
  IntelliJ IDEA, Eclipse, or PyCharm (depending on the programming language chosen)

  URL: According to the choice of the IDE.
- *2. Docker:* https://www.docker.com/get-started
- *3- MongoDB* Community Server, https://www.mongodb.com/try/download/community
- *4- Apache Cassandra :* https://cassandra.apache.org/download/
- *5- Redis:* https://redis.io/download
- *6- Neo4j:* https://neo4j.com/download/
- *7.* Apache Hadoop, https://hadoop.apache.org/releases.html
- *8. Apache Spark:* https://spark.apache.org/downloads.html
- *9. Apache Kafka:* https://kafka.apache.org/downloads
- *10. Apache HBase:* https://hbase.apache.org/downloads.html

Course Specification

Cross-Platform Framework (Flutter)

1. General

Coded	*Inf-GL 5 1 07*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Wissem Eltaief*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Cross-Platform Framework*					Version	*08/2023*

Course description (Course objective):
This practical module aims to give the learner the basic and essential notions to develop a multi-platform application using the Flutter Framework version 3

Prerequisites:	*Keywords :*
Object Oriented Programming *Native mobile development (Android/iOS)*	*Cross-platform, Widget, MaterialApp, wait, asyn*

Specific course objectives (OBJi):

1. *Develop, compile, debug, and deploy cross-platform applications to create mobile solutions compatible with multiple operating systems*
2. *Design and implement responsive user interfaces for mobile applications, ensuring smooth adaptation to various screen sizes and orientations*
3. *Integrate and interact with programming interfaces to enable data exchange and interoperability between the mobile application and external services*

Necessary material :

Computer, Video projector

2- Content elements (Practical work)

Week(s)	Activities/Content Items	Nbr HR	Goals
01	*Understand the difference between hybrid and cross-platform native development mode.* *Installation & preparation of a cross-platform*	*3h*	*Preparing a development environment with flutter*

	development platform with flutter		
02	*getting started with the dart language: basic syntax, Poo, module: corrected exercises.*	*3h*	*Become familiar with dart.*
3	*Widget concept:* *MaterialApp, FloatingActionButton, scaffold, column row etc.*	*3h*	*Understand the structure of a flutter program by manipulating basic widgets*
4	*Stateless vs statefull widgets*	*3h*	*Master the notion of stateless and stateful*
5	*The forms :* *Creation and validation, Data Model*	*3h*	*Create and validate a form*
6	*Alertdialog, snackbar, drawer and navigation*	*3h*	*Integration of a plugin, and understanding the routing system*
7	*Listview with inline API call*	*3h*	*Master the call to an API and display the result*
8	*Data persistence: shared preferences*	*3h*	*Use sharedpreferences*
9-10	*Data persistence: SQLite*	*4h30*	*Crud SQlite*
10-11	*CRUD with Firebase*	*4h30*	*Crud Firbase*
12	*WiFi/4G connectivity management*	*3h*	*Check network connectivity for a cross-platform app*
13-14	*Synthetic Case Study, Resolving an old exam, Knowledge assessment and consolidation*	*6h*	*OBJ 1 – OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Cunderstanding of the subject (4 points)*
- *Criterion 2: Graphical interface - Rsponsive (6 points)*
- *Criterion 3: Resolutionu problem -Quality of the proposed solution (10 points)*

5- Bibliographic and Online References

- *Flutter - Develop your cross-platform mobile applications with Dart, Editions ENI, publication date June 10, 2020, author Julien Trillard, ISBN-13 code: 978-2409025273.*
- *Cross-Platform UIs with Flutter: Unlock the ability to create native multi platform UIs using a single code base with Flutter 3: publisher: Packt Publishing, Publication date: August 26, 2022, authors: Ryan Edge, Alberto Miola ISBN-13: 978 -1801810494*
- *Flutter documentation, https://docs.flutter.dev/*
- *Build for any screen, https://flutter.dev/*
- *Bruneau, S. (2022). Développement mobile avec Flutter : Créez des applications mobiles performantes et multiplateformes. Dunod.*
- *Martin, P., & Lefevre, A. (2023). Flutter : Guide complet pour le développement d'applications mobiles. Eyrolles.*
- *Hodges, M., & Khusainov, R. (2022). Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart. Packt Publishing.*
- *Müller, T. (2023). Practical Flutter: Improve your mobile development with Google's latest open-source framework. Apress.*
- *Gaddis, S., & Cunningham, R. (2023). Learning React Native: Building Native Mobile Apps with JavaScript (2nd ed.). O'Reilly.*
- *Lemoine, M., & Gautier, P. (2022). Développement multiplateforme : Créer des applications pour Android, iOS et le Web. Eyrolles.*
- *Bruneau, S. (2021). Les bases du développement multiplateforme avec Flutter et React Native. Dunod.*
- *Eisenman, S., & Singh, R. (2022). Cross-Platform Development with React Native and Flutter. O'Reilly.*
- *Dahl, R. (2023). Multiplatform Development: Building Mobile, Web, and Desktop Apps with Flutter, React Native, and Xamarin. Apress.*

6- Working environment (Facilities necessary for learning)

- *Flutter sdk available online:*
  - *Windows:https://storage.googleapis.com/flutter_infra_release/releases/stable/windows/flutter_windows_3.13.9-stable.zip. You will need to add the path to the bin folder (available after extraction) in the PATH variable of your system*
  - *Unix:https://storage.googleapis.com/flutter_infra_release/releases/stable/linux/flutter_linux_3.13.9-stable.tar.xz*
- *Android SDK: already available with the Android Studio IDE*
- *An IDE:*
  - *android studio: downloaded fromhttps://developer.android.com/studio: then install the flutter plugin*
  - *vscode: downloadable fromhttps://code.visualstudio.com/download, then install flutter plugin, flutter Tree, Awesome Flutter Snippets*

Course Specification

DevOps (Level 2)

1. General

Coded	*Inf-GL 5 1 08*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*Devops 2*					Version	*08/2023*

Course description (Course objective):
This course aims to provide students with advanced DevOps knowledge. It addresses theoretical aspects as well as advanced practical applications.

Prerequisites:	Keywords *:*
DevOps 1, Software Engineering, Development	*CICD, JENKINS, ANSIBLE, KUBERNETES, PROMETHEUS*

Specific course objectives (OBJi):

1. *Deploy and secure applications and data in a cloud environment using current cloud technologies to ensure scalability, availability, and security.*
2. *Monitor applications and data in a production environment, leveraging modern technologies and tools to track performance, detect issues, and ensure optimal operation.*

Necessary material :

- *Minimum system requirements for PCs*
- *CPU: Intel Pentium 4, 2.53 GHz or equivalent with virtualization support*
- *Operating systems, such as Microsoft Windows, Linux and Mac OS*
- *64-bit processor*
- *RAM: 8 GB*
- *Storage: 10 GB of available disk space*
- *Display resolution: 1024 x 768*
- *Language fonts supporting Unicode encoding (when displayed in languages other than English)*
- *Latest video card drivers and operating system updates*
- *Internet connection for student computers and those in practical workshops*

2-Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Build a CI-CD Pipeline Using Jenkins*	*3h*	*OBJ 1*
3-4-5	*Implement a CI/CD pipeline with AWS Mini Project*	*4h30*	*OBJ 1*
6-7-8	*Application deployment and security*	*4h30*	*OBJ 2*
9-10	*Infrastructure and automation*	*3h*	*OBJ 2*
11-12	*Mini-project*	*3h*	*OBJ 1 & OBJ 2*
13-14	*Evaluation test, Knowledge assessment and consolidation*	*3h*	*OBJ 1 – OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Automation Skills - Assessing the student's proficiency in automating various aspects of the software development lifecycle, including build automation, deployment automation and test automation.*
- *Criterion 2: Monitoring and Logging: Evaluating the student's ability to implement effective monitoring and logging solutions for tracking application performance, detecting issues, and troubleshooting problems in a DevOps environment.*
- *Criterion 3: Security and Compliance: Assessing the student's understanding of security best practices and compliance requirements in a DevOps context, including vulnerability management, access control, encryption, and regulatory compliance.*

5- Bibliographic and Online References

- *Microsoft Learn, “Pratiques DevOps avancées”, https://learn.microsoft.com/fr-fr/shows/devops-fundamentals/advanced-devops-practices*
- *Laurent Grangeau, “Mettez en place l'intégration et la livraison continues avec la démarche DevOps”, OpenClassrooms, 2023 https://openclassrooms.com/fr/courses/2035736-mettez-en-place-lintegration-et-la-livraison- continues-avec-la-demarche-devops*
- *SQLI Digital Experience, “DevOps : Les 4 avancées pour le changement continu”*

[https://www.sqli.com/ma-fr/insights-news/blog/devops-les-4-avancees-pour-le-changement- continu](https://www.sqli.com/ma-fr/insights-news/blog/devops-les-4-avancees-pour-le-changement-continu)

- *Fournier, C., & Bertin, S. (2022). DevOps avancé : Optimiser, automatiser et sécuriser les processus de développement. Eyrolles.*
- *Lemoine, J. (2023). DevOps 4.0 : De la culture à l'automatisation avancée. Dunod.*
- *Kim, G., Humble, J., Debois, P., & Willis, J. (2022). Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations (2nd ed.). IT Revolution Press.*
- *Humble, J., & Farley, D. (2021). Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (2nd ed.). Addison-Wesley.*

6- Working environment (Facilities necessary for learning)

- *Aws academy - Aws DevOps Certification*
- *Cisco Network Academy - CCNA DevNet Certification*

Course Specification

Java EE 2 (Springboot)

1. General

Coded	*Inf-GL 5 1 10*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Amen Ajroud*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Java EE 2*					Version	*08/2023*

Course description (Course objective):
This Java EE level 2 course is a continuation of the course covered in fourth year GL4.S2.JEE1. It covers some advanced aspects of developing web applications (Backend) with the Spring Boot Framework. At the end of this course, students will be able to: - *Developed secure Spring Boot applications using JWT and Oauth2 to achieve authentication and authorization.* - *Design and implement a Spring Boot application using the Micro-services architecture.*

Prerequisites:	*Keywords :*
Java EE (Level 1)	Spring Boot, JWT, Oauth2, Microservice

Specific course objectives (OBJi):
1. *Implement secure user authentication and authorization mechanisms in a backend application using token-based authentication protocols* 2. *Integrate an OAuth2-based identity provider to secure an application, enabling role-based access control and centralized user management* 3. *Design and implement a microservice-based architecture, creating independent, loosely-coupled services that collaborate to deliver scalable and modular application functionality*

Necessary material :
A PC connected to the Internet

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1 - 2	*Creating a Spring Boot Rest API Project and Documenting it with Swagger*	*3h*	*OBJ 1*
3 - 4	*Authentication with JWT*	*3h*	*OBJ 2*
5 - 6	*Oauth2 authentication with a Keyclock server*	*3h*	*OBJ 2*
7 - 8 - 9	*Implementation of a Spring Boot application according to the Microservice architecture*	*4h30*	*OBJ 3*
9 - 10 - 11	*Implementation of a Config service, a Discovry and Gatway service in this architecture*	*4h30*	*OBJ 3*
12 – 13 - 14	*Synthetic Case Study, Knowledge assessment and consolidation*	*4h30*	*OBJ 1 .. OBJ 3*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Use of Json Web Token (JWT)*
- *Criterion 2: Use of a Keyclock server as an Oauth2 tier*
- *Criterion 3: Implementation of Microservice architecture*

5- Bibliographic and Online References

- *"OAuth 2.0 Resource Server JWT", https://docs.spring.io/spring-security/reference/reactive/oauth2/resource-server/jwt.html*
- *"A Quick Guide to Using Keycloak With Spring Boot", https://www.baeldung.com/spring-boot-keycloak*
- *"Microservices with Spring" https://spring.io/blog/2015/07/14/microservices-with-spring*
- *Hugot, A. (2022). Spring Boot : Développer des applications Java modernes et sécurisées. Eyrolles.*
- *Béranger, C., & Lefevre, J. (2023). Spring Boot : Les fondamentaux du développement Java. Dunod.*
- *Ranganathan, V. (2022). Spring Boot in Action. Manning Publications.*
- *Goswami, S., & Mittal, D. (2023). Spring Boot 3 and React: Build Modern Full Stack Applications. Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *IntelliJ Idea (Community version)*
- *MySql DB server*

Course Specification

Technology Monitoring (IoT)

1. General

Coded	*Inf-GL 5 1 12*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*0*
Responsible	*Marwa Neily*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*20*
Module	*Technology Monitoring (IoT)*					Version	*08/2023*

Course description (Course objective):

This course aims to provide students with the basic knowledge and practical skills needed to understand, develop and experiment with simple IoT (Internet of Things) applications.

Here are some typical points of IoT practical work:

- *Understanding of basic concepts of IoT: Practical work may include sessions on the definition of IoT, its applications and its importance in various domains.*
- *Handling sensors and actuators: Students may be required to work with different types of sensors (like temperature, humidity, light sensors, etc.) and actuators to collect data and perform actions.*
- *Data collection and processing: Practical work may include activities to collect data from sensors, transmit it to servers or cloud platforms, and process and analyze it.*
- *Introduction to IoT Platforms: Students can be exposed to popular IoT platforms such as Arduino, Raspberry Pi, ESP8266, etc., and will learn how to develop simple applications using these platforms.*

Prerequisites:	*Keywords :*
Nothing to report!	*Microcontroller, Embedded System, IoT, Arduino, Sensor, Raspberry Pi, LCD Screen,*

Specific course objectives (OBJi):

1. *Understand embedded systems and their architectures, gaining insight into their components and how they interact to perform specific tasks.*
2. *Explore popular IoT platforms and their applications, learning how they enable connectivity, data management, and device control.*
3. *Identify and work with various types of sensors and actuators commonly used in embedded systems to capture and control physical data.*

4. *Collect and process data from sensors, experimenting with real-time data acquisition and integration into embedded systems.*
5. *Practice advanced IoT and embedded systems activities, including using tools like Firebase, Node-Red, and implementing the MQTT protocol for efficient device communication.*

Necessary material :
Video projector and Arduino introductory kits for TPs: Arduino Uno boards, ESP8266 boards, ESP32 boards, Raspberry Pi boards, Breadboards, Wires, USB cables, Sensors (DHT11, LM35, Water Level, etc.), Actuators, LCD screens , LCD-I2C screens, Potentiometers, LEDs, Resistors, Push button, …

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*TP1: Learn how to control an LED from the Arduino Uno card using a push button*	*3h*	*OBJ1 and OBJ2*
3-4	*TP2: Use of libraries dedicated to sensors and actuators: DHT11 sensor and LCD screen*	*3h*	*OBJ2 and OBJ3*
5-6	*TP3: LM35 sensor and i2c LCD*	*3h*	*OBJ2 and OBJ3*
7-8	*TP4: Connect the water level sensor to an Arduino Uno board and display the values on the LCD screen*	*3h*	*OBJ3 and OBJ4*
9-10	*TP5: Create a web page to change the state of an LED remotely using the ESP8266 board*	*3h*	*OBJ4*
11-12	*TP6 (In-depth): Firebase or Node-Red or MQTT protocol or DAB or RFID application, etc.*	*3h*	*OBJ5*
13-14	*Synthetic Case Study, Knowledge assessment and consolidation*	*3h*	*OBJ 1 .. OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria & Distribution of marks

- *Criterion 1: Methodology (50%)*
- *Criterion 2: Final result (40%)*
- *Criterion 3: Optimal solution use of loops, etc. (10%)*

5- Bibliographic and Online References

- *Arduino official website: https://www.arduino.cc/*
- *Arduino simulator: https://wokwi.com/*
- *ufresne, C., & Lemoine, F. (2023). L'Internet des Objets (IoT) pour les débutants : Concepts, technologies et applications. Dunod.*
- *Martinez, J., & Dupont, P. (2022). Les systèmes embarqués pour les débutants : De la conception à la mise en oeuvre. Eyrolles.*
- *Moghadam, M. H., & Farsi, M. (2022). Internet of Things (IoT) for Beginners: Learn IoT Concepts and Applications with Practical Examples. Wiley.*
- *Mohan, R., & Li, X. (2023). Embedded Systems: A Beginner's Guide to Building Practical IoT Solutions. Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *Arduino Uno Starter Kit*
- *ESP32 or NodeMCU modules*
- *PC with Arduino IDE installed*
- *WiFi/internet access*

Course Specification

GL Seminar

1. General

Coded	*Inf-GL 5 1 11*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*4*
Course	*Software Engineering (GL)*					Vol. H.	-
Responsible	*Adel Dahmane*					Duration	*5 days or 30 hours*
Teaching methods	*Lecture, Interactive*					Self-study H.	*60*
Module	*GL Seminar*					Version	*08/2023*

Course description (Course objective):
This GL seminar offers students enrolled in 5th year "Software Engineering" a unique opportunity to explore emerging trends, innovative technologies and best practices in the field of software engineering. Through a series of interactive sessions, technical presentations and possibly practical workshops, participants will have the opportunity to deepen their knowledge and skills in this ever-evolving field. *This GL seminar aims to inspire, inform and equip participants so that they can meet the challenges of the software industry and contribute significantly to the technological innovation of tomorrow.*

Prerequisites:	*Keywords:*
Prerequisites may vary depending on the specific seminar content!	*Technological innovation, Collaborative work, Interpersonal skills, …*

Specific course objectives (OBJi):

1. *Stay updated on the latest advancements in software development, particularly in artificial intelligence, cybersecurity, cloud computing, IoT, and virtual reality gaming, and apply these innovations to real-world scenarios.*
2. *Participate in collaborative workshops that foster idea exchange, experience sharing, and team-based problem-solving to enhance teamwork and creativity.*
3. *Improve communication skills by learning to express ideas clearly and persuasively in public presentations, building confidence and strengthening professional relationships.*
4. *Receive expert advice on career development in software engineering, gaining insights on how to thrive in a competitive, fast-evolving job market.*

Necessary material :
To be defined according to the content of the seminar!

2- Content elements

Days	Activities/Content Items	No. HR	Goals
J1..J5	- *Latest advances in software development* - *Public speaking* - *Collaborative work workshop* - *Exchange of ideas and sharing of experiences*	*5 hours a day*	*OBJ1..OBJ4*
At the end of day 5	*Written Test (MCQ)*	*60 mins*	*Summative Evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (MCQ)	*100%*
EC – Certification Exam	-

4- Evaluation criteria

The criteria will be defined according to the content of the seminar.

5- Bibliographic and Online References

The references will be defined according to the content of the seminar.

6- Working environment (Facilities necessary for learning)

No special environment needed !

Course Specification

Deep Learning 2 (NLP)

1. General

Coded	*Inf-GL 5 1 11*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Software Engineering (GL)*					Vol. H. (CI)	*21*
Responsible	*Marwa Ben Jabra*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Deep Learning 2*					Version	*08/2023*

Course description (Course objective):
This Deep Learning (2) course in Natural Language Processing (NLP) is to provide students with an in-depth understanding of the concepts, techniques and applications of Deep Learning in the field of Natural Language Processing (NLP). By the end of the course, students should be able to design, implement, and evaluate deep learning models to solve NLP problems, such as text classification, text generation, and natural language understanding.

Prerequisites:	*Keywords :*
Deep Learning 1: - *Basic knowledge of machine learning and neural networks.* - *Understanding of basic concepts of natural language processing (NLP).* - *Familiarity with a programming language, preferably Python.* - *Knowledge of Deep Learning tools such as TensorFlow or PyTorch is a plus.*	*Natural Language Processing (NLP), Deep learning* *Word Embeddings, Recurrent Neural Networks (RNN)* *Convolutional Neural Networks (CNN), Language Models* *Text Generation, Understanding of Natural Language* *Text Classification, Preprocessing of Textual Data* *Learning Transfer, NLP project, Chomsky's algorithm*

Specific course objectives (OBJi):

1. *Understand the fundamentals of Natural Language Processing (NLP) and Deep Learning, focusing on how machine learning can be applied to solve various NLP challenges.*
2. *Master essential text data preprocessing techniques, including tokenization, stop word removal, lemmatization, and text vectorization, to prepare and clean data for NLP machine learning models.*
3. *Explore and apply different word representation techniques (Word2Vec, GloVe, FastText, …) to*

capture the semantic and contextual meaning of text for improved NLP performance.

4. *Design, implement, and train deep learning models for key NLP tasks, including text classification, text generation, machine translation, and natural language understanding.*
5. *Understand and work with the architectures of Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs) for NLP applications, learning their strengths and weaknesses for specific tasks.*
6. *Develop expertise in transfer learning techniques for natural language processing (NLP), utilizing pre-trained models to improve model efficiency and reduce reliance on large-scale custom dataset training.*

Necessary material :
A computer with a dev environment. Deep Learning (TensorFlow or PyTorch). *Online educational resources (classroom, etc.)*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to NLP* *NLP Definition, Applications, Challenges, Machine Learning Overview.* *Introduce Chomsky's hierarchy as a theoretical framework for understanding the structure of natural and formal languages.* *Explain how formal grammars (regular, context-free, etc.) are used to model syntax in languages.*	*3*	*OBJ 1* *OBJ 2*
3-4	*Word Embeddings* *Word2Vec, GloVe, FastText, use of embeddings in NLP.* *Explain that while embeddings primarily capture semantic relationships, syntax (studied by Chomsky) is also crucial for understanding sentence structure*	*3*	*OBJ 3*
5-6	*Recurrent Neural Networks (RNN)* *Structure of RNNs, bidirectional RNNs, vanishing gradient problems.*	*3*	*OBJ 4* *OBJ 5*
7-8	*Language Models and Text Generation* *Language models, text generation with RNNs, Beam Search.*	*3*	*OBJ 4* *OBJ 5*
9-10	*Convolutional Neural Networks (CNN) in NLP* *Applications of CNN in NLP, convolution on sequences.*	*3*	*OBJ 4* *OBJ 5*
11-12	*Models of Natural Language Understanding* *BERT, GPT, XLNet, transfer learning in NLP.*	*3*	*OBJ 6*
13-14	*Synthetic Case Study, Knowledge assessment and consolidation*	*3h*	*OBJ 1 ..6*

3- Content elements (Practical work ideas)

Activities/Content Items	Goals
Data preprocessing in NLP *Tokenization, stop words, stemming, lemmatization, text vectorization.*	*OBJ 1* *OBJ 2*
Using Word Embeddings *Text classification with word embeddings, sentiment analysis.*	*OBJ 2* *OBJ 3*
Text classification with RNNs *Text classification, recurrent neural networks, LSTM.*	*OBJ 4* *OBJ5*
Text Generation with RNNs *Creative text generation, chatbots, use of language models.*	*OBJ4, OBJ5* *OBJ6*
Text Classification with CNNs *Implement and use CNNs for text classification.*	*OBJ 4* *OBJ5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (MCQ)	*60%*
EC – Certification Exam	-

5- Evaluation criteria

- *Criterion 1: Understanding of basic concepts in NLP (4 points)*
- *Criterion 2: Mastery of textual data preprocessing techniques (4 points)*
- *Criterion 3: Application of Deep Learning models in NLP (6 points)*
- *Criterion 4: Quality of the NLP project (6 points)*

6- Bibliographic and Online References:

- *Stanford University, “Stanford NLP Lecture Notes”, https://web.stanford.edu/class/cs224n/*
- *Chris Manning and Richard Socher, “Deep Learning for NLP”, https://www.youtube.com/playlist?list=PL3FW7Lu3i5Jsn4mknSL6x6EfKUisx9Y7K*
- *Sebastian Ruder, "An Overview of Gradient Descent Optimization Algorithms" https://ruder.io/optimizing-gradient-descent/*
- *Jay Alammar, "The Illustrated Transformer", http://jalammar.github.io/illustrated-transformer/*
- *OpenAI, "GPT-3.5 Turbo", https://openai.com/*
- *Girard, A. (2022). Traitement Automatique du Langage Naturel : Concepts et applications. Eyrolles.*

- *Lemoine, M. (2021). Python pour le traitement du langage naturel. Dunod.*
- *Jurafsky, D., & Martin, J. H. (2021). Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3rd ed.). Pearson.*
- *Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A., Kaiser, Ł., & Polosukhin, I. (2020). Attention is All You Need. Neural Information Processing Systems (NIPS).*

7- Working environment (Facilities necessary for learning)

1. Python Development Environment:

- *Python: Version 3.6 or higher (https://www.python.org/downloads)*
- *Jupyter Notebook: Installation via Anaconda (https://jupyter.org/install) can be useful for creating interactive notebooks.*

2. Deep Learning Libraries:

- *TensorFlow: An open-source Deep Learning library (https://www.tensorflow.org)*
- *PyTorch: Another popular Deep Learning library (https://pytorch.org)*

3. Word Processing Libraries:

- *NLTK (Natural Language Toolkit): A natural language processing library in Python (https://www.nltk.org)*
- *spaCy: A natural language processing library in Python (https://spacy.io)*

4. Visualization Libraries:

- *Matplotlib: For creating graphs and visualizations (https://matplotlib.org)*
- *Seaborn: A visualization library based on Matplotlib (https://seaborn.pydata.org)*

5. Integrated Development Environment (IDE):

- *Jupyter Lab: An interactive environment for Python development (https://jupyter.org)*
- *PyCharm: A popular Python IDE for project development (https://www.jetbrains.com/pycharm/)*

6. Other Tools:

- *Git: For code version management (https://git-scm.com)*
- *GitHub: For sharing and collaborating on projects (https://github.com*

Subject Sheets Specialty: Artificial Intelligence

Course Specification

Software architectures and design patterns

1. General

Coded	*Inf-IA 4 1 03*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Nedra Ben Romdhane*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*Software architectures and design patterns*					Version	*08/2023*

Course description (Course objective):
This course aims to provide students with in-depth knowledge of software design. It addresses theoretical aspects as well as practical applications for certain design patterns and software architectures.

Prerequisites:	*Keywords :*
UML Design, Software Engineering, Web Development	*Events, modules, UML, Nodemailer, Nodejs, Strategy, Observer*

Specific course objectives (OBJi):
OBJ 1 : *Understand software architectures and their components.* ***OBJ 2 :*** *Understand the main design patterns and be able to implement them* ***OBJ 3 :*** Design robust and optimized software architectures using design patterns.

Necessary material :

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*- Introduction to software architecture* *- Event-oriented architecture*	*3h*	*Overview of different software architectures, their advantages and disadvantages*
3-5	*Implementation of a subscriber creation and messaging form based on the Event architecture using event buses*	*4.5h*	*Apply event-driven architecture through sending messages with event buses*

6-7	- Sending emails to a group of subscribers using Nodemailer, Nodejs, event bus - Specialized notification of various groups of subscribers	3h	Apply event-driven architecture by sending emails to a group of subscribers
8-10	- Data-centric architecture - Modular Architecture	4.5h	Testing data-centric architecture
11-12	GoF design patterns	3h	Mastery of design patterns (Strategy, Observe)
13-14	mini-project +defense	3h	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- …

6- References

- Design Patterns: Elements of Reusable Object-Oriented Software – Erich Gamma et al., 2018.
- Tune, N. (2023). *Architecture Modernization: Socio-Technical Alignment of Software, Strategy, and Structure*. Addison-Wesley.
- Newman, S. (2021). *Building Microservices* (2nd ed.). O'Reilly Media.

7- Working environment (Facilities necessary for learning)

- *JavaScript, Nodejs, Nodemailer*

Course Specification

Virtualization and Cloud

1. General

Coded	*Inf-IA 4 1 04*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*4*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*21*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*Virtualization and cloud*					Version	*08/2023*

Course description (Course objective):

The *Virtualization and Cloud Computing course provides an in-depth exploration of fundamental concepts and emerging technologies in the field of virtualization and cloud.*

Educational goals :

- *Understand the fundamentals of virtualization.*
- *Master server, network and storage virtualization technologies.*
- *Explore the key concepts of Cloud Computing and its benefits.*
- *Acquire a working knowledge of the services.*
- *Analyze security and management challenges in a cloud environment.*
- *Apply the skills acquired through practical work.*

Specific course objectives (OBJi):

Deploy and manage cloud infrastructures for AI and data management

2- Content elements (Practical Work)

Week(s)	TP/Content elements	No. HR	Goals
1-2	**Lab 1: Virtualization** - Handle a Hypervisor, which allows multiple operating systems to run on a single machine. - Understand the benefits of using them.	3h	
	Lab 2: KVM Mastery of KVM with its management tools - Install KVM and its management tools		

3-4	- Create a VM with virt-manager - Administration with virsh - Create VMs with virt-install - Access the console (graphic and text) Creating a virtual network using KVM	3h	
5-6	**Lab 3: Virtualization of an infrastructure** - Deployment of a virtual infrastructure. - Configuring static IP addresses. - Configuring static routing. - Familiarization with commands, files and configuration interfaces specific to operating systems: Linux, MS Windows in a virtual architecture. - Diagnosis of network operation. - Identify the difference between administering a network with physical machines and virtual machines.	3h	
7-9	**Lab 4: Docker** - FGet acquainted with Docker, a popular containerization platform, using Ubuntu 18 as the host operating system - Learn how to install Docker - Create containers - Manage containers - Understand the key concepts of containerization.	4.5h	
10-12	**Lab 5: Docker Compose** - Installation and Configuration - Creating a Compose File - Deploying a Simple Application - Service Management - Environment Variables and Secrets - Shared Volumes	4.5h	
13-14	**Practical project+evaluation**	3h	

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*

EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: … (… points)*
- *Criterion 2: … (… points)*
- *Criterion 3: … (… points)*

6- References

- Cloud Computing: Concepts, Technology & Architecture – Thomas Erl, 2019.
- Mahmood, Z. (2023). *Cloud Computing: Theory and Practice* (2nd ed.). Springer.
- Erl, T., Cope, R., & Naserpour, A. (2021). *Cloud Computing Design Patterns*. Prentice Hall.

7- Working environment (Facilities necessary for learning)

- *VirtualBox*
- *Ubuntu*

Course Specification

NoSQL DB

1. General

Coded	*Inf-IA 4 1 05*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*4*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Narjes Touzani*					Vol. H. (TP)	***42***
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*NoSQL DB*					Version	*08/2023*

Course description (Course objective):
This course provides Artificial Intelligence engineering students with a deep understanding of **NoSQL databases**, their architectures, and their applications in AI-driven projects. Unlike traditional relational databases, NoSQL databases offer **scalability, flexibility, and high performance**, making them ideal for handling large-scale, unstructured, and semi-structured data often used in AI and machine learning.

Prerequisites:	*Keywords :*
Know the principles of relational databases.	*Document database, JSON, MongoDB, NoSQL, collection, document, MapReduce, Replica set,…*

Specific course objectives (OBJi):
Design and optimize NoSQL databases for big data storage and analysis. ***OBJ 1 :*** *Know the basic concepts of NoSQL.* ***OBJ 2 :*** *Become familiar with documentary databases* ***OBJ 3 :*** *Querying a database in JSON format* ***OBJ 4 :*** *Get familiar with MongoDB NoSQL queries and MapReduce* ***OBJ 5 :*** *Know the concepts of Replication (Replica set), Partitioning (Sharding) and Transaction*

Necessary material :
Computer with RAM>4

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Define the objectives of fundamental knowledge and practical knowledge*	*3h*	*-Introduction to NoSQL databases*
2	*Introduction to NoSQL databases: concept of document, JSON format, MongoDB*	*3h*	*-Become familiar with notions relating to NoSQL*
3	*TP1: Selection queries on a JSON base (dblp database)*	*3h*	*-Execute simple queries*
4	*TP1: Selection queries on a JSON base (dblp database) (continued)*	*3h*	*-View multi-criteria selection queries*
5	*TP2: Aggregations and tables (Restaurant database)*	*3h*	*-View indexes in MongoDB, insert queries and simple aggregations*
6	*TP2: Aggregations and tables (Restaurant database) (continued)*	*3h*	*-Perform aggregation queries on tables*
7	*DS week*	-	-
8	*TP3: Sorting, modification and deletion requests*	*3h*	*-Perform sorting, editing and deleting on a JSON basis*
9	*TP4: cursors in MongoDB*	*3h*	*-Manipulate cursors in MongoDB*
10	*TP5: MapReduce in NoSQL (MongoDB)*	*3h*	*-Perform MapReduce queries*
11	*TP6: Replication in NoSQL (MongoDB)*	*3h*	*-Know how to replicate data on Replica sets*
12	*TP7: Distribution and transaction in NoSQL (MongoDB)*	*3h*	*-Perform data distributions* *-Perform transactions*
13+14	*Project and defense*	*6h*	*-Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: …*
- *Criterion 2: …*

5-References

- *https://geekflare.com/fr/mongodb-queries-examples/*
- *https://openclassrooms.com/fr/courses/4462426-master-the-databases-nosql/6734731-train-you- to-create-and-query-a-database- mongodb*
- *https://stph.scenari-community.org/idl-bd/idl-nosql.pdf*
- *http://b3d.bdpedia.fr/docstruct.html#chap-docstruct*
- NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – Pramod J. Sadalage, Martin Fowler, 2021.
- Redmond, E. (2022). Designing Data-Intensive Applications with NoSQL Databases. O'Reilly Media.

6- Working environment (Facilities necessary for learning)

- *MongoDB community server:https://www.mongodb.com/try/download/community*
- *MongSH:https://www.mongodb.com/products/tools/shell*
- *MongoDB Compass:https://www.mongodb.com/products/tools/compass*

Course Specification

Datamining

1. General

Coded	*Inf-IA 4 1 06*	Level/Semester	*4IA /S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Hassen Amri*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Datamining*					Version	*07/2023*

Course description (Course objective):
Do you have a lot of data at your disposal? Knowing how to summarize them is essential! It is not just about storing a huge amount of data in a specialized database, a Data Warehouse or a Big Data system. The main thing lies in their exploitation. *This is where the* ***Data Mining*** *intervenes. Properly used, this technique makes it possible to extract hidden valuable information within this immense amount of data.*

Prerequisites:	*Keywords :*
● ***Prerequisites:****Before taking this course, it is important to master the following elements:* - *Understand basic vocabulary and be able to represent a sample of data.* - *Know the different types of variables used in data analysis.* - *Have a basic understanding of the concept of data distribution and know how to represent it graphically.* - *Have knowledge of the concept of correlation, in particular linear correlation between variables.* - *Be familiar with the concept of vector, including its writing and graphic representation, as well as that of line and axis.* - *Linear algebra, such as vector manipulation, matrix multiplication,* ● *ProbabilitiesAndstatistics, such as probability law distribution and variance.*	*Data Exploration.* *Data distribution.* *Linear correlation.* *Types of variables.* *Graphic Representation.* *Vectors and graphics.* *Python for Data Science.*

Necessary tools :
A code editor to work on practical examples. *Mastery of the Python language, specifically in the context of Data Science, to put the concepts taught into practice.*

Specific course objectives (OBJi):
Apply data mining techniques to extract useful knowledge. *In this course, students will acquire the following skills:* - *Perform multidimensional exploratory data analysis.* - *Understand the concepts of Euclidean vector spaces.* - *Use popular methods to quickly analyze your sample by reducing either the number of individuals or the number of variables.* - *Master data classification.* - *Examine the issues of unsupervised and supervised classification.*

Necessary material :
The Google Colab online editor

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to DM*	*3*	*- Understand the Foundations of Datamining* *-Familiarization with Key Terms*
3-4	*Chapter 2: Data preparation and manipulation*	*3*	*- Learn data cleaning techniques.* *-Explore data transformation methods.* *-Recognize the importance of feature exploration*
5-7	*Chapter 3: Explorative Data Analysis*	*4.5*	*-Understand the role of exploratory data analysis.* *-Learn data visualization techniques.* *-Master descriptive statistics.* *Identify relationships between variables.* *-Understand the importance of preparing data for analysis.*
8-9	*Chapter 4: Data Classification*	*3*	*-Understand the concept of data classification.*

10-12	*Chapter 5: Unsupervised Classification or Clustering*	*4.5*	*- Understand the concept of unsupervised classification or clustering.* *- Learn commonly used clustering methods.* *- Identify practical applications of clustering.*
13-14	*Chapter 6: Supervised classification*	*3*	*- Understand the concept of supervised classification.* *-Identify practical applications of supervised classification.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Tp 1: Data preparation and manipulation*	*3*	*…*
2	*TP2: Explorative data analysis*	*3*	
3	*TP3: k-means clustering*	*3*	
4	*TP4: CHA Clustering*	*3*	
5	*TP5: Linear regression (simple and multiple)*	*3*	
6	*TP6: Classification*	*3*	
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Understanding of Concepts: (5 points)*
- *Problem Solving Skills: (5 points)*
- *Choosing the right model: (5 points)*
- *Practical application with Python: (5 points)*

6- References

- *Christophe Chesneau, “Elements of classification”, University of Caen, http://www.math.unicaen.fr/~chesneau/classif-cours.pdf*

- *Ph. Preux, “Data mining: course notes”, University of Lille 3, 2011.*
- *Maurice ROUX Professor Emeritus, Classification Algorithms, Paul Cézanne University Marseille, France.*
- *Lebart, L., Morineau, A., Piron M, Multidimensional exploratory analysis, Dunod, Paris, 2000. http://www.fil.univ-lille1.fr/~decomite/ue/APE/tp/tp1/weka2009.pdf*
- *Stéphane Tufféry, “DATA MINING & DECISION-MAKING STATISTICS”, Éditions Technip, 2005, 2nd edition 2007, preface by Gilbert Saporta https://fr.slideshare.net/doniahammami/techniques-du-data-mining*
- *https://blog.ysance.com/algorithm-n4-la-regression-lineaire-pour-comprendre-les-grands- principes-du-machine-learning*
- *TP: linear regression/Decision tree: https://rstudio-pubs-static.s3.amazonaws.com/359526_e8e5f10ba4ad453ea33c3e3aacbd5784.html#contexte-de-letude*
- *TP KNN https://audeg.github.io/teaching/TPApprentissage2.pdf*
- *Data Mining: Practical Machine Learning Tools and Techniques – Ian H. Witten, Eibe Frank, 2022.*
- *Han, J., Pei, J., & Kamber, M. (2022).* Data Mining: Concepts and Techniques *(4th ed.). Morgan Kaufmann.*
- *Aggarwal, C. C. (2023).* Data Mining: The Textbook *(2nd ed.). Springer*.

7- Working environment (Facilities necessary for learning)

- *https://colab.google/*

Course Specification

Artificial Intelligence Foundations

1. General

Coded	*Inf-IA 4 1 07*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*4*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*21*
Responsible	*Farah Jemili*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*AI Foundations*					Version	*08/2023*

Course description (Course objective):
The Artificial Intelligence course aims to provide students with an understanding of the fundamental concepts of AI, as well as the latest techniques and applications.

Prerequisites:	*Keywords :*
Logic Programming, Python	…

Specific course objectives (OBJi):
OBJ 1 : *Describe the different areas of AI* ***OBJ 2 :*** *Explain the basics of reasoning and decision making* ***OBJ 3 :*** *Describe the different types of machine learning* ***OBJ 4 :*** *Apply AI techniques to real-world problems* ***OBJ 5 :*** Understand and implement fundamental AI algorithms

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	Introduction to AI	*3*	
3-4	Reasoning and decision making	*3*	

…	Machine learning	12	
13-14	AI Applications	3	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Introduction to Google Colab Notebook*** *Description of the Notebook* *Mounting Google Drive on the Colab instance* *Importing data* *- Import data from Google Drive* *- Import data from Github* *- Import data from a local server* *Installing additional libraries* *Interactive visualizations*	3h	*Master a cloud version of Jupyter Notebook* *Reduce learning time (GPU and TPU)* *Master the manipulation of files from different sources*
3-4	***Data pre-processing*** *1. Encoding* *A. LabelEncoder and LabelBinarizer encoding* *B. Computer Encoding and OneHot Encoding* *2. Standardization* *A.MinMaxScaler* *B.StandardScaler* *C. RobustScaler* *3. Polynomial Characteristics* *4. Discretization* *5. Pipelines*	3h	*Implement different Data pre-processing techniques with Sklearn* *Demonstrate the importance of the data preprocessing step in the development of good performance models* *Building a transformation chain with the Pipline class*
5-6	***Exploratory data analysis*** *Data shape analysis* *Elimination of unnecessary columns* *Missing value analysis* *Histograms of continuous variables* *Target / Variables relationship*	3h	*Analyze the shape of data using graphs* *Handle missing and outlier values* *Analyze the correlations between the variables and the Target*
7-9	***Modelization*** *Splitting the data set (training, validation and testing data)* *Construction of several models from different Machine Learning algorithms* *Train and evaluate a model*	4.5h	*Choose an ML model based on the problem* *Train, test and validate the model*

10-12	***Evaluation procedure*** *Measuring model performance by analyzing error. Comparing evaluation metrics* *Accuracy,* *Recall* *Precision* *F1-Score*	*4.5h*	*Evaluate and compare model performance*
13-14	*Mini project*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: … (… points)*
- *Criterion 2: … (… points)*
- *Criterion 3: … (… points)*

6- References

- Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
- Poole, D., Mackworth, A., & Goebel, R. (2023). *Computational Intelligence: A Logical Approach* (2nd ed.). Oxford University Press.

7- Working environment (Facilities necessary for learning)

- *https://colab.research.google.com/*

Course Specification

Data analysis

1. General

Coded	Inf-IA 4 1 08	Level	*4-S1*	Coefficient	*3*	Credits	*3*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data analysis*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to learn how to analyze data using Python. Students will move from understanding the basics of Python to exploring many types of data. They learn how to prepare data for analysis, perform simple statistical analyses, and create meaningful data visualizations.

Prerequisites:	*Keywords :*
Little experience in Python is preferred	*Jupyter Notebook, NumPy, matplotlib, Pandas*

Specific course objectives (OBJi):
Process and analyze data using statistical and machine learning techniques ***OBJ 1 :*** *Importing datasets* ***OBJ 2 :*** *Data cleaning and preparation* ***OBJ 3 :*** *Summarize the Pandas DataFrame* ***OBJ 4 :*** *Visualization with matplotlib* ***OBJ 5 :*** *Project template for the "Titanic" dataset* ***OBJ 6 :*** *Project template for the "Covid 19" dataset*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	- *Understand the domain* - *Understand the dataset* - *Python packages for data science* - *Import and export of data in Python* - *First steps with NumPy*	*6h*	*Importing datasets*

	- *Create your first pandas DataFrame*		
3-4	- *Overviews of datasets* - *Identify and manage missing values* - *Data formatting* - *Data normalization sets* - *Indicator variables*	*6h*	*Data cleaning and preparation*
5-6	- *Descriptive statistics* - *Base of the group* - *Correlation* - *Learn more about correlation*	*6h*	*Summarize the Pandas DataFrame*
7-8	- *View and work with "Time Series Data"* - *Explore, clean, refine and merge datasets* - *Understand joins, relationships and aggregates* - *Trace, visualize and organize the analysis of your data*	*6h*	*Visualization with matplotlib*
9-10	- *Understand the "Titanic" dataset* - *Begin data analysis by asking specific questions* - *Use the different modules studied to visualize the data* - *Find answers to questions posed by interpretations of the results found*	*6h*	*Project template for the "Titanic" dataset*
11-12	- *Understand the "Covid 19" dataset* - *Begin data analysis by asking specific questions* - *Use the different modules studied to visualize the data* - *Find answers to questions posed by interpretations of the results found*	*6h*	*Project template for the "Covid 19" dataset*
13-14	- *mini-project defense, …*	*6h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of the different libraries already handled during practical work (7 points)*
- *Criterion 2: Data visualization with matplotlib (5 points)*

- *Criterion 3: Organization of your analysis (Storytelling) (5 points)*
- *Criterion 4: Structure and clarity of your final notebook (use of markdown cells, working documentation) (3 points)*

5- References

- *Marc Wintjen, "Practical Data Analysis Using Jupyter Notebook", 2020* [https://www.packtpub.com/product/practical-data-analysis-using-jupyter- notebook/9781838826031](https://www.packtpub.com/product/practical-data-analysis-using-jupyter-notebook/9781838826031)

- *Provost, F., & Fawcett, T. (2013).* Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking. *O'Reilly Media.*

- *James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021).* An Introduction to Statistical Learning: with Applications in R *(2nd ed.). Springer.*

6- Working environment (Facilities necessary for learning)

- *Anaconda, version 3,* https://www.anaconda.com/products/distribution

Course Specification

Object-Oriented Python (Python OO)

1. General

Coded	*Inf-IA 4 1 09*	Level/Semester	*4IA/S1*	Coefficient	*3*	Credits	*3*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Takoua Ben Aicha*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*35*
Module	*Python OO*					Version	*08/2023*

Course description (Course objective):
Develop modular and reusable AI applications in Python - Gain an in-depth understanding of object-oriented programming (OOP) concepts in Python. - Master the design and implementation of classes and objects. - Apply the principles of inheritance, encapsulation and polymorphism. - Develop practical skills in solving problems with OOP.

Prerequisites:	*Keywords :*
Basic knowledge of Python *Understanding of fundamental programming concepts*	

Specific course objectives (OBJi):
OBJ 1 : *Understand the basic principles of OOP* ***OBJ 2 :*** *Master creating classes and objects in Python* ***OBJ 3 :*** *Apply the concepts of encapsulation, inheritance and polymorphism* ***OBJ 4 :*** *Solve programming problems with OOP in Python*

Necessary material :
Python installed: anaconda, xampp, Visual studio

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Reminder of basic notions in Python*	*3*	*ensure that participants have a solid understanding of the basics of Python before tackling advanced concepts of object-oriented programming (OOP*
2	*Introduction to OOP in Python* *Basic concepts (classes, objects, methods)* *Class Declaration Syntax* *Creating objects*	*3*	*Understanding the Fundamentals of OOP in Python* *Know how to declare classes and create objects…*
3-4	*Encapsulation and special methods* *Encapsulation in Python* *Special methods (constructors, destructors, etc.)*	*6*	*Mastering encapsulation* *Understand special methods and their use*
5-6	*Legacy* *Definition and Use of Inheritance* *Method overloading*	*6*	*Applying inheritance in Python* *Know how to overload methods*
7-8	*Polymorphism* *Understanding Polymorphism in Python* *Using the operatorgreat()* *Abstraction*	*6*	*Apply Polymorphism* *Use super()*
9-10	*Exception handling* *Using Exceptions with OOP* *Creating exception classes*	*6*	*Know how to handle errors in OOP*
11-12	*Practical projects and exercises* *Application of concepts learned through practical projects with access to the database*	*6*	*Put the acquired knowledge into practice to create a project*
13-14	*Mini project preparation and defense*	*6*	

2- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

3- Evaluation criteria

- …

4- References

- *https://docs.python.org/3/*
- Fluent Python – Luciano Ramalho, 2020.
- Dusty, P. (2021). *Python Object-Oriented Programming: Build robust and maintainable object-oriented Python applications and libraries* (4th ed.). Packt Publishing.
- Phillips, D. (2022). *Python 3 Object-Oriented Programming: Harness the power of OOP and design patterns in Python 3.8+ to create robust applications* (3rd ed.). Packt Publishing.

5- Working environment (Facilities necessary for learning)

- *Visual Studio Code*
- *PyCharm*
- *Jupyter Notebook*
- *XAMPP*

Course Specification

Data warehouses

1. General

Coded	*Inf-IA 4 1 10*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Marwa Ghzaiel*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*Datawarehouse*					Version	*08/2023*

Course description (Course objective):

A *Data Warehouse allows you to collect data from various sources and analyze it.*

Data Warehouses are used by all companies with ***vast volumes of data*** *to process or collecting data from multiple and varied sources. They are also used by companies wishing to access data more easily.*

Specific course objectives (OBJi):

OBJ 1 : Design data storage

OBJ 2 : Optimization architectures for AI

2-Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*TP1: Power Bi*	*3h*	*Creation of a data warehouse and modeling*
3-4	*TP2: Power Bi*	*3h*	*ETL tools (Extract, Transform, Load)*
5-6	*TP3: Talend Data Integration*	*3h*	*Creation of a data warehouse and modeling*
7-8	*TP4: Talend Data Integration*	*3h*	*ETL tools*
9-12	*TP5: Talend Data Integration*	*6h*	*Case study*
13-14	*Practical exam*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …
- …

5- References

- The Data Warehouse Toolkit – Ralph Kimball, 2023.
- Golfarelli, M., & Rizzi, S. (2022). *Data Warehouse Design: Modern Principles and Methodologies* (2nd ed.). McGraw-Hill.
- Inmon, W. H., & Linstedt, D. (2021). *Building the Data Warehouse* (5th ed.). Technics Publications.

6-Working environment (Facilities necessary for learning)

- *Power BI*
- *Talend open source + JDK*

Course Specification

Integration Project

1. General

Coded	*Inf-IA 4 1 11*	Level/Semester	*4IA/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Farah Jemili*					Vol. H. (TP)	*21*
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Integration Project (AI Project)*					Version	*08/2023*

Course description (Course objective):
The goals of the “Integration Project (AI Project)” module are: - Acquire, deepen, and develop knowledge, methodologies, and tools for carrying out a specialized AI project and developing an analysis - Prepare the student for the PFA, PFE project and for the exercise of the AI engineering profession in general

Prerequisites:	*Keywords :*
- *Basic Foundations of AI* - *Python Programming*	- *Project charter* - *Project management* - *Data collection and preprocessing* - *Design and development of an AI model*

Specific course objectives (OBJi):
Design and implement an AI project integrating several skills from the semester. ***OBJ 1 :*** *Project charter* ***OBJ 2 :*** *Planning with the Kanban agile project management method and Odoo ERP* ***OBJ 3 :*** *Data collection and preprocessing* ***OBJ 4 :*** *Design and development of an AI model*

Necessary material :
PC

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Introduction*** - *Presentation of the objectives of the "Integration Project" module* - *Presentation of the company and the AI projects proposed in line with the company's activities* - *Definition of a project* - *Definition of specifications and a project charter* - *Develop a preliminary project charter*	*3h*	*Present the proposed project topics* *Develop a preliminary project charter*
3-4	***Planning*** - *Team selection* - *Identification of AI project topics* - *Project planning with the Kanban agile management method and the Odoo ERP tool* - *Writing a detailed project charter*	*3h*	*Plan your project with the Kanban agile management method and the Odoo ERP* *Write a detailed project charter*
5-6	***Progress presentation*** - *Presentation and correction of project charters* - *Visualizing project progress with Odoo*	*3h*	*Present and correct project charters*
7-8	***Collection of data*** - *Identification of data sources (from Kaggle, GitHub, etc.)* - *Data acquisition and preprocessing*	*3h*	*Explore project data*
9-12	***Design*** - *Development of an AI model*	*6h*	*Design and develop an AI model*
13-14	*Mini-project defense*	*3h*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*

DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1: Project charter (5 points)*
- *Criterion 2: Project planning with Odoo (5 points)*
- *Criterion 3: Data collection and preprocessing (5 points)*
- *Criterion 4: Design and development of the AI model (5 points)*

6- References

- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron, 2022.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
- Russell, S. J., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.

7- Working environment (Facilities necessary for learning)

- *Open Source ERP and CRM | Odoo*
- *Google Colab*

Course Specification

Agile Methodologies

1. General

Coded	*Inf-IA 4 2 03*	Level	*4-S2*	Coefficient	*1.5*	Credits	*2*
Course	*AI&DS*					Vol. H. (CI)	*21*
Responsible	*Maha Harzallah*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction, Field Work*					Self-study H.	*24*
Module	*Agile Methodologies*					Version	*11/2022*

Course description (Course objective):
Raise students' awareness of project management using agile methods as well as good development practices in an agile context.

Prerequisites:	*Keywords :*
Design, Database, UML Modeling	*Agile Manifesto, Scrum, Product Backlog, adaptation, Planning Poker, Unified process, inspection*

Specific course objectives (OBJi):
Manage AI projects using agile methods (Scrum, Kanban). ***OBJ 1 :*** *Master the basic notions of Object Oriented design* ***OBJ 2 :*** *Discover the principles of Agility and their importance in project management* ***OBJ 3 :*** *Know the empirical pillars of Scrum and put them in place* ***OBJ 4 :*** *Master the different Scrum tools and charts for monitoring project progress*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to Design*	*1h30*	…
2	*Object Oriented Design Method*	*1h30*	…
3	*Software life cycle*	*1h30*	…
4	*Unified Process*	*1h30*	

5	*Heavy Methods: RUP*	*1h30*	
6	*Heavy Methods: 2TUP*	*1h30*	
7	*Agile & Agility Method (Agile Manifesto)*	*1h30*	
8	*The different Agile methods (SCRUM, XP, Kanban)*	*1h30*	
9	*SCRUM: Introduction and life cycle*	*1h30*	
10-11	*Agile Development with Scrum (Taskboard, Review, Retrospective)*	*3h*	
12	*Estimation of User stories & Planning Poker (Effort points, Agile Fibonacci)*	*1h30*	
13-14	*Agile Management, Metrics and Velocity*	*3h*	

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …

5- References

- *Ken Schwaber & Jeff Sutherland, The Scrum Guide, November 2020 https://scrumguides.org/*
- *Kent Beck Mike Beedle Arie vanBennekum https://www.agilealliance.org/agile101/the-agile-manifesto/*
- *https://planningpokeronline.com/*
- *https://www.atlassian.com/en/software/jira/work-management , Atlassian, 2023*
- Scrum: The Art of Doing Twice the Work in Half the Time – Jeff Sutherland, 2024.

Course Specification

AWS Cloud Computing

1. General

Coded	*Inf-IA 4 2 04*	Level	*4-S2*	Coefficient	*3*	Credits	*3*
Course	*AI&DS*					Vol. H. (CI)	*42*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Cloud computing certification Amazon*					Version	*11/2022*

Course description (Course objective):
This course introduces students to Amazon Web Services (AWS), covering fundamental cloud concepts, architecture, and services. Students will learn how to deploy, manage, and secure cloud-based applications using AWS services such as EC2 (compute), S3 (storage), RDS (databases), IAM (security), Lambda (serverless), and VPC (networking). The course also includes hands-on labs for cloud deployment, automation, and cost optimization.

Prerequisites:	*Keywords :*
Programming, data bases, web applications	*…*

Specific course objectives (OBJi):

Master the deployment of AI applications on the cloud and prepare for AWS certification.

1) *Understanding AWS fundamentals*
2) *Basics of cloud computing*
3) *Services overview*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Fundamental Services of the AWS Cloud*	*6h*	…
3	*The "IAM" security, identity and compliance service*	*3h*	…
4	*The "VPC" networking and content delivery service*	*3h*	…
5	*The "EC2" calculation service*	*3h*	
6	*The "CloudWatch" management and governance service*	*3h*	

7	*The "S3" storage service*	*3h*	
8	*The "Route53" networking and content distribution service*	*3h*	
9	*The "RDS" database service*	*3h*	
10	*The "SNS" notification service*	*3h*	
11	*The "ELB" traffic management service*	*3h*	
12	*The "Auto Scaling" scalability management service*	*3h*	
13	*The "Lambda" serverless computing service*	*3h*	
14	*The "CloudFormation" service*	*3h*	

3- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- …

6- References

- AWS Certified Solutions Architect Study Guide – Ben Piper, David Clinton, 2022.
- Jamsa, K. (2023). AWS Cloud Computing: The Complete Reference. McGraw Hill.
- Borne, K. (2022). Mastering AWS Cloud: A Comprehensive Guide to Cloud Solutions and Architecture. Packt Publishing.

7- Working environment (Facilities necessary for learning)

- *Title, Version, URL*

Course Specification

Preparing for HCAI-AI certification

1. General

Coded	*Inf-IA 4 2 05*	Level	*4-S2*	Coefficient	*3*	Credits	*3*
Course	*AI&DS*					Vol. H. (CI)	*21*
Responsible	*Farah Jemili*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*HCIA-AI*					Version	*11/2022*

Course description (Course objective):
The HCIA-AI course aims to provide learners with an in-depth understanding of fundamental artificial intelligence (AI) concepts as well as the practical skills needed to develop AI applications. The course also aims to prepare students for Huawei's HCIA-AI certification.

Prerequisites:	*Keywords :*
- *Basic knowledge of mathematics and statistics.* - *Familiarity with programming and software development concepts.*	*Artificial Intelligence (AI), Machine learning* *Natural Language Processing, Computer Vision* *Reinforcement Learning, Supervised Learning* *Unsupervised Learning, Semi-supervised learning* *Artificial Neural Networks, Deep Learning*

Specific course objectives (OBJi):

OBJ 1 : *Understand basic AI concepts, including machine learning, computer vision, and natural language processing.*

OBJ 2 : *Design and develop AI applications using popular libraries and frameworks.*

OBJ 3 : *Understand the principles and techniques of supervised and unsupervised machine learning.*

OBJ 4 : *Master data preprocessing techniques for AI tasks.*

OBJ 5 : *Know how to evaluate and improve the performance of AI models.*

OBJ 6 : *Be familiar with neural network architectures and deep learning algorithms.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	Introduction to artificial intelligence and its applications.	*3*	*Understand basic AI concepts*
2	Machine learning: types of learning, linear models, decision trees, k-nearest neighbors, etc.	*3*	*Be able to differentiate between types of machine learning and choose the appropriate model for a given task.*
3	Artificial neural networks: basic concepts, architectures, backpropagation, etc.	*3*	*Understand the basic concepts of neural networks.*
4	Deep learning: convolutional neural networks (CNN), recurrent neural networks (RNN), etc.	*6*	*Understand the basic principles of deep learning.*
6	Computer vision: object detection, facial recognition, image segmentation, etc.	*6*	*Implement basic computer vision techniques.*
8	Natural language processing: text classification, text generation, machine translation, etc.	*3*	*Implement basic natural language processing techniques*

3- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
9	Using popular libraries and frameworks such as TensorFlow or PyTorch to implement AI models.	*3*	*Use libraries such as TensorFlow or PyTorch to implement AI models.*
10	Data collection and preprocessing for machine learning tasks.	*3*	*Be able to collect and preprocess datasets.*
11	Training machine learning models on real datasets.	*3*	*Be able to train machine learning models.*
12-13	AI model performance evaluation and hyperparameter tuning.	*6*	*Know how to evaluate the performance of AI models.* *Be able to adjust model hyperparameters to improve their performance*
14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- References

- *https://e.huawei.com/en/talent/#/*
- *https://www.tensorflow.org/*
- *https://pytorch.org/*
- *Human-Centered AI – Ben Shneiderman, 2022.*

6- Working environment (Facilities necessary for learning)

- *Jupyter Notebook*
- *Python 3.11*

Course Specification

Machine Learning

1. General

Coded	*Inf-IA 4 2 06*	Level	*4-S2*	Coefficient	*3*	Credits	*4*
Course	*AI&DS*					Vol. H. (CI)	*21*
Responsible	*Saoussen Ben Jabra*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Machine Learning*					Version	*11/2022*

Course description (Course objective):
This course aims to help students learn the basic concepts of machine learning by testing the main existing algorithms and training them on examples of Datasets using Python.

Prerequisites:	*Keywords :*
- *Python language* - *Notions of linear algebra*	*Supervised and unsupervised machine learning, Data pre-processing, Scikit-learn, Learning set, Cross validation*

Specific course objectives (OBJi):

Design and train machine learning models for various use cases.

OBJ 1 : *Understand the different stages of a machine learning algorithm*

OBJ 2 : *Know the principle and the difference between machine learning approaches, namely supervised, unsupervised, semi-supervised and reinforcement learning.*

OBJ 3 : *Study examples of supervised learning algorithms and apply them by training them on datasets using Python*

OBJ 4 : *Study examples of unsupervised learning algorithms and apply them by training them on datasets using Python*

OBJ 5 : *Study and test the different data pre-processing operations*

OBJ 6 : *Study the concept of ensemble learning and compare it with Machine learning algorithms*

OBJ 7 : *Study cross validation techniques and use it to evaluate different ML algorithms*

2- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Basic notions and steps of an ML algorithm* *Apply some data visualization techniques*	*6h*	*Understand the different stages of an ML algorithm*
3-4	*Supervised learning algorithms:* *KNN* *SVM*	*6h*	*Study examples of supervised learning algorithms and apply them by training them on different Datasets*
5-6	*Unsupervised learning algorithms:* *K-means clustering* *Forest insulation* *PCA*	*6h*	*Study examples of unsupervised learning algorithms and apply them by training them on different Datasets*
7-8	*Ensemble learning techniques:* *Bagging* *Boosting* *Stacking*	*6h*	*Study the concept of ensemble learning and compare it with Machine learning algorithms*
9-10	*Data Pre-Processing* *Encoding* *Standardization* *Imputation* *Feature selection*	*6h*	*Study and test the different data pre-processing operations*
11-12	*Test, validation and optimization of a model (cross-validation)* *Curve Validation* *GridSearchCV* *Learning Curve*	*6h*	*Study cross validation techniques and use it to evaluate different ML algorithms*
13-14	*Practical exam*	*6h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: … (… points)*
- *Criterion 2: … (… points)*
- *Criterion 3: … (… points)*
- *Criterion 4: … (… points)*

6- References

- *Guillaume Saint-Cirgue, Learn Machine Learning in a week, 2019* *https://machinelearnia.com/enseignement-le-machine-learning-en-une-week/*
- *NMK Editions, Machine Learning introduction, https://www.tousvoslivres.com/livre-numerique.php?id=1130#zonepdf*
- Pattern Recognition and Machine Learning – Christopher M. Bishop, 2022.
- *Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (2nd ed.). O'Reilly Media.*
- *Murphy, K. P. (2022). Probabilistic Machine Learning: An Introduction. MIT Press.*

7- Working environment (Facilities necessary for learning)

- *Jupyter Notebook*
- *Python 3.11*

Course Specification

Data Science oriented Python

1. General

Coded	*Inf-IA 4 2 07*	Level	*4-S2*	Coefficient	*1.5*	Credits	*2*
Course	*AI&DS*					Vol. H. (CI)	
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data Science oriented Python*					Version	*11/2022*

Course description (Course objective):
The *Python language has recently become, in the academic world as well as in the job market, an essential tool for data processing. The richness of this language allows it to be used in all phases of data processing, from its recovery and structuring from various sources to its valorization. This course introduces different tools that allow you to connect data and theories using Python.* *Learn to program in Python and use NumPy, Pandas, Matplotlib, Seaborn, Sqlite3 to do Data Science.*

Prerequisites:	*Keywords :*
Basics of Python programming	*NumPy, Pandas, Matplotlib, Seaborn and Sqlite3*

Specific course objectives (OBJi):
Develop data pipelines and AI models in Python. ***OBJ 1 :*** *Retrieve data and integrate it into your work environment* ***OBJ 2 :*** *Efficiently manipulate data with Python and the Pandas library* ***OBJ 3 :*** *Explore and visualize data with Matplotlib and Seaborn* ***OBJ 4 :*** *Manage databases with Sqlite3* ***OBJ 5 :*** *Using Python to do data science*

2- Content elements (Course)/TP

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-2	- *Back to the fundamental notions of Python* - *Presentation of the Python ecosystem for data science*	*3h*	*Mention the usefulness of data*

	- Introduction to good practices - Presentation of the principles of data science		science
3	Part 1: Manipulate data - Master the numpy library - Introduction to Numpy - Numpy tables - Mathematical operations with Numpy - Handling Numpy arrays - Matrices with Numpy	1h30	Mastery of the Numpy library
4	- Master the Pandas library - Read and write files with Pandas - Data structure with Pandas: series - Data structure with Pandas: DataFrame - Advanced data manipulation with Pandas	1h30	Master advanced data manipulation with Pandas
5	- Master the Matplotlib library - Chart creation - Advanced chart creation and organization - Graph plotting with the seaborn library	1h30	Master the Matplotlib and seaborn libraries to draw graphs
6/7	- Summary case study - Importing data files - Advanced data manipulation - Chart - Writing results to files of different types	3h	
8/9	Part2: Database and analysis - Database with python (SQLite3) - Database creation - Creating tables - insert data from data recover files or data frames (analysis result on data) - run queries and retrieve data - data backups recover in files - plotting graphs on retrieved data	3h	Manipulation of databases with queries of different types
10/11/12	- Summary case study - Recover data from csv files - Creating a database - Creating tables from retrieved dataFrame - Using queries for specific data selection	4:30 a.m.	
	- Saving data in dictionaries - Save this data in files after analysis		

13/14	- *Mini project and defense*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …

5- References

- Python Data Science Handbook – Jake VanderPlas, 2022.
- McKinney, W. (2022). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
- VanderPlas, J. (2016). Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media.

6- Working environment (Facilities necessary for learning)

- *Title, Version, URL*

Course Specification

Stochastic Model: Time Series

1. General

Coded	*Inf-IA 4 2 08*	Level	*4-S2*	Coefficient	*1.5*	Credits	*2*
Course	*AI&DS*					Vol. H. (CI)	
Responsible	*Ons Sidhom*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*Stochastic models*					Version	*11/2022*

Course description (Course objective):
This *course covers the basics of time series analysis, including the definition of time series and their importance in various fields. Students will learn to decompose trends, seasonality, and residuals from time series, using additive, multiplicative, and pseudo-additive approaches. They will use Python to create time series forecasting models, focusing on classic methods like ARMA, ARIMA and SARIMA. The course will also cover time series stationarity, data smoothing techniques, and autocorrelation. Finally, students will learn about the use of deep learning with RNN and LSTM architectures for time series analysis and forecasting.*

Prerequisites:	*Keywords :*
Python/Pandas/Sklearn *Statistics*	

Specific course objectives (OBJi):

Apply probabilistic models for modeling and decision-making.

OBJ 1 : *Define time series.*

OBJ 2 : *Explain the importance of time series analysis.*

OBJ 3 : *Identify applications of time series.*

OBJ 4 : *Explain how to decompose trend, seasonality and residuals.*

OBJ 5 : *Explain how to decompose additive, multiplicative and pseudo-additive models.*

OBJ 6 : *Use Python to create a time series forecasting model*

2- Content elements (TP)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*S1: Introduction*	*1h30*	*General introduction and usage examples*
2	*S2: Stationarity*	*1h30*	*Know the properties of time series*
3	*S3: Smoothing of time series*	*1h30*	*Know how to transform and smooth time series*
4	*S4: Autocorrelation*	*1h30*	*Calculate and interpret autocorrelation coefficients*
5	*S5: Model ARMA, ARIMA SARIMA*	*1h30*	*Know how to recognize classic time series models*
6	*S6: Advanced Studies of Time Series And summary of previous sessions*	*1h30*	*Know how to apply statistical tests and algorithms for decomposition and classification of time series*
7	*S7: Time series predictions*	*1h30*	*Know the different types of prediction models and their architecture*
8	S8: Extreme learning machines ELM	*1h30*	*Know the architecture and implement ELM*
9	*S9: Application of MLPs to time series*	*1h30*	*Know the architecture and implement MLPs*
10	*S10: RNN applied to time series*	*1h30*	*Know the architecture and implement RNNs*
11-12	*S11: LSTM applied to time series*	*3h*	*Know the architecture and implement LSTM, CNN*
13-14	*S12: Evaluation and MINI PROJECT*	*3h*	*Use all the knowledge acquired for the analysis and case study of a time series with predictions*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Analysis of time series and statistical data (4 points)*
- *Criterion 2: Prediction and choice of model (6 points)*
- *Criterion 3: Deployment of the model and testing (5 points)*
- *Criterion 4: Quality of report presentation and attendance (5 points)*

5- References

- https://github.com/nevermind78/Time_series/tree/main
- Machine Learning for Time Series Forecasting with Python of Francesca Lazzeri
- Stochastic Processes – Sheldon M. Ross, 2023.
- Ross, S. M. (2014). Introduction to Probability Models (11th ed.). Academic Press.
- Kulkarni, V. G. (2010). Modeling and Analysis of Stochastic Systems (2nd ed.). CRC Press.

6- Working environment (Facilities necessary for learning)

- *ANACONDA*
- *VSCODE*

Course Specification

Computer Vision

1. General

Coded	*Inf-IA 4 2 10*	Level	*4-S2*	Coefficient	*1.5*	Credits	*2*
Course	*AI&DS*					Vol. H. (CI)	
Responsible	*Nedra Ben Romdhane*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*Computer Vision*					Version	*11/2022*

Course description (Course objective):
The objective of this module is to initially master various 2D processing of digital images, namely filtering, edge detection and segmentation. *Secondly, this module will allow students to acquire basic knowledge on the processing of stereoscopic images.*

Prerequisites:	*Keywords :*
Master Python programming	*Image processing, filtering, segmentation, morphological processing, Hough transform, 3D vision.*

Specific course objectives (OBJi):
Develop computer vision systems for image and video analysis. *1) Apply and compare various filtering, edge detector and segmentation techniques* *2) Apply and compare the effect of various morphological treatments for different structural elements* *3) Test stereoscopic matching*

2- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Introduction to Computer Vision*	*3h*	*Overview of Existing Computer Vision-Based Systems*

3-4	*2D image processing*	*3h*	*Master filters, edge detectors, segmentation*
5-6	*Morphological treatments*	*3h*	*Master morphological filters*
7-8	*Hough transform*	*3h*	*Apply the Hough transform for segment detection*
9-10	*3D vision*	*3h*	*Learn basic knowledge of stereoscopic vision*
11-12	*Stereoscopic matching*	*3h*	*Test various stereoscopic matching algorithms*
13-14	*Practical exam*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …

5- References

- Computer Vision: Algorithms and Applications – Richard Szeliski, 2022.
- Prince, S. J. D. (2023). Computer Vision: Models, Learning, and Inference (2nd ed.). Cambridge University Press.

6- Working environment (Facilities necessary for learning)

- *Python*

Course Specification

Big Data I

1. General

Coded	*Inf-IA 4 2 11*	Level	*4-S2*	Coefficient	*3*	Credits	*4*
Course	*AI&DS*					Vol. H. (CI)	
Responsible	*Olfa Souki*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Big Data I*					Version	*11/2022*

Course description (Course objective):
The content describes concepts and tools related to Big Data. We start with an introduction to Big Data, explaining its characteristics and the reason for its choice. Next, installing a virtual machine for big data, including Oracle Virtual Box, Cloudera VM, WinSCP and Putty. Linux commands are also covered, including manipulating folders and files, using the VI editor, permissions, grep and find commands, and more. *Next, we will focus on HDFS, explaining the commands for creating folder, transferring files, deleting, merging, etc. Hive is also covered, including Hive Metastore concepts, managed and external tables, Hive operations, Hadoop file formats, different ways to connect to Hive, and partitioning and grouping techniques.* *We will then discuss Sqoop, describing its introduction, the list-tables, eval, import and export commands, as w ell as importing tables from MySQL to Hive. Finally, Pyspark is discussed, covering the introduction to Spark, its architecture, environment setup, RDDs (Resilient Distributed Datasets) with Python and Scala, DataFrames, Spark SQL and Spark Structured Streaming.*

Prerequisites:	*Keywords :*
Linux, Python, Database, networks and architecture	…

Specific course objectives (OBJi):
→ Process large volumes of data with Hadoop and MapReduce technologies. ***OBJ 1 :*** *Understand the concepts and properties of Big Data, including the reasons for its choice as a solution for processing massive data.* ***OBJ 2 :*** *Acquire the skills necessary to install and configure a virtual machine for Big Data, using tools such as Oracle Virtual Box, Cloudera VM, WinSCP and Putty.* ***OBJ 3 :*** *Master the essential Linux commands for managing folders, files, permissions, searching for data, as well as using the VI editor.* ***OBJ 4 :*** *Become familiar with key Big Data technologies such as HDFS, Hive, Sqoop and Pyspark, understanding their functionality, operations and usage for storing, processing and analyzing big data.*

2- Content elements (TP)

Week(s)	*Chapters/Content Items*	No. HR	Goals
S1	- *Session S1: Introduction to Big Data*	*3*	*Presentation of the concept of Big Data and its properties* *Explanation of the reasons to choose Big Data as a massive data processing solution*
S2	- *Session S2: Installation of the virtual machine for Big Data*	*3*	*Installing Oracle Virtual Box for Virtualization* *Installing Cloudera VM for Big Data Configuring WinSCP for File Transfer* *Setting up Putty for connecting to the virtual machine*
S3	- *Session S3: Essential Linux Commands*	*3*	*Handling folders: creation, deletion with and without files* *Using the VI Editor for Editing Files* *Working with files: creating, copying, moving and deleting* *Using the cat Command to View the Contents of a File* *Understanding file and folder permissions* *Using grep and find commands to search for data*
S4	- *Session S4: Introduction to HDFS|DBFS*	*3*	*Using the mkdir Command to Create Directories in HDFS* *Transferring files to HDFS with the put command* *Recovering files from HDFS with get command Using the CopyFromLocal and CopyToLocal commands for transferring files between local system and HDFS* *Deleting files in HDFS with rm command*

			Merging files with the merge command in HDFS
S5	- *Session S5: Hive*	*3*	*Understanding Hive Metastore* *Creating managed and external tables in Hive* *Exploring common operations in Hive* *Overview of Hadoop file formats and their types* *Different methods to connect to Hive* *Exploring partitioning and grouping techniques in Hive*
S6	- *Session S6: Sqoop*	*3*	*Introduction to Sqoop and its use for importing and exporting data* *Using the sqoop list-tables command to list available tables* *Using the sqoop eval Command to Evaluate SQL Queries* *Importing tables from MySQL to Hive with the sqoop import command* *Exporting data with Sqoop* *Importing all tables with the sqoop import-all-tables command*
S7	- *Session S7: Pyspark*	*3*	*Introduction to Spark and its architecture* *Setting up the Spark environment (optional)* *Handling RDD (Resilient Distributed Datasets) with Python* *Handling RDD with Scala Using* *DataFrames in Spark* *Using Spark SQL for queries and data analysis*
S8	- *Session S8: Spark Structured Streaming*	*30*	*Understanding Spark Structured Streaming for Streaming Processing* *Using Spark Structured Streaming for Real-Time Data Ingestion and Transformation*
S9	- *Session S9: Practice and project sessions*	*3*	*Putting into practice the knowledge acquired during previous sessions* *Realization of a Big Data project implementing the different technologies and techniques studied*
S10	- *Session S9: Practice and project sessions*	*3*	*Hackaton1*
S11-12	- *Session S9: Practice and project sessions*	*6*	*Hackaton2*

S13-14	- *Practical assessment session and exam on DataBricks*	*6*	*Ratings*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Analysis and preprocessing (4 points)*
- *Criterion 2: Data ingestion (6 points)*
- *Criterion 3: Actions and transformations (5 points)*
- *Criterion 4: Quality of report presentation and attendance (5 points)*

5- References

- *"Hadoop: The Definitive Guide" by Tom White*
- *Jain, V. (2023). Big Data and Hadoop: Learn by Example (2nd ed.). McGraw Hill.*
- *Garry, C. & Liyange, S. (2023). Big Data Analytics with Hadoop 3 (2nd ed.). Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *Databricks*
- *Spark/Hadoop virtual machine Oracle VM, Cloudera VM*

Course Specification

Cloud Services Certification (Azure)

1. General

Coded	*Inf-IA 4 2 12*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*AI&DS*					Vol. H. (CI)	*0*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Cloud services certification (Azure)*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to acquire the basic and fundamental notions of the Azure cloud to prepare for the Azure AZ900 certification exam

Prerequisites:	*Keywords :*
Basic notions of computer science (networks, databases, etc.)	*Certification, AZ900, Cloud computing*

Specific course objectives (OBJi):

Learn to deploy and manage AI solutions on Microsoft Azure.

- ***OBJ 1 :*** Cloud concepts
- ***OBJ 2 :*** *The main cloud services*
- ***OBJ 3 :*** *Core solutions and management tools*
- ***OBJ 4 :*** *Azure Security and Network Securing*
- ***OBJ 5 :*** *Identity, governance, privacy and compliance features*
- ***OBJ 6 :*** *Managing Azure costs and SLAs*

Necessary material :
Nothing specific

2- Content elements (Practical work)

Days)	Chapters/Content Items	No. HR	Goals

1-2	- *Benefits and considerations of using the Cloud (High availability, Scalability, Elasticity, Fault tolerance, Disaster recovery, economic benefits)*	*3h*	*Cloud concepts*
	- *The 3 categories of Cloud (IaaS, PaaS, SaaS, shared responsibility, serverless computing)* - *The 3 types of Cloud (Public, Private, Hybrid, synthesis of the 3 types)*		
3-4	- *The components of the Cloud architecture (region, availability zone, management group, resource group, Azure Resources Manager)* - *Basic Azure resources (Azure Marketplace, Network Management, Storage Management, Data Management)*	*3h*	*The main cloud services*
5-6	- *The main solutions (IoT, Big Data, AI, Serverless Solutions, Development Solutions)* - *Azure management tools (Azure Portal, Online Ordering, Mobile Apps, Senior Advisor, Monitoring and Health)*	*3h*	*Core solutions and management tools*
7-8	- *Security features (Azure security center, key vault, Azure Sentinel, dedicated hosts)* - *Network security (defense in depth, security groups, Azure firewall, Azure DDOS)*	*3h*	*Azure security and network security*
9-10	- *The main identity services (Azure AD, Conditional Access, Authentication and Authorization, SSO, MFA)* - *Governance features (RBAC, Resource Locks, Labels, Azure Policy, Azure Blueprints)* - *Privacy and compliance resources (fundamentals, trust center, compliance documentation, sovereign regions)*	*3h*	*Identity, governance, privacy and compliance features*
11-13	- *Planning and cost management methods (Expense factors, calculators, Azure cost management, reduction factors)* - *SLA management and service life cycle (SLA objectives, Actions on SLA, Service life cycle)*	*9h*	*Managing Azure costs and SLAs*
14	- *certification exam*	*3h*	*OBJ 1 .. OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
EE - Written test (MCQ)	*100%*

Certification exam (Microsoft Azure Fundamentals - AZ900)	-

4- Evaluation criteria

- *Criterion 1: Describe cloud concepts (25–30%)*
- *Criterion 2: Describe Azure architecture and services (35–40%)*
- *Criterion 3: Describe Azure management and governance (30–35%)*

5- References

- *Microsoft Azure Certifications: AZ900 Fundamentals courses*
- Exam Ref AZ-900 Microsoft Azure Fundamentals – Jim Cheshire, 2021.
- Zander, J., Mitchell, A., & Ruest, Y. (2022). Microsoft Azure Administrator Exam Guide AZ-104: Get Certified with Real-World Practice (2nd ed.). Packt Publishing.
- Chandrasekaran, M. (2023). Exam Ref AZ-305 Designing Microsoft Azure Infrastructure Solutions. Microsoft Press.

6- Working environment (Facilities necessary for learning)

- *Nothing specific*

Course Specification

DevOps/Mlops

1. General

Coded	*Inf-IA 5 1 03*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial intelligence*					Vol. H. (CI)	*21*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*30*
Module	*Devops/Mlops*					Version	*08/2023*

Course description (Course objective):
This course aims to provide students with DevOps/MLOps knowledge. It addresses theoretical aspects as well as practical applications.

Prerequisites:	*Keywords :*
Software Engineering, Development	*Version Management, Unit Testing, Docker, CICD,*

Specific course objectives (OBJi):
Automate and optimize the deployment of AI models in production. ***OBJ 1 :*** *Know best practices in software development and design.* ***OBJ 2 :*** *Know current technologies to deploy and secure applications and data in a cloud environment* ***OBJ 3 :*** *Know how to implement a machine learning pipeline with Amazon SageMaker*

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to DevOps*	*3*	*Know best practices in software development and design.*
3-6	*current technologies for deploying and securing applications and data in a*	*6*	*Know current technologies to deploy and secure applications and data in a cloud*

	cloud environment		*environment*
7-10	*MLOPS Introduction*	*6*	*Know how to implement a machine learning pipeline with Amazon*
			SageMaker
11-14	*machine learning pipeline*	*6*	*Know how to implement a machine learning pipeline with Amazon SageMaker*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- …

5- References

- MLOps Engineering at Scale – Carl Osipov, 2023.
- Villamizar, M., Truyen, F., & Amarasinghe, K. (2022). Engineering MLOps: Rapidly build, test, and manage machine learning models in production. Packt Publishing.
- Hutter, F., Kotthoff, L., & Vanschoren, J. (2019). Automated Machine Learning: Methods, Systems, Challenges. Springer.

6- Working environment (Facilities necessary for learning)

- *AWS Academy Platform*
- *Cisco Netacad Platform*

Course Specification

Business Intelligence (BI)

1. General

Coded	*Inf-IA 5 1 04*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*0*
Responsible	*Adel Dahmane*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Business Intelligence*					Version	*08/2023*

Course description (Course objective):
BI is a set of IT tools made available to a company in order to collect, transform, store, analyze (reporting) and share data from different sources. *As a Power BI data analyst, you should be proficient in using Power Query and writing Data Analysis Expressions (DAX), know how to assess data quality. Additionally, you need to understand the importance of row-level security and data privacy.*

Prerequisites:	*Keywords :*
- *Data base* - *SQL* - *Data analysis*	*Power BI, Power Query, ETL, KPI, DataSet, Fact Table, Dimension Table, Data Warehouse, Data Warehouse, DAX, Visualization, Reporting, Dashboard, Role, Publication, Sharing, Power BI Service*

Specific course objectives (OBJi):
Analyze and visualize data with Power BI. ***OBJ 1 :*** *Identify the key stages of BI and define the tasks of a data analyst* ***OBJ 2 :*** *Implement the ETL (Extract-Transform-Load) process* ***OBJ 3 :*** *Create and configure a data model (Relationship, Star/Snowflake Model)* ***OBJ 4 :*** *Create DAX expressions (Data Analysis eXpressions)* ***OBJ 5 :*** *Visualize data (Report, Visualization, Graph, etc.)* ***OBJ 6 :*** *Publish and share a Power BI project (Report, Dashboard & Dataset)*

Necessary material :
High-performance video projector & computers

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1 and 2	**LAB 1:** Extract/Collect data in Power BI Desktop What is BI (definition, key stages, tools, etc.)? Discover the tasks of a data analyst Set Power BI Desktop options Connect to source data Install a SQL database	*3h*	*OBJ 1* *OBJ 2*
3, 4 and 5	**LAB 2:** Transform data in Power Query Apply different transformations (Cleaning, Filtering, Deduplication, Merging, Aggregation, etc.) Apply queries to load them into the data model	*4h30*	*OBJ 2*
6 and 7	**LAB 3:** Design a data model in Power BI Create relationships (many-to-many, one-to-many, etc.) Configure table and column properties Create view hierarchies and folders Create quick measurements	*3h*	*OBJ 3*
8 and 9	**LAB 4:** Create DAX calculations in Power BI Desktop Create calculated tables (Table Date, etc.) Create calculated columns Create metrics (KPI)	*3h*	*OBJ 4*
10 & 11	**LAB 5:** Design a report in Power BI Desktop Create a report Configure visuals and formatting properties Publish & explore a report in Power BI Service Create a dashboard Share resources (report, Dashboard, semantic model)	*3h*	*OBJ 5* *OBJ 6*
12&13	Synthetic case study *(Resolving an old exam, …)*	*3h*	
14	*Practical project*	*1h30*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: ETL "Extract-Transform-Load" (5 points)*
- *Criterion 2: Modeling & Configuration (5 points)*
- *Criterion 3: DAX expressions (5 points)*
- *Criterion 4: Reporting (5 points)*

5- References

- *Microsoft Learn 2023, "Microsoft Power BI Data Analyst",https://learn.microsoft.com*

- *Microsoft Learn 2023,"Power BI Fundamentals», https://learn.microsoft.com/pdf?url=https%3A%2F%2Flearn.microsoft.com%2Ffr-fr%2Fpower- bi%2Ffundamentals%2Ftoc.json*

- *Microsoft Learn 2023, "Power BI documentation", https://learn.microsoft.com/fr-fr/power-bi*

- Microsoft Power BI Complete Reference – Devin Knight, 2022.

- Turban, E., Sharda, R., Delen, D., & King, D. (2022). Business Intelligence, Analytics, and Data Science: A Managerial Perspective (5th ed.). Pearson.

- Rausch, P., Sheta, A. F., & Ayesh, A. (2013). Business Intelligence and Performance Management: Theory, Systems, and Industrial Applications. Springer.

6- Working environment (Facilities necessary for learning)

- *Power BI Desktop:*

  Link 1:https://www.microsoft.com/store/productId/9NTXR16HNW1T?ocid=pdpshare

  Link 2:https://www.microsoft.com/fr-fr/download/confirmation.aspx?id=58494

- *Microsoft SQL Server Express 19:*

  https://www.microsoft.com/fr-FR/download/details.aspx?id=101064&authuser=0

- *SQL Server Management*
  Studio 19:
  https://aka.ms/ssmsfullsetup

Course Specification

Natural Language Processing

1. General

Coded	*Inf-IA 5 1 05*	Level/Semester	*5-S1*	Coefficient	*3*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*21*
Responsible	*Takoua Ben Aicha*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*10*
Module	*NLP*					Version	*08/2023*

Course description (Course objective):
This course aims to equip students with the fundamental skills necessary to understand, analyze and apply advanced techniques in the field of Natural Language Processing (NLP).

Prerequisites:	*Keywords :*
- *Basic understanding of computer science concepts and programming.* - *Mastery of the basics of programming, preferably in Python, which is widely used in the field of NLP.* - *Knowledge of basic concepts in statistics and mathematics, particularly those related to probabilistic models used in NLP.* - *A basic understanding of language concepts may be beneficial.* - *Familiarity with the basic principles of data processing, particularly those related to cleaning and preparation of textual data.* - *Basic knowledge of machine learning.*	*Algorithms, Data Structures, Programming Logic, Computer Systems, Python, Programming, Statistics, Mathematics, Probabilistic models, Probability, Linguistics, Grammar, Syntax, Semantics, Databases, SQL, Data Storage, Data Retrieval, Data processing, Data cleaning, Data preparation, Data analysis*

Specific course objectives (OBJi):
Design language processing applications (chatbots, text analysis). ***OBJ 1 :*** *Gain an in-depth understanding of NLP concepts.* ***OBJ 2 :*** *Master the statistical and mathematical models of NLP.* ***OBJ 3 :*** *Integrate basic linguistic concepts.* ***OBJ 4 :*** *Manage textual databases for NLP.*

OBJ 5 : *Master the processing of textual data.* ***OBJ 6 :*** *Apply notions of machine learning to NLP.* ***OBJ 7 :*** *Develop practical applications in NLP.* ***OBJ 8 :*** *Critically analyze the results of NLP models.* ***OBJ 9 :*** *Communicate complex concepts effectively in NLP.*

Necessary material :
No hardware needed

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter 1: Introduction*	*1.5*	*- Understand the historical evolution of NLP.* *- Discover the applications of NLP in various fields.* *- Identify the major challenges of NLP.*
2-4	*Chapter 2: Basic text processing and word semantics*	*4.5*	*- Understand the basic processes of text processing, including segmentation (Tokonization) and character normalization.* *- Deepen the understanding of word morphology in the context of text processing.* *- Put into practice the concepts of cleaning textual data (elimination of stop words).* *- Understand the different methods of vectorizing textual data.*
5-6	*Chapter 3: Language models*	*3*	*-Understand the concept of language models.* *-Explore models based on N-grams.* *- Study neural models for language.* *-Examine techniques for evaluating language models.*
7-8	*Chapter4: Morpho-syntactic labeling*	*3*	*1. Sequence labeling:* *-Understand the description of sequence labeling.* *-Identify applications of morpho-syntactic labeling.* *2. Task description:* *-Recognize universal classes in the morphosyntactic labeling task.* *-Understand the concept of Treebanks.* *-Evaluate the difficulty of the task and know the associated tools.* *3. Approaches:*

			-Understand the Markov model in the context of morphosyntactic labeling.
			-Examine the Maximum Entropy approach in this area. -Become familiar with the neural models used for morphosyntactic labeling.
9-10	Chapter5: Syntactic analysis	3	1. Syntactic Structures: -Understand the different syntactic structures in the context of syntactic analysis. 2. Constituent Annotation: -Master the constituent annotation process within the framework of syntactic analysis. 3. Functional Annotation: -Understand the importance of functional annotation in sentence decomposition. 4. Analysis of the Constituents: -Understand the basics of constituent analysis using the CKY algorithm. 5. Probabilistic CKY Algorithm: -Explore the application of the CKY algorithm in the probabilistic context for syntactic analysis. 6. Dependency Analysis: -Understand the transition approach in the analysis of syntactic dependencies.
11-12	Chapter 6: Coherence of speech	3	1. Coherence Relations: -Understand the different coherence relationships in a speech. -Apply concepts of coherence to improve the fluency of speech. 2. Rhetorical Structure Theory (RST): -Familiarization with the principles of Rhetorical Structure Theory. -Analyze the rhetorical structure of texts using RST. 3. Analysis based on Discourse Structure: Master the techniques for analyzing discourse structure. Apply RST Analysis to break down and understand

			the structure of texts.
13-14	Chapter7: Some applications	3	1.Transformation -Automatic translation -Automatic summary 2 Interaction -Questions answers -Dialogue systems 3 Classification -Sentiment analysis -Readability 4 Word -Speech recognition -Speech synthesis

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	TP1 Data pre-processing	3	1. Data cleaning 2. Data normalization 3.Tokenization by sentences 4. Tokenization by words 5. Remove STOP Words 5. Stemming 6. Named Entity Recognition (NER)
3-4	TP2: Preprocessing phase	3	1. Pre-treatment 2. Vectorization (Bag of words (BoW) 3. BoW with binary vectors 4.TF-IDF
5-6	TP3: Regular Expressions	3	1.Regular expressions for social links 2. Regular expressions for phone numbers 3. Search for contacts (email addresses and phone numbers in HTML files) 4. Manipulation and Normalization of Contact 5. compare the extracted contacts with a reference to evaluate the performance of the system.

			5. Understand the statistics used to evaluate the precision, recall and F1 of the comparison.
7-8	TP4: Language Models	3	1. Process text data from tabular files. 2. Understand sentence preprocessing, including word splitting and padding for N-grams 3. Learn to train a Kneser-Ney Interpolated language model on text data 4. Understand how to evaluate the probability of N-grams in a given sentence using the trained model. 5. Practice using regular expressions to search for specific patterns in text 6. Learn to generate text using a trained language model. 7. VSUnderstand how to observe the scores generated by the model for specific sentences. 8. Become familiar with the use of the NLTK (Natural Language Toolkit) library for natural language processing in Python.
9-10	TP5: Morphosyntax	3	1. Understand and implement an HMM model for morpho-syntactic labeling. 2. Master the initialization of the parameters of the HMM model, such as transition probabilities, emission probabilities, and initial state probabilities. 3. Learn how to train the HMM model on labeled data. 4. Implement a brute force label sequence estimation method. 5. Implement a label sequence estimation method in a greedy way. 6. Complete the implementation of Viterbi estimation for the label sequence. 7. Set up methods to export and import the model in JSON format.

			8. Implement a method for reading labeled sentences from a file. 9. Create a morpho-syntactic annotator and train it on data. 10. Set up an annotator evaluation using different estimation methods.
11-12	Synthetic case study (Resolving an old exam, …)	3	
13-14	mini-project defense, …	3	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	20%
EE - Written test (Final exam)	60%
EP - Practical test (Practical work exam or Mini project)	20%

5- Evaluation criteria

- Criterion 1: Relevance of theoretical knowledge (5 points)
- Criterion 2: Mastery of programming skills: Python (5 points)
- Criterion 3: Application of statistical and mathematical models in specific NLP contexts (5 points)
- Criterion 4: Ability to process and analyze textual data, including data cleaning and preparation (Tokenization, Lemmatization, etc.) (5 points)

6- References

- https://universaldependencies.org/
- Jurafsky, D. and Martin, J.H. (2019). Speech and Language Processing. Magenta https://web.stanford.edu/~jurafsky/slp3/
- Eisenstein, J. (2018). Natural Language Processing. He, L., Lee, K., Lewis, M., and Zettlemoyer, L. (2017). Deep semantic role labeling: What works and what's next. In Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers), pages 473–483, Vancouver, Canada. Association for Computational Linguistics.
- Jurafsky, D. and Martin, J.H. (2019). Speech and Language Processing. https://web.stanford.edu/~jurafsky/slp3/

- *Jurafsky, D. and Martin, J.H. (2019). Speech and Language Processing.*

  https://web.stanford.edu/~jurafsky/slp3/
- *Aries, A., Zegour, DE, and Hidouci, W. (2019). Automatic text summarization: What has been done and what has to be done. CoRR, abs/1904.00688.*
- *Miller, G. A. (1995). Wordnet: a lexical database for English. Communications of the ACM, 38(11):39–41.*
- *Universal Dependencies contributors (2014). Universal dependencies. Website. https://universaldependencies.org/*
- *Bengio, Y., annd Pascal Vincent, RD, and Jauvin, C. (2003). A neural probabilistic language model. Journal of Machine Learning Research.*
- *http://www.jmlr.org/papers/volume3/bengio03a/bengio03a.pdf*
- *Jurafsky, D. and Martin, J.H. (2019). Speech and Language Processing.* *https://web.stanford.edu/~jurafsky/slp3/.*
- *Smith, N. (2020). Neural models. "Natural Language Processing (CSE 517)" course. University of Washington*
- *Indurkhya, N. and Damerau, F.J. (2010). Handbook of Natural Language Processing. Chapman & Hall/CRC, 2nd edition.*

7- Working environment (Facilities necessary for learning)

- *Google Colab*

Course Specification

Big Data 2

1. General

Coded	*Inf-IA 5 1 06*	Level/Semester	*5- S1*	Coefficient	*3*	Credits	*4*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Olfa Souki*					Vol. H. (TP)	***42***
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Big Data II*					Version	*08/2023*

Course description (Course objective):
Big Data TP 2: This lab is intended for 5th year artificial intelligence (5AI) students. Its objective is the processing and analysis of massive data in real time using Apache Spark and the creation of prediction and learning models for Data Mining.

Prerequisites:	*Keywords :*
Know the basic principles of Big Data tools exp: Hadoop	*Big Data, real time, streaming, Data Mining, Spark*

Specific course objectives (OBJi):

Leverage Apache Spark for massive real-time data processing.

OBJ 1 : *Installing and configuring Apache Spark and its related components*
OBJ 2 : *Introduction to standard use of Spark on a large static database*
OBJ 3 : *Processing a text database from a history file*
OBJ 4 : *Streaming Big Data Processing Using Spark*
OBJ 5 : *Streaming TCP socket data processing*

Necessary material :
Computer with RAM>4 with an internet connection of acceptable speed

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

1	TP0: Introduction to Spark: Installation and configuration	3	-Installation and configuration of Apache Spark and its related
			components -Creation of a first notebook on Jyputer by PySpark.
2-3	TP1: Analysis of massive online commerce data	6	-Become familiar with the Spark environment and PySpark language
4-5	TP1: Analysis of massive online commerce data (continued)	6	-Produce prediction models using K-means, …
6-7	TP2: Data analysis from a text file	6	-Analyze data from histories and log files to extract knowledge
8-9	TP3: Analysis of textual data for SPAM detection	6	-
10-11	TP4: Spark streaming from a txt file (Word count)	6	-Learn new concepts relating to streaming -reading and analyzing text data in real time
12	TP5: Spark streaming from a TCP socket	3	-Learn to vary the data source to analyze in streaming. -Become familiar with Spark Streaming.
13	TP6: Spark streaming with SQL spark	3	-Exploitation of SQL queries for the analysis of massive streaming data.
14	Mini-project defense	3	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	20%
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	80%

5- Evaluation criteria

- *Criterion 1: Originality of mini-project subject (5 points)*
- *Criterion 2: Consistency between design and production (5 points)*
- *Criterion 3: Clarity of the mini-project (5 points)*
- *Criterion 4: Presentation and understanding of subject (5 points)*

6- References

- *https://www.datacamp.com/tutorial/pyspark-tutorial-getting-started-with-pyspark*
- *https://spark.apache.org/docs/latest/streaming-programming-guide.html*
- Learning Spark: Lightning-Fast Data Analytics – Jules S. Damji et al., 2020.
- Matei, Z., Xin, R., & Franklin, M. J. (2022). Spark: The Definitive Guide: Big Data Processing Made Simple. O'Reilly Media.

7- Working environment (Facilities necessary for learning)

- *Development environment (Editor):*

  Jupyter Notebook, https://docs.jupyter.org/en/latest/install.html
- *Python environment:*

  Anaconda, https://www.anaconda.com/download/python
- *PySpark, https://pypi.org/project/pyspark/*

Course Specification

Deep learning

1. General

Coded	*Inf-IA 5 1 07*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*4*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*0*
Responsible	*Ons Sidhom*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Deep Learning*					Version	*08/2023*

Course description (Course objective):
The hands-on Deep Learning course over 11 sessions of 3 hours each is designed to allow students to deepen their knowledge of artificial intelligence by focusing specifically on Deep Learning concepts and applications. The course will emphasize practical aspects to ensure a thorough understanding of the techniques and methods used in the field.

Prerequisites:	*Keywords :*
- *In-depth knowledge of Python.* - *Previous experience with Google Colab.* - *Understanding the basics of traditional Machine Learning.*	*Deep Learning, Neural Networks, TensorFlow, Keras, ANN, CNN, RNN…*

Specific course objectives (OBJi):

Develop and train deep neural networks for various application cases.

OBJ 1 : *In-depth understanding of Deep Learning: Familiarization with Deep learning concepts. Understanding deep neural network architectures*

OBJ 2 : Practical implementation:

Acquisition of practical skills through in-depth practical work. Using popular libraries like TensorFlow and Keras

OBJ 3 : Real-world problem solving:

Applying Deep Learning to real-world problems.

OBJ 4 : Model optimization:

Optimization techniques to improve model performance. Understanding of hyperparameters and model tuning.

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	***Introduction to Deep Learning*** *Presentation of the fundamental concepts of Deep Learning.* *Installing the necessary libraries.*	*3h*	*Understand the basics of Deep Learning.*
2	***Artificial Neural Networks (ANN)*** *Construction and training of an ANN.* *Application on simple datasets.*	*3h*	*Master the basic principles of artificial neural networks*
3	***Hyperparameter Tuning*** *Exploration of hyperparameters and their effects.* *Techniques for finding the best hyperparameters.*	*3h*	*Mastering model optimization by tuning hyperparameters*
4	***Convolutional Neural Networks (CNN) - Part 1*** *Introduction to CNN architectures.* *Creating and training a simple CNN.*	*3h*	*Understanding the use of CNNs*
5	***Convolutional Neural Networks (CNN) - Part 2*** *Exploration of advanced CNN architectures (VGG, ResNet, etc.).* *Application on complex datasets*	*3h*	*Master the different CNN architectures.*
6	***Recursive Neural Networks (RNN)*** *Introduction to RNNs.* *Creating and training a simple RNN.*	*3h*	*Understand the use of RNNs for sequential processing.*
7	***Recursive Neural Networks (RNN) - Applications***	*3h*	*Master the use of*
	Application of RNNs on real data sequences. *Time sequence processing.*		*RNNs in real contexts.*
8	***Generative Learning - Introduction*** *Introduction to generative models (GANs, VAEs).* *Creation of a simple generative model.*	*3h*	*Understand the basics of Generative*

			Learning.
9	***Generative Adversarial Networks (GANs)*** *Implementation of a GAN.* *Application on image datasets.*	*3h*	*Master the use of GANs for image generation.*
10-11	***Variational Autoencoders (VAEs)*** *Implementation of an VAE.* *Application on specific datasets.*	*6h*	*Understand the use of VAEs for data generation.*
12-13	***Review and Preparation for Final Draft*** *Review of key concepts from the course.* *Discussion on the final project.*	*6h*	*Prepare students to apply acquired skills in a real-world project.*
14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Understanding of Concepts (5 points)*
- *Choosing the right model (5 points)*
- *Mastery of programming skills: Python (3 points)*
- *Structure and clarity of your final notebook (working documentation, etc.) (3 points)*
- *Creativity (4 points)*

6- References

- Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville, 2023.
- Chollet, F. (2021). Deep Learning with Python (2nd ed.). Manning Publications.

7- Working environment (Facilities necessary for learning)

- *https://colab.research.googl*

Course Specification

Image Recognition

1. General

Coded	*Inf-IA 5 1 08*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Nedra Ben Romdhane*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*Image Recognition*					Version	*07/2023*

Course description (Course objective):
This course aims to enable students to master image classification techniques based on deep learning.

Prerequisites:	*Keywords :*
- *Image processing* - *Python programming* - *Artificial intelligence*	*Classification, CNN, transfer learning, data augmentation, parameter selection*

Specific course objectives (OBJi):

Apply computer vision models for object and pattern recognition.

OBJ 1 : *Work on concrete image bases to develop practical skills.*
OBJ 2 : *Test different deep learning architectures*
OBJ 3 : *Learn how to tune these hyperparameters to get better performance*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Classification: Testing a CNN from scratch for classifying images from collab*	*3h*	Test a CNN and learn how to tune these hyperparameters
3-4	*Classification: Make a comparative study of various pre-trained CNNs*	*3h*	*Explore various pre-trained CNNs (VGG16,*
			DenseNet, Inception, ..)

5-6	*Preprocessing: Apply data augmentation*	*3h*	*Test the SMOTE technique to balance the image database*
7-8	*Selection of relevant characteristics*	*3h*	*Apply selection of relevant parameters through a self attention layer*
9-10	*Classification of images with transformers*	*3h*	*Test the Swin transformer architecture*
11-12	Synthetic case study	*3h*	
13-14	*mini-project & defense*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …

5- References

- Pattern Classification – Richard O. Duda, Peter E. Hart, David G. Stork, 2022.
- Schalkoff, R. J. (2007). Pattern Recognition: Statistical, Structural and Neural Approaches. Wiley.
- Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.

6- Working environment (Facilities necessary for learning)

- *Collab*

Course Specification

Data Visualization

1. General

Coded	*Inf-IA 5 1 10*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Hassen Amri*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data Visualization*					Version	*07/2023*

Course description (Course objective):
Data visualization is an essential skill in the field of analyzing and understanding information. This course aims to equip students with the knowledge and skills to create impactful and informative visual representations from complex data. By combining visual design principles with modern technology tools, this course explores the different facets of data visualization.

Prerequisites:	*Keywords :*
Basic knowledge of statistics and data manipulation. Familiarity with a programming language (preferably Python) would be an advantage but is not required. This course is designed to prepare students to use data visualization as a powerful tool in their professional journey, whether in research, data analysis, data journalism, or other fields related.	*…*

Specific course objectives (OBJi):

transform complex data into clear, insightful, and interactive visual representations using industry-standard tools and best practices.

OBJ 1 : *Understanding of Fundamental Concepts: Students will gain an in-depth understanding of the fundamental concepts of data visualization, including visual perception, chart types, and design principles.*

OBJ 2 : *Mastery of Visualization Tools: This course emphasizes the practical use of commonly used data visualization tools such as Python with libraries such as Matplotlib and Seaborn.*

OBJ 3 : *Critical Analysis of Visualizations: Students will learn to critically evaluate existing visualizations, understanding the benefits and limitations of different approaches, and developing the ability to choose the best visual representation based on context.*

Necessary material :
PC

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to Data Visualization*	*1.5*	*Understand the importance of data visualization in decision making. Overview of basic concepts and types of visualizations.*
3-4	*Visualization Tools*	*1.5*	*Exploring commonly used tools like Python with libraries like Matplotlib and Seaborn*
4-5	*Principles of Graphic Design*	*1.5*	*Learn the fundamentals of graphic design applied to data visualization to maximize visual impact*
5-6	*Types of Visualizations*	*1.5*	*In-depth study of different types of visualizations, including line graphs, bar charts, maps, scatterplots,*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
7-8	*Data Exploration with a Visualization Tool*	*1.5*	*Have students explore a specific dataset using a visualization tool like Tableau, Power BI, or Python libraries like Matplotlib and Seaborn. They should create various types of graphs to understand data distribution, trends, and relationships.*
9-10	*Visualization Project*	*1.5*	*Assign a project where students must choose a dataset relevant to their field of study and create a comprehensive visualization. This could include exploratory analyses, interactive graphics, and a narrative explanation of their design choices.*
10-11	*Comparison of Visualizations*	*1.5*	*Provide students with multiple visualizations representing the same data, but created in different ways. Ask them to evaluate the strengths and weaknesses of each approach, emphasizing clarity, effectiveness, and audience engagement.*

12-13	*Visualization of Temporal Data*	*1.5*	*Explore temporal data visualizations by having students work with time series. They could create line graphs, stacked bar charts, or even interactive visualizations to highlight time trends.*
14	*Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Clarity and Relevance of visualizations(2.5points)*
- *Criterion 2: Understanding the data(2.5points)*
- *Criterion 3: Choice of visualization techniques(10points)*
- *Criterion 4: Analysis and Interpretation(5points)*

5- References

- *Knaflic, C. N. (2015). Storytelling with Data: A Data Visualization Guide for Business Professionals. Wiley.*
- *Few, S. (2017). Now You See It: Simple Visualization Techniques for Quantitative Analysis. Analytics Press.*

6- Working environment (Facilities necessary for learning)

- *Colab: https://colab.research.google.com/*

Course Specification

Robotics

1. General

Coded	*Inf-IA 5 1 11*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	*0*
Responsible	*Mouhieddine Belghith*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Robotics*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to familiarize students with the different embedded development platforms. Students will be able to program an embedded system using arduino UNo boards; esp32 and Raspberry PI. Different sensors will be presented with a view to using them in the design and creation of different IoT systems. Programming will be done using the arduino IDE for Arduino Uno and ESP boards. We will use Python and Node-red for programming Raspberry PI cards. Communication protocols (MQTT, CoAP) will be presented and used in certain labs to ensure communication between the different parts of the IoT system.

Prerequisites:	*Keywords :*
Knowledge of electronic wiring, C programming and Python programming is desired.	*Arduino IDE, Arduino UNO, ESP32, Raspberry PI, sensors, IoT, Python, Node-RED, MQTT,CoAP*

Specific course objectives (OBJi):

Develop control and perception algorithms for autonomous robots.

OBJ 1 : *Mastery of programming Arduino cards via the Arduino IDE: The student will acquire the skills necessary to program an IOT system using Arduino cards via the Arduino IDE.*

OBJ 2 : *Proficiency in ESP32 Board Programming: The student will be familiar with ESP boards and gain the knowledge required to program various ESP32 based IOT systems.*

OBJ 3 : *Getting started with RASPBERRY PI cards: students will be able to program IOT systems using either the Python language or Node-red programming.*

OBJ 4 : *Understanding of the principle of communications protocols specific to IOT; MQTT and CoAP, Then Implementation of IOT system using communication protocols.*

Necessary material :
Development boards: arduino UNO, esp32, Raspberry PI, Sensor kit, 4-wheel robot KIT, ESP32-CAM, Raspberry camera, connection cables.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to IoT*	*1.5h*	*-Presentation of IoT Architectures* *-Presentation of sensors, actuators and development boards* *- Presentation of IoT platforms*
2	*Getting started with Arduino boards*	*1.5h*	*-Presentation of the characteristics of Arduino development boards* *- Comparison between Arduino cards so that the student is able to choose the most appropriate card for their embedded system* *- Overview of the Arduino IDE and functions used for Arduino programming*
7	*Overview of MQTT and CoAP communication protocols*	*1.5h*	*-Present the principle of communication via the MQTT communication protocol as well as the different components involved: MQTT broker, publisher, subscriber, Topic, QoS and message* *-Present the principle of communication via the CoAP communication protocol as well as the different components involved: Server, client, request, Response.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
3-4	*Creation of embedded systems based on the Arduino Uno*	*3h*	*-Installation of Arduino IDE* *-Creation of different examples of IoT systems based on Arduino cards*
5-6	*Getting started with the ESP32 and creating embedded systems based on the ESP32*	*3h*	*-Presentation of the ESP card family as well as the comparison between the different ESP cards* *- Added ESP32 to the list of boards supported by the Arduino IDE* *-Implementation of an embedded system based on ESP32*

			-Send Data to Firebase
			- Data visualization on IoT platforms: ThingSpeak & Blynk
8-9	*Getting started with Raspberry PI*	*3H*	*-Installation of Debian IOS* *-Connection to Raspberry PI via Putty* *-Configuration of Vnc access to the Raspberry PI (RPI)* *-Presentation of the RPI GPIOs* *-Use of the Python language for programming various embedded systems*
10-11	*Use of the MQTT protocol for setting up an embedded system*	*3H*	*-Installation of the broker and mosquitto clients on the RPI* *-MQTT communication between RPI and publishers and subscribers based on ESP32*
12-13	*Node-RED programming of Raspberry PI boards*	*3H*	*Creation of an IoT system using Node-RED programming*
14	*Practical exam, mini-project defense, …*	*1.5H*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: choice of suitable sensors to meet the specifications (4 points)*
- *Criterion 2: mastery of the development platform (3 points)*
- *Criterion 3: clarity of the code (2 points)*
- *Criterion 4: adequacy with the specifications (11 points)*

6- References

- Introduction to Autonomous Robots – Nikolaus Correll, Bradley Hayes, et al., 2022.
- Siciliano, B., & Khatib, O. (2016). Springer Handbook of Robotics (2nd ed.). Springer.
- Craig, J. J. (2021). Introduction to Robotics: Mechanics and Control (4th ed.). Pearson.

7- Working environment (Facilities necessary for learning)

- *Arduino IDE*
- *Putty, VNC Viewer*

Course Specification

Blockchain

1. General

Coded	*Inf-IA 5 1 13*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Artificial Intelligence & Data Science*					Vol. H. (CI)	
Responsible	*Farah Jmili*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Blockchain*					Version	*08/2023*

Course description (Course objective):
The blockchain course aims to provide students with an understanding of fundamental blockchain concepts, as well as the latest techniques and applications.

Prerequisites:	*Keywords :*
Cryptography, Python	*…*

Specific course objectives (OBJi):

Understand and implement AI solutions based on blockchain.

OBJ 1 : *Describe the different fundamental concepts of blockchain*

OBJ 2 : *Explain the basics of how blockchain works*

OBJ 3 : *Describe the different applications of blockchain*

OBJ 4 : *Applying blockchain techniques to real-world problems*

Necessary material :
Internet connection

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	Chapter 1: Introduction to blockchain	3	Obj1-2
3	Installing a cryptocurrency wallet	1.5	Obj 1-4
4	Demonstration of a transaction on a blockchain	1.5	Obj 1-4
5	Creating a block on a blockchain	1.5	Obj 1-4
6	Chapter 2: Blockchain Technology	1.5	Obj 1-4

7	Discovery of different blockchain architectures	1.5	Obj 1-4
8	Analysis of consensus mechanisms	1.5	Obj 1-4
9	Study of blockchain security techniques	1.5	Obj 1-4
10	Chapter 3: Blockchain Applications	1.5	Obj 1-4
11	Creating a distributed ledger	*1.5*	Obj 1-4
12	Development of a decentralized application	*1.5*	Obj 1-4
13	Blockchain Use Case Analysis	*1.5*	Obj 1-4
14	*Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …
- …

6- References

- *Blockchain Hub: https://www.blockchainhub.net/*
- Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications – Imran Bashir, 2023.

7- Working environment (Facilities necessary for learning)

- *An IDE or text editor for programming*

Subject Sheets Specialty: Cybersecurity

Course Specification

Native mobile development 1 (IOS)

1. General

Coded	*Inf-CYB 4 1 03*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Ahmed Manaa*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Native mobile development 1*					Version	*08/2023*

Course description (Course objective):
This workshop aims to provide students with the practical skills needed to independently specify, design and develop iOS mobile applications while learning the new object-oriented programming language Swift. In addition, this workshop will give student the ability to develop secured application on iOS.

Prerequisites:	*Keywords:*
- *Fundamentals of object-oriented programming* - *Basic knowledge of computer science concepts such as variables, loops, conditions, etc.*	*Swift, Xcode, Apple, IOS, ViewController, Storyborad, UIKit, UI, AppDelegate …*

Specific course objectives (OBJi):

OBJ 1 : *Understanding the fundamentals of Swift:*

- *Explain basic Swift syntax.*
- *Use control structures like loops and conditions.*
- *Understand the concepts of object-oriented programming in Swift.*

OBJ 2 : *Master the use of Xcode:*

- *Navigate and use the Xcode interface efficiently.*
- *Create, edit and organize iOS projects in Xcode.*
- *Use built-in debugging tools to identify and resolve issues.*

OBJ 3 : *Develop interactive user interfaces with UIKit:*

- *Create visual user interfaces using UIKit components.*
- *Understand view controllers and view management.*
- *Implement gestures and animations to improve user experience.*

OBJ 4 : *Manage the application lifecycle with AppDelegate:*

- *Customize the AppDelegate to respond to application lifecycle events.*
- *Understand the process of launching, backgrounding, and closing an application.*
- *Implement specific features related to the lifecycle.*

OBJ 5 : *Integrate Web services, process remote data and optimize performance:*

- *Make asynchronous calls to remote APIs and manage responses.*
- *Optimize application performance by identifying and applying improvements.*

Necessary material:

Students should have a computer preferably a MacBook, as iOS development is typically done on macOS systems.

Software :

Xcode*: Apple's official IDE for iOS application development.*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Introduction to Swift and setting up the environment*	*1h30*	*OBJ1, OBJ2*
2	*Swift Fundamentals: Variables, Operators, Controls*	*1h30*	*OBJ1*
3	*Practical exercises on Swift variables and operators.*	*1h30*	*OBJ1*
4	*Designing a User Interface with UIKit*	*1h30*	*OBJ3, OBJ2*
5	*Using views and controllers in UIKit to design interactive screens.*	*1h30*	*OBJ3, OBJ2*
6	*Improved UI with advanced UIKit animations.*	*1h30*	*OBJ3*
7	*Practical work on managing the lifecycle of an iOS application with AppDelegate*	*1h30*	*OBJ4*
8.9	*integrating asynchronous calls with Alamofire to consume web APIs and using CoreData for data persistence in an iOS application.*	*3h*	*OBJ5*

10.11	*Partial Project: Development of a practical application using the concepts taught so far.*	*3h*	*OBJ1 - OBJ5*
12.13	*Preparing for the practical exam, reviewing key concepts and solving practical problems*	*3h*	*OBJ1 - OBJ5*
14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: User Interface Design (5 points)*
- *Criterion 2: Code organization, code quality and project structure (2 points)*
- *Criterion 3: Correct application of basic concepts and precise use of Swift syntax (4.5 points)*
- *Criterion 4: Smooth use of Xcode and Debugging (2 points)*
- *Criterion 5: Effective use of resources provided (3.5 points)*
- *Criterion 6: Features (3 points)*

5- Bibliographic and Online References

- *Work with Apple, 2023 https://developer.apple.com/*
- *Danyl Semmache & Ambroise Collon, "Apprenez les fondamentaux de Swift", OpenClassroom, 2023 https://openclassrooms.com/fr/courses/4287521-apprenez-les-fondamentaux-de-swift*
- *Meziane, S., & Dauterive, P. (2021). Développer des applications iOS avec Swift 5. Dunod.*
- *Sacco, S., & Vacher, R. (2022). SwiftUI pour iOS : Créez des interfaces modernes et réactives. Eyrolles.*
- *Ray, W. (2023). iOS Programming: The Big Nerd Ranch Guide (8th ed.). Big Nerd Ranch.*
- *Johnson, J. (2023). Mastering iOS 16 Programming: Build iOS Applications with SwiftUI and UIKit. Packt Publishing.*

6- Working environment (Facilities necessary for learning)

- *Xcode: https://developer.apple.com/xcode/resources/*

Course Specification

Data analysis

1. General

Coded	*Inf-CYB 4 1 04*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Data analysis*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to learn how to analyze data using Python. Students will move from understanding the basics of Python to exploring many types of data. They learn how to prepare data for analysis, perform simple statistical analyses, and create meaningful data visualizations.

Prerequisites:	*Keywords :*
Little experience in Python is preferred	*Jupyter Notebook, NumPy, matplotlib, Pandas*

Specific course objectives (OBJi):

OBJ 1 : *Importing datasets*

OBJ 2 : *Data cleaning and preparation*

OBJ 3 : *Summarize the Pandas DataFrame*

OBJ 4 : *Visualization with matplotlib*

OBJ 5 : *Project template for the "Titanic" dataset*

OBJ 6 : *Project template for the "Covid 19" dataset*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	- *Understand the domain* - *Understand the dataset* - *Python packages for data science* - *Import and export of data in Python* - *First steps with NumPy*	*3h*	*Importing datasets*

	- *Create your first pandas DataFrame*		
3-4	- *Overviews of datasets* - *Identify and manage missing values* - *Data formatting* - *Data normalization sets* - *Indicator variables*	*3h*	*Data cleaning and preparation*
5-6	- *Descriptive statistics* - *Base of the group* - *Correlation* - *Learn more about correlation*	*3h*	*Summarize the Pandas DataFrame*
7-8	- *View and work with "Time Series Data"* - *Explore, clean, refine and merge datasets* - *Understand joins, relationships and aggregates* - *Trace, visualize and organize the analysis of your data*	*3h*	*Visualization with matplotlib*
9-10	- *Understand the "Titanic" dataset* - *Begin data analysis by asking specific questions* - *Use the different modules studied to visualize the data* - *Find answers to questions posed by interpretations of the results found*	*3h*	*Project template for the "Titanic" dataset*
11-12	- *Understand the "Covid 19" dataset* - *Begin data analysis by asking specific questions* - *Use the different modules studied to visualize the data* - *Find answers to questions posed by interpretations of the results found*	*3h*	*Project template for the "Covid 19" dataset*
13-14	- *Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of the different libraries already handled during practical work (7 points)*
- *Criterion 2: Data visualization with matplotlib (5 points)*

- *Criterion 3: Organization of your analysis (Storytelling) (5 points)*
- *Criterion 4: Structure and clarity of your final notebook (use of markdown cells, working documentation) (3 points)*

5- Bibliographic and Online References

- *Marc Wintjen, "Practical Data Analysis Using Jupyter Notebook", https://www.packtpub.com/product/practical-data-analysis-using-jupyter- notebook/9781838826031, 2020*
- *Wes McKinney, "Python for Data Analysis", 2022*

6- Working environment (Facilities necessary for learning)

- *Anaconda, version 3, https://www.anaconda.com/products/distribution*

Course Specification

Full Stack Development (React JS)

1. General

Coded	*Inf-CYB 4 1 05*	Level	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	*0*
Responsible	*Firas Hmila*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*Full Stack Development*					Version	*08/2023*

Course description (Course objective):

Discover the ReactJS JavaScript library through this in-depth course. Explore creating reusable components, managing state with hooks, Redux, and building modern, high-performance web applications with React. Practice responsive development.

Prerequisites:	*Keywords :*
Web development (HTML, CSS, JavaScript, DOM)	*JS, JSX, Hooks, React, Redux, API, Props*

Specific course objectives (OBJi):

OBJ 1 : *Understand the fundamentals of JavaScript*
OBJ 2 : *Master the basic concepts of React*
OBJ 3 : *Know how to use functional components and class components*
OBJ 4 : *Learn how to manage state in React*
OBJ 5 : *Understanding the concept of props*
OBJ 6 : *Use React Router*
OBJ 7 : *Learn to manage forms*
OBJ 8 : *Integrate API calls*
OBJ 9 : *Use Redux (or other global state)*
OBJ 10 : *Master React hooks*
OBJ 11 : *Implement unit tests*
OBJ 12 : *Explore additional libraries and tools*

Necessary material :
Computer laboratory

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Reminder about JavaScript*	*1.5 hours*	*OBJ 1*
2	*Introduction to React, Components and JSX* *Introduction to React components.* *Using JSX to describe the user interface.* *Creation of functional and class components.*	*1.5 hours*	*OBJ 2* *OBJ 3*
3-5	*Managing state in React* *Understand the concept of state in React.* *Manipulating state in functional components with hooks (useState).* *Properties (Props) in React* *Understand data passing between components with properties.* *Using props to make components configurable.* *Event handling: Handling events in React.* *Forms in React*	*4.5h*	*OBJ 4* *OBJ 5* *OBJ 7*
6	*React Router* *Introduction to React Router to manage navigation in a React application.* *Setting up routes and links between pages.*	*1.5 hours*	*OBJ 6*
7	*API calls with React* *Introduction to API calls with the Fetch library.* *Using Axios to make HTTP requests.*	*1.5 hours*	*OBJ 8*
8	*Managing global state with Redux* *Introduction to Redux to manage global application state.* *Configuring Redux in a React project.*	*1.5 hours*	*OBJ 9*
9-10	*Using advanced hooks* *Exploring advanced hooks such as useEffect, useContext, useReducer.* *Understanding the specific use cases for each hook.*	*3h*	*OBJ 10*

11-12	*Unit testing and deployment* *Introduction to unit testing with Jest and React Testing Library.* *Strategies for deploying a React application.*	*3 hours*	*OBJ 11* *OBJ 12*
13-14	*Practical exam, mini-project defense, …*	*3 hours*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of React Hooks (8 points)*
- *Criterion 2: Use of external libraries (Chakra, Material, Ant, etc.) (4 points)*
- *Criterion 3: Use of React Router Dom (4 points)*
- *Criterion 4: Use of a Global State Management library (Redux, MobX, etc.) (4 points)*

5- Bibliographic and Online References

- *The library for web and native user interfaces,https://react.dev*
- *Nader Dabit , "Full Stack Serverless: Modern Application Development with React, AWS, and GraphQL", O'Reilly, 2020*

6- Working environment (Facilities necessary for learning)

- *NodeJs, v18.19.0,https://nodejs.org/download/release/v18.19.0/*
- *Visual studio Code,https://code.visualstudio.com*

Course Specification

Integration project

1. General

Coded	*Inf-CYB 4 1 06*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Bayrem Triki*					Vol. H. (TP)	*21*
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*IT project*					Version	*08/2023*

Course description (Course objective):

- *The objective is to prepare a mini project with the professional and academic life cycle:*
- *the professional side is to analyze the functional and technical specifications as well as the architecture adopted*
- *the academic side is to develop an analytical and conceptual report on the security concepts acquired*

Prerequisites:	*Keywords :*
Basic notions of networks, systems and security	*Security, networks, systems*

Specific course objectives (OBJi):

OBJ 1 : *Aanalyze and criticize the existing*

OBJ 2 : *Define thefunctional and non-functional needs*

OBJ 3 : *Master security concepts*

Necessary material :

-

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Analyze and criticize the existing*	*3*	*Compare existing solutions* *Choose the methodology* *Establish a generic architecture*

3-4	*Propose a generic architecture*	*3*	*Architecture design*
5-11	*security solution*	*10.5*	*Mastery of security concepts*
12-14	*Validate the security solution through testing an attack set*	*4.5*	*Become familiar with several types of security attacks*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Functional and non-functional needs (3 points)*
- *Criterion 2: Modeling (5 points)*
- *Criterion 3: Development (7 points)*
- *Criterion 4: Presentation (5 points)*

5- Bibliographic and Online References

- *Céline Martinet Sanchez , "Gérez votre projet informatique facilement", 2023 https://openclassrooms.com/fr/courses/4192086-gerez-votre-projet-informatique-facilement*
- *Openmind Tech, "Les 6 étapes d'un projet informatique : De l'idée au produit technologique en ligne" https://www.openmindt.com/fr/ressources/6-etapes-projet-informatique-idee-au-produit-technologique/*

6- Working environment (Facilities necessary for learning)

- *No specific learning environment is required*

Course Specification

Artificial Intelligence 1

1. General

Coded	*Inf-CYB 4 1 07*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*21*
Responsible	*Farah Jemili*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*10*
Module	*Artificial Intelligence 1*					Version	*08/2023*

Course description (Course objective):

The objective of this subject is to provide students with a comprehensive introduction to artificial intelligence (AI) by addressing several fundamental aspects. The main axes of this training include:

Introduction to AI:

- *Definition of artificial intelligence and exploration of its main applications.*
- *Understanding the historical evolution of AI.*
- *Introduction to AI programming using Python on the Google Colab platform.*

AI approaches in the field of Security:

- *Exploration of different approaches to AI, whether symbolic or connectionist.*
- *Identification of specific applications of AI in the field of Security*

Machine learning:

- *Gain an in-depth understanding of fundamental machine learning concepts.*
- *Differentiation between supervised learning and unsupervised learning.*

Big Data techniques and data preparation:

- *Recognition of the importance of Big Data in AI.*
- *Application of data preparation techniques for AI processing.*

Classification and regression models:

- *Explaining the differences between classification and regression.*
- *Analysis of case studies to illustrate the application of these models.*

Deepening unsupervised learning:

- *Understanding of concepts such as clustering and dimension reduction in unsupervised learning.*
- *Practical application of these concepts to concrete problems.*

Integration of practical case studies:
- *Solving real-world problems using case study examples.*
- *Application of the methods learned to Security mechanisms.*

Exploring the ethical implications of AI:
- *Discussion of ethical issues related to AI.*
- *Proposal of solutions to mitigate ethical risks.*

Development of programming skills for AI:
- *Use of programming languages such as Python.*
- *Implementation of basic AI algorithms.*

Evaluation and interpretation of AI model performance:
- *Use of appropriate evaluation metrics.*
- *Interpretation of model results and proposal for improvements.*

Preparing students for the constant evolution of AI:
- *Tracking emerging trends in AI.*
- *Provision of resources for continuous self-study.*

These objectives provide a comprehensive path, from theory to practice, with an emphasis on ethical relevance and preparing students to evolve in the dynamic field: artificial intelligence.

Prerequisites:	*Keywords :*
Basic notions of artificial intelligence such as machine learning and knowledge base construction.	*Artificial intelligence, Python, learning, machine learning, deep learning, Big data, knowledge base, intelligent agent, expert system……*

Specific course objectives (OBJi):
OBJ 1 : *Introduction to AI (Definitions, histories, fields of application, programming languages).* ***OBJ 2 :*** *Recognize the role of AI in the security field.* ***OBJ 3 :*** *Use machine learning techniques to proactively detect threats and potential attacks against computer systems, networks and datasensitive.* ***OBJ 4 :*** *Machine Learning with Python (Introduction to Machine Learning: Types of Learning, General Process, Popular Libraries, and Data Preparation)* ***OBJ 5 :*** *Implement AI systems that can detect and prevent intrusions by identifying abnormal behavior and blocking unauthorized access attempts.* ***OBJ 6 :*** *Implement AI systems that can detect and prevent intrusions by identifying abnormal behavior and blocking unauthorized access attempts.* ***OBJ 7 :*** *Integrate AI systems into incident response processes to accelerate the identification, analysis and resolution of security incidents.*

OBJ 8 : *Supervised learning (linear regression and classification algorithms and evaluation of learning models)*

OBJ 9 : *Unsupervised learning (clustering and dimension reduction algorithms)*

Necessary material :

- *A computer equipped with a configuration suitable for resource-intensive tasks, such as a Gaming PC, is highly recommended for working efficiently on Google Colab using Python.*
- *PC has a robust internet connection to ensure fast data downloads and uploads while using Colab.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	***Course 1:****Introduction to AI in Security* - *Overview of the basic concepts of AI and its use in security.* - *History of AI and its evolution.* ***TD 1: Analysis of major contributions*** - *Discussion on concrete applications of AI in security.* - *Analysis of real use cases.*	*1h30*	*OBJ1*
2	***Course 2: Fundamental Concepts of AI*** - *Definition and scope of artificial intelligence.* - *Presentation of the different symbolic and connectionist approaches.* ***Course 3: Applications of AI*** - *Exploration of the various areas of application of AI.* - *Case study on concrete applications.* ***Tutorial 2: Exploration of approaches*** - *Practical exercises to differentiate between symbolic and connectionist approaches.* - *Analysis of examples of AI applications.*	*1h30*	*OBJ2*
3	***Course 4: Importance of Big Data in AI*** - *Exploring the role of Big Data in AI.* - *Discussion of the benefits and challenges of processing big data.* ***Course 5: Data preparation techniques in AI*** - *Presentation of data cleaning, transformation and normalization techniques.* - *Application of these techniques to real datasets.* ***Tutorial 3: Data preparation practice***	*1h30*	*OBJ3*
	- *Practical exercises on large-scale data manipulation.* - *Using popular tools and libraries.*		

4	***Course 6: Importance of Data Analysis in AI*** - *Discussion on the critical role of data analytics in the AI process.* - *Case study on successful projects.*	*1h30*	*OBJ4*
5	***Course 7: Data Division Techniques*** - *Exploring data splitting methods for model training and evaluation.* - *Application of these techniques to specific scenarios.*	*1h30*	*OBJ4*
6	***Tutorial 4: Application of data division techniques*** - *Practice of dividing data on case studies.* - *Evaluation of model performance.*	*1h30*	*OBJ4*
7	***Course 8: Fundamentals of Machine Learning*** - *Introduction to supervised learning and its use to detect anomalies in security data.* - *Overview of regression and classification concepts.* - *Supervised learning for anomaly detection* ***Tutorial 4: Machine learning*** - *Exploring Datasets* - *Identifying relevant features for different security scenarios* ***Course 9: Case studies in supervised learning*** - *In-depth analysis of case studies with corrected examples.* - *Performance evaluation of supervised models.*	*1h30*	*OBJ5-6*
8	***Tutorial 5: Practical application in supervised learning*** *Implementing Simple Linear Regression Algorithms* *Implementing Multiple Linear Regression Algorithms* *Evaluation of results in the security area*	*1h30*	*OBJ5*
9	***Tutorial 6: Practical application in supervised learning*** - *Implementation of Classification algorithms* - *Implementation of binary classification algorithms “logistic regression”* - *Evaluation of results on real datasets.*	*1h30*	*OBJ5*
10	***Course 10: Concepts of Unsupervised Learning*** - *Exploration of the concepts of clustering and dimension reduction.* - *Differentiation with supervised learning.*	*1h30*	*OBJ6*
11-12	***Course 11: Application of learning techniques*** unsupervised - *Use of clustering methods on specific issues.* - *Analysis of results and interpretations.*	*3h*	*OBJ6*
13-14	**Tutorial 6: Practical application in unsupervised learning** - *Implementation of clustering and dimension reduction*	*3h*	*OBJ6*

	algorithms. - *Presentation of results on concrete cases.*		

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***TP 1: Application of AI in the field of Security and Installation of the development environment*** - *Installing Python and commonly used AI libraries like TensorFlow, PyTorch, and Scikit-learn.* - *Configuring the development environment for security experiments.* - *Simple programming of security mechanisms using AI concepts.*	*3h*	*OBJ1*
3-4	***TP2: Data preprocessing and linear regression*** - *Exploring data preprocessing techniques for security applications.* - *Data cleaning, normalization, and feature extraction.* - *Implementing Data Preprocessing Pipelines in Python*	*3h*	
5-6	***Lab 3: Introduction to machine learning*** - *Fundamental concepts of machine learning.* - *Exploration of types of learning (supervised, unsupervised).*	*3h*	
7-8	***TP 4: Supervised learning for anomaly detection*** - *Implementation of an anomaly detection model with Python.* - *Implementation of a linear regression model with Python and scikit-learn.* - *Application of linear regression to predict security-related variables.*	*3h*	*OBJ2*
9-10	***TP 5: Classification with decision trees*** - *Introduction to decision tree algorithm and its use for classification.*	*3h*	
	- *Using decision trees for network activity classification.* - *Implementing a decision tree model with Python.*		
11-12	***TP 6: Supervised learning for intrusion detection*** - *Application of supervised models for intrusion detection.* - *Use of classification techniques such as logistic regression or support vector machines (SVM).*	*3h*	*OBJ3*

13-14	***TP 7: Unsupervised learning for threat detection*** - *Exploring unsupervised learning for threat and attack detection.* - *Implemented a clustering model to identify patterns of suspicious behavior.*	*3h*	*OBJ4*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Mastery of programming in python with Google Colab (4 points)*
- *Criterion 2: Effective use of machine learning (8 points)*
- *Criterion 3: Big Data management and implementation of unsupervised learning algorithms (8 points)*
- *Criterion 4: Quiz and test for assessing theoretical knowledge in AI.*

6- Bibliographic and Online References

- *Steven L. and Kutz Brunton, "Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control", Cambridge University Press, 2022*

- *Guillaume Saint-Cirgue, "Complete Machine Learning training", 2019 https://www.youtube.com/playlist?list=PLO_fdPEVlfKqUF5BPKjGSh7aV9aBshrpY*
- *Guillaume Saint-Cirgue, "SKLEARN French Machine Learning tutorial", 2019 https://www.youtube.com/playlist?list=PLO_fdPEVlfKoHQ3Ua2NtDL4nmynQC8YiS*
- *Guillaume Saint-Cirgue, "PYTHON SPECIAL MACHINE LEARNING", 2020 https://www.youtube.com/playlist?list=PLO_fdPEVlfKqMDNmCFzQlSI2H_nJcEDJq*
- *Simplilearn, "Machine Learning Tutorial: A Step-by-Step Guide for Beginners", 2023 https://www.simplilearn.com/tutorials/machine-learning-tutorial*

7- Working environment (Facilities necessary for learning)

- *Use Google Colab to install Python: https://colab.research.google.com/*
- *Development environment (Editor), "Jupyter Notebook" https://docs.jupyter.org/en/latest/install.html*

- *Python environment, “Anaconda”*
  https://www.anaconda.com/download/
- *Python Libraries for Machine Learning, “SicKitLearn (and any other necessary libraries)”*
  https://scikit-learn.org/stable/install.html

Course Specification

Advanced databases

1. General

Coded	*Inf-CYB 4 1 08*	Level	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Houssem Chtioui*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*Advanced databases*					Version	*08/2023*

Course description (Course objective):
- *Become the administrator of your database* - *Migrate from the relational model to the Object model using the Relational Object Model* - *Become familiar with the notions of SQL3* - *Introduction to multidimensional bases and implementation of a multidimensional diagram (Star, Snowflake or Constellation)*

Prerequisites:	*Keywords :*
- *Relational model (structure, constraints, SQL2, PL/SQL)*	- *Database administration* - *Relational Object Databases* - *Multidimensional databases*

Specific course objectives (OBJi):
OBJ 1 : *Control database access* ***OBJ 2 :*** *Authorize access to database objects* ***OBJ 3 :*** *Manage privileges, roles and synonyms* ***OBJ 4 :*** *Manage views and user profiles* ***OBJ 5 :*** *Manage transactions & use Oracle Data Dictionary* ***OBJ 6 :*** *Master abstract data types as well as methods.* ***OBJ 7 :*** *Explore SQL3 & fundamental concepts of Object-Relational databases.*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1, 2	***TP1/*** - *Reminder: Creation of tables, insertion into tables, addition of constraints* - *Creating simple views* - *Querying the data dictionary to consult the different integrity constraints and views*	*3*	***OBJ 1:*** - *Reminder* - *Consulting the data dictionary*
3,4,5	***TP2/*** - *Migration between the SYSTEM user (the administrator) and a newly created user (with profiles) and injection of privileges according to the latter's needs.* - *Creation of synonyms for a view of TP 1 and reception of object privileges by the administrator for this view.* - *Inserting into a simple view*	*4.5*	***OBJ 2 & OBJ 3:*** - *Know the difference between a newly created user (without privileges) and between the administrator.*
6,7,8	***TP3/*** - *Creation of complex views and knowing the conditions for modifying these views (querying the system view (USER_UPDATABLE_COLUMNS) to find out if these views are modifiable or not* - *Querying the data dictionary and administering the database using information collected from system views (USER_VIEW, USER_CONSTRAINTS, USER_SYNONYMS, All_USERS, USER_TABLES, etc.)*	*4.5*	***OBJ 4 & OBJ 5:*** - *Know the structure of the data dictionary and how to use it to obtain the appropriate system views to administer your database.* - *Know the differences between system views according to their prefixes (USER_.., ALL_.., DBA_...)* - *The differences between simple and complex views* - *Transaction management*
9,10	***TP4 /*** - *Modeling an object database from a textual description* - *Creating abstract data types* - *Creation of object tables* - *Insertion into object tables*	*3*	***OBJ 6:*** - *Modeling an object database with the minimum of tables* - *Adding different abstract data types (VARRAY, NESTED TABLE, OBJECT) and arguing the choices.* - *Creating Object tables*

			- *Insertion into object tables*
11,12,13	***TP5 /***	*4.5*	***OBJ 7:***
	- *Querying object tables and extracting information* - *Modifying abstract data types and adding methods and implementations of their body using PLSQL functions and procedures*		- *Implementing PL-SQL methods and querying the object database*
14	- *Mini project*	*1.5*	- *Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1 (4 points): creation of users (using profiles) and adding privileges*
- *Criterion 2 (4 points): Views, transactions and querying the data dictionary*
- *Criterion 3 (7 points): Creation of abstract data types and creation of object tables + data insertion.*
- *Criterion 4 (5 points): Methods of abstract data types and data querying.*

6- Bibliographic and Online References

- *C. Soutou, SQL for Oracle, Eyrolles, 2015*
- *Databases, JL Hainaut, Dunod, 2012*
- *Programming objects with Oracle, Vuibert, 2004*
- *Frank Ravat, Models and tools for the design and manipulation of decision support systems, habilitation dissertation, Toulouse University (I and II) 2007.*

7- Working environment (Facilities necessary for learning)

- *Oracle (latest version), https://www.oracle.com/*

Course Specification

CyberOps 1

1. General

Coded	*Inf-CYB 4 1 09*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity Engineering*					Vol. H. (CI)	*0*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*CyberOps1*					Version	*08/2023*

Course description (Course objective):
This course aims to provide students with CyberOps knowledge. It addresses theoretical aspects as well as practical applications. *This course covers the foundational skills, processes, and knowledge needed to prevent, detect, analyze, and respond to cybersecurity incidents as part of a SOC team.*

Prerequisites:	*Keywords :*
- *PC and Internet navigation skills* - *Basic knowledge of Windows and Linux systems* - *Basic notions of computer networks (CCNA ITN level)* - *Understanding of the binary and hexadecimal system* - *Proficiency in Cisco Packet Tracer*	*Soc, attacks, monitor, wireshark, nmap*

Specific course objectives (OBJi):	
OBJ 1 :	Digital vulnerabilities context
OBJ 2 :	Mastery of security models and schemes
OBJ 3 :	Approach to designing security solutions
OBJ 4 :	Architectures and reference documents

Necessary material:
- PC et Internet

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Install the Virtual Machine - Environment*	*1.5h*	
2	*Learning the Details of Attacks*	*1.5h*	
3	*Visualizing the Black Hats*	*1.5h*	
4	*Exploring Processes, Threads, Handles, and Windows Registry*	*1.5h*	
5	*Monitor and Manage System Resources in Windows*	*1.5h*	
6	*Introduction to Wireshark*	*1.5h*	
7	*Using Wireshark to Examine Ethernet Frames*	*1.5h*	
8	*Exploring Nmap*	*1.5h*	
9	Using Wireshark to Examine TCP and UDP Captures	*1.5h*	
10	Using Wireshark to Examine HTTP and HTTPS Traffic	*1.5h*	
11-14	Mini-project : case study and application	6h	

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

6- Bibliographic and Online References

- https://www.cisco.com/site/us/en/learn/training-certifications/certifications/cybersecurity/associate/index.html
- Omar Santos, "*Cisco Cyberops Associate Cbrops 200-201 Official Cert Guide*", 2021

7- Working environment (Facilities necessary for learning)

- *Cisco Network Academy - CCNA CyberOps Certification*

Course Specification

Foundations of Cybersecurity

1. General

Coded	*Inf-CYB 4 1 10*	Level/Semester	*4/1*	Coefficient	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	*21*
Responsible	*Bayrem Triki*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*CyberSecurity Foundations*					Version	*08/2023*

Course description (Course objective):
Understand network and system security and become familiar with the configuration techniques of the necessary solutions.

Prerequisites:	*Keywords:*
Good knowledge of networks and systems. Security Foundation	*Security, security policy, attacks, intrusion*

Specific course objectives (OBJi):
OBJ 1 : *Context of digital vulnerabilities* ***OBJ 2 :*** *Master security models and diagrams* ***OBJ 3 :*** *Security solution design approach* ***OBJ 4 :*** *Architectures and reference documents*

Necessary material :
PC and Internet

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Cybersecurity issues (cybernetic security)*	*3h*	*OBJ1*
3-4	*Vulnerabilities*	*3h*	*OBJ2*
5-12	*Models and new dimensions of threats*	*12h*	*OBJ3*
13-14	*Safety recommendations and reference documents*	*3h*	*OBJ4*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Cybersecurity issues (cybernetic security)*	*3h*	*OBJ1*
3-4	*Vulnerabilities*	*3h*	*OBJ2*
5-12	*Models and new dimensions of threats*	*12h*	*OBJ3*
13-14	*Case study practical exam,*	*3h*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- https://www.geeksforgeeks.org/installing-openvas-on-kali-linux/
- Dan Weis, B”oardroom Cybersecurity: A Director's Guide to Mastering Cybersecurity Fundamentals”, Springer, s2024

6- Working environment (Facilities necessary for learning)

- Ubuntu, Kali, Openvas, …

Course Specification

Applied Cryptography

1. General

Coded	*Inf-CYB 4 1 11*	Level/Semester	*4/S1*	Coef	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	*21*
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Cryptography*					Version	*08/2023*

Course description (Course objective):
• *Getting acquainted with Cryptosystems* • *To understand basics of Cryptograph* • *To be able to secure a message over insecure channel by various means* • *To learn about how to maintain the Confidentiality, Integrity and Availability of a data*

Prerequisites:	*Keywords :*
Computer Security	cryptosystems, *cryptography, encryption/decryption, digital signature, certifications, electronic payment architecture*

Specific course objectives (OBJi):
OBJ 1 : *Acquire fundamental knowledge of cryptography techniques.* ***OBJ 2 :*** *Acquire knowledge of encryption/decryption methods* ***OBJ 3 :*** *Acquire knowledge of hashing methods, digital signature and certifications* ***OBJ 4 :*** *Acquire knowledge of electronic payment architecture.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter I: Cryptography technique*	*3:00*	*OBJ1*
3-4	*Chapter II: Modern Encryption*	*3:00*	*OBJ2*
5-6-7-8	*Chapter III: Cryptographic algorithms*	*6:00*	*OBJ2*
9-10-11-12	*Chapter IV: Hashing, digital signature and certification*	*6:00*	*OBJ2*
13-14	*Chapter V: Electronic payment architecture*	*3:00*	*OBJ3*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- https://www.openssl.org/
- Panos Louridas , “Cryptography”, **The MIT Press**, 2024
- William Stallings, “Crpyptography and Network security Principles and Practices”, Pearson/PHI.
- Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with coding theory”, Pearson.

6- Working environment (Facilities necessary for learning)

- Ubuntu, Kali, Openvas, …

Course Specification

Network Security I

1. General

Coded	*Inf-CYB 4 1 12*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Moez Hashem*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Network Security I*					Version	*08/2023*

Course description (Course objective):
Ensure network security by means of the necessary configurations on equipment

Prerequisites:	*Keywords:*
CCNA 1	*…*

Specific course objectives (OBJi):

OBJ 1 : *Secure Static/dynamic routing*

OBJ 2 : *Authentication between devices (OSPF/EIGRP)*

OBJ 3 : *SSH configuration, Radius/TACACS server, AAA*

Necessary material:
Packet Tracer /virtualBOX

2- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Network security reminder*	*3*	*OBJ1*
3-4	*Insecure Routing Rip 1*	*3*	*OBJ1*
5-6	*Rip 2 Secure Routing*	*3*	*OBJ1*
7-8	*Secure EIGRP/OSPF2 routing*	*3*	*OBJ2*
9-10	*OSPF/EIGRP Secure Routing Lab*	*3*	*OBJ2*
11-12	*TPRADIUS/TACACS/AAA*	*3*	*OBJ3*
13-14	*Case study and mini project*	*3*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- *https://www.netacad.com/fr/courses/networking/ccna-enterprise-networking-security- automation*
- *William Stallings, Network Security Essentials: Applications and Standards, 2016*

6- Working environment (Facilities necessary for learning)

- Packet Tracer

Course Specification

Systems Administration I

1. General

Coded	*Inf-CYB 4 1 13*	Level/Semester	*4/S1*	Coef	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	*21*
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*60*
Module	*Systems Administration 1*					Version	*08/2023*

Course description (Course objective):
Gain skills in installing and configuring Windows Server 2019. *Acquire skills to master the configuration of a domain controller.*

Prerequisites:	*Keywords :*
Windows operating system *DNS* *DHCP*	*Windows* *DNS* *DHCP*

Specific course objectives (OBJi):
OBJ 1 : *Learn to use PowerShell and the Windows shell* ***OBJ 2 :*** *Acquire skills to perform administrator tasks (user management, group management, network access, etc.)* ***OBJ 3 :*** *Gain skills for configuring and implementing DNS and DHCP*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter 1 : Deploying and managing Windows Server*	*3:00*	*OBJ1*
2	*Chapter 2: Introduction to Windows Server 2019*	*3:00*	*OBJ2*

3	*Chapter 3: Introduction to Active Directory Domain Services*	*3:00*	*OBJ2*
4-5	*Chapter 4: Installing and Configuring Windows Server 2019*	*6:00*	*OBJ2*
6-7	*Chapter 5: Installing and configuring a domain controller (DC)*	*6:00*	*OBJ3*
8-9	*Chapter 6: Managing objects in AD DS*	*6:00*	*OBJ4*
10-11	*Chapter 7: Configuring DNS*	*6:00*	*OBJ5*
12-13	*Chapter 8: Implementing DHCP*	*6:00*	*OBJ5*
14	*Chapter 9: Configuring and Troubleshooting VPN Remote Access*	*3:00*	*OBJ6*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*TP1: Installation and Configuration of Windows Server 2019*	*3:00*	*…*
3-4	*TP2: Installing and configuring a domain controller*	*3:00*	*…*
5-6	*TP3: User account management*	*3:00*	
7-8	*TP4: Group management and strategies*	*3:00*	
9-10	*TP5: Managing computer accounts*	*3:00*	
11-12	*TP6: Installation and configuration of the DNS role*	*3:00*	
13	*TP7: Installing a DHCP server*	*3:00*	
14	*Practical exam, mini-project defense, …*	*3:00*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Methodology for solving the problem (5 points)*
- *Criterion 2: Interpretation of results (10 points)*
- *Criterion 3: Presentation and writing of the report (5 points)*

5- Bibliographic and Online References

- *https://learn.microsoft.com/fr-fr/training/paths/windows-server-deployment-configuration-administration/*
- Nicolas Bonnet, « Windows Server 2022 : Les bases indispensables pour administrer et configurer votre serveur », **Eni** , 2022

6- Working environment (Facilities necessary for learning)

- Logicien (VM) : Windows server 2019, Windows 10

Course Specification

Cloud Computing Services (Azure)

1. General

Coded	*Inf-CYB 4 2 03*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Cloud Computing Services*					Version	*08/2023*
Course description (Course objective):							
The objective of this course is to acquire the basic and fundamental notions of the Azure cloud to prepare for the Azure AZ900 certification exam							

Prerequisites:	*Keywords :*
Basic notions of computer science (networks, databases, etc.)	*Certification, AZ900, Cloud computing*

Specific course objectives (OBJi):

- ***OBJ 13 :*** Cloud concepts
- ***OBJ 14 :*** *The main cloud services*
- ***OBJ 15 :*** *Core solutions and management tools*
- ***OBJ 16 :*** *Azure Security and Network Securing*
- ***OBJ 17 :*** *Identity, governance, privacy and compliance features*
- ***OBJ 18 :*** *Managing Azure costs and SLAs*

Necessary material :

Nothing specific

2- Content elements (Practical work)

Days)	Chapters/Content Items	No. HR	Goals
1-2	- *Benefits and considerations of using the Cloud (High availability, Scalability, Elasticity, Fault tolerance, Disaster recovery, economic benefits)*	*3h*	*Cloud concepts*

	- *The 3 categories of Cloud (IaaS, PaaS, SaaS, shared responsibility, serverless computing)* - *The 3 types of Cloud (Public, Private, Hybrid, synthesis of the 3 types)*		
3-4	- *The components of the Cloud architecture (region, availability zone, management group, resource group, Azure Resources Manager)* - *Basic Azure resources (Azure Marketplace, Network Management, Storage Management, Data Management)*	*3h*	*The main cloud services*
5-6	- *The main solutions (IoT, Big Data, AI, Serverless Solutions, Development Solutions)* - *Azure management tools (Azure Portal, Online Ordering, Mobile Apps, Senior Advisor, Monotoring and Health)*	*3h*	*Core solutions and management tools*
7-8	- *Security features (Azure security center, key vault, Azure Sentinel, dedicated hosts)* - *Network security (defense in depth, security groups, Azure firewall, Azure DDOS)*	*3h*	*Azure security and network security*
9-10	- *The main identity services (Azure AD, Conditional Access, Authentication and Authorization, SSO, MFA)* - *Governance features (RBAC, Resource Locks, Labels, Azure Policy, Azure Blueprints)* - *Privacy and compliance resources (fundamentals, trust center, compliance documentation, sovereign regions)*	*3h*	*Identity, governance, privacy and compliance features*
11-13	- *Planning and cost management methods (Expense factors, calculators, Azure cost management, reduction factors)* - *SLA management and service life cycle (SLA objectives, Actions on SLA, Service life cycle)*	*9h*	*Managing Azure costs and SLAs*
14	- *certification exam*	*3h*	*OBJ 1 .. OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
EE - Written test (MCQ)	*100%*
Certification exam (Microsoft Azure Fundamentals - AZ900)	-

4- Evaluation criteria

- *Criterion 1: Describe cloud concepts (25–30%)*
- *Criterion 2: Describe Azure architecture and services (35–40%)*
- *Criterion 3: Describe Azure management and governance (30–35%)*

5- Bibliographic and Online References

- *Microsoft Azure Certifications: AZ900 Fundamentals courses*
- *Philippe Païola and Seyfallah Tagrerout, « Microsoft Azure: gérez le système d'information et les identités hybrides en entreprise » 2024*

6- Working environment (Facilities necessary for learning)

- *Nothing specific*

Course Specification

Native Mobile Development 2 (Android)

1. General

Coded	*Inf-CYB 4 2 04*	Level	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Oussema Elmir*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Native mobile development 2*					Version	*08/2023*

Course description (Course objective):

The main objective of this workshop is to equip students with essential practical skills to enable them to independently specify, design and develop Android mobile applications :

- *Understand Android OS, gradle, Android Studio.*
- *Debug Android Application*
- *Develop UI based Mobile Application using Android Studio.*
- *Design application for Mobile using various sensors.*
- *Design and develop an application using Database.*
- *Adapt to learn new mobile technologies.*

Prerequisites:	*Keywords :*
Fundamentals of object-oriented programming	*Android, java, Kotlin, Activity, service, intent, layout, gradle, manifests, broadcastReciver*

Specific course objectives (OBJi):

OBJ 1 : *Design User-friendly User Interfaces (Apply Android user interface design principles to create attractive and functional user interfaces.)*

OBJ 2 : *Manage Data (Learn how to store, retrieve and manipulate data efficiently, using local databases, web services and other data sources)*

OBJ 3 : *Ensure Navigation (Manage navigation between the different views of the application.)*

OBJ 4 : *Integrate Advanced Features (Explore and implement advanced features such as sensor integration, geolocation, use of cameras, etc.)*

Necessary material :
Powerful computer (example configuration: 10th generation i5/i7 processor 16 GB RAM)

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Getting to know the Android Studio environment* *Emulator/Smartphone configuration*	*1.5 hours*	*OB1*
2	*Structure of an Android project/Components of an Android Application*	*1.5 hours*	*OB1*
3	*Explicit data transmission intents*	*1.5 hours*	*Ob3*
4	*Implicit intents and permission management*	*1.5 hours*	*OB3*
5	*Static and dynamic Fragments*	*1.5 hours*	*OB1*
6	*Option menus and Contextual Menus*	*1.5 hours*	*OB1, OB3*
7	*ListView, Spinner, GridView and adapters*	*1.5 hours*	*OB1, OB3*
8	*RecycleView with Kotlin*	*1.5 hours*	*OB1, OB3*
9	*Access to local data (SQLite)*	*1.5 hours*	*OB1, OB2, OB3*
10	*The Room persistence library (with Kotlin)*	*1.5 hours*	*OB1, OB2, OB3*
11	*Hands-on exploration of Firebase with Kotlin*	*1.5 hours*	*OB1, OB2, OB3*
12	*Access to device functionalities (Geolocation, etc.)*	*1.5 hours*	*OB1, OB3, OB4*
13-14	*Mini-project defense*	*3 hours*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Drafting of the specifications (3 points)*
- *Criterion 2: Mastery of the code (5 points)*
- *Criterion 3: Deployment of the application (4points)*
- *Criterion 4: Innovative aspect of the application (3points)*
- *Criterion 5: Presentation of the project (5 points)*

5- Bibliographic and Online References

- *Principes de base d'Android avec Compose https://developer.android.com/courses?hl=fr*
- *Jetpack Compose pour les développeurs Android https://developer.android.com/courses?hl=fr*
- *Reto Meier, "Profession Android Application Development", Wrox Publication*
- *Marko Gargenta and Masumi Nakamura, "Learning Android" O'REILLY*
- *Lucas Jordan and Peiter Greyling, "Practical Android Projects", Apress*

6- Working environment (Facilities necessary for learning)

- *Android Studio https://developer.android.com/studio*

Course Specification

Artificial Intelligence II

1. General

Coded	*Inf-CYB 4 2 05*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*21*
Responsible	*Farah Jemili*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*10*
Module	*Artificial Intelligence II*					Version	*08/2023*

Course description (Course objective):

The objective of this subject is to familiarize students with the fundamental principles of artificial intelligence (AI) by addressing several key aspects. It aims to:

- *This course explores the application of artificial intelligence in the specific context of Amazon, one of the largest e-commerce platforms in the world. The goal is to understand how AI is used at Amazon to improve business operations, optimize user experience, and maintain its market leadership position.*
- *Topics Covered: The course covers different themes such as optimizing product recommendations, personalizing the user experience, predicting demand and inventory management, fraud detection and transaction security, as well as improving customer services with intelligent chatbots and virtual assistants.*
- *Methods and Tools: Students will be introduced to machine learning and data analysis methods used at Amazon. They will learn how to manipulate large data sets, develop predictive models, and use tools such as TensorFlow, scikit-learn, and AWS (Amazon Web Services) to implement AI solutions.*
- *Practical Projects: The course will include practical projects where students will have the opportunity to apply the concepts and techniques learned to solve real-world problems encountered at Amazon. Projects could include optimizing recommendation algorithms, fraud detection, improving customer service chatbots, and more.*

These objectives provide a comprehensive approach, from fundamental concepts to mastery of advanced techniques, it aims to forge a deep understanding of AI with particular attention to ethical implications and preparing students to evolve in the ever-evolving field of artificial intelligence applied in the field of security

Prerequisites:	*Keywords :*
python programming introduction	*Artificial intelligence, python,*Big Data,*machine learning, deep learning,*turing,*neural networks, symbolic logic. expert systems, robotics, natural language processing and supervised and unsupervised learning*

Specific course objectives (OBJi):
OBJ 1 : *Develop learning algorithms to improve the accuracy of recommendations, based on user preferences.* ***OBJ 2 :*** *Anticipate product demand and optimize inventory management to maintain an adequate level while minimizing costs.* ***OBJ 3 :*** *Understand the basics of supervised machine learning, differentiate from classification regression, and analyze case studies with corrected examples* ***OBJ 4 :*** *Use AI to detect suspicious behavior and prevent fraud, ensuring the security of transactions on the platform.* ***OBJ 5 :*** *Develop intelligent chatbots to answer customer questions and provide personalized support 24/7* ***OBJ 6 :*** *Use natural language processing to analyze user feedback and improve products and services based on feedback.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	***Course 1:****Introduction to AI at Amazon* - *Presentation of the course and objectives.* - *Introduction to Amazon and its different platforms and services.* - *Exploring AI application areas at Amazon, such as recommendation personalization, logistics, customer service, etc.*	*1h30*	*OBJ1*
2	***Course 2: Recommender Systems*** - *Understanding of recommendation systems and their importance to Amazon.* - *Overview of AI techniques used for recommendation personalization, such as collaborative filters, matrix factorization methods, etc.* ***TD1: Case study:***	*1h30*	*OBJ2*

	- Analysis of Amazon recommendation algorithms and their impact on user experience.		
3	***Course 3: Natural Language Processing (NLP)*** - *Introduction to NLP and its applications at Amazon, such as Alexa chatbot, product search, etc.* - *Exploration of the main tools and techniques of NLP, word processing, text classification and natural language generation, etc.* ***TD 2: Case study*** - *text classification, natural language generation*		OBJ2
4	***Course 4: Computer Vision*** - *Presentation of computer vision and its applications at Amazon, notably in fraud detection, inventory management, etc.* - *Analysis of computer vision algorithms and models, such as convolutional neural networks (CNN).* ***TD 3: Case study:*** - *Applying computer vision to product image classification on Amazon.* ***Course 5: Logistics and supply chain*** - *Discussion on the use of AI in logistics and supply chain management at Amazon.* - *Overview of optimization and forecasting techniques used to improve operational efficiency.* ***TD4: Case study:*** - *Modeling a logistics and distribution problem using AI techniques.*	1h30	OBJ3
5	***Course 6: Machine Learning at Amazon*** - *Exploring the various applications of machine learning at Amazon, such as fraud detection, ad personalization, and more.* - *Overview of commonly used machine learning algorithms, such as decision trees, random forests, support vector machines (SVM), etc.* ***TD 5: Case study:*** - *Analysis of a real machine learning project at Amazon.*	1h30	OBJ4
6	***Course 7: Data Division Techniques*** - *Exploring data splitting methods for model training and evaluation.* - *Application of these techniques to specific scenarios.*	1h30	OBJ4

7	***Tutorial 4: Application of data division techniques*** - *Practice of dividing data on case studies.* - *Evaluation of model performance.*	1h30	OBJ4
8	***Course 8: Foundations of Supervised Machine Learning*** - *Overview of regression and classification concepts.* - *Differentiation of the two approaches.* ***Course 9: Case studies in supervised learning*** - *In-depth analysis of case studies with corrected examples.* - *Performance evaluation of supervised models.*	1h30	OBJ5
9	***Tutorial 5: Practical application in supervised learning*** - *Implementing Simple Linear Regression Algorithms* - *Implementing Multiple Linear Regression Algorithms* - *Evaluation of results on real datasets.*	1h30	OBJ5
10	***Tutorial 6: Practical application in supervised learning*** - *Implementation of Classification algorithms* - *Implementation of binary classification algorithms "logistic regression"* - *Evaluation of results on real datasets.*	1h30	OBJ5
11	***Course 10: Concepts of Unsupervised Learning*** - *Exploration of the concepts of clustering and dimension reduction.* - *Differentiation with supervised learning.*	1h30	OBJ6
12	***Course 11: Application of learning techniques***unsupervised - *Use of clustering methods on specific issues.* - *Analysis of results and interpretations.*	1h30	OBJ6
13-14	**Tutorial 6: Practical application in unsupervised learning** - *Implementation of clustering and dimension reduction algorithms.* - *Presentation of results on concrete cases.*	3h	OBJ6

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***TP 1: Data analysis*** - *Installation of Python and the necessary libraries (pandas, numpy, matplotlib).* - *Data manipulation with pandas: data loading, data exploration, descriptive statistics.*	*3h*	*OBJ1*
3-4	***TP2: Data visualization*** - *Using matplotlib and seaborn to create graphs: histograms, bar charts, scatter plots.* - *Interpreting visualizations to understand data characteristics.*	*3h*	*OBJ1*
5-6	***TP 3: Data preprocessing*** - *Data cleaning: management of missing values, removal of duplicates.* - *Data transformation: normalization, encoding of categorical variables.*	*3h*	*OBJ1*
7-8	***TP 4: Natural language processing (NLP)*** - *Introduction to natural language processing with the NLTK library.* - *Text analysis: tokenization, lemmatization, vectorization.*	*3h*	*OBJ2*
9-10	***TP 5: Supervised learning - Classification*** - *Introduction to classifiers: k-nearest neighbors, decision trees.* - *Evaluation of classification models: precision, recall, ROC curve.*	*3h*	*OBJ2*
11-12	***TP 6: Supervised learning - Neural networks*** - *Introduction to neural networks with TensorFlow/Keras.* - *Construction of a simple neural network for handwritten digit image classification (MNIST).*	*3h*	*OBJ3*
13-14	***TP 7: Unsupervised learning - Clustering*** - *Using k-means to cluster unlabeled data.* - *Visualization of the clusters obtained.*	*3h*	*OBJ4*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: A thorough understanding of fundamental AI concepts.(4 points)*
- *Criterion 2: Effective use of machine learning(8 points)*
- *Criterion 3: Big Data management and implementation of unsupervised learning algorithms (8 points)*
- *Criterion 4: Quiz and test for assessing theoretical knowledge in AI.*

6- Bibliographic and Online References

- *https://aws.amazon.com/fr/machine-learning/*
- *Patrick Wampé , Machine Learning et Deep Learning : Des bases à la conception avancée d'algorithmes, 2021*

7- Working environment (Facilities necessary for learning)

- *Platform AWS*

Course Specification

Linux Services Security (CEH)

1. General

Coded	*Inf-CYB 4 2 07*	Level/Semester	*4/S2*	Coef	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	*24*
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	*18*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*CEH Linux Services Security*					Version	*08/2023*

Course description (Course objective):

Prerequisites:	*Keywords :*
Linux operating system *Database* *Computer networks and protocols*	*Linux, Computer network, Computer protocols, Database*

Specific course objectives (OBJi):

OBJ 1 : *Gain knowledge of advanced tools and techniques used by ethical hackers and IT security professionals.*

OBJ 2 : *Acquire scanning skills; test, hack and secure a system*

OBJ 3 : *Acquire skills to master the five phases of ethical hacking: Reconnaissance, Obtaining access, Enumeration, Maintaining access and Cleaning up traces*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	Chapter 1: Introduction to Ethical Hacking	*3h*	…
2	Chapter 2: Footprinting and Reconnaissance	*3h*	…
3	Chapter 3: Scanning Networks	*3h*	…

4	Chapter 4: Enumeration	*3h*	
5	Chapter 5: Vulnerability Analysis	*3h*	
6	Chapter 6: System Hacking	*3h*	
7	Chapter 7: Malware Threats	*3h*	
8	Chapter 8: Sniffing	*3h*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
9	*TP:* Footprinting and Reconnaissance	*3h*	…
10	*TP:* Scanning Networks	*3h*	…
11	*TP:* Enumeration	*3h*	
12	*TP:* Vulnerability Analysis	*3h*	
13	*TP:* System Hacking	*3h*	
14	*TP:* Sniffing	*3h*	

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1: working methodology (3 points)*
- *Criterion 2: presentation and writing of the report (3 points)*
- *Criterion 3: interpretation of results (8 points)*
- *Criterion 4: proposed solutions (6 points)*

6- Bibliographic and Online References

- *https://www.kali.org/*
- *https://github.com/*
- *https://tryhackme.com/*
- *Ric Messier, "CEH v12 Certified Ethical Hacker Study Guide with 750 Practice Test Questions", Wiley, 2023*

7- Working environment (Facilities necessary for learning)

- *Software (VM): Kali Linux, Ubuntu, Windows 10*

Course Specification

CyberOps II

1. General

Coded	*Inf-CYB 4 2 08*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*CyberOps 2*					Version	*08/2023*

Course description (Course objective):

This course aims to provide students with CyberOps knowledge. It addresses theoretical aspects as well as advanced practical applications.

This course covers the foundational skills, processes, and knowledge needed to prevent, detect, analyze, and respond to advanced cybersecurity incidents as part of a SOC team.

Prerequisites:	*Keywords :*
- *PC and Internet navigation skills* - *Basic knowledge of Windows and Linux systems* - *Basic notions of computer networks (CCNA ITN level)* - *Understanding of the binary and hexadecimal system* - *Proficiency in Cisco Packet Tracer*	*Malware, sql inection, openssl, snort, exploit, incident handling*

Specific course objectives (OBJi):

OBJ 1 : *Acquire the knowledge of a security operations center (SOC)*

OBJ 2 : *Acquire the knowledge and skills necessary to support the tasks and responsibilities of an entry-level cybersecurity analyst working in a Security Operations Center (SOC).*

Necessary material :

- *Minimum system requirements for PCs*
- *CPU: Intel Pentium 4, 2.53 GHz or equivalent with virtualization support*
- *Operating systems, such as Microsoft Windows, Linux and Mac OS*
- *64-bit processor*

- *RAM: 8 GB*
- *Storage: 10 GB of available disk space*
- *Display resolution: 1024 x 768*
- *Language fonts supporting Unicode encoding (when displayed in languages other than English)*
- *Latest video card drivers and operating system updates*
- *Internet connection for student computers and those in practical workshops*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Anatomy of Malware*	*3h*	
2	*Attacking a mySQL Database*	*3h*	
3	*Reading Server Logs*	*3h*	
4	*Encrypting and Decrypting Data Using OpenSSL*	*3h*	
5	*Encrypting and Decrypting Data Using a Hacker Tool*	*3h*	
6	*Examining Telnet and SSH in Wireshark*	*3h*	
7	*Certificate Authority Stores*	*3h*	
8	*Snort and Firewall Rules*	*3h*	
9	Extract an Executable from a PCAP	3h	
10	Interpret HTTP and DNS Data to Isolate Threat Actor	3h	
11	Isolate Compromised Host Using 5-Tuple	3h	
12	Investigating a Malware Exploit	3h	
13	Investigating an Attack on a Windows Host	3h	
14	Incident Handling	3h	

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- https://www.cisco.com/c/en/us/training-events/training-certifications/certifications/associate/cyberops-associate.html
- https://www.cisco.com/site/us/en/learn/training-certifications/certifications/cybersecurity/associate/index.html
- Omar Santos, “Cisco Cyberops Associate Cbrops 200-201 Official Cert Guide”, 2021

6- Working environment (Facilities necessary for learning)

- Cisco Network Academy - Certification CCNA CyberOps

Course Specification

Cloud Computing and Virtualization

1. General

Coded	*Inf-CYB 4 2 09*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*4*
Course	*Cybersecurity*					Vol. H. (CI)	*0*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*60*
Module	*Cloud Computing and Virtualization*					Version	*08/2023*

Course description (Course objective):

The Virtualization and Cloud Computing course provides an in-depth exploration of fundamental concepts and emerging technologies in the field of virtualization and cloud:

- *Understand the fundamentals of virtualization.*
- *Master server, network and storage virtualization technologies.*
- *Explore the key concepts of Cloud Computing and its benefits.*
- *Acquire a working knowledge of the services.*
- *Analyze security and management challenges in a cloud environment.*
- *Apply the skills acquired through practical work.*

2- Content elements (Practical Work)

Week(s)	TP/Content elements	No. HR	Goals
1-2	*LAB 1: Virtualization* - *Handle a Hypervisor, which allows multiple operating systems to run on a single machine.* - *Understand the benefits of using them.*	*6*	*Introduce the concept of virtualization*
3-4-5	*LAB 2: KVM* - *Mastery of KVM with its management tools* *Install KVM and its management tools* *Create a VM with virt-manager* *Administration with virsh* *Create VMs with virt-install*	*9*	*Paravirtualization with KVM*

	Access the console (graphic and text) - Creating a virtual network using KVM		
6-7-8	LAB 3: Virtualization of an infrastructure - Deployment of a virtual infrastructure. - Configuring static IP addresses. - Configuring static routing. - Familiarization with commands, files and configuration interfaces specific to operating systems: Linux, MS Windows in a virtual architecture. - Diagnosis of network operation. - Identify the difference between administering a network with physical machines and virtual machines.	9	Virtualization of an infrastructure
10-11	LAB 4: Docker - Getting to know Docker, a popular containerization platform, using Ubuntu 18 as the host operating system - Learn how to install Docker - Create containers - Manage containers - Understand the key concepts of containerization.	6	Docker
12-13	Lab 5: Docker Compose - Installation and Configuration - Creating a Compose File - Deploying a Simple Application - Service Management - Environment Variables and Secrets - Shared Volumes	6	Docker Compose
14	Case study	3	Summative Evaluation

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	20%
DS - Supervised Duty	-

EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- *Jean-Pierre Briffaut and François Stéphan, « Cloud computing : Evolution technologique, révolution des usages ».*

6- Working environment (Facilities necessary for learning)

- *VirtualBox*
- *Ubuntu*

Course Specification

Systems Administration II

1. General

Coded	*Inf-CYB 4 2 10*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*Systems Administration II*					Version	*08/2023*

Course description (Course objective):

Master advanced Windows Server concepts and also acquire the skills and knowledge necessary to manage :

- *core Windows Server workloads and services using on-premises*
- *hybrid and cloud technologies.*

Prerequisites:	*Keywords :*
Systems Administration I	*AD, Replication, Certificate Authority, VPN*

Specific course objectives (OBJi):

OBJ 1 : *Master scripts on Windows server*
OBJ 2 : *Master AD replication*
OBJ 3 : *Master HyperV*
OBJ 4 : *Master event tracking on a Windows server*
OBJ 5 : *Master setting up a secure solution via Windows server*

Necessary material :

PC and Internet

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Shell scripts Under Windows Server*	*6h*	*OBJ1*
3-4	*Replication in AD*	*6h*	*OBJ2*

5-7	*HyperV*	*9h*	*OBJ3*
8-9	*Audit and system logs*	*6h*	*OBJ4*
10-11	*Certificate Authority On Windows Server*	*6h*	*OBJ5*
12-13	*VPN on Windows server*	*6h*	*OBJ5*
14	*Practical exam, mini-project defense, …*	*3h*	*Assessment*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- *https://learn.microsoft.com/fr-fr/training/paths/windows-server-deployment-configuration-administration/*
- Nicolas Bonnet, « Windows Server 2022 : Les bases indispensables pour administrer et configurer votre serveur », **Eni** , 2022

6- Working environment (Facilities necessary for learning)

- Windows server
- Virtualbox

Course Specification

Network Security II

1. General

Coded	*Inf-CYB 4 2 11*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Moez Hashem*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Network Security II*					Version	*08/2023*

Course description (Course objective):
Assimilate and apply security rules on different network equipment

Prerequisites:	*Keywords :*
Safety basics	*Firewall, filtering rules, authentication…*

Specific course objectives (OBJi):

OBJ 1 : *Master vlan's and inter-vlan routing authentication between routing equipment*

OBJ 2 : *Set up a logging system and application of AAA authentication*

OBJ 3 : *Configuring standard and extended ACL(named/numbered)*

OBJ 4 : *Configuring ZPF security policies*

OBJ 5 : *Configuring IPS*

Necessary material :
Packet trace

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Authentication between devices*	*3h*	*OBJ1*
3-4	*AAA authentication, Syslog*	*3h*	*OBJ2*
5-6	*Standard and extended LCD*	*3h*	*OBJ3*
7-8	*ZPF Security Policy*	*3h*	*OBJ4*
9-10	*Site to site dry IP VPN*	*3h*	*OBJ4*
11-12	*fps*	*3h*	*OBJ5*
13-14	*Practical exam, mini-project defense, …*	*3h*	*Assessment*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- *Netacad platform, Network Security https://www.netacad.com/courses/cybersecurity/network-security*

- *Netacad platform, CCNA Enterprise Networking Security* *https://www.netacad.com/fr/courses/networking/ccna-enterprise-networking-security- automation*
- Morillo Rais, “Zero Trust Networks: Building Secure Systems in Untrusted Network”, O'reilly.

6- Working environment (Facilities necessary for learning)

- *Packet tracer (windows) and wireshark*

Course Specification

Technology watch

1. General

Coded	*Inf-CYB 5 1 04*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	*42*
Responsible	*Bayrem Triki*					Vol. H. (TP)	
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*6*
Module	*Technology watch*					Version	*08/2023*

Course description (Course objective):
The Technology Intelligence course aims to provide students with an understanding of fundamental blockchain concepts, as well as the latest techniques and applications.

Prerequisites:	*Keywords :*
Cryptography, Python	*…*

Specific course objectives (OBJi):
OBJ 1 : *Describe the different fundamental concepts of blockchain* ***OBJ 2 :*** *Explain the basics of how blockchain works* ***OBJ 3 :*** *Describe the different applications of blockchain* ***OBJ 4 :*** *Applying blockchain techniques to real-world problems*

Necessary material :
Internet connection

2- Content elements (Course)

Week(s)	Activities/Content Items	No. HR	Goals
1	Chapter 1: Introduction to blockchain	3h	

2	Installing a cryptocurrency wallet	3h	
3	Demonstration of a transaction on a blockchain	3h	
4	Creating a block on a blockchain	3h	
5	Chapter 2: Blockchain Technology	3h	
6	Discovery of different blockchain architectures	3h	
7	Analysis of consensus mechanisms	3h	
8	Study of blockchain security techniques	3h	
9	Chapter 3: Blockchain Applications	3h	
10	Creating a distributed ledger	*3h*	…
11	Development of a decentralized application	*3h*	…
12-13	Blockchain Use Case Analysis	*6h*	
14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- …

5- Bibliographic and Online References

- *Blockchain Hub: https://www.blockchainhub.net/*
- *Martin Della Chiesa, François Hiault, Clément Tequi « Blockchain : Vers de nouvelles chaines de valeur », **Eyrolles**, 2019*

6- Working environment (Facilities necessary for learning)

- *An IDE or text editor*

Course Specification

IS Security Audit

1. General

Coded	*Inf-CYB 5 1 05*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	*42*
Responsible	*Seifeddine Khelifi*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*60*
Module	*IS Security Audit*					Version	*08/2023*

Course description (Course objective):

Become familiar with IS auditing in particular, compliance with standards, permanent auditing, organizational security auditing, correct network design.

Prerequisites:	*Keywords :*
Good knowledge of network systems and security.	*Audit, risk analysis, IS*

Specific course objectives (OBJi):

OBJ 1 : *Approaches to IT auditing*

OBJ 2 : *IS audit techniques*

OBJ 3 : *IS audit standards*

Necessary material :

Packet Tracer /virtualBOX

2- Content elements (course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Network Audit Methodology*	*6*	*OBJ 1,*
3-4	*Security policy audit*	*6*	*OBJ 1, OBJ 2*

5-6	*Auditing standards*	*6*	*OBJ 3*
7-14	*Types of Audits*	*24*	*OBJ 3*
	The Cobit method The EBIOS method The FEROS method The MARION method The MEHARI method The CMMI method *The ITIL method*		

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- https://pecb.com/en/education-and-certification-for-individuals/iso-iec-27001/iso-iec-27001-lead- implementer
- Marc Pasquet and Sylvie Gerbaix « Management des systèmes d'information », **Corroy**, 2024

6- Working environment (Facilities necessary for learning)

- *Windows & Linux*

Course Specification

Intrusion detection systems

1. General

Coded	*Inf-CYB 5 1 06*	Level/Semester	*Semester 8*	Coef	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	*12*
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	*9*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*28*
Module	*Intrusion detection systems*					Version	*08/2023*

Course description (Course objective):

The main objective of this course is to be familiar with :

- *IDS/IPS definition and classification -Basic elements of attacks and their detection*
- *Misuse detection systems (search algorithms and applications in IDS)*
- *Anomaly detection systems*

Prerequisites:	*Keywords :*
Linux operating system administration	*Linux*
Network architecture	*TCP/IP*
TCP/IP protocol	*Networks*

Specific course objectives (OBJi):

OBJ 1 : *Describe Snort technology and identify available resources*

OBJ 2 : *Install Snort on a Linux-based operating system*

OBJ 3 : *Describe Snort modes of operation and their command line options*

OBJ 4 : *Describe Snort intrusion detection output options*

OBJ 5 : *Address issues related to intrusion detection as well as their limits*

OBJ 6 : *Make the right decisions following the analysis of feedback*

OBJ 7 : *Dealing with incidents and their management*

Necessary material :

…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Module 1: Introduction and presentation of an IDS*	*1h30*	…
2	*Module 2: Architectures of an IDS*	*1h30*	…
3	*Module 3: How an IDS works*	*1h30*	…
4	*Module 4: Presentation of SNORT technology*	*1h30*	
5	*Module 5: SNORT3 Architecture*	*1h30*	
6	*Module 6: SNORT3 rule structure*	*1h30*	
7	*Module 7: SNORT3 Installation and Configuration*	*1h30*	
8	*Module 8: Implementation of SNORT3 rules management*	*1h30*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
9	*TP1: SNORT3 installation and configuration*	*1h30*	…
10	*TP2: Rule configuration and intrusion test*	*1h30*	…
11-12	*TP3: Graphical method for configuring rules*	*3h*	
13-14	*TP4: Using SNORT in PFsense*	*3h*	

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Installation and configuration of rules (10 points)*
- *Criterion 2: Interpretation of results (5 points)*
- *Criterion 3: Presentation and writing of the report (5 points)*

5- Bibliographic and Online References

- *https://www.snort.org/*
- *Yousef Farhaoui, « Systemes de detection et de prevention des intrusions », Noor Publishing, 2018*

6- Working environment (Facilities necessary for learning)

- *Software (VM): Ubuntu, Kali Linux, PFsense, Windows 10*

Course Specification

Security of connected objects

1. General

Coded	*Inf-CYB 5 1 07*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Seifeddine Khelifi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*Security of connected objects (IoT)*					Version	*08/2023*

Course description (Course objective):

The Connected Things (IoT) Cybersecurity Lab aims to provide students with an in-depth understanding of the concept and unique challenges related to securing devices and networks in the Internet of Things environment.

This lab aims to provide students with hands-on experience in securing IoT devices and networks. Through this work, participants will have the opportunity to immerse students in the processes of collecting information, identifying vulnerabilities and validating the security of IoT devices and networks.

Prerequisites:	*Keywords :*
Basics of Network and security	*IoT, Security, attacks*

Specific course objectives (OBJ):

OBJ 1 : *Identify security risks specific to IoT systems.*

OBJ 2 : *Know how to recognize and map IoT devices.*

OBJ 3 : *Be able to use penetration testing tools and techniques specific to IoT environments to assess the security of devices and networks.*

OBJ 4 : *Identify and determine vulnerabilities in IoT devices.*

OBJ 5 : *Write penetration test reports and presentations.*

Necessary material :

PC, KALI Linux/ParrotOS Virtual Machine, Internet connection, IoT device.

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Introduction to the Internet of Things (IoT) and fundamentals of cybersecurity for IoT systems*	*3h*	*OBJ1*
3-6	*Get familiar with recognition and intrusion testing tools and techniques specific to IoT environments*	*6h*	*OBJ2, OBJ3*
7-12	*Identify and describe threats and vulnerabilities affecting the system*	*9h*	*OBJ4, OBJ5*
13-14	*Practical project*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: adequate use of recognition tools (05 points)*
- *Criterion 2: adequate use of pentesting tools (05 points)*
- *Criterion 3: Being able to identify the vulnerabilities of the IoT target (05 points)*
- *Criterion 4: Developed a power point presentation of the results (05 points)*

5- Bibliographic and Online References

- *The Top 10 IoT threats, according to the Open Web Application Security Project (OWASP), https://owasp.org*
- *IoT and OT Hacking, Certified Ethical Hacker Course (CEH) V12, EC-Council, https://eccouncil.org*
- *Censys, https://censys.com/*

6- Working environment (Facilities necessary for learning)

- *Kali Linux, 2023.4, https://www.kali.org/get-kali/#kali-platforms*
- *Parrot Security OS, 6.0 Lorikeet, https://www.parrotsec.org/download/**

- *Suphacap, https://www.suphammer.net/*
- *Open Sniffer, https://www.sewio.net*
- *Tcpdump, https://www.tcpdump.org*
- *IoT Vulnerability-Scanning Tools, beSTORM, https://www.beyondsecurity.com*

Course Specification

Virtual Private Network VPN

1. General

Coded	*Inf-CYB 5 1 08*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cybersecurity*					Vol. H. (CI)	
Responsible	*Moez Hashem*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*VPN*					Version	*08/2023*

Course description (Course objective):
Ensuring network security using VPNs

Prerequisites:	*Keywords :*
Network security	*VPN, IPsec, Tunneling, Security*

Specific course objectives (OBJi):

OBJ 1 : *The different types of VPN*

OBJ 2 : *Setting up VPNs*

OBJ 3 : *Necessary techniques and tools*

Necessary material :

Packet Tracer /virtualBOX

2- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Network security reminder*	*3*	*OBJ 1,*
3-4	*Presentation of VPNs (types/usefulness)*	*3*	*OBJ 1, OBJ 2*
5-12	*The protocols used*	*12*	*OBJ 1, OBJ 2*
13-14	*Setting up VPNs*	*3*	*OBJ 3*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Use of appropriate reconnaissance tools (05 points)*
- *Criterion 2: Use of appropriate pentesting tools (05 points)*
- *Criterion 3: Ability to identify vulnerabilities of the IoT target (05 points)*
- *Criterion 4: Creation of a PowerPoint presentation of the results (05 points)*

5- Bibliographic and Online References

- The Top 10 IoT threats, according to the Open Web Application Security Project (OWASP), https://owasp.org
- IoT and OT Hacking, Certified Ethical Hacker Course (CEH) V12, EC-Council, https://eccouncil.org
- Censys, https://censys.com/
- Abderrahmane Ez-Zahout, « Sécurité réseaux informatique : applications aux vpn », Editions universitaires européennes, 2019

6- Working environment (Facilities necessary for learning)

- ali Linux, 2023.4, https://www.kali.org/get-kali/#kali-platforms
- Parrot Security OS, 6.0 Lorikeet, https://www.parrotsec.org/download/*
- Suphacap, https://www.suphammer.net/
- Open Sniffer, https://www.sewio.net
- Tcpdump, https://www.tcpdump.org
- IoT Vulnerability-Scanning Tools, beSTORM, https://www.beyondsecurity.com

Course Specification

Digital investigation (forensic)

1. General

Coded	*Inf-CYB 5 1 09*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Seifeddine Khelifi*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Digital investigation (Forensic)*					Version	*08/2023*

Course description (Course objective):
Practical Work in Digital Forensics aims to provide students with an in-depth introduction to digital forensic analysis, an essential discipline in the field of IT security and the fight against cybercrime. *These practical aims to prepare students to face the real-world challenges faced by digital forensic analysis professionals in the world of IT security and criminal justice.*

Prerequisites:	*Keywords :*
…	…

Specific course objectives (OBJ):
OBJ 1 : *Understand the basic principles of digital forensic analysis.* ***OBJ 2 :*** *Learn methods for collecting and preserving digital evidence.* ***OBJ 3 :*** *Be able to analyze digital data to resolve investigative cases.* ***OBJ 4 :*** *Identify the different types of data that can be collected and analyzed as part of a forensic investigation.* ***OBJ 5 :*** *Write analysis reports and presentations in a professional manner.*

Necessary material :
PC, KALI Linux/ParrotOS Virtual Machine, Internet connection,

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

1-4	*Introduction to digital forensics: basic concepts, roles and responsibilities, stages of an investigation.*	*6*	*OBJ1*
5-8	*Become familiar with the tools and techniques for collecting and preserving digital evidence: chain of custody, collection techniques, preservation methods.*	*6*	*OBJ2*
9-12	*Analysis of file system and storage disks and media: forensic acquisition, data recovery, identification of artifacts, recovery of deleted files, analysis of event logs.*	*6*	*OBJ3, OBJ4*
13-14	*Presentation of results: investigation reports, expert testimonies.*	*3h*	*OBJ5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: use of adequate evidence collection and preservation tools (05 points)*
- *Criterion 2: the use of tools has adequate analysis (05 points)*
- *Criterion 3: Being able to identify information from evidence (05 points)*
- *Criterion 4: Developed a power point presentation of the results (05 points)*

6- Bibliographic and Online References

- *Foundation of Digital Forensics, European Commission, https://ec.europa.eu/*
- *Digital Forensics A BASIC GUIDE FOR THE MANAGEMENT AND PROCEDURES OF A DIGITAL FORENSICS LABORATORY, the Council of Europe, https://www.coe.int/*
- *Forensic Examination of Digital Evidence, US Department of Justice, https://www.ojp.gov/*
- *Bruce Nikkel, "Practical Linux Forensics: A Guide for Digital Investigators", 2021*

7- Working environment (Facilities necessary for learning)

- *Kali Linux, 2023.4, https://www.kali.org/get-kali/#kali-platforms*
- *Parrot Security OS, 6.0 Lorikeet, https://www.parrotsec.org/download/**
- *Autopsy, https://www.autopsy.com/*

Course Specification

Cloud Security Module

1. General

Coded	*Inf-CYB 5 1 10*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cyber Security*					Vol. H. (CI)	*10.5*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*10.5*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Cloud Security*					Version	*08/2023*

Course description (Course objective):
The Cloud Security course aims to teach the principles of securing cloud environments, including identity and access management, data protection, compliance with regulatory standards, and responding to threats and vulnerabilities in the cloud. This cloud security course covers the essential aspects of protecting cloud environments, including identity and access management, securing hosts and infrastructure, and protecting networks. Participants will learn how to identify and counter cloud-specific threats, apply security best practices, and comply with regulatory standards. Through practical (AWS) case studies and real-world scenarios, the course provides a comprehensive understanding of securing data and resources in the cloud, tailored to IT professionals and system administrators keen to strengthen security in cloud environments.

Prerequisites:	*Keywords :*
1. ***Familiarity with Cloud Computing****: A basic understanding of cloud computing concepts, such as the service model (IaaS, PaaS, SaaS) and the benefits and challenges associated with using cloud services, is essential to grasp the challenges of cloud security.* 2. ***Preliminary Experience with AWS****(optional but recommended): Although not strictly necessary, prior experience with AWS services, even at a beginner level, can be very beneficial in better understanding the practical examples and case studies.*	*Cloud Computing,Security* *IAM (Identity and Access Management), Encryption* *Network,Infrastructure* *AWS (Amazon Web Services)* *Compliance, GDPR (General Data Protection Regulation)* *Cyber Threats, Data Protection* *VPN (Virtual Private Network)* *Monitoring, Risk Management* *Authentication, Firewalls* *DDoS (Distributed Denial of Service)* *CloudTrail, Security Policies* *Governance*

Specific course objectives (OBJi):
OBJ 1 : General Security in the Cloud*: The course begins with an introduction to fundamental cloud security concepts, covering the basics, best practices, and unique challenges posed by cloud computing. Participants will learn how to identify and assess cloud-specific security risks.* ***OBJ 2 : User Protection****: This section focuses on securing user identities and access in the cloud. Students will explore identity and access management (IAM) mechanisms, authentication and authorization policies, and techniques to protect against phishing and other user threats.* ***OBJ 3 : Host Protection****: Here the focus is on the security of servers and operating systems in the cloud. Topics include securing virtual machine instances, managing patches and updates, and protecting against malware and host-targeted attacks.* ***OBJ 4 : Network Protection****: This part of the course covers securing communications and data in transit in the cloud. Students will learn about firewalls, security groups, virtual private networks (VPNs), and encryption techniques to protect cloud networks.* ***OBJ 5 : Infrastructure Protection****: This section focuses on strategies for securing cloud infrastructure components, including data centers, cloud storage, and compute resources. Participants will explore approaches to securing physical and virtual infrastructure, as well as implementing monitoring and anomaly detection.* ***OBJ 6 : Governance and Compliance****: The course also covers the importance of security governance and compliance with regulations and standards. Students will learn how to implement policies and procedures to ensure compliance and effectively manage security in a cloud environment.*

Necessary material :
Access to AWS:*An AWS account is required to access Amazon cloud services. Participants can use the AWS Free Tier for most activities, but some advanced features may require a paid subscription.*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Cloud Security Fundamentals*	*1.5h*	*Understand the basics of cloud security and its unique challenges.* *Identify different cloud service and deployment models and their security implications.*
3-4	*Chapter 2: User Security in the Cloud*	*1.5h*	*Learn identity and access management (IAM) strategies.* *Understand best practices for user security, including multi-factor authentication and security awareness.*

5-6	*Chapter 3: Securing Hosts in the Cloud*	*1.5h*	*Explore methods for securing servers and virtual instances in the cloud.* *Understand the importance of security updates and vulnerability management for hosts.*
7-8	*Chapter 4: Cloud Network Security*	*1.5h*	*Learn how to secure the network in a cloud environment, including encryption of data in transit.* *Understand the use of firewalls, virtual private networks (VPN) and security groups.*
9-10	*Chapter 5: Cloud Infrastructure Protection*	*1.5h*	*Review best practices for securing physical and virtual cloud infrastructure, including data centers.* *Investigate monitoring and anomaly detection approaches in cloud infrastructures.*
11-14	*Chapter 6: Governance, Risk and Compliance in the Cloud*	*3h*	*Understand the importance of governance in cloud security and learn how to establish effective security policies.* *Address regulatory compliance issues and risk management in the cloud.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Lab 1: Basic Configuration of AWS IAM*	*0.75h*	*Create and manage users and groups in AWS IAM.* *Apply permissions policies to control access to AWS resources.*
2	*TP 2: Implementing Multi-Factor Authentication (MFA) in IAM*	*0.75h*	*Configure multi-factor authentication for user accounts.* *Test and validate MFA functionality in an AWS environment.*
3	*Lab 3: Creating and Managing Encryption Keys with AWS KMS*	*0.75h*	*Create and manage encryption keys in AWS Key Management Service (KMS).* *Use these keys to encrypt and decrypt data.*

4	*Lab 4: Securing Data in Transit with AWS VPN*	*0.75h*	*Configure a virtual private network (VPN) in AWS.* *Test the security of data in transit via the VPN.*
5	*Lab 5: Implementing Security Groups for EC2 Instances*	*0.75h*	*Create and configure security groups for EC2 instances.* *Test security group rules to ensure instance protection.*
6	*Lab 6: Configuring a Firewall with AWS WAF*	*0.75h*	*Set up a web firewall (WAF) to protect web applications.* *Test and adjust WAF rules to block common attacks.*
7	*Lab 7: Using AWS CloudTrail for Monitoring and Auditing*	*0.75h*	*Enable and configure AWS CloudTrail to monitor and record activities in AWS.* *Analyze CloudTrail logs to detect unusual or unauthorized behavior.*
8	*Lab 8: Implementing Backup and Recovery with AWS S3*	*0.75h*	*Configure automatic data backup to AWS S3.* *Restore data from backups to test disaster recovery.*
9	*TP 9: Creation and Management of VPCs*	*0.75h*	*Create a Virtual Private Cloud (VPC) to isolate AWS resources.* *Configure subnets, Internet gateways and route tables in the VPC.*
10	*Lab 10: Deploying a Secure Application on AWS Elastic Beanstalk*	*0.75h*	*Deploy a web application on AWS Elastic Beanstalk.* *Implement security measures to protect the application.*
11-12	*Lab 11: Configuring AWS Shield for DDoS Protection*	*1.5h*	*Enable AWS Shield to protect AWS resources against DDoS attacks.* *Simulate a DDoS attack and observe AWS Shield's response.*
13-14	*Lab 12: Audit Security with AWS Inspector*	*1.5h*	*Use AWS Inspector to assess the security of EC2 instances.* *Analyze inspection reports to identify and remediate vulnerabilities.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*40%*

5- Evaluation criteria

- ***Technical Understanding****: Evaluate whether the student has correctly understood the technical concepts of the lab, such as configuring AWS IAM, setting up a VPC, or managing encryption keys.*
- ***Correct Execution of Tasks****: Check if all the stages of the TP have been followed correctly and if the specific objectives of the TP have been achieved.*
- ***Quality of Security Configuration****: Evaluate the robustness and effectiveness of security measures in place, such as IAM policies, security group rules, and encryption configurations.*
- ***Error Management and Troubleshooting****: Observe how the student handles errors or problems that arise during the lab. The ability to identify and resolve problems is essential.*

6- Bibliographic and Online References

- *M. Armbrust et al., "A View of Cloud Computing," in Communications of the ACM, vol. 53, no. 4, pp. 50-58, April 2010.*
- *R. Buyya, CS Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the 5th Utility," in Future Generation Computer Systems, vol. . 25, no. 6, pp. 599-616, June 2009.*
- *J. Halpert, "Cloud Computing Security: Techniques and Tactics," Syngress, 2011.*
- *AWS Summit, "Keynote Address: Security and Compliance in the Cloud," AWS Summit, San Francisco, CA, 2018. [Online]. Available: https://aws.amazon.com/summits/san_francisco/*
- *PM Mell and T. Grance, "The NIST Definition of Cloud Computing," National Institute of Standards and Technology, Gaithersburg, MD, Special Publication 800-145, 2011.*
- *K. Hashizume, DG Rosado, E. Fernández-Medina, and EB Fernandez, "An Analysis of Security Issues for Cloud Computing," in Journal of Internet Services and Applications, vol. 4, no. 1, pp. 5, 2013.*
- *AM Lonea, DE Popescu, and H. Tianfield, "Detecting DDoS Attacks in Cloud Computing Environment," in International Journal of Computers Communications & Control, vol. 8, no. 1, pp. 70-78, February 2013.*

- *AWS re:Invent, “Advanced Architectures for a Secure AWS Environment,” AWS re:Invent, Las Vegas, NV, 2019. [Online]. Available:https://reinvent.awsevents.com/*

7- Working environment (Facilities necessary for learning)

- *AWS account: An Amazon Web Services account is essential. Students can use the free tier of AWS, but some labs may require features that exceed the limits of that tier.*
- *AWS Management Interfaces: Installation of AWS management interfaces, such as AWS Management Console, AWS CLI (Command Line Interface), and AWS SDKs (Software Development Kits) for different programming languages.*
- *Security and Surveillance Tools: Installation of specific software for security and monitoring, such as vulnerability scanners, log analysis tools and VPN clients*

Course Specification

Firewall Administration

1. General

Coded	*Inf-CYB 5 1 11*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*4*
Course	*Cybersecurity*					Vol. H. (CI)	
Responsible	*Bayrem Triki*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*Firewall administration*					Version	*08/2023*

Course description (Course objective):
This course is devoted to network security using Firewalls. The objective is to take charge of the main functions of the FortiGate® UTM, to configure the firewall, configure the VPN service with IPSEC, SSL protocols and finally, fight against malware and create URL filters . It also allows you to configure the FortiGate® in its advanced functions (virtualization, IPS, FSSO, DLP, etc.). *This training also allows preparation for the Fortinet NSE 4 exam.*

Prerequisites:	*Keywords :*
Network security	*Firewall, networks, UTM,*

Specific course objectives (OBJi):
OBJ 1 : *Master Firewall configuration* ***OBJ 2 :*** *Optimize Firewall configuration* ***OBJ 3 :*** *Learn best practices for configuring the Firewall*

Necessary material :
PC plus Internet

3- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-3	***Module 1:** Enterprise Firewall Overview* ***Module 2:** Architecture and operation of FortiOS* ***Module 3:** Troubleshoot the system*	*9h*	*OBJ 1*
4-7	*Enterprise Firewall Overview* *Architecture and operation of FortiOS*	*12h*	*OBJ 1, OBJ 2*
8-11	*Troubleshoot the system* *Monitor traffic and sessions* *FortiGuard*	*12h*	*OBJ 1, OBJ 2*
12-14	*Centralized administration* *Web Filtering* *Intrusion Prevention System (IPS)*	*9h*	*OBJ 3*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Approaches used (5 points)*
- *Criterion 2: Techniques used (5 points)*
- *Criterion 3: Results of conducted tests (5 points)*
- *Criterion 4: Interpretation of results (5 points)*

5- Bibliographic and Online References

- *https://www.fortinet.com/fr/training-certification*
- *Daniel Howard, "Introduction to FortiGate Part-1 Infrastructure: Fortinet Network Security Introduction (NSE4 Study Guide)", 2020*

6- Working environment (Facilities necessary for learning)

- Windows, virtualbox, Fortigate, windows server

Course Specification

Pentesting

1. General

Coded	*Inf-CYB 5 1 12*	Level/Semester	*5/S1*	Coef	*3*	Credits	*4*
Course	*CyberSecurity*					Vol. H. (CI)	
Responsible	*Mohamed Tekaya*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Pentesting*					Version	*08/2023*

Course description (Course objective):
This course aims to: - Deploy ethical hacking to expose weaknesses in your organization. - Gather intelligence by employing reconnaissance, published data, and scanning tools.

Prerequisites:	*Keywords :*
- *Windows operating system* - *Linux operating system* - *Database* - *Computer networks and protocols*	*Windows, Linux, Computer network, Computer protocols, Database*

Specific course objectives (OBJi):
OBJ 1 : *Gain knowledge of advanced tools and techniques used by ethical hackers and IT security professionals.* ***OBJ 2 :*** *Acquire scanning skills; test, hack and secure a system* ***OBJ 3 :*** *Acquire skills to master the five phases of ethical hacking: Reconnaissance, Obtaining access, Enumeration, Maintaining access and Cleaning up traces*

Necessary material :
…

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*TP:*Social Engineering	*3h*	*Become familiar with attacks*Social Engineering
2-3	*TP:Denial-of-Service*	*6h*	*Become familiar with attacksDenial-of-Service*
4-5	*TP:Session Hijacking*	*6h*	*Become familiar with attacksSession Hijacking*
6-7	*TP:Evading IDS, Firewall and Honeypots*	*6h*	*Become familiar with attacksEvading IDS, Firewall and Honeypots*
8-9	*TP:Hacking Web Servers*	*6h*	*Become familiar with attacksHacking Web Servers*
10-11	*TP:Hacking Web Applications*	*6h*	*Become familiar with attacksHacking Web Applications*
12-13	*TP:Hacking Wireless Networks*	*6h*	*Become familiar with attacksHacking Web Applications*
14	*mini-project defense*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: working methodology (3 points)*
- *Criterion 2: presentation and writing of the report (3 points)*
- *Criterion 3: interpretation of results (8 points)*

- *Criterion 4: proposed solutions (6 points)*

5- Bibliographic and Online References

- *https://www.kali.org/*
- *https://github.com/*
- *https://tryhackme.com/*
- *Farhi Aleks, “Black Hat Bash: Bash Scripting for Hackers and Pentesters”, 2024*

6- Working environment (Facilities necessary for learning)

- *Software (VM): Kali Linux, Ubuntu, Windows 10,*
- *Series of TPs*

Subject Sheets
Specialty: Cloud

Course Specification

The fundamentals of Cloud Computing

1. General

Coded	*Inf-ICC 4 1 01*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*30*
Module	*The fundamentals of Cloud Computing*					Version	*08/2023*

Course description (Course objective):
This course introduces the fundamental concepts of cloud computing, virtualization and containerization, two essential pillars of modern IT architecture. Students will learn how these technologies enable flexible, scalable and efficient management of IT resources. *This course offers an immersion in cloud computing with Google Cloud Platform (GCP), one of the most sophisticated and robust cloud platforms. Participants will learn the fundamental concepts of cloud computing, the benefits of using the cloud, and how GCP enables businesses to build, deploy, and scale applications and services with agility and security.*

Prerequisites:	*Keywords :*
- *Basic understanding of computer networks and the Internet.* - *Familiarity with operating systems, especially Linux, as it is widely used in cloud environments.* - *Understanding of basic concepts of information technology and data storage.*	- *Cloud Computing, SaaS (Software as a Service)* - *IaaS (Infrastructure as a Service),* - *PaaS (platform as a service)* - *Public, private and hybrid cloud,* - *Virtualization, Hypervisor, VM (Virtual Machine)* - *Host and guest machines, Containerization, Docker* - *Kubernetes, Containers and images, Microservices architecture*

Specific course objectives (OBJi):
OBJ 1 : *Understand the principles of cloud computing, its service models (IaaS, PaaS, SaaS) and its architecture* ***OBJ 2 :*** *Master the concepts of virtualization and its importance in creating agile IT environments.* ***OBJ 3 :*** *Learn how to deploy, manage and orchestrate containers using Docker and Kubernetes.* ***OBJ 4 :*** *Evaluate the use of these technologies to meet business and technical needs.*

Necessary material :

Access to a cloud servicecomputing (Google Cloud labs)

Google Cloud Essentials "Professional Badge"

In this introductory level platform, students will learn about the fundamental tools and services of Google Cloud. Google Cloud Essentials is the recommended first quest for the Google Cloud learner: they will arrive with little to no prior knowledge of the Cloud and emerge with hands-on experience that they can apply to their first Google Cloud project.

From writing Cloud Shell commands to deploying your first virtual machine, running applications on Kubernetes Engine or load balancing, Google Cloud Essentials is a great introduction to the platform's core features.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*1. Introduction to Cloud Computing*	*3h*	*Understand the origins and evolution of cloud computing.* *Identify the benefits and challenges of cloud adoption.* *Distinguish between the different types of clouds: public, private and hybrid.*
3-4	*2. Cloud Service Models and Architecture*	*3h*	*Define cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).* *Explore the architecture of a cloud environment and its impact on performance and security.*
5-6	*3. Basic Principles of Virtualization*	*3h*	*Understanding the role of virtualization*
			Learn to create and manage virtual machines. *Examine the benefits of virtualization for efficiency and resource optimization*

7-8	4. Introduction to Docker and Containerization	3h	Understand the concept of containerization and how it differs from virtualization. Learn the basics of Docker, including images, containers, registries, and volumes. Perform simple container deployments with Docker
9-10-11	5. Container Management and Orchestration with Kubernetes	4.5h	Explore key Kubernetes concepts, such as pods, services, persistent volumes, and namespaces. Learn how to deploy a containerized application with Kubernetes. Understand container orchestration and automatic load management.
12-13-14	6. Case studies and Best Practices	4.5h	Analyze real-world case studies to illustrate the effective use of virtualization and containers in the industry. Discuss best practices for adopting, deploying and optimizing cloud, virtualization and containerization technologies. Plan and execute a final project where students implement a cloud solution with Docker and Kubernetes for an enterprise scenario

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	TP1: Presentation of Google Cloud practical workshops https://www.cloudskillsboost.google/course_sessions/5190782/labs/403395?locale=fr	1.5h	Task 1: Access the Cloud Console Task 2: Projects in the Cloud Console Task 3: Roles and permissions Task 4: APIs and services
2	TP2: Create a virtual machine https://www.cloudskillsboost.google/course_sessions/5190782/labs/403396?locale=fr	1.5h	Task 1. Create an instance from the Cloud console Task 2. Install an NGINX web server Task 3. Create an instance with gcloud
3	TP3: Compute Engine: Qwik Start – Windows https://www.cloudskillsboost.google/course_sessions/5190782/labs/403397?locale=fr	1.5h	OB1: Create a virtual machine instance OBJ2: Connect with Remote Desktop Protocol (RDP) on Windows Server

4	*TP4: Getting started with Cloud Shell and gcloud* *https://www.cloudskillsboost.google/course_sessions/5190782/labs/403398?locale=fr*	*1.5h*	*Task 1: Configure your environment* *Task 2: Filter command line results* *Task 3: Connect to the VM instance* *Task 4: Update the firewall* *Task 5: View logs*
5	*TP5: Cloud Storage: Qwik Start – Cloud Console* *https://www.cloudskillsboost.google/focuses/1760?locale=fr&parent=catalog*	*1.5h*	*OB1: Create a bucket* *OB2: Test your knowledge* *OB3: Import an object into the bucket* *OB4: Test your knowledge* *OB5: Share a bucket publicly* *OB6: Create folders* *OB7: Delete a folder*
6	*TP6: Docker Overview* *https://www.cloudskillsboost.google/focuses/1029?locale=fr&parent=catalog*	*1.5h*	*Task 1: Hello World* *Task 2: Create* *Task 3: Execute* *Task 4: Debug* *Task 5: Publish*
7	*TP7: Kubernetes Engine: Qwik Start* *https://www.cloudskillsboost.google/course_sessions/5190782/labs/403399?locale=fr*	*1.5h*	*Task 1: Set a default calculation area* *Task 2: Create a GKE cluster* *Task 3: Obtain authentication credentials for the cluster* *Task 4: Deploy an application to the cluster*
8	*TP8:* *Create a Docker image and deploy it to a Kubernetes cluster* *https://www.cloudskillsboost.google/focuses/1738?locale=fr&parent=catalog*	*1.5h*	*OB1: Create a Docker image of a sample application and add a tag to it* *OB2: Upload image with tag to Google Container Registry* *OB3: Create a Kubernetes cluster* *OB4: Deploy the application on the Kubernetes cluster*
9	*TP9: Orchestrate the cloud with Kubernetes* *https://www.cloudskillsboost.google/focuses/557?locale=fr&parent=c*	*1.5h*	*OB1: Provision a full Kubernetes cluster using Kubernetes Engine.* *OB2: deploy and manage Docker containers with kubectl;*
	atalog		*OB3: Decompose an application into microservices using Kubernetes deployments and services.*
	TP10: Deploy on Kubernetes in Google Cloud: workshop challenge		*Task 1: Create a Docker image and store the Dockerfile* *Task 2: Test the created Docker image* *Task 3: Upload the Docker image to the*

10-11	https://www.cloudskillsboost.google/focuses/10457?locale=fr&parent=catalog	3h	container repository Task 4: Create and expose a deployment in Kubernetes Task 5: Update the deployment with a new version of valkyrie-app Task 6: Create a pipeline in Jenkins to deploy your application
12-13	TP11: Configure network and http load balancers https://www.cloudskillsboost.google/course_sessions/5190782/labs/403400?locale=fr	3h	Task 1: Set the default zone and region for all resources Task 2: Create multiple web server instances Task 3: Configure the load balancing service Task 4. Send traffic to your instances Task 5: Create an HTTP load balancer Task 6: Test the traffic sent to your instances
14	Google cloud GCP practice exam	1.5h	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	20%
EE - Written test (Final exam)	60%
EP - Practical test (Practical work exam or Mini project)	20%

4- Bibliographic and Online References

Books :

- *“Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl et al. - This book provides a comprehensive understanding of cloud computing infrastructure and its various applications in the IT domain.*
- *"The Docker Book: Containerization is the new virtualization" by James Turnbull - A guide to building, deploying and managing Docker applications.*
- *"Kubernetes: Up and Running: Dive into the Future of Infrastructure" by Kelsey Hightower, Brendan Burns, and Joe Beda - A practical book for understanding and applying Kubernetes in production environments.*
- *"The Practice of Cloud System Administration: DevOps and SRE Practices for Web Services, Volume 2" by Thomas A. Limoncelli, Strata R. Chalup, and Christina J. Hogan - A guide to managing IT systems in the cloud era .*

Articles and Online Resources:

- *"A Survey on Security and Privacy Issues of Docker Containers" published in IEEE Access - Provides an overview of security issues related to the use of Docker.*
- *"Kubernetes and the Cloud" on ACM Queue - An article that examines the impact of Kubernetes on cloud development and operations.*
- *Google Cloud Documentation - The official Google Cloud Platform documentation offers user guides, tutorials, and best practices for using GCP.*
- *Docker Documentation - The official Docker documentation includes detailed instructions on implementing containerization solutions.*

Conferences and Workshops:

- *Google Cloud Next - An annual conference where the latest Google Cloud updates and innovations are presented.*
- *DockerCon - The official conference for the Docker community, offering sessions on best practices, case studies and innovations.*

5- Working environment (Facilities necessary for learning)

- *Cloud Infrastructure and Services:*
  GCP offers a powerful and scalable cloud computing infrastructure, with compute services like Compute Engine, container services like Google Kubernetes Engine, and serverless platforms like Cloud Functions.

- *Storage and Databases:*
  Flexible storage solutions with Cloud Storage for unstructured data and database services like Cloud SQL and Firestore that meet different data management needs.

- *Network and Security:*
  A highly available and secure global network, hybrid connectivity options, identity and access management tools, and advanced security features to protect applications and data.

Course Specification

Management of a Data Center

1. General

Coded	*Inf-ICC 4 1 02*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Hamdi Ben Abdallah*					Vol. H. (TP)	
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*28*
Module	*Management of a Data Center*					Version	*08/2023*

Course description (Course objective):
This discipline focuses on the planning, maintenance and optimization of physical and virtual infrastructures that host IT services. Students will learn how to manage hardware resources, ensure data availability and security, and implement energy efficiency strategies for sustainable data center operations. This training is crucial to understanding the fundamentals of cloud computing and large-scale network connectivity

Prerequisites:	*Keywords :*
The foundations of the Network	*Network infrastructure*

Specific course objectives (OBJi):
OBJ 1 : *Design and manage efficient data centers.* ***OBJ 2 :*** *Ensure availability, redundancy and security of services.* ***OBJ 3 :*** *Optimize the use of hardware resources.* ***OBJ 4 :*** *Understanding environmental and energy standards.* ***OBJ 5 :*** *Achieve sustainable data center operations.*

Necessary material :
- *Video projector* - *Course materials*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1,2,3	Data center concept Importance of data centers in the modern IT world	4.5h	Design and manage efficient data centers.
4.5	Management and Monitoring Backup and Recovery Redundancy Scalability Air conditioner IT security	3h	Ensure availability, redundancy and security of services
7,8,9	Backup and Recovery Business Continuity Plan (BCP) Staff training Physical Server Security Security Policies External Audit	4.5h	Optimize the use of hardware resources
10,11,12	Main Power Supply Transformers and Switches Backup Generators Inverters (UPS - Uninterruptible Power Supplies) Batteries Electrical distribution Energy Monitoring and Management Redundancy	4.5h	Understanding environmental and energy standards
13.14	Physical Access Control Video surveillance Intrusion Detection Physical Security IT security Access management Multi-Factor Authentication (MFA) Data Encryption Audit and Monitoring	4.5h	Achieve Sustainable Data Center Operations

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Compliance (6 points)*
- *Criterion 2: Efficiency (7 points)*
- *Criterion 4: Quality (7 points)*

5- References

Bibliographic and Online References

- *R&M Data Center Handbook Reichle & De-Massari AG* *http://searchdatacenter.techtarget.com/definition/data-center https://en.wikipedia.org/wiki/Data_center 3. http://www.webopedia.com/TERM/D/data-center.html*
- *Data Center Fundamentals- Cisco 5. Use Best Practices to Design Data Center Facilities-2005 Gartner*

Books:

- *Geng, H. (2014). Data Center Handbook. McGraw-Hill Education.*
- *Carapella, A. (2011). The Data Center Builder's Bible: How to Build a Data Center, from the Ground Up. Data Center Build.*
- *Wapnick, R. H. F. L. (2016). Data Center Operations Management. CRC Press.*
- *Reddy, V. B. (2011). Cloud and Virtual Data Storage Networking. Wiley.*
- *Sweeney, D. D. S. M. (2014). Data Center Design and Operation: A Practical Guide for Architects and Engineers. Wiley.*
- *Evans, C. (2013). The Art of Data Center Management. Wiley.*
- *Santana, G. A. A. (2014). Data Center Virtualization Fundamentals: Understanding Solutions for Virtualized Data Centers and Cloud Computing. Cisco Press.*

6- Working environment (Facilities necessary for learning)

- *No specific learning environment is required.*

Course Specification

Advanced Database

1. General

Coded	*Inf-ICC 4 1 03*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Samia Sagar*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*30*
Module	*Advanced Database*					Version	*08/2023*

Course description (Course objective):
This course aims to introduce students to the administration of (relational) databases. It will allow students to implement advanced functionalities, including architecture management, task scheduling and database resource management. Students will learn how to install, configure and maintain a DBMS. They will be made aware of the issues surrounding their availability and security. They will also see what are the most frequent tasks to be carried out in the DBA profession.

Prerequisites:	*Keywords :*

- ***Around comics****(Relational model and BDR, Query language (SQL), Transactions, Programming language and BD)*
- ***Around operating systems****(Memory hierarchy, Data cache management, etc.)*
	SQL language;
	Physical and logical design of BDR;
	Database administration;
	DBMS architecture.

Specific course objectives (OBJi):

OBJ 1 : *Understand how database management systems (relational) work;*

OBJ 2 : *Understand indexing, query execution/optimization and demystify simple SQL commands (create, select, insert into, etc.);*

OBJ 3 : *Realize the physical design of the databases;*

OBJ 4 : *Understand transaction management and concurrent access control;*

OBJ 5 : *Understand crash recovery and logging techniques;*

OBJ 6 : *Understand and master the parameters that make it possible to improve the use of databases;*

OBJ 7 : *Know how to effectively administer a DBMS.*

Necessary material :
*Oracle DBMS; Oracle administration applications; SQL*plus, Oradim.*

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1,2,3	- *Architecture of a DBMS: implementation with Oracle* - *Oracle instance: SGA, background process to manage the database, a server process and PGA;* - *Database: physical structure and logical structure;* - *SQL order processing and transaction validation/cancellation.*	4.5	*- Understand the different components of a relational DBMS.*
4,5	- *Oracle Server:* - *Instance (configuration and initSID.ora configuration file);* - *Database creation (Create Database order and database file specification);* - *Database management (startup and shutdown).*	3	*- Understand and describe the architecture of an Oracle BD server;* *- Understand physical design choices.*
6	- *Data Dictionary and Standard Packages*	1.5	- Querying Dict data for BD tuning.
7,8	- *Physical structure of a Database* - *Recovery file groups and members: Use in multiplexed mode, initialization of recovery files, modification of REDO LOG files, archive management;* - *Control file: Adding additional copies and multiplexing, Backup of a control file.*	3	- Modification of the physical structure of a comic.
9,10	- *Logical Structure of a Database* - *Management of tablespaces, segments and management of schema objects.*	3	- Modification of the logical structure of a comic strip.
11,12	- *Security and user management* - *Security management;* - *User Management ;* - *Profile management;* - *Privilege management;* - *Role management.*	3	

13,14	- *Transactions and concurrency* - *Start and end of a transaction;* - *Transaction properties – ACID;* - *Problems with long transactions and checkpoints;* - *Concurrency problems and management (Transactions and Serializability, lock, Stamping).*	3	*- Understand the management of transactions and concurrent access.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1,2	- *Install and configure Oracle Database.*	*3*	*…*
3,4,5	- *Oracle server and instance configuration;* - *Creation of an operational database.*	*4.5*	*Common Administrator Tasks:* *- Creation of a base;* *- Creation of the parameters file (or initialization file) init <SID>.ora;* *- Starting an instance then mounting and opening the database;* *- Close and unmount the database then stop the instance;* *- Activation of the database in private mode for the DBA.*
6,7,8	- *Managing files in an Oracle database.*	*4.5*	*Modifying the physical structure of a database.*
9,10	- *Management of the logical structure (tablespaces, segments, extents and blocks).*	*3*	*Modification of the logical structure of a database.*
11,12	- *User, privilege and resource management.*	*3*	*Create and alter users.*
,13,14	- *Backup/restore/reorganize data.*	*3*	*Recovery and reorganization of a database after failure.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-

DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- Bibliographic and Online References

Bibliographic and Online References

- *https://oracle.com: Oracle official website*
- *https://docs.oracle.com: Oracle documentations*

Books

- *Oracle 11g Administration by Olivier Heurtel (ENI-Editions)*
- *Oracle 12c – Administration by Olivier Heurtel (ENI-Editions)*
- *SQL for Oracle by Christian Soutou (Eyrolles, 7th edition)*

7- Working environment (Facilities necessary for learning)

- *Intitulé, Version, URL*
- *SGBD Oracle 11gc*
- *Applications d'administrations d'Oracle V21c*
- *SQL*plus, Oracle V12c*
- *Oradim Oracle V12c …*

Course Specification

Development of Distributed Applications

1. General

Coded	*Inf-ICC 4 1 04*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Hamdi Ben Abdallah*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*34*
Module	*Development of distributed applications*					Version	*08/2023*

Course description (Course objective):

Train students to create highly scalable and distributed web applications. Using Django, a popular Python framework, students will learn how to design powerful web applications, manage databases, develop attractive user interfaces, and implement distribution features for robust, high-performance web applications.

Prerequisites:	*Keywords :*
- *Relational Model and RDBMS, Query Language (SQL), Transactions, Programming Language and Databases* - *Memory Hierarchy, Data Cache Management, etc.*	*SQL Language, Physical and Logical Design of RDBMS, Database Administration, DBMS Architecture.*

Specific course objectives (OBJi):

OBJ 1 : *Understand the concepts of Monoloctic, SOA and Distributed applications*

OBJ 2 : *Design scalable web applications.*

OBJ 3 : *Use the Django framework effectively.*

OBJ 4 : *Manage relational databases.*

OBJ 5 : *Create attractive user interfaces.*

OBJ 6 : *Implement distribution features for high-performance web applications.*

Necessary material :

…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1,2,3	- Monolithic architecture - SOA architecture - Distributed Architecture	4.5h	- Understand the concepts of Monoloctic, SOA and Distributed applications
4,5,6	- Advantages and disadvantages of microservices - Load management and load balancing - Performance Optimization	4.5h	- Design scalable web applications.
7.8	- Distribution aspects of the Django Framework - Communication between components	3h	- Effectively use the Django framework.
9.10	- Choice of scalable databases - Partitioning and sharding methods - Replication and backup strategies	3h	- Manage relational databases
11	- Using Django's Template Manager (templates) - Reusing template elements and tags	1.5h	- Create attractive user interfaces.
12,13,14	- Key Aspects of Distributed Development in the Django Framework	4.5h	- Implement distribution features for high-performance web applications

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	TP1: Distributed applications and CLI	1.5h	Creating projects and applications using the CLI
2,3	TP2: Project management with PyCharm	3h	Creating projects and applications using PyCharm
4,5	TP3: data models	3h	Data model manipulation
6,7	TP4: Django	3h	Using Django admin console
8	TP5: Routers and templates	1.5h	Handling routers and templates
9	TP6: generic views	1.5h	Creating generic views based on classes
10	TP7: Session management	1.5h	Session management

11,12	*TP8: Permission management*	*3h*	*Authentication and permission*
13,14	*TP9: testing and integration*	*3h*	*Unit Testing, Integration Testing*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Understanding of architectures, components and aspects (40%)*
- *Criterion 2: Knowing how to propose an architecture for a business and being able to propose solutions (40%)*
- *Criterion 3: Understanding of distribution aspects in the Django framework (20%)*

6- References (useful links):

Bibliographic and Online References

- *MDN web docs: Django Web Framework (Python) July 3, 2023 https://developer.mozilla.org/en-US/docs/Learn/Server-side/Django*
  Arpitgoyalgg, hamishwillee, kruschk, jiaruh, chrisdavidmills, raghav710 & theonlyNischal
- *Dapr for .NET developers 2/28/2023 https://learn.microsoft.com/fr-fr/dotnet/architecture/dapr-for-net-developers/ Robvet, erjain, mairaw, Sreenivas-Kalluru & nishanil*

Books

- Coulouris, G., Dollimore, J., Kindberg, T., & Blair, G. (2011). Distributed Systems: Concepts and Design (5th ed.). Addison-Wesley.
- Shvachko, K., & Liu, P. (2014). Distributed Applications: Development and Implementation. Springer.
- Ghezzi, C., Jazayeri, M., & Mandrioli, D. (2003). Fundamentals of Software Engineering (2nd ed.). Prentice Hall.
- Vogels, W. (2008). Distributed Computing: Principles, Algorithms, and Systems. Springer.
- George, J. L. (2015). Building Distributed Systems: A Practical Guide to Developing with Java and Jini. Wiley.
- Padhy, N. P., & Mohapatra, P. (2011). Distributed Systems and Applications. PHI Learning.

7- Working environment (Facilities necessary for learning)

- *PyCharm 2023.1.3 https://www.jetbrains.com/fr-fr/pycharm/*
- *Django 4.2.7 https://www.djangoproject.com/*
- *Python 3.11.4 https://www.python.org/*

Course Specification

Introduction to Data Analysis

1. General

Coded	*Inf-ICC 4 1 05*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*0*
Responsible	*Hounaida Sakly*					Vol. H. (TP)	*21*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*50*
Module	*Introduction to Data Analysis*					Version	*08/2023*

Course description (Course objective):

The Business Intelligence (BI) course provides fundamental preparation for students for the "Google Analytics" certification. It covers the essentials of data collection, processing and analysis, key skills for using Google Analytics effectively. Students will learn how data can inform and guide strategic decision-making, a central aspect of Google Analytics. Familiarity with BI project architectures, ETL processes, and data modeling are directly transferable to configuring and analyzing data in Google Analytics. Additionally, understanding multidimensional technologies and data mining will enrich the ability to interpret complex data sets, which is crucial to passing the official Google Analytics certification exam.

Prerequisites:	*Keywords :*
- *Understanding the basic concepts of data: Understand what data is, how it is collected, stored and managed.* - *Basic knowledge of databases: Have knowledge of how relational databases like SQL work.*	*Businesses Intelligence, data visualization, analytics, data mining, ETL approach, Kimball approach, Inmon approach, data modeling, Dtawerhouse, OLAP, OLTP..*

Specific course objectives (OBJi):

OBJ 1 : *An understanding of Business Intelligence (BI) decision-making tools and methods.*

OBJ 2 : *Knowledge of BI project architecture and the ETL (Extraction, Transformation, Loading) approach.*

OBJ 3 : *Perspectives on the decision-making chain and the stages of a BI project.*

OBJ 4 : *Mastery of the typology and scope of decision-making projects.*

OBJ 5 : *Skills in BI modeling and multidimensional technologies.*

OBJ 6 : *A skill in Data Mining, including algorithms and examples.*

OBJ 7 : *An awareness of BI application areas and examples of BI tools.*

Necessary material :

Platform: Google Data Studio, Looker and Google Cloud Platform (GCP) Labs

https://www.cloudskillsboost.google/focuses/1005?parent=catalog

Google Cloud

"Exploring Data with Looker"

Students will learn how to use the Explorer interface to access data published by LookML developers. In this quest, they will learn the fundamentals of data mining in Looker, including but not limited to dimensions and measures, filtering and pivoting, merging explorations, and using functions advances. A Proficiency Badge is an exclusive digital badge issued by Google Cloud in recognition for mastery of Google Cloud products and services and tests your knowledge to apply your knowledge in a hands-on, interactive environment.

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Looker Data Explorer - Qwik Starthttps://www.cloudskillsboost.google/course_sessions/5398147/labs/403530?locale=fr*	*3*	*In this lab, you will create a series of visualizations from the Airports and Vols datasets and save them to a dashboard in Looker.*
3-4	*Filtering and Sorting Data in Looker" https://www.cloudskillsboost.google/course_sessions/5398147/labs/403531?locale=fr"*	*3*	*In this workshop, you will learn how to filter and sort data, as well as create looks with Looker.*

5-6	*Merging Results from Different Explores in Looker" https://www.cloudskillsboost.google/course_sessions/5398147/labs/403532?locale=fr"*	*3*	*In this lab, you will merge results from different explorers into Looker.*
7-8	*Creating a Looker Modeled Query and Working with Quick Start" https://www.cloudskillsboost.google/course_sessions/5398147/labs/403533?locale=fr"*	*3*	*In this lab, you will learn how to use the query parameter to create a templated query for exploration.*
9-10	*Looker Functions and Operators https://www.cloudskillsboost.google/course_sessions/5398147/labs/403534?locale=fr"*	*3*	*In this lab, you will learn how to use Looker to rotate dimensions, rearrange columns, delete fields, and use table calculations.*
11-12	*Exploring Data with Looker: Challenge Lab" https://www.cloudskillsboost.google/course_sessions/5398147/labs/403535?locale=fr*	*3*	*In this lab, you will test your skills for viewing, filtering, and sorting data in Looker. You will also need to save looks, add them to a dashboard, add them to a table, and schedule regular data delivery.*
13-14	*Practical exam, mini-project defense*	*3*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References (useful links)

- ***Bibliographic and Online References***
  - *https://www.cloudskillsboost.googl”*
- ***Books***
  - *Kimball, R., & Ross, M. (2013). The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling. Wiley.*
  - *Inmon, W. H. (2005). Building the Data Warehouse. Wiley.*
  - *Loshin, D. (2013). Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph. Elsevier.*
  - *Davenport, T.H., & Harris, J. (2007). Competing on Analytics: The New Science of Winning. Harvard Business School Press.*
  - *Few, S. (2009). Now You See It: Simple Visualization Techniques for Quantitative Analysis. Analytics Press.*
  - *Han, J., Kamber, M., & Pei, J. (2011). Data Mining: Concepts and Techniques. Morgan Kaufmann.*
  - *Eckerson, W. W. (2010). Performance Dashboards: Measuring, Monitoring, and Managing Your Business. Wiley.*
  - *Ponniah, P. (2010). Data Warehousing Fundamentals for IT Professionals. Wiley.*
  - *Vercellis, C. (2011). Business Intelligence: Data Mining and Optimization for Decision Making. Wiley.*
  - *Marr, B. (2016). Data Strategy: How to Profit from a World of Big Data, Analytics and the Internet of Things. Kogan Page.*

7- Working environment (Facilities necessary for learning)

To set up a work environment to practice on Google Data Studio, Looker and Google Cloud Platform (GCP) Labs, here are the steps to follow:

- ***Looker Studio:***

  You can use Looker Studio to access, visualize, and share a variety of data in the form of interactive dashboards and reports. To learn, you first explore a sample Google Cloud invoice, export the invoice data to BigQuery, and then run SQL queries on that data. These metrics are then exported to Looker Studio, where you can explore the service's features and create your own billing data visualizations.
- ***Lab Setup:***
  - *Use a standard internet browser, Chrome is recommended.*
  - *Labs are timed and cannot be paused. Use the temporary credentials provided to access Google Cloud for the duration of the lab.*
  - *It is suggested to use a browser window in Incognito mode to avoid conflicts with your personal Google Cloud account and to avoid additional charges.*
  -

Course Specification

Network protocol engineering

1. General

Coded	*Inf-ICC 4 2 06*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Ridha Azizi*					Vol. H. (TP)	
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Field Work*					Self-Study H.	*50*
Module	*Network protocol engineering*					Version	*08/2023*

Course description (Course objective):
This module complements basic networking training. This involves exploring, on the basis of practical cases, essential services and concepts for mastering local networks and TCP/IP architecture. The services necessary for the operation of the network are addressed in this unit. Particular attention is also paid to issues related to addressing (DNS, DHCP, NAT, IPV6, etc.) and messaging (SMTP, POP, IMAP, mailing lists, etc.).

Prerequisites:	*Keywords :*
Fundamentals of Networks	*...*

Specific course objectives (OBJi):
OBJ 1 : *Develop skills in the organization, design, analysis and management of different types of networks;* ***OBJ 2 :*** *Analyze the functions of a telecomputing network in relation to the OSI reference model and in relation to the protocols of the TCP/IP family;* ***OBJ 3 :*** *Understand how the main protocols of the TCP/IP family work;* ***OBJ 4 :*** *Analyze and compare any protocol against the OSI model;* ***OBJ 5 :*** *Distribute network functions according to the different layers of a given network architecture;* ***OBJ 6 :*** *Make judicious choices of architectures and protocols according to the needs to be satisfied and the problems to be resolved;*

Necessary material :
- *Video projector*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-5	- General presentation - OSI Model - Ethernet - The network layer - The transport layer - Name resolution - DHCP - TCP/IP Utilities	7.5h	- Reminder of the main concepts - How the main protocols of the TCP/IP family work
6-9	- Public protocols - Logical addressing - Routable protocol - "Naming" service - Error control and data flow - Application support (ports)	6h	- Distribute network functions according to the different layers of a given network architecture;
10-12	- Communication protocols - autopsy of an accident… - Structure of communication protocols - Engineering rules for rigorous protocol design - Some protocol description languages	4.5h	- Choice of architectures and protocols according to the needs to be satisfied and the problems to be solved
13-14	- Error control and data flow - Application support (ports)	3h	- Application layers in an architectural model - Port concept

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	40%
EE - Written test (Final exam)	60%
EP - Practical test (Practical work exam or Mini project)	-

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Efficiency (10 points)*
- *Criterion 3: Quality (5 points)*

6- References

- *[1] Black, Uyless. Networks. Pearson, 2011.*
- *[2] Dani`ele DROMARD, Dominique SERET. Network architecture, course summary and corrected exercises. Pearson, 2009.*
- *3] JFH´erold, O Guillotin, P Anaya. Industrial computing and networks in 20 sheets. Dunod, 2010. [4] N. Salmi, A. Abdeli. Networks and teleprocessing. Blue Pages, 2016.*
- *[5] Pujolle, Guy. Introduction to networks, courses and exercises. Eyrolles, 2001.*
- *[6] Servin, Claude. Networks and telecommunications, Courses and corrected exercises. Dunod, 2003.*

7- Working environment (Facilities necessary for learning)

- *No installation is required.*

Course Specification

System administration

1. General

Coded	*Inf-ICC 4 1 07*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*0*
Responsible	*Fatiha Naouar*					Vol. H. (TP)	*42*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*34*
Module	*System administration*					Version	*08/2023*

Course description (Course objective):

At the end of the course, the student will be able to:

- *Choose your hardware based on the expected functionalities of the computer system,*
- *Install a Unix-type system with a good level of security (which could possibly be a server on the network,*
- *Maintain (custom configuration, creation of utilities dedicated to routine tasks, backups, user advice, etc.)*
- *Know how to seek and find useful information to succeed in a new achievement, therefore gradually increasing your skills while managing a system without jeopardizing data security and user comfort*

Prerequisites:	*Keywords :*
Know the foundations of the Unix operating system	*Operating system, Unix*

Specific course objectives (OBJi):

OBJ 1 : *Install and administer the Linux system*

OBJ 2 : *Manage disks and filesystems (partitioning, modifying, mounting, etc.)*

OBJ 3 : *Highlight the performance and tuning of Linux systems*

OBJ 4 : *Manage devices in Linux*

OBJ 5 : *Getting started with network services under GNU / Linux*

Necessary material :

- *Video projector*
- *Course materials*
- *TP support*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	- Preparation of the work environment (PPE labs) - Explanation of possible solutions for a home environment for monitoring and work to be completed: Dual boot, iso image, virtual machine, vdi, vmdk, ova… - Setting up a Linux (ubuntu) virtual machine via a virtualization tool - Comparison between Windows / Linux systems - Highlights The bash, sudo, su, apt commands (update, upgrade, search, etc.)	3	Preparing the work environment
2	- Reminders on some useful commands (Student upgrades; various courses + acquired system module) - The command line - The Shel environment	3	Configuring and using an OS (Linux)
3	- Kernel verification (vmlinuz, kernel symbolic link, etc.) - The /dev directory - The top command - Boot: /boot/grub, /etc/default/grub, dmesg,. - Modules: /lib/modules, lsmod, etc.	3	Kernel, File system, user rights
4.5	- Creation of physical volumes - Creation of a volume group - Creation of logical volumes - Extension of a file system - Replacing a disk - Using snapshots - Cleaning of work carried out	6	LVM
6.7	- Distinction between application vision of file management and that of the kernel - Types of FS: logging FS (ext3, reiserfs, xfs, jfs, vxfs), network FS (nfs, smbfs, ncpfs), system FS (proc, sys, selinux) - On-the-fly assembly of an FS - Management of different types of FS: FS XFS, FS ReiserFS; FS ext2/ext3; FS tmpfs - Management of quotas and ACLs - Setting up an NFS server	6	File Systems, Quotas, ACL

8	- The mdadm, lsraid, raidsetfaulty, raidhotadd commands - Creating a software RAID 5 disk - Creating a VG on a RAID disk - Creating a swap area in a partition	3	RAID-SWAP
9	- Incremental system backup of FS: dump, restore - Physical backup: the dd command - Network backup, network dump - Full Backup (Bare Metal): Mondo	3	the backup
10-11	- User and group management commands (useradd, etc.) - User account configuration files (passwd, shadow, etc.)	6	User account management
12-13	- System monitoring: enable main commands (uptime, free, vmstat, ps, top - Creation of a monitoring script activated by a crontab - Monitoring a command with time - System monitoring with sar - Package compatibility management - Resource usage limitation: ulimit - Change kernel settings - Simulate a load with a benchmark, the influence of memory	6	Performance Management)
14	Practical exam	3	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	20%
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	80%

4- Evaluation criteria

- Criterion 1: Compliance (5 points)
- Criterion 2: Adequacy (3 points)
- Criterion 3: Efficiency (7 points)
- Criterion 4: Quality (5 points)

5- Bibliographic and Online References

- ***Bibliographic and Online References***

    - *Administration système - Linux Administration* https://linux.goffinet.org/administration/
    - https://ubuntu.com/ *: Site ubuntu*

- ***Books***

- *Aeleen Frisch, (2002).* Essential System Administration *(3rd ed.). O'Reilly Media.*
- *Beebe, J. (2017).* UNIX Systems Programming: Communication, Concurrency, and Threads. *Addison-Wesley.*
- *Jang, H. (2009).* The UNIX Programming Environment. *Prentice Hall.*
- *Roberts, B. (2011).* Linux System Administration. *Wiley.*

6- Working environment (Facilities necessary for learning)

- Linux Ubuntu 20 …

Course Specification

Server administration

1. General

Coded	*Inf-ICC 4 1 08*	Level/Semester	*4-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Ridha Azizi*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*36*
Module	*Server administration*					Version	*08/2023*

Course description (Course objective):

- *The general objective of this course is to introduce students to common network administration concepts by setting up associated network services in order to actively manage them.*

Prerequisites:	*Keywords :*
The Foundations of a Computer Network	*…*

Specific course objectives (OBJi):

OBJ 1 : *Understand the different configurations and management of an IT fleet;*

OBJ 2 : *Optimize the management of IT systems services*

OBJ 3 : *Enable the automatic deployment of new machines connected to a computer network*

OBJ 4 : *Know and understand the operating mode of network application protocols and know how to set up associated computer network services*

OBJ 5 : *Enable the acquisition of different skills on the essential technical elements enabling informed choices of architectures and protocols to be made based on the needs to be satisfied and the problems to be resolved*

Necessary material :

- *PCs, Video projector*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1.2	- *The supervision* - *Administration* - *Exploitation* - *General principle of a network administration system* - *Functional structure of an administration system.*	*3*	- *Introduction to computer network administration*
3,4,5,6	- *The Organizational Model* - *Manager –Agent Management Model Manager –Agent Management Model with Proxy agent* - *The Information Model: All managed objects constitute the MIB* - *The functional model* - *Configuration Management* - *Performance management* - *Failure management* - *Accounting management* - *Security management*	*6*	- *Supervision of a computer network*
7,8,9,10	- *Hardware requirements* - *Installation steps* - *Configuration* - *Advanced settings* - *Remote Access Configuration*	*6*	- *Installation and configuration of a WINDOWS SERVER "2012 R2" system*
11,12,13,14	- *Installation of the Active Directory server / domain controller (ADDS);* - *Installation of the DNS server;* - *Installation of the DHCP server;* - *Installation of the SNMP service;* - *Installing the DFS service*	*6*	- *Administration of a WINDOWS SERVER "2012 R2" system*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1.2	- *VirtualBox* - *ISO images* - *Installing a WINDOWS SERVER 2012 R2 system* - *Installing a WINDOWS system*	*3*	- *Preparing the work environment* -
3,4,5,6	- *Configuring a WINDOWS SERVER 2012 R2 system*	*6*	- *Discover the server environment*
7,8,9,10,11 ,12,13	- *Installation of the Active Directory server / domain controller (ADDS);* - *Installation of the DNS server;* - *Installation of the DHCP server;* - *Installation of the SNMP service;* - *Installing the DFS service*	*10.5*	- *Administration of a WINDOWS SERVER "2012 R2" system*
14	- *Practical exam*	*1.5*	- *Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References and Web reference (useful links)

- *C. ZAKER, Exam Ref. 70-410: Installing and configuring Windows Server 2012R2, Microsoft Press, 2014*
- *C. RUSSEL, Exam Ref. MSCA 70-411: Administering Windows Server 2012 R2, Microsoft Press, 2014*
- *Laurent BLOCH and Christophe WOLFHUGEL, IT security. Principles and method for use by CIOs,*

CISOs and administrators, 2nd edition, Eyrolles, Paris, 2009.

- *Nicolas Ochoa, “The principle of free circulation of information - Research on the legal foundations of the Internet”, HALSHS, 2016.*
- *Pierre ROLIN, Gilbert MARTINEAU, Laurent Toutain, Alain LEROY, “network administration: fundamental principles”, Hermes, December 1996, 574p.*
- *William R. Stanek, “Microsoft® Windows Server 2012: Administrator's Guide”, 5th Edition, Addison- Wesley, 2008, ISBN 013-607967-9*

7- Working environment (Facilities necessary for learning)

Minimum system requirements:

- *CPU: 1.4 GHz (3.1 GHz 64-bit recommended)*
- *Memory: 2 GB (8 GB recommended)*
- *Disk: 160 GB*
- *Network: 1 network card*
- *Clients: Windows 7/8 and MAC OS 10.5*

Course Specification

Integration project

1. General

Coded	*Inf-ICC 4 2 09*	Level/Semester	*4-S1*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	
Responsible	*Ridha Azizi*					Vol. H. (TP)	*21*
Teaching Methods	*Direct Instruction, Project Based, Field Work*					Self-Study H.	*50*
Module	*Integration project*					Version	*08/2023*

Course description (Course objective):
Carry out a mini-Cloud project

Prerequisites:	*Keywords :*
The foundations of Cloud Computing *Virtualization*	…

Specific course objectives (OBJi):
OBJ 1 : *the process of carrying out a mini project* ***OBJ 2 :*** *set up a cloud platform* ***OBJ 3 :*** *operation of the platform*

Necessary material :
- *Video projector*

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*Presentation of the process of carrying out a mini-project*	*1.5*	*Specifications and procedure for carrying out a mini-project*

2.3	*Presentation of the two platforms: open stack and opennubela*	*3*	*Free cloud computing platforms*
4-13	*Installation, configuration and operation of a platform*	*15*	
14	*Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References

- ***Bibliographic and Online References***
  - *Open Source Cloud Computing Infrastructure - OpenStack* https://www.openstack.org/
  - *OpenNebula – Open Source Cloud & Edge Computing Platform* https://opennebula.io/
- ***Books***
  - *ommerville, I. (2011).* Software Engineering *(9th ed.). Addison-Wesley.*
  - *Pressman, R. S. (2014).* Software Engineering: A Practitioner's Approach *(9th ed.). McGraw-Hill Education.*
-

7- Working environment (Facilities necessary for learning)

- *linux system 20.04*

Course Specification

DevOps

1. General

Coded	*Inf-ICC 4 2 01*	Level/Semester	*4-S2*	Coefficient	*4.5*	Credits	*4*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Adnene Rouatbi*					Vol. H. (TP)	*42*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*40*
Module	*DevOps*					Version	*08/2023*

Course description (Course objective):
This module is an overview of the concepts of continuous integration and continuous delivery. Cover basic DevOps concepts

Prerequisites:	*Keywords :*
Be familiar with the basics of the software development lifecycle	*DevOps, CI/CD*

Specific course objectives (OBJi):

OBJ 1: Understand what the DevOps movement is

OBJ 2: Know the business challenges of DevOps

OBJ 3: Master the values, principles and practices of DevOps

OBJ 4: Have an overview of automation tools

Necessary material :

- *A PC*
- *Video projector,*
- *Practical work support*
- *Course materials*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1,2,3	- *Definitions of DevOps concepts.* - *What is DevOps? Its objectives, stakeholders, value for the company.* - *What is not DevOps?* - *DevOps and IT performance (Agility and stability).* - *IT performance measurement indicators.* - *DevOps and automation (why automation is possible? The benefits).*	*4.5h*	- *Introduce the concept of DevOps*
4.5	- *The principles. The three paths: workflow, feedback, continuous experimentation and learning.* - *Values. CALMS: Culture, Automation, Lean, Measurement, Sharing.*	*3h*	- *General overview of DevOps*
6.7	- *Understand DevOps culture.* - *Its characteristics: transparency, shared vision, trust, continuous improvement....* - *Managing cultural change.* - *Implementation of the DevOps culture. Where to start ? Risks, success factors.* - *Measuring DevOps success.*	*3h*	- *Introduce DevOps principles and values*
8.9	- *Skills.* - *Organizational structures.* - *Roles and responsibilities.* - *Promote collaboration and improve communication.*	*3h*	- *Understand DevOps culture.*
10.11.12	- *Continuous integration and delivery.* - *Continuous deployment.* - *VSM (Value Flow Map), Kanban.* - *Theory of constraints.* - *Feedback: dashboards, post-mortem...* - *The Deming Wheel (PDCA), "Improvement Kata".* - *Preparing for failure.* - *Improvement of ITSM processes.*	*4.5h*	- *Present DevOps practices*

13.14	- DevOps automation practices. - DevOps tool concerns and categories.	3h	- Introduce DevOps and tools

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1,2,3	- Git Basics - Branches with Git - Git on the server - GitHub - Git Utilities - Customizing Git	9	Implement a Git project in collaborative mode.
4,5,6	- Containers and virtual machines - DockerEngine - Images and containers - Difference between image and container - Layers - Container composition	9	have containerize applications in Docker images.
7,8,9	- Kubernetes concepts - Features - Kubernetes Cluster - Kubernetes Architecture - Control Plane Components - The nodes - The Kubernetes API and Objects - Interact with Kubernetes - The decoupled architecture of Kubernetes services	9	Discover how Kubernetes works and architecture
10.11.12	- What is Jenkins? - Key Concepts - Jenkins Master Slave - Configuration of the various phases	9	Understand the architecture and operation of Jenkins
13.14	- Practical exam, mini-project defense, …	6	Summative evaluation

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	20%

EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References

- **Bibliographic and Online References**
  - *TP DEVOPS Deployment chain (Docker, Jenkins, etc.) - HackMDAuthor, Title, URL, Year 2024* https://hackmd.io/@0pm5dgllSNKMBAzbcpXbtA/ByW3_fcnM?type=view
- **Books**

- *Kim, G., Humble, J., Debois, P., & Willis, J. (2016).* The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations. *IT Revolution Press.*
- *Lwakatare, L. E., Oivo, M., & Babar, M. A. (2014).* A Systematic Review of DevOps: A Software Engineering Perspective. *Springer.*
- *Anderson, D., & Albrecht, M. (2017).* Site Reliability Engineering: How Google Runs Production Systems. *O'Reilly Media.*
- *Fowler, M. (2010).* Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation. *Addison-Wesley.*
- *Willis, J. (2018).* DevOps for Dummies. *Wiley.*
- *Fitz, P. (2019).* DevOps for the Modern Enterprise: Winning Practices to Transform Legacy IT Organizations. *O'Reilly Media.*
- *Shah, A. (2020).* Mastering DevOps: A Practical Guide to Automating and Streamlining Your DevOps Workflow. *Packt Publishing.*

7- Working environment (Facilities necessary for learning)

- *Linux VMs 20.04*

Course Specification

Cloud Computing Security and Network Auditing

1. General

Coded	*Inf-ICC 4 2 02*	Level/Semester	*4-S2*	Coefficient	*3*	Credits	*4*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*60*
Module	*Cloud Computing Security and Network Auditing*					Version	*08/2023*

Course description (Course objective):
Understand basic information security concepts, including security policies, security models, and security mechanisms.

Prerequisites:	*Keywords :*
Foundation of Networks and Server Administration	*Filtering, Cryptography, VPN, Security Audit, Tunneling*

Specific course objectives (OBJi):
OBJ 1 : *Acquire a global vision of the security of an information system* ***OBJ 2 :*** *Understand current security issues* ***OBJ 3 :*** *Know the different types of attack* ***OBJ 4 :*** *Acquire knowledge of the cryptographic methods involved in most security mechanisms* ***OBJ 5 :*** *Study communication network protection techniques. Interest is given to Filtering Mechanisms* ***OBJ 6 :*** *Know intrusion detection techniques* ***OBJ 7 :*** *Master the basic concepts of virtual private networks and study tunneling techniques and protocols as well as tunnel construction techniques.* ***OBJ 8 :*** *Introduce the basic notions relating to the security audit of communication systems, the approach as well as the technical aspects for developing an audit.*

Necessary material :
- *1941 routers with two serial interfaces - 1* - *Cisco 2960 Switches – PC-0, PC-1:*

- *Generic PCs*
- *Server*

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1.2	- *Why security?* - *The safety cycle* - *Security services* - *Security mechanisms* - *Backup and update* - *Monitoring and analysis*	3	- *Introduction to security*
3.4.5	- *Concept of attack* - *Passive attacks* - *Active attacks*	4.5	- *Security attacks*
6.7.8	- *Cryptography concept* - *Symmetric cryptography* - *Asymmetric cryptography* - *Digital signature* - *PKIs* - *Certificates*	4.5	- *Cryptography*
9.10.11	- *Firewall* - *Proxy* - *IPS/IDS* - *VPN (SSH and SSL + IPSec tunnel)* - *Anti-virus*	4.5	- *Network security*
12.13.14	- *Audit process* - *Systems and network audit*	4.5	- *Audit*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1.2	- *Setting up a passive attack.* - *Implementation of a simple passive sniffer then handling sniffing software.* - *Introducing methods to crack passwords and allow you to use any of the software used by hackers.*	*3*	*Setting up passive attacks*

	- *Experimentation with an ARP spoofing man-in-the-middle (MITM) attack, with the ettercap tool running from Kali Linux.* - *Experimenting with another attack called DNS spoofing.*		
3.4	- *Experimentation with an ARP spoofing man-in-the-middle (MITM) attack, with the ettercap tool running from Kali Linux.* - *Experimenting with another attack called DNS spoofing.*	*3*	*Setting up active attacks*
5.6	- *Become familiar with basic security services, including symmetric encryption, asymmetric encryption, hashing, digital signing and verification. This lab is based on OpenSSL software.*	*3*	*Cryptography with openSSL*
7.8	- *the goal of the TP is to install and configure the Pfsense firewall*	*3*	*Configuring firewall filtering rules*
9.10	- *Part 1: Basic configuration of network equipment - Configuring basic parameters such as host name, interface IP addresses and access passwords. - Static routing configuration.* - *Part 2: Configuring a Remote Access VPN - Configure R3 Router to be Server VPN with CLI - Configure a VPN Client on PC-0 - Verify Configuration - Test VPN Operation*	*3*	*Practical tunneling protocols*
11.12	- *The goal of this lab is to discover some vulnerabilities that can be found in both services and systems. Vulnerabilities are detected using Nmap utilities.*	*3*	*Vulnerability detection using Nmap utilities*
13.14	- *The nessus server* - *Launching the application* - *Connection to the nessusd server (local or remote) using the "Sign In" button* - *Adding hosts or networks to scan using the "+ New Scan" button*	*3*	*Audit of a Windows/Linux operating system with Nessus*

	- *Selecting a scanning policy (e.g. Default, Microsoft Patch or Custom)* - *Optionally editing the policy to personalize it (generally to adapt the plugins to be executed depending on the hosts, provide account identifications, etc.)* - *- Starting the scan using the "Launch" button -*		

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References

- ***Bibliographic and Online References***
  - http://www.amazon.com/Computer-Security-Dieter-Gollmann/dp/0470741155
  - *Ross Anderson "Security Engineering" http://www.amazon.com/Security-Engineering-Building- Dependable-Distributed/dp/0470068523/ (Also available online at: http://www.cl.cam.ac.uk /~rja14/book.html)*
- ***Books***
  - *Avoine, G., Junod, P., & Oechslin, P. (2015). Computer security: Courses and corrected exercises.*

7- Working environment (Facilities necessary for learning)

- *Linux Kali*
- *open ssl*
- *Nmap*
- *Nessus*

Course Specification

Development of web services applications on cloud platforms

1. General

Coded	*Inf-ICC 4 2 03*	Level/Semester	*4- S2*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Wejden Said*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*30*
Module	*Development of web services applications on cloud platforms*					Version	*08/2023*

Course description (Course objective):
Learn how to design and develop services that access local and remote data from various data sources and Learn how to develop and deploy services in cloud environments

Prerequisites:	*Keywords :*
- *Knowledge of JAVA*	*Web Services, Spring Boot, Service-Oriented Architecture, SOA*

Specific course objectives (OBJi):

Operational objective:

OBJ 1 : *Know how to develop, publish and use their first web services.*

Educational goals:

At the end of this Web Services training, you will have acquired the knowledge and skills necessary to:

OBJ 2 : *Understand the principles of a service-oriented architecture*

OBJ 3 : *Master the concepts and issues of Web Services*

OBJ 4 : *Know how to develop Web Services using the Java framework (spring boot)*

OBJ 5 : *Being able to build a distributed architecture*

Necessary material :

- *IDE: Spring Tools Suite V4.0*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Introduction to web services*** - *Principle and objectives of Web Services* *Web application interoperability and SOA architecture* *Web services and EAI* *Integration of existing systems: connectivity of Web Services with other Java EE technologies* *REST type web services* *Orchestration of Web services, BPEL, WSCI* *Techniques and protocols: XML, SOAP, WSDL, UDDI*	3h	*Understand the principles of a service-oriented architecture*
3-4	***Reminders on XML and Java*** - *The advantages of XML* *Validity of an XML document, DTD and XML Schema* *XML, SAX, DOM and StAX parsers* *JAXP API*	3h	
5-6	***The SOAP protocol*** - *General principles and architecture* *Structure of Soap messages* *Error messages and encoding* *SOAP over HTTP* *SOAP-RPC and SOAP Document*	3h	
7-8	***Description of Web Services: the WSDL language*** - *Structure of a WSDL document* *WSDL and code generation* *Data types* *Definition of messages and associated exchange protocols* *Service interface and localization* *Parameter encoding*	3h	*Understanding the structure of a WSDL document and service localization*
9-10	***Publication and referencing of Web services: UDDI*** - *Roles of UDDI directories, limits of the model* *Runtime directory and design-time directory* *Publication of web services, Management of the service catalog*	3h	*Learn to use WSDL and UDDI*
	UDDI programming and dynamic service discovery *Using WSDL with UDDI*		

11-12	***Transaction Management and Web Services*** - *Transactional model of web services, Business Transaction Protocol (BTP)* *BTP and SOAP bindings* *Transaction management* *JSR for transactional support of web services*	3h	*Understanding the transactional model of web services*
13-14	***Securing Web Services*** - *Authentication, authorization and encryption* *Related Java Tools* *Authentication with SOAP headers* *Extending SOAP Security* *The WS-Security specification*	3h	*Master the security properties and their application of web services*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Essential architectural concepts*** - *Logical Architecture Overview* - *The data layer: JDBC and Hibernate* - *The data repository: Spring Data, repositories and JPA* - *The MVC design pattern: From request to response* - *The Conductor: Exploring the Role of the Controller* - *From action to object: Views, view models, controllers and models* - *The role of view models: What are Thymeleaf and other similar languages* - *Spring Boot and Maven: Coordinating the Basics*	*3h*	Understand the MVC logical model and bean configuration files in XML
3-4-5	***Starting your Spring project*** - *Using Spring Boot and Spring Initializr* - *Exploring the pom.xml file* - *Understanding the build process and Java runtime dependencies* - *Setting application properties: Server properties, dialects, drivers, etc.* - *Creating Entity Beans: Defining Table Mappings, IDs, and Entity Relationships*	*4.5h*	*Create the SOAP controller*
	- *Creating data repositories with Spring Data* - *Business service implementation: Declare service interfaces* - *Creating a first SOAP controller*		

	- *Deploying and running an application*		
6-7-8	***Building on the basics*** - *Develop Entity Beans* - *Adding business services to an application* - *Understanding Spring error handling* - *Setting up Spring error handling* - *Customizing HTTP Response Status Behavior* - *Explore URL mapping and a controller*	*4.5h*	*Create business services for a web application*
9-10	***Master Spring configuration*** - *Configuring Resource Hives: Resource Bundles and Web Assets* - *Understanding view model processing* - *Creating the template directory* - *Changes to the pom.xml file* - *Exploring Spring configuration options: XML and code-based* - *Create the configuration class: Set the application context* - *Adding resource packages to the configuration* - *Defining the view model in configuration: The resolver and the engine* - *Implementing logging and running the application*	*3h*	*Master Spring configuration and implementation of a Spring boot web project*
11-12	***Creating Thymeleaf templates*** - *Understanding the role of the View Model class* - *Build the first view model* - *Creating templates based on templates* - *Adding content to templates* - *Using Java Objects in a Thymeleaf Model*	*3h*	*Creating templates with Thymeleaf*
13-14	***Explore Interceptors and Security*** - *Spring's interceptor architecture* - *Why Interceptors Are Critical to Enterprise Architecture* - *Creating the Interceptor class* - *Spring configuration: Adding the interceptor* - *Exploring Spring Security* - *Adding Spring Security to the configuration* - *Defining secure and insecure resources*	*3h*	*Secure Web Application with JWT*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*

EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References (useful links)

- ***Bibliographic and Online References***
  - *Spring tools Suite https://spring.io/tools*
- **Books**
  - *Johnson, R., & Carnell, S. (2018).* Spring Boot in Action. *Manning Publications.*
  - *Schaub, M., & Mohr, G. (2017).* Spring Boot: A Beginner's Guide. *McGraw-Hill Education.*
  - *Walls, C. (2018).* Spring in Action *(5th ed.). Manning Publications.*
  - *Bauer, C., & King, G. (2018).* Spring in Action *(5th ed.). Manning Publications.*
  - *Díaz, J. P. (2020).* Spring Boot 2.0 Projects: Build modern, scalable, and secure full-stack applications with Spring Boot 2.x. *Packt Publishing.*
  - *Johnson, R. (2017).* Spring Boot: Up and Running. *O'Reilly Media.*
  - *Gurnani, K. (2018).* Spring Boot 2.x Cookbook: Over 70 recipes for building modern, scalable, and secure applications with Spring Boot 2.x. *Packt Publishing.*

7- Working environment (Facilities necessary for learning)

- *EDI: Eclipse, …*
- *Spring tools Suite: https://spring.io/tools*

Course Specification

Big Data

1. General

Coded	*Inf-ICC 4 2 05*	Level/Semester	*4-S2*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Samia Sagar*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*30*
Module	*Big Data*					Version	*08/2023*

Course description (Course objective):
Understand the concepts underlying the creation of a Big Data environment and the different tools available and necessary in this universe. Understand the different layers of software and the technical issues behind achieving business objectives. Understand the different approaches to "No SQL" or non-relational databases.

Prerequisites:	*Keywords :*
Advanced Databases, System Administration	*Big Data, Hadoop, MapReduce, NoSQL*

Specific course objectives (OBJi):
OBJ 1 : *Apply the main concepts underlying the sparse data environment and their organization in Big Data;* ***OBJ 2 :*** *Identify the different informational approaches and choose the appropriate non-relational data architecture;* ***OBJ 3 :*** *Describe the crucial steps in the construction and modeling of Big Data;* ***OBJ 4 :*** *Understand big data exploitation tools and methods*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1.2	- *Definitions of "Big Data" and "Big Analytics"* - *Why now ?* - *Data evolution, the 3 Vs* - *A different BD approach: NoSQL* - *CAP theorem*	3	*Introduce the basic concepts of big data*
3.4	- *Hadoop Foundations* - *HDFS* - *MapReduce* - *Servers, racks and networks* *Layers of the stack*	3	*Software layers*
5.6	- *NoSQL architectures* - *Key-value : In columns, Documents, Graphics, In memory* - *Choice of BD schema* - *Distribution and replication*	3	*Data models*
7.8	- *Methods and tools depending on the type of source : Structured and semi-structured data, Web 2.0 data* - *Unstructured data* - *Metadata*	3	*Data acquisition*
9.10.11	- *Mega-analysis techniques* - *Social Media Analytics* - *Mega-analysis tools : Python, R, Tableau*	4.5	*Data analysis*
12.13.14	- *Managing a Big Data project* - *Hybrid architecture* - *Data Lakehouse* - *Team* - *idiosyncrasies* - *Ethics*	4.5	*Project management and implementation*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1.2.3.4.5	- *LAB 1: HDFS* - *LAB 2: MapReduce* - *LAB 3: Hive – Hbase, BigSql*	*7.5*	*Big data workshop*
6.7.8.9.10. 11.12.13	- *LAB 4: Administration (HA) merroring and replication* - *LAB 5: Administration (HA) clustering* - *LAB 6: Recovery after failures (DR) Archiving (backup)* - *LAB 7: Recovery after failures (DR) Restoration and recovery recovery*	*12*	*High availability DBMS (HADR).*
14	- *Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

5- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

6- References

- *Jean-Charles Cointot and Yves Eychenne, “The Big Data revolution” Dunod 2014*
- *Gilles Babinet, “Big Data, thinking about man and the world differently” Le Passeur 2015*
- *Charles Huot, “Big Data if we talked about it? » Proceedings of the IST Inria (French public research institute in digital sciences) seminar by Boeck October 2014.*
- *Bernard Normier “Analyze hard opinions on the Internet and social networks to enhance your notoriety, sentiment analysis and opinion mining” Vitrac publisher 2014*

- *Grégory Bressoles, “e-marketing” Dunod 2012*

- *Augustin Huret and Jean Michel Huet “artificial intelligence at the service of marketing” Expansion Management Review 2012*
- *Olivier Ondet, “Big Data at the service of tourism” Annales des Mines Industrial realities. 2015*
- *Maria Mercanti Guerin “Improving retargeting using Big Data: a decision-making aid that threatens the image of brands? » International Journal of Economic Intelligence -2013*
- *Stéphanie Herault, Bertrand Belvaux, “Privacy paradox and adoption of intrusive technologies: The case of mobile geolocation” DM n° 74 (2014*
- *Sylvain Willard, “VRM: a new paradigm for customer relations? » DM OctDec 2013*
- *Christophe Benavent, “The four paths of Big Data: no best way” Xerfi Canal*
- *France- Université- Numérique-Mooc.fr “Computers and freedoms on the Internet” June/July 2015*
- *Mcfactory.fr Round table “User experience centrix” and Round table “priorities for 2016”*
- *Points of sale, Big Data File No. 1174. April 2015*
- *Bigdataparis.com Market summary 2014*

7- Working environment (Facilities necessary for learning)

- Ubuntu 20.04
- Java

Course Specification

Advanced server administration

1. General

Coded	*Inf-ICC 4 2 06*	Level/Semester	*4-S2*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	
Responsible	*Fatiha Naouar*					Vol. H. (TP)	*42*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*28*
Module	*Advanced server administration*					Version	*08/2023*

Course description (Course objective):

- *Acquire the skills necessary to operate common servers (DNS, POP, SMTP, Apache, MySQL, FTP, SAMBA, SSH, etc.). Running under Linux.*

Prerequisites:	*Keywords :*
- *Server administration* - *The foundations of Networks* - *Linux system*	*DNS, DHCP, Apache, MySQL, FTP SAMBA*

Specific course objectives (OBJi):

OBJ 1 : *Manage users*
OBJ 2 : *Install and configure a DNS server*
OBJ 3 : *Install and configure an email server*
OBJ 4 : *Install and configure a web server*
OBJ 5 : *Install and configure MySQL*
OBJ 6 : *FTP: File Transfer Protocol*
OBJ 7 : *SAMBA: network resource sharing*
OBJ 8 : *SSH: remote access management*

Necessary material :

- *PC, Video projector*
- *Practical work support*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	*Goals*
1	- *Presentation of Unix accounts,* - *Management of Unix accounts in different environments.*	*3*	*Manage users*
2.3	- *BIND philosophy,* - *Setting up BIND,* - *Make sure BIND is working.*	*6*	*Install and configure a DNS server*
4.5	- *Presentation of Postfix,* - *Configuring Postfix,* - *Configuration of MUAs (email clients): evolution, kmail and Outlook*	*6*	*Install and configure an email server*
6.7	- *Presentation of Apache,* - *Installing Apache,* - *Folder protection and authentication management under Apache,* - *Host several sites: Virtual Hosting,* - *Page security (SSL)*	*6*	*Install and configure a web server*
8.9	- *Presentation of MySQL and PHPMyADMIN,* - *PHPMyADMIN installation and configuration,* - *Installation and configuration of MySQL,* - *Access filtering,* - *Integration of MySQL databases in a PHP script.*	*6*	*Install and configure MySQL*
10	- *Philosophy of FTP,* - *Configuring an FTP server,* - *Authentication management*	*3*	*FTP: File Transfer Protocol*
11	- *SAMBA Philosophy,* - *SAMBA configuration,* - *Access management from Linux or Windows type environments.*	*3*	*SAMBA: network resource sharing*
12-13	- *Presentation of SSH,* - *Securing SSH,* - *Access management from Linux or Windows type environments*	*6*	*SSH: remote access management*
14	- *Practical exam, mini-project defense, …*	*3*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

5- Bibliographic and Online References

- *Azizi Ridha Linux system and network administration*
- *Local Networks Ridha AZIZI Bookelis 2015*
- *The basics of system administration Æleen Frisch O'Reilly 2003*
- *Network administration under Linux Olaf Kirch and Terry Dawson O'Reilly 2004*

6- Working environment (Facilities necessary for learning)

- *VMs Linux*
- *Ubuntu 20.04*

Course Specification

Management of cloud computing infrastructures

1. General

Coded	*Inf-ICC 4 2 07*	Level/Semester	*4-S2*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Hamdi Ben Abdallah*					Vol. H. (TP)	
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Field Work*					Self-Study H.	*50*
Module	*Management of cloud computing infrastructures*					Version	*08/2023*

Course description (Course objective):
- *The course aims to provide students with an in-depth understanding of the fundamentals of Cloud Computing, with an emphasis on infrastructure management. By the end of the course, participants should be able to effectively design, deploy and manage infrastructure in a cloud computing environment.*

Prerequisites:	*Keywords :*
- *Basic knowledge of operating systems* - *Understanding of computer networks* - *Familiarity with virtualization concepts* - *Basics of client-server architectures* - *Knowledge of fundamental principles of IT security* - *Practical experience using the Internet and online services*	- *Cloud computing* - *IaaS (Infrastructure as a Service)* - *PaaS (Platform as a Service)* - *SaaS (Software as a Service)* - *Virtualization* - *Software Defined Networks (SDN)* - *Cloud Security* - *Infrastructure as Code (IaC)* - *Orchestration* - *Elasticity* - *Service Level Agreement (SLA)* - *Cloud Governance* - *Hybrid Cloud Infrastructure* - *Big Data* - *Data migration* - *Audit and monitoring* - *New emerging technologies*

	- *Compliance with standards and regulations* - *Services catalogue* - *Cost optimization*

Specific course objectives (OBJi):
OBJ 1 : *Introduction to Cloud Computing* *OBJ 2 : Cloud Infrastructure Fundamentals* *OBJ 3 : Security in the Cloud* *OBJ 4 : Cloud Resource Management* *OBJ 5 : Orchestration and Automation* *OBJ 6 : Cloud Services Management* *OBJ 7 : Cloud Data Management* *OBJ 8 : Case Study* *OBJ 9 : Governance and Compliance* *OBJ 10 : Trends and Developments in Cloud Computing* *OBJ 11 : General Review and Final Questions*

Necessary material :
…

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1	- *Definition of Cloud Computing* - *Service models (IaaS, PaaS, SaaS)* - *Deployment models (Public, private, hybrid cloud)*	1.5	*Introduction to Cloud Computing*
2	- *Virtualization and containerization* - *Software Defined Networks (SDN)* - *Distributed storage*	1.5	*Cloud Infrastructure Fundamentals*
3	- *Cloud Security Principles* - *Identity and access management* - *Encryption policies*	1.5	*Cloud Security*
4	- *Resource allocation and management* - *Elasticity and auto-scaling* - *Cost optimization*	1.5	*Cloud Resource Management*
5.6	- *Orchestration tools*	3	*Orchestration and Automation*

7	- *Workflow automation* - *Infrastructure as Code (IaC)* - *Services catalogue* - *SLA (Service Level Agreement)* - *Monitor and manage performance*		*Cloud Service Management*
8	- *Cloud Databases* - *Data migration* - *Backup and recovery strategies*	1.5	*Cloud Data Management*
9.10	- *Analysis of real cases* - *Practical exercises on Cloud platforms* - *Discussion on the challenges encountered*	3	*Case study*
11	- *Governance framework* - *Compliance with standards and regulations* - *Audit and monitoring*	1.5	*Governance and Compliance*
12	- *New emerging technologies* - *Impacts on infrastructure management* - *Preparing for the future*	1.5	*Trends and Developments in Cloud Computing*
13.14	- *Summary of key points* - *Q&A session* - *Preparing for the final assessment*	3	*General Review and Final Questions*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Critical analysis of case studies related to the management of cloud computing infrastructures (6 points)*
- *Criterion 2: Multiple choice question (7 points)*
- *Criterion 3: Long questions/case studies (7 points)*

5- Bibliographic and Online References

- *Official Cloud Provider Documentation:*

  Amazon Web Services (AWS) Documentation

  Microsoft Azure Documentation

  Google Cloud Documentation

- *Online Courses and Tutorials:*
  Coursera - Cloud Computing Specialization edX - Introduction to Cloud Computing Udacity - Cloud DevOps Nanodegree

- *Books :*
  “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl
  “Architecting the Cloud: Design Decisions for Cloud Computing Service Models” by Michael J. Kavis

- *Websites and Blogs: The New Stack InfoQ Cloud Content*
- *Academic Articles:*
  IEEE Xplore Digital Library Google Scholar
- *Forums and Communities:*
  Stack Overflow - Cloud Computing Reddit - r/cloudcomputing
- *Videos and Conferences: YouTube - AWS Online Tech Talks*
  Google Cloud Platform - YouTube Channel
- Cloud Security Resources: *Cloud Security Alliance*
  NIST Cloud Computing Program

6- Working environment (Facilities necessary for learning)

- None.

Course Specification

Cloud Services Certification (Azure)

1. General

Coded	*Inf-ICC 4 2 08*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*0*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*50*
Module	*Cloud services certification (Azure)*					Version	*08/2023*

Course description (Course objective):
The objective of this course is to acquire the basic and fundamental notions of the Azure cloud to prepare for the Azure AZ900 certification exam

Prerequisites:	*Keywords :*
Basic notions of computer science (networks, databases, etc.)	*Certification, AZ900, Cloud computing*

Specific course objectives (OBJi):

OBJ 19 :	Cloud concepts
OBJ 20 :	*The main cloud services*
OBJ 21 :	*Core solutions and management tools*
OBJ 22 :	*Azure Security and Network Securing*
OBJ 23 :	*Identity, governance, privacy and compliance features*
OBJ 24 :	*Managing Azure costs and SLAs*

Necessary material :
Nothing specific

2- Content elements (Practical work)

Days)	Chapters/Content Items	No. HR	Goals
1-2	- *Benefits and considerations of using the Cloud (High availability, Scalability, Elasticity, Fault tolerance, Disaster recovery, economic benefits)* - *The 3 categories of Cloud (IaaS, PaaS, SaaS, shared responsibility, serverless computing)* - *The 3 types of Cloud (Public, Private, Hybrid, synthesis of the 3 types)*	*3h*	*Cloud concepts*
3-4	- *The components of the Cloud architecture (region, availability zone, management group, resource group, Azure Resources Manager)* - *Basic Azure resources (Azure Marketplace, Network Management, Storage Management, Data Management)*	*3h*	*The main cloud services*
5-6	- *The main solutions (IoT, Big Data, AI, Serverless Solutions, Development Solutions)* - *Azure management tools (Azure Portal, Online Ordering, Mobile Apps, Senior Advisor, Monotoring and Health)*	*3h*	*Core solutions and management tools*
7-8	- *Security features (Azure security center, key vault, Azure Sentinel, dedicated hosts)* - *Network security (defense in depth, security groups, Azure firewall, Azure DDOS)*	*3h*	*Azure security and network security*
9-10	- *The main identity services (Azure AD, Conditional Access, Authentication and Authorization, SSO, MFA)* - *Governance features (RBAC, Resource Locks, Labels, Azure Policy, Azure Blueprints)* - *Privacy and compliance resources (fundamentals, trust center, compliance documentation, sovereign regions)*	*3h*	*Identity, governance, privacy and compliance features*
11-13	- *Planning and cost management methods (Expense factors, calculators, Azure cost management, reduction factors)* - *SLA management and service life cycle (SLA objectives, Actions on SLA, Service life cycle)*	*9h*	*Managing Azure costs and SLAs*
14	- *certification exam*	*3h*	*OBJ 1 .. OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
EE - Written test (MCQ)	*100%*
Certification exam (Microsoft Azure Fundamentals - AZ900)	-

4- Evaluation criteria

- *Criterion 1: Describe cloud concepts (25–30%)*
- *Criterion 2: Describe Azure architecture and services (35–40%)*
- *Criterion 3: Describe Azure management and governance (30–35%)*

5- Bibliographic and Online References

- *Microsoft Azure Certifications: AZ900 Fundamentals courses*

6- Working environment (Facilities necessary for learning)

- *Nothing specific*

Course Specification

Agile Methods adapted to Cloud applications

1. General

Coded	*Inf-ICC 5 1 01*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Marwen Ben Moussa*					Vol. H. (TP)	
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Field Work*					Self-Study H.	*50*
Module	*Agile Methods adapted to Cloud applications*					Version	*08/2023*

Course description (Course objective):
- *Present agile methods as groups of IT development project practices (software design), which can be applied to various types of projects (particularly high value-added cloud applications: marketing operations with customers, innovative services , etc.).*

Prerequisites:	*Keywords :*
- *Having knowledge in project management, Software Development Life Cycle*	- *Scrum, Collaboration Techniques, Shared Understanding, Agile Teams*

Specific course objectives (OBJi):
OBJ 1 : *Understand the fundamentals of Scrum* ***OBJ 2 :*** *Know how to use Scrum tools* ***OBJ 3 :*** *Be able to start your Scrum project*

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-2	- *The agile manifesto* - *Comparison of agile methodologies*	3	*Understand the fundamentals of Scrum*
3-6	- *SCRUM* - *The roles*	6	*Know how to use Scrum tools*

	- Needs Iteration management		
7-14	- Introduction to ITIL v3 repository - Asset and configuration management - Management of events, incidents, changes - Service management (transition, catalog, continuous improvement, life cycle)	12	*Be able to start your Scrum project*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Compliance (7 points)*
- *Criterion 2: Effectiveness (7 points)*
- *Criterion 3: Quality (6 points)*

5- Bibliographic and Online References

- *GO Zaïbet, "Towards the collective intelligence of work teams: a case study, Abstract", Manag. Future, vol. No. 14, No. 4, p. 4159, Dec. 2008.*
- *"FD ISO 10006 - Quality management systems - Guidelines for quality management in projects - Edition 2". Editions Afnor, Paris, www.afnor.org, 01-Jan-2005.*
- *"NF ISO 21500 – Guidelines on project management". Afnor Edition, www.afnor.org, 01-Oct-2012.*
- *J. Lynch, J. Johnson, J. Crear, L. Vianna, and T. Mulder, "CHAOS Report 2015," The Standish Group.*
- *Kent Beck et al., "Manifesto for Agile Software Development."*
- *"VersionOne 10th Annual State of Agile Report," Version One, 10, 2016.*
- *"PROJECT MANAGEMENT: CLASSIC METHOD VS AGILE METHODS | Access Dev - Digital Communication Agency in Montpellier". [Online]. Available at: http://www.accessdev.com/access-dev/la-gestion-de-projet-methodes-classiques-vs-methodes- agiles / . [Accessed: 26-Apr-2023].*

- *“A brief history of organizational agility - Management Questions - Eric Delavallée's blog”. [Online]. Available at: http://www.questions-de-management.com/petitehistoire-de-lagilite-organizationnelle/ [Accessed: 26-Apr-2023].*
- *Jurgen Appelo, Managing for Happiness: Games, Tools, and Practices to Motivate Any Team. John Wiley & Sons Inc, 2016.*
- *Jeff Sutherland and Ken Schwaber, “The Scrum Guide”. 2016.*
- *F. TRAORE, “Are you more agile or classic? », Governance and Management Blog, October 25, 2016.*
- *“SCRUM, ScrumBan, Kanban: complementarity and a matter of context”, QualityStreet - Agile Blog since 2007.*
- *“Simple, complicated, complex or chaotic”. [Online]. Available at: http://developpementagile.com/posts/2013/february/simple-complique-complexe-ouchaotique [Accessed: 26-Apr-2022].*
- *RD Stacey, Strategic management and organizational dynamics: the challenge of complexity to ways of thinking about organizations, 5th ed. Harlow: Financial Times Prentice Hall, 2007.*
- *“Repository of Agile practices”. Available at: http://institutagile.fr/invest.html . [Accessed: 27-Apr-2020].*

6- Working environment (Facilities necessary for learning)

- *None.*

Course Specification

SaaS and PaaS operational solutions

1. General

Coded	*Inf-ICC 5 1 02*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Ridha Azizi*					Vol. H. (TP)	
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction*					Self-Study H.	*30*
Module	*SaaS and PaaS operational solutions*					Version	*08/2023*

Course description (Course objective):

- *Present the priority areas where SaaS and PaaS solutions are essential: messaging, support functions such as CRM, HR, budgets, business intelligence, etc.*

Prerequisites:	*Keywords :*
- *DevOps, Software Development Life Cycle, Fundamentals of Cloud Computing*	- *SaaS Solutions, PaaS Solutions, Collaborative Applications*

Specific course objectives (OBJi):

OBJ 1 : *Present Communication, collaborative and office automation*
OBJ 2 : *Migrate to a SaaS office from Office, Exchange or Lotus Notes Structured Applications solutions.*
OBJ 3 : *To present**L'***Interoperability of SaaS solutions*
OBJ 4 : *To present EcosystemsSaaS*

Necessary material :

…

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
	- *Office 2.0: Google Apps, Zoho, Office 365. Main differences, how to choose.*		*Communication, collaborative and*

1.2.3	- *Web 2.0 tools: blogs, wikis, social networks, in SaaS mode: differences with Intranet solutions.*	4.5	*office automation*
4.5.6	- *A CRM as a first SaaS use. Example of the success of Salesforce.com.* - *ERP SaaS: Infor, NetSuite, Workday.* - *SaaS for support functions: human resources (SuccessFactors, Talensoft, Cornerstone), finance (Adaptive Insight), project management (Clarizen, BaseCamp).* - *BPaaS (Business Process as a Service): specialized processes, usable directly by businesses.* - *SaaS for Big Data and Business Intelligence uses: Hadoop, MapReduce, Bigquery, RedShift, BIME.* - *SaaS strategy of historical publishers: IBM, Microsoft, SAP, Adobe, Oracle... Examples of BYD (Business By Design) from SAP and Oracle On-Demand. Acquisitions of SuccessFactors and Concur by SAP and of Taleo by Oracle.*	4.5	*Migrate to SaaS office automation from Office, Exchange or Lotus Notes solutions Structured applications*
7.8.9.10	- *Main options: mashup, connectors, open APIs.* - *"Best of Breed" SaaS vs integrated solutions: what trade-offs, what complementarities.* - *Coexistence of SaaS and legacy solutions: operational solutions.*	6	*Interoperability of SaaS solutions*
11.12.13.14	- *Grouping around large industrial platforms. Towards a "federation of clouds".* - *Current leaders: Google Apps Marketplace, Salesforce AppExchange, Microsoft Azure.* - *Market consolidation; future of independent SaaS solutions. Europe Square.* - *IT services companies, integrators: changes in "business models" in the face of the reduction in specific developments and major integration contracts.* - *Top PaaS Platforms: Salesforce Force.com, Google AppEngine, Apprenda, etc.* - *Specialized PaaS offerings: EngineYard for Ruby, TenGen, Aptana Cloud; advantages, limitations.*	6	*SaaS ecosystems*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-

DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

5- Bibliographic and Online References

- *Asay, Matt. "Forrester: Middle-Aged Developers Driving Cloud Computing." ReadWrite Blog (April 30, 2013). readwrite.com/2013/04/30/middle-aged-developersdriving-cloud-computing*
- *Kanaracus, Chris. "PaaS Market to Reach $14 Billion by 2017, IDC Says." InfoWorld (November 8, 2013). infoworld.com/d/cloud-computing/paas-market-reach-14-billion2017-idc-says-230440*
- *"Cloud-Related Spending by Businesses to Triple from 2011 to 2017." IHS (press release) (February 14, 2014). press.ihs.com/press-release/design-supplychain/cloud-related-spending-businesses-triple-2011-2017*
- *Knorr, Eric. "The Pivotal Launch and What It Means to IT." InfoWorld (April 29, 2013). infoworld.com/t/paas/the-pivotal-launch-and-what-it-means-it-217453*
- *Spence, Catherine, Travis Broughton, Murthy Upadhyayula, David Sisson. Extending Intel's Enterprise Private Cloud with Platform as a Service. Intel IT (June 2012). intel.com/content/www/us/en/it- management/intel-it-best-practices/extending-intels-enterprise-private-cloud-with-platform-as-a- service.html*

6- Working environment (Facilities necessary for learning)

- *Title, Version, URL*

Course Specification

Development Technologies and DBMS for Cloud Applications

1. General

Coded	*Inf-ICC 5 1 03*	Level/Semester	*5-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	
Responsible	*Houssem Chtioui*					Vol. H. (TP)	*42*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*30*
Module	*Development Technologies and DBMS for Cloud Applications*					Version	*08/2023*

Course description (Course objective):
- *Scaling NoSQL Databases* - *Deploy, administer and use a cluster*

Prerequisites:	*Keywords :*
- *Data base* - *Good knowledge of the UNIX environment* - *Basic network knowledge*	*NoSQL, MongoDB, SaaS, PaaS, Web Services Applications*

Specific course objectives (OBJi):
OBJ 1 : *Handle frameworks (open source and proprietary) for developing web services applications on cloud platforms* ***OBJ 2 :*** *Handle operational SaaS and PaaS solutions* ***OBJ 3 :*** *Managing new generations of DBMS*

Necessary material :
…

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	*Goals*
1.2.3.4.5	- *LAB 1: spring IoC,* - *LAB 2: spring Security,* - *LAB 3: spring WS,* - *LAB 4: spring-aop,* - *LAB 5: The Java Message Service (JMS) programming interface*	*15*	*Open source frameworks for the development of PaaS Applications*
6.7.8.9.10.	- *LAB 1: Office automation 2.0: Google Apps, Zoho, Office 365.* - *LAB 2: Web 2.0 tools: blogs, wikis, social networks, in mode* - *LAB 3: Migrate to SaaS Office Automation* - *LAB 4: SaaS ERP: Infor, NetSuite, Workday.* - *LAB 5: BPaaS (Business Process as a Service)* - *LAB 6: SaaS for Big Data and Business Intelligence uses* - *LAB 7: PaaS platforms: Force.com from Salesforce,* - *LAB 8: Google AppEngine PaaS platform,* - *LAB 9: Apprenda PaaS platform, etc.*	*15*	*SaaS and PaaS operational solutions*
11.12.13	- *LAB 1: Graph-oriented noSQL databases.* - *LAB 2: Key value oriented noSQL databases.* - *LAB 3: Column-oriented noSQL databases.* - *LAB 4: Document-oriented noSQL databases.* - *LAB 5: Mobile DBMSs* - *LAB 6: Multidimensional DBMS (XMLA)*	*9*	*The new generations of DBMS*
14	- *Practical exam, mini-project defense, …*	*3*	*Summative evaluation*

4- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

5- References and Web reference (useful links)

- *MongoDB: La Plateforme De Données D'application | MongoDB*
- *Introduction à Express/Node - Apprendre le développement web | MDN (mozilla.org)*
- *Apache HBase - GeeksforGeeks*
- Schaub, M., & Mohr, G. (2017). Spring Boot: A Beginner's Guide. McGraw-Hill Education.
- Johnson, R. (2017). Spring Boot: Up and Running. O'Reilly Media.

6- Working environment (Facilities necessary for learning)

- *MongoDB*
- *Apache HBase*
- *Apache Cassandra*
- *Neo4j*
- *OrientDB*
- *DynamoDB*

Course Specification

Administration of Cloud platforms and Web services

1. General

Coded	*Inf-ICC 5 1 04*	Level/Semester	*5-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching Methods	*Lecture, Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*28*
Module	*Administration of Cloud platforms and Web services.*					Version	*08/2023*

Course description (Course objective):
- *Master the Administration of Cloud platforms and Webservices installed on Windows and/or Linux operating systems.*

Prerequisites:	*Keywords :*
- *Linux* - *Server administration* - *Foundation of Cloud Computing*	*Web Services, Private Cloud, Paravirtualization*

Specific course objectives (OBJi):
OBJ 1 : *Administration of Cloud platforms and Web services (Windows)* ***OBJ 2 :*** *Configuring and deploying a private cloud* ***OBJ 3 :*** *Administration of Cloud platforms and Web services (Linus Openstack)* ***OBJ 4 :*** *Paravirtualization*

Necessary material :
- *Video projector* - *Course materials & Support for practical work*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	- Introduction to the administration of Cloud platforms and Web services (Windows)	3	Administration of Cloud platforms and Web services (Windows)
3-4	- HyperV installation and configuration presentation	3	
5-6	- Configuring and deploying a private cloud with System Center 2016	3	Configuring and deploying a private cloud
7-8	- IIS Server	3	
9-10	- Linux: Web Service (HTTP/HTTPS), - Openstack,	3	Administration of Cloud platforms and Web services (Linus Openstack)
11-12	- Virtualization, - JSP/Servlet server, - Installations and advanced administration Apache-PHP-mysql server	3	
13-14	- Paravirtualization - KVM	3	Paravirtualization

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2-3	- HyperV installation and configuration presentation	4.5	Administration of Cloud platforms and Web services (Windows)
4-5-6	- Configuring and deploying a private cloud with System Center 2016	4.5	
7-8	- IIS Server	3	
9-10	- Linux: Web Service (HTTP/HTTPS), - Openstack,	3	Administration of Cloud platforms and Web services (Linus Openstack)
11-12	- Paravirtualization - KVM	3	
13-14	- Practical exam, mini-project defense, …	3	Summative evaluation

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

5- Bibliographic and Online References

- *Web Services Administration - IBM Documentation*
- *Cloud Computing Training and Courses - Training and Certification - AWS (amazon.com)*
- *Web App Service | Microsoft Azure*
- *Hales, D. (2013).* Cloud Computing: A Hands-On Approach. *CreateSpace Independent Publishing Platform.*
- *Moyer, J. (2018).* Cloud Administration: A Complete Guide to Managing and Administering Cloud Infrastructure. *O'Reilly Media.*
- *Chhabra, S., & Saran, N. (2017).* Cloud Computing: Concepts, Technology & Architecture. *Pearson Education.*
- *Tremblay, M. (2019).* Cloud Computing for Administrators: The Complete Guide to Managing Cloud Platforms. *Wiley.*
- *Zhao, G. (2020).* Cloud Management and Security: Fundamentals, Techniques, and Applications. *Springer.*

6- Working environment (Facilities necessary for learning)

- *Linux*
- *Windows server 2016*

Course Specification

Hybrid mobile development of cloud applications

1. General

Coded	*Inf-ICC 5 1 05*	Level/Semester	*5-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Oussema Elmir*					Vol. H. (TP)	*21*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*36*
Module	*Hybrid mobile development of cloud applications*					Version	*08/2023*

Course description (Course objective):

This module aims to give learners the fundamental foundations needed to develop cross-platform applications using the latest version of the Flutter framework (version 3). With a focus on the synergy between Flutter and cloud services, participants will be guided through a progressive learning path, covering essential aspects of modern mobile development interacting with cloud services

Prerequisites:	*Keywords :*
- *Native mobile development* - *Object Oriented Programming*	*Cross-platform, Widget, MaterialApp, wait, asyn*

Specific course objectives (OBJi):

OBJ 1 : *The student must be able to develop, compile, debug and generate cross-platform applications using the Flutter Framework*

OBJ 2 : *Design and implement responsive layouts for a mobile application*

OBJ 3 : *Communicate with Cloud Services*

Necessary material :

- *Powerful computer (example configuration: 10th generation i5/i7 processor 16 GB RAM)*

2- Content elements (Courses and practical work)

Week(s)	Activities/Content Items	Nbr HR	Goals
01-02	- *Understand the difference between hybrid and cross-platform native development mode.* - *Installation & preparation of a cross-platform development platform with flutter*	*6h*	- *Preparing a development environment with flutter*
03	- *Getting started with the dart language: basic syntax, Poo, module: corrected exercises.*	*3h*	- *Become familiar with dart.*
04-05	- *notion of widget: MaterialApp, FloatingActionButton, scaffold, column row etc.*	*6h*	- *Understand the structure of a flutter program by manipulating basic widgets*
06	- *Stateless vs statefull widgets*	*3h*	- *Master the notion of stateless and stateful*
07	- *Forms: creation and validation, Data Model,*	*3h*	- *create and validate a form*
08	- *Alertdialog, snackbar, drawer and navigation*	*3h*	- *Integration of a plugin, and understanding the routing system*
09	- *Listview with inline API call*	*3h*	- *Master the call to an API and display the result*
10	- *Data persistence: shared preferences*	*3h*	- *Use sharedpreferences*
11	- *Data persistence: SQLite*	*3h*	- *Crud SQlite*
12	- *CRUD with Firebase*	*3h*	- *Crud Firbase*
13	- *WiFi/4G connectivity management*	*3h*	- *Check network connectivity for a cross-platform app*
14	- *Practical exam, mini-project defense, …*	*3h*	- *Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Drafting of the specifications and understanding of the subject (3 points)*
- *Criterion 2: implemented responsive graphic interface (5 points)*
- *Criterion 3: Deployment of the application (4points)*
- *Criterion 4: Innovative aspect of the application (3points)*
- *Criterion 5: Presentation of the project (5 points)*

6- Bibliographic and Online References

- *Flutter - Develop your cross-platform mobile applications with Dart: Editions ENI, publication date June 10, 2020, author Julien Trillard, ISBN-13 code: 978-2409025273.*
- *Cross-Platform UIs with Flutter: Unlock the ability to create native multi-platform UIs using a single code base with Flutter 3: publisher: Packt Publishing, Publication date: August 26, 2022, authors: Ryan Edge, Alberto Miola ISBN-13: 978-1801810494*
- *https://flutter.dev/*
- *https://docs.flutter.dev/*

7- Working environment (Facilities necessary for learning)

- *Android Studio: https://developer.android.com/studio*
- *Flutter sdk available online:*
  - *windows: https://storage.googleapis.com/flutter_infra_release/releases/stable/windows/flutter_windows_3.13.9-stable.zip.*

    Note : you will need to add the path to the bin folder (available after extraction) in the PATH variable of your system
  - *unix: https://storage.googleapis.com/flutter_infra_release/releases/stable/linux/flutter_linux_3.13.9-stable.tar.xz*
- *the android sdk: already available with the Android Studio ide*
- *An EDI:*
  - *Android studio: downloaded from https://developer.android.com/studio: then install the flutter plugin*
  - *vscode: downloadable from https://code.visualstudio.com/download, then install flutter plugin, flutter Tree, Awesome Flutter Snippets*

Course Specification

Firewall Administration

1. General

Coded	*Inf-ICC 5 1 06*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	
Responsible	*Bayrem Triki*					Vol. H. (TP)	*21*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based, Field Work*					Self-Study H.	*50*
Module	*Firewall Administration*					Version	*08/2023*

Course description (Course objective):
- *Know the functionalities of the firewall* - *Configure a firewall* - *Configure essential functions using ASDM and CLI Configure access policy based on ACLs (Access Control Lists) Analyze and restrict flow (inbound and outbound)* - *Configure a VPN for remote access Optimize security rules*

Prerequisites:	*Keywords :*
- *Good knowledge of network administration and IT security*	*Firewall, CLI, ACLs, VPN*

Specific course objectives (OBJi):
OBJ 1 : *Know the functionalities of the firewall* ***OBJ 2 :*** *Configure a firewall* ***OBJ 3 :*** *Configure essential functions using ASDM and CLI Configure access policy based on ACLs (Access Control Lists) Analyze and restrict flow (inbound and outbound)* ***OBJ 4 :*** *Configure a VPN for remote access Optimize security rules*

Necessary material :
- *PC* - *Practical Work Support*

4- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2-3	- *Firewall technologies and characteristics.* - *Presentation of firewalls. Terminology and features.* - *Examples of architecture. The ASA range.*	*4.5*	*Know the functionalities of the firewall*
4-5-6	- *Connections, port forwarding.* - *DMZ configuration* - *Downloading ACLs.* - *AAA Troubleshooting*	*4.5*	*Configure a firewall*
7-8-9	- *Reminders about VLANs.* - *Supported features.* - *Groups of objects.* - *Presentation of groups of objects. Uses.* - *Configuration of object groups.* - *Overview of Cisco Secure ACS.* - *Installing Cisco Secure ACS.* - *Configure authentication and authorization*	*4.5*	*Configure essential functions using ASDM and CLI Configure access policy based on ACLs (Access Control Lists) Analyze and restrict flow (inbound and outbound)*
10-11-12-13	- *Setting up VPNs.* - *Configuring IPSec.* - *The Cisco VPN client.* - *Configuring remote access with Easy VP*	*6*	*Configure a VPN for remote access Optimize security rules*
14	- *Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Compliance (5 points)*
- *Criterion 2: Adequacy (3 points)*
- *Criterion 3: Effectiveness (7 points)*
- *Criterion 4: Quality (5 points)*

5- Bibliographic and Online References

- *http://www.nwinternet.com/~pchelp/security/firewalls.html*
- *http://usenet-fr.news.eu.org/fur/comp/securite/firewall.html*

- *Anderson, R. (2020).* Security Engineering: A Guide to Building Dependable Distributed Systems *(3rd ed.). Wiley.*

- *Stallings, W. (2017).* Cryptography and Network Security: Principles and Practice *(7th ed.). Pearson Education.*

- *Pfleeger, C. P., & Pfleeger, S. L. (2012).* Security in Computing *(5th ed.). Pearson.*

- *Schneier, B. (2015).* Secrets and Lies: Digital Security in a Networked World*. Wiley.*

6- Working environment (Facilities necessary for learning)

- Ubuntun20.04
- Cisco Packet Tracer

Course Specification

Data Analysis and BI

1. General

Coded	*Inf-ICC 5 1 07*	Level/Semester	*5-S1*	Coefficient	*3*	Credits	*3*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Adel Dahmane*					Vol. H. (TP)	*21*
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*30*
Module	*Data Analysis and BI*					Version	*08/2023*

Course description (Course objective):

This course, focused on Data Analysis and Business Intelligence (BI), aims to provide students with an in-depth understanding of the techniques and tools used to transform raw data into relevant and useful information for business decision-making. The course will cover the fundamentals of data collection, storage, processing and analysis. Students will learn to use BI tools to create data visualizations, reports, and dashboards that facilitate data interpretation and support decision-making processes.

Prerequisites:

- ***Knowledge of databases***: *Understanding of database management systems, including basic relational database concepts.*
- ***Fundamentals of programming***: *Programming skills, preferably with SQL experience, to manipulate and query data.*
- ***Statistics and data analysis***: *Knowledge of statistics and ability to perform basic analyzes on data sets.*
- ***Information system***: *Understanding of information systems, particularly their role in data collection and storage.*

Keywords :

- ***ETL (Extract, Transform, Load)***: *The process of collecting data from various sources, transforming it for analysis, and loading it into a data warehouse.*
- ***Inmon and Kimball models***: *Two main approaches to data warehouse design, each with its own methodology and structure.*
- ***OLAP (Online Analytical Processing)***: *Technology that allows multidimensional analysis of data stored in a data warehouse.*
- ***OLTP (Online Transaction Processing)***: *Systems designed to manage daily transactions in a business.*
- ***Data Warehouse***: *Centralized system for storing and managing large amounts of historical data.*
- ***Data Mining***: *The process of exploring and analyzing data to discover hidden patterns and relationships.*

	- ***Business Intelligence (BI)****: Use of technologies, applications and practices for the collection, integration, analysis and presentation of business information.* - ***Dashboards and visualization****: Tools and techniques to present data in a visual and interactive way, facilitating decision-making.*

Specific course objectives (OBJi):

OBJ 1 : *Understand the Basic Concepts and Principles of BI:*
Master the fundamentals of Business Intelligence and its role in supporting business decision-making.

OBJ 2 : *Acquire skills in ETL (Extract, Transform, Load):*
Learn how to extract data from multiple sources, transform it to meet analysis needs and load it into a data warehouse.

OBJ 3 : *Exploring Data Warehouse Models (Inmon and Kimball):*
Study and compare the data warehouse design models of Bill Inmon and Ralph Kimball, understanding their practical applications.

OBJ 4 : *Mastery of OLAP and OLTP Systems:*
Understand the difference between OLAP (for analysis) and OLTP (for transactions) systems and their use in business contexts.

OBJ 5 : *Data Mining Skills Development:*
Learn data mining techniques to discover patterns, correlations and insights from large data sets.

OBJ 6 : *Application of BI in Real Scenarios:*
Put into practice the knowledge acquired in BI to solve real case studies and business problems.

OBJ 7 : *Creation of Dashboards and Data Visualizations:*
Develop skills in designing interactive dashboards and data visualization for effective communication of insights.

OBJ 8 : *Critical Analysis of Current Trends in BI and Data Analysis:*
Study the latest trends and innovations in the field of BI and data analytics, assessing their potential impact on businesses.

OBJ 9 : *Development of a Structured Analytical Approach:*
Cultivate a methodical approach to data analysis, integrating critical thinking and data-driven problem solving.

OBJ 10 : *Effective Collaboration and Communication:*
Strengthen communication and teamwork skills, essential for BI project management and interaction with stakeholders.

Necessary material :
Microsoft Power BI Desktop: *Installing the latest version of Microsoft Power BI Desktop. This application is available for free on the official Microsoft website.* ***A Microsoft account***: *To access all Power BI features, including Power BI Service, a Microsoft account is required. A work or school account is recommended for more features.*

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*- Goals*
1-2	**Chapter 1: Introduction to Microsoft Power BI** - *Overview of Power BI and its components (Power BI Desktop, Power BI Service, Power BI Mobile).* - *Installation and configuration of the work environment.* - *Introduction to basic concepts of BI and data visualization.*	3	- *Understand the Power BI ecosystem, including the differences and uses of Power BI Desktop, Service and Mobile.* - *Learn basic skills to install Power BI Desktop, configure the work environment, and explore the user interface.*
3-4	**Chapter 2: Data Exploration with Power BI** - *Connection to various data sources (databases, Excel files, online services).* - *Data transformation and cleansing techniques in Power BI.* - *Creating basic data models and working with data relationships.*	3	- *Master connecting to various data sources and understand data transformation and cleansing methods.* - *Learn how to create simple data models and establish effective relationships between different data sources.*
5-6	**Chapter 3: Introduction to the DAX Language** - *DAX basics and its role in Power BI.* - *Creating calculated measures and columns.* - *Key concepts like filter context and basic DAX functions.*	3	- *Understand the fundamentals of DAX, including creating calculated measures and columns.* - *Learn about basic concepts like filter context and essential DAX functions for basic calculations.*

7-8	**Chapter 4: Advances with DAX** - *Advanced DAX techniques for more complex analyses.* - *Time functions, cumulative calculations, and table functions.*	3	- *Deepen DAX skills to perform complex analyzes and advanced calculations.* - *Apply advanced DAX functions in real-world scenarios, focusing on practical case studies.*
	- *Practical scenarios and case studies using DAX in Power BI.*		
9-10-11	**Chapter 5: Data Visualization and Report Creation** - *Design of dashboards and interactive reports.* - *Use of the various visual elements available in Power BI.* - *Best practices for data presentation and storytelling.*	4.5	- *Develop skills to design data visualizations and interactive reports using various graphical elements in Power BI.* - *Learn best practices for data storytelling, creating clear and informative dashboards.*
12-13-14	**Chapter 6: Power BI and MDX Language** - *Introduction to the MDX language for OLAP cubes.* - *Using MDX in Power BI for queries on multidimensional models.* - *Practical examples and integration of MDX queries in Power BI.*	4.5	- *Gain a basic understanding of the MDX language and its application in OLAP environments.* - *Integrate MDX queries into Power BI for multidimensional data analysis and solve specific use cases.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	- *TP 1: Getting started with Power BI*	*3*	- *Become familiar with the Power BI Desktop user interface.* - *Connect Power BI to a simple data source (for example, an Excel file) and create a first basic report.*
3-4	- *TP 2: Data Cleaning and Transformation*	*3*	- *Use the Power BI query editor to clean and transform a dataset.* - *Learn how to handle missing data, filter data, and create new calculated columns.*
5-6	- *TP 3: Creating Measurements with DAX*	*3*	- *Create basic metrics (KPIs) using the DAX language.* - *Apply DAX functions to calculate aggregates*

			such as sum, average, and count.
7-8	- TP 4: Advanced Analysis with DAX	3	- Design advanced metrics using DAX for complex analytical scenarios (e.g., cumulative calculations or temporal comparisons).
			- Interpret the results and understand the calculation context in DAX.
9-10	- TP 5: Design of Dashboards	3	- Create an interactive dashboard using various visualization elements in Power BI. - Learn how to use filters, slices, and interactions between visualizations for dynamic reporting.
11-12	- TP 6: Data Exploration with MDX	3	- Initiate the use of the MDX language in the context of OLAP cubes. - Perform basic MDX queries to extract insights from multidimensional data.
13-14	- Mini-project defense	3	- Mini Defense

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

Technical Mastery:

- *Competency assessment in using Power BI, manipulating DAX, and understanding MDX.*
- *Ability to perform tasks such as connecting to data sources, data cleaning, creating measures, and visualizations.*

Quality of Reports and Dashboards:

- *Quality of created reports and dashboards, including clarity, accuracy, aesthetics, and effectiveness of data visualization.*
- *Creative and relevant use of Power BI features to communicate insights.*

Application of Analytical Concepts:

- *Ability to apply learned analytical concepts in practical work.*
- *Understanding of business scenarios and appropriate application of analysis tools and techniques.*

Problem Solving and Critical Thinking:

- *Ability to use data to solve problems and apply critical thinking to interpret results.*
- *Ability to formulate recommendations based on data analysis.*

6- Bibliographic and Online References

Books :

- *[1] B. Powell, “Microsoft Power BI Cookbook,” Packt Publishing, 2018.*
- *[2] A. Ferrari and M. Russo, “The Definitive Guide to DAX: Business intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel,” Microsoft Press, 2019.*
- *[3] A. Ferrari and M. Russo, “Analyzing Data with Power BI and Power Pivot for Excel,” Microsoft Press, 2017.*

Articles and Research Papers:

- *[4] Author(s) Unknown, “Integrating Business Intelligence Into Enterprise Systems,” Journal of Information Systems, vol. XX, no. YY, pp. ZZ-AAA, year.*
- *[5] Unknown Author(s), "Data Visualization in Business Intelligence: Review and Research Challenges," Journal of Data Visualization, vol. XX, no. YY, pp. ZZ-AAA, year.*
- *Conferences and Seminars:*
- *[6] “Microsoft Business Applications Summit,” [Online].* *https://www.microsoft.com/en-us/businessapplicationssummit*.
- *[7] “PASS Summit,” [Online].* *https://www.pass.org/summit/2023/Home.aspx*.
- *[8] “Gartner Data & Analytics Summit,” [Online].* *https://www.gartner.com/en/conferences/na/data-analytics-us*.

7- Working environment (Facilities necessary for learning)

Installation of Microsoft Power BI Desktop:

- *Download and install the latest version of Power BI Desktop, available for free on the official Microsoft website.*
- *Ensure students have a compatible operating system (Windows 10 or later).*

Microsoft account:

- *Create a Microsoft account, if not existing, to access Power BI Service and other online features.*
- *Consider purchasing Power BI Pro licenses to access advanced features, if necessary.*

Access to SQL Server or Other Databases:

- *Provide access to SQL Server or other database management systems for practicing SQL queries and integrating with Power BI.*

Microsoft Excel:

- *Have Microsoft Excel installed for activities that involve integrating Excel data with Power BI.*

Course Specification

Cloud for IoT

1. General

Coded	*Inf-ICC 5 1 08*	Level/Semester	*5-S1*	Coefficient	*1.5*	Credits	*2*
Course	*Cloud and Networks*					Vol. H. (CI)	*21*
Responsible	*Ridha Azizi*					Vol. H. (TP)	
Teaching Methods	*Interactive Lecture, Direct Instruction, Project Based*					Self-Study H.	*24*
Module	*Cloud for IoT*					Version	*08/2023*

Course description (Course objective):

- *The course focuses on the understanding and implementation of technologies related to connected objects and cloud computing. This educational program is designed to provide students with an in-depth understanding of how connected objects interact with the cloud to manage and process data. It covers aspects such as the design of connected objects, the integration of sensors and actuators, wireless communication, and the use of the cloud for data storage and analysis.*

- *Students will learn to design and deploy IoT solutions using various technologies and platforms. The course will also emphasize the importance of security in IoT systems, given the sensitive nature of the data collected and processed. In addition, real case studies and practical projects will be integrated to reinforce learning and understanding of concepts.*

Prerequisites:	*Keywords :*
- ***Programming****: Programming skills, ideally in languages like Python, JavaScript, or C++, which are commonly used in IoT development.* - ***Basic Electronics****: Understanding the basic principles of electronics, including reading circuit diagrams and using components like microcontrollers.* - ***Knowledge of Cloud Platforms****: Familiarity with cloud computing platforms such as AWS, Microsoft Azure, or Google Cloud Platform.* - ***IT security****: Knowledge of basic IT security principles, essential for protecting data in IoT and cloud environments.*	*IoT (Internet of Things); Cloud Computing; Sensors and Actuators; Wireless Communication* *IoT Security; Data Analytics; IoT Platforms; Connectivity*

Specific course objectives (OBJi):	
OBJ 1 :	*Understanding the Fundamentals of IoT and Cloud Computing:* *Gain a solid understanding of the fundamentals of the Internet of Things (IoT) and Cloud Computing.* *Explore the history, evolution, and current trends in these areas.*
OBJ 2 :	*Master the Design and Development of Connected Objects:* *Learn to design and develop connected objects using sensors, microcontrollers and communication modules.* *Understand sensor integration and data acquisition.*
OBJ 3 :	*Develop Programming Skills for IoT:* *Strengthen programming skills for IoT, using languages like Python, C++, or JavaScript.* *Learn to program IoT devices and interact with cloud servers.*
OBJ 4 :	*Understanding IoT Communication Protocols:* *Study the different wireless communication protocols used in IoT, such as Wi-Fi, Bluetooth, Zigbee, and LoRa.* *Learn how to implement these protocols for data transmission.*
OBJ 5 :	*Exploring Cloud Platforms and Services:* *Become familiar with various cloud platforms such as AWS, Azure, and Google Cloud, specific to IoT.* *Learn how to use the cloud for storing, processing, and analyzing IoT data.*
OBJ 6 :	*Security and Privacy in IoT:* *Understand security and privacy issues in IoT systems.* *Learn best practices for securing IoT devices and data.*
OBJ 7 :	*Practical Projects and Case Studies:* *Carry out practical projects to reinforce theoretical learning.* *Analyze real-world case studies to understand IoT and Cloud applications in different sectors such as healthcare, home automation, and smart cities.*
OBJ 8 :	*Preparation for Innovation and Research in IoT:* *Encourage innovation and creativity in the design of IoT solutions.* *Prepare students to pursue advanced research or professional careers in the field of IoT and Cloud Computing.*

Necessary material :

1. Electronic Hardware and IoT

- *Microcontrollers: Like Arduino, Raspberry Pi, or ESP32, which serve as a basis for creating connected objects.*
- *Sensors and Actuators: Different types of sensors (temperature, humidity, motion, etc.) and actuators (motors, LEDs, etc.) to experiment with data collection and physical reaction.*
- *Communication Modules: Wi-Fi, Bluetooth, or other modules to allow devices to communicate with each*

other or with the cloud.

- *Breadboards and Connection Cables: For rapid prototyping without soldering.*

- *Basic Tools: Such as screwdrivers, pliers, and soldering iron for assembling components.*

2. Software

- *Development Environments: IDEs like Arduino IDE, Python IDLE, or Visual Studio Code for programming.*
- *Simulation Software: To simulate IoT circuits and systems before physical construction.*
- *Cloud Platforms: Access to platforms such as AWS IoT, Microsoft Azure IoT Hub, or Google Cloud IoT to experiment with storing and processing data in the cloud.*
- *Security Tools: Software for testing and securing IoT communications and data.*

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-2	*Chapter 1: Introduction to IoT and Cloud Computing*	3	- *Understand the fundamental concepts of IoT and Cloud Computing.* - *Explore the history, applications, and impact of IoT across different sectors.* - *Identify the key components of an IoT system, including devices, network, and cloud.*
3-4	*Chapter 2: Microcontrollers and Development Environments*	3	- *Become familiar with microcontrollers commonly used in IoT (like Arduino and Raspberry Pi).* - *Learn to configure and program microcontrollers.* - *Understand the importance of Integrated Development Environments (IDEs) and how to use them for IoT development.*
5-6	*Chapter 3: Sensors, Actuators, and Data Collection*	3	- *Understand the role of sensors and actuators in IoT devices.* - *Learn how to connect and program sensors to collect environmental data.* - *Analyze and process data collected by sensors.*

7-8	*Chapter 4: IoT Communication and Protocols*	3	- *Explore the different modes of communication used in IoT, including Wi-Fi, Bluetooth, and Zigbee.* - *Study IoT communication protocols and their implementation.* - *Understand how to ensure efficient and secure communication between IoT devices.*

9-10-11	*Chapter 5: Cloud Integration and Data Processing*	4.5	- *Learn how to connect IoT devices to cloud platforms.* - *Understand the principles of data processing in the cloud, including data storage, analysis, and visualization.* - *Explore the use of cloud services to improve the functionality of IoT devices*
12-13-14	*Chapter 6: Security, Privacy, and Ethical Aspects in IoT*	4.5	- *Understand security and privacy issues specific to IoT.* - *Learn best practices for securing IoT devices and the data they generate.* - *Discuss ethical considerations and regulations related to the use of IoT in various contexts.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

1. Theoretical Understanding

- *Written Tests and MCQs: Assess understanding of fundamental concepts of IoT and Cloud Computing.*
- *Oral Presentations: Assess the ability to explain and discuss IoT concepts, technologies and applications.*

2. Practical Skills

- *Quality of Practical Work (TP):Evaluate the ability to apply theoretical knowledge in practical projects.*
- *Innovation and Creativity : Encourage and evaluate the ability to develop innovative and*

creative solutions in public works.

3. End of Course Projects

- *Conception and development: Assess the ability to design and develop a complete IoT project, from initial conception to practical implementation.*
- *Functionality and Reliability: Evaluate the functionality, efficiency and reliability of the final project.*
- *Documentation and Project Report: Evaluate the quality of the technical documentation and project report.*

4. Communication Skills

- *Presentation of the Final Project: Evaluate communication and presentation skills during the defense of the final project.*
- *Participation in class and practical work: Evaluate engagement and active participation in class and during practical sessions.*

5. Understanding of Ethical and Security Aspects

- *Application of Safety Standards: Evaluate the consideration and implementation of security standards in IoT projects.*
- *Ethical Consciousness: Assess understanding and application of ethical considerations related to IoT.*

5- Bibliographic and Online References

Newspaper articles

- *Al-Fuqaha, A., et al. (2015). "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications." IEEE Communications Surveys & Tutorials.*
- *Perera, C., et al. (2014). "Context Aware Computing for The Internet of Things: A Survey." IEEE Communications Surveys & Tutorials.*
- *Miorandi, D., et al. (2012). "Internet of Things: Vision, Applications and Research Challenges." Ad Hoc Networks.*
- *Atzori, L., Iera, A., & Morabito, G. (2010). "The Internet of Things: A survey." Computer Networks.*
- *Gubbi, J., et al. (2013). "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions." Future Generation Computer Systems.*

Conference Publications

- *Zhao, K., & Ge, L. (2013). "A Survey on the Internet of Things Security." Proceedings of the 9th International Conference on Computational Intelligence and Security.*
- *Borgia, E. (2014). "The Internet of Things vision: Key features, applications and open issues." Computer Communications Workshops (INFOCOM WKSHPS).*
- *Alaba, FA, et al. (2017). "Internet of Things Security: A Survey." Proceedings of the IEEE Conference on Dependable and Secure Computing.*
- *Khan, R., et al. (2012). "Future Internet: The Internet of Things Architecture, Possible Applications and Key Challenges. " Proceedings of the 10th International Conference on Frontiers of*

Information Technology.

- *Academic Books*
- *Buyya, R., & Dastjerdi, AV (Eds.). (2016). "Internet of Things: Principles and Paradigms." Morgan Kaufmann.*
- *Minoli, D. (2013). "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications." Wiley.*
- *Yan, Z., Zhang, P., & Vasilakos, AV (Eds.). (2017). "Autonomic Computing and Networking." Springer.*
- *Mattern, F., & Floerkemeier, C. (2010). "From the Internet of Computers to the Internet of Things." Informatik-Spektrum.*

6- Working environment (Facilities necessary for learning)

Electronics and Computers Laboratory

- *Equipped Workstations: Computers with the necessary software and development tools installed, such as IDEs for microcontroller programming (Arduino IDE, Raspberry Pi OS, etc.).*
- *Electronic Equipment: Providing oscilloscopes, multimeters, power sources, and test kits for electronic practice.*

IoT Hardware Kits

- *Microcontrollers and Development Kits: Arduino, Raspberry Pi, ESP32, and other kits suitable for teaching IoT.*
- *Miscellaneous Sensors and Actuators: To allow students to work on various projects.*
- *Communication Modules: Like Wi-Fi, Bluetooth, LoRa modules, etc., for wireless communications.*

Access to Cloud Platforms

- *Student Accounts on Cloud Platforms: AWS, Microsoft Azure, Google Cloud, etc., for the hands-on experience of managing IoT data in the cloud.*
- *Simulation and Modeling Software: To simulate IoT networks and cloud integrations before physical implementation.*

Subject Sheets Specialty: IoT and Robotic Programming

Course Specification

Advanced OOP

1. General

Coded	IoT4.S1.03	Level/Semester	4/S1	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mouhieddine Belghith					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	30
Module	Advanced OOP					Version	08/2023

Course description (Course objective):
This advanced Object Oriented Programming course in Java expands OOP skills. It explores advanced concepts such as GUIs, events, databases, threads and advanced collections. Students will learn sophisticated programming techniques, designing robust software architectures, and solving complex problems with Java. Practical work and case studies are integrated to reinforce advanced OOP skills and encourage the development of concrete projects.

Prerequisites:	Keywords :
- *In-depth knowledge of fundamental concepts of object-oriented programming (classes, objects, inheritance, polymorphism, interfaces, and collections in Java).* - *Advanced understanding of basic Java programming concepts, including data manipulation and control structures.* - *Hands-on experience with Java language fundamentals.*	Interface Graphics, database, thread, collection, exception, event, mvc

Specific course objectives (OBJ):
***OBJ 1 :** Deepen students' understanding of advanced object-oriented programming concepts in Java.* ***OBJ 2 :** Explain in detail advanced aspects such as GUIs, events, system interaction, databases, threads and advanced collections.* ***OBJ 3 :** Provide students with advanced Java programming skills to design robust software architectures.* ***OBJ 4 :** Teach sophisticated techniques for solving complex problems using object-oriented programming.* **OBJ 5 :** *Encourage practical application through practical work, case studies and concrete projects to*

consolidate the skills acquired.
Necessary material :
- *A computer with a Java development environment such as IntelliJ IDEA, Eclipse or NetBeans.* - *Internet access for additional resources, Java documentation and updates.* - *A Java reference manual for quick reference of concepts.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	*Goals*
01-02	**Graphic interface (GUI - Graphical User Interface)** - *Introduction to graphical interfaces in Java.* - *Use of graphic components: buttons, text fields, menus, etc.* - *Creating windows and panels for user interface design.* - *Using layouts to organize graphic components.*	6	*Understanding the basics of GUIs in Java, creating windows, adding components and layout*
03-04	**Event Handling** - *Understanding the event model in Java.* - *Handling user events: mouse clicks, keyboard touches, etc.* - *Attaching event listeners to widgets.* - *Implementing responses to events.*	6	*Proficient in handling user events (mouse clicks, keyboard touches) and binding event listeners*
05-06	**Databases** - *Connection to a database from Java.* - *Using JDBC (Java Database Connectivity) to perform read and write operations in a database.* - *Management of transactions and advanced SQL queries.*	6	*Connecting to a database, using JDBC to perform read/write operations and manipulating data*
07-08	**Threads** - *Introduction to multi-threaded programming in Java.* - *Creation and management of threads.* - *Synchronization and conflict management in multi-threaded programs*	6	*Learn multi-threaded programming, creation, thread management and synchronization to prevent conflicts*
09-10	**Collections**	6	*Advanced use of Java data structures*

			to store and manipulate information
	- *Presentation of the different data structures provided by Java: lists, sets, maps, etc.* - *Using collections to store, manipulate, and organize data efficiently.*		*efficiently*
11	**Graphics** - *Using drawing and graphics rendering features in Java.* - *Creating simple and complex graphics.* - *Manipulation of images and graphics.*	3	*Image manipulation, graphics rendering, and 2D chart creation*
12	**Model-View-Controller (MVC)** - *Introduction to MVC software architecture.* - *Application of MVC pattern in Java application development.*	3	*Introduction to MVC software architecture and application in Java application development*
13	**Mini-project** - *Evaluation of mini projects*	3	*The main goal of an advanced OOP mini-project could be to create a simple graphical application to demonstrate understanding of basic Java programming and user interface concepts with Swing*
14	**Exam** - *Practical exam*	3	*An advanced OOP practice exam generally aims to assess students' practical skills in advanced Java programming.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Web references (useful links)

- *Oracle Java Documentation: https://docs.oracle.com/javase/ - The official Java documentation provided by Oracle, containing tutorials, guides and references for Java SE.*
- *Vogella Java Tutorials: http://www.vogella.com/tutorials/java.html - Comprehensive and*

detailed tutorials on Java, including object-oriented programming.

- *JavaTpoint: https://www.javatpoint.com/ - A site offering tutorials, code samples, articles and Q&As about Java and OOP.*
- *Baeldung: https://www.baeldung.com/ - A site with articles and how-to tutorials on many Java topics, including OOP.*
- *JournalDev Java Tutorials: https://www.journaldev.com/java-tutorials-example - A collection of tutorials, examples and articles on different aspects of Java.*
- *Stack Overflow: https://stackoverflow.com/questions/tagged/java - A Q&A platform where you can find answers to specific questions about Java and OOP, as well as ask your own questions.*
- *Apprendre la Programmation Orientée Objet avec le langage Java, (4e édition), Auteur(s): Luc GERVAIS.*
- *Apache NetBeans (2e édition), Auteur(s) : Romain LEMOUNEAUThierry et RICHARDThomas BROUSSARD.*
- *Java: Les fondamentaux du langage (avec exercices pratiques et corrigés), Auteur(s) : Thierry RICHARD*

5- Working environment (Facilities necessary for learning)

- *Software and Tools: Access to integrated development environments (IDE) such as IntelliJ IDEA, Eclipse or NetBeans for Java programming.*
- *Libraries and Frameworks: Where applicable, access to specific libraries or frameworks used in the course, such as JavaFX*

Course Specification

Advanced Python Programming

1. General

Coded	IoT4.S1.04	Level/Semester	4/S1	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mouna Ben Hadj Mbarek					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	36
Module	Advanced python programming					Version	08/2023

Course description (Course objective):
The Advanced Python Programming course aims to deepen mastery of advanced Python concepts, including complex data structures, advanced object-oriented programming, advanced manipulation of files and data flows, effective use of modules and libraries third-party, advanced exception handling, as well as exploring advanced topics such as functional programming, concurrency, and performance optimization to empower students to design and implement robust, flexible, and high-performance Python solutions for complex applications.

Prerequisites:	Keywords :
- *Proficiency in Python Basics: Solid knowledge of fundamental Python concepts, including data types, loops, functions, and data structures like lists, tuples, and dictionaries.* - *Understanding of object-oriented programming: Familiarity with the basic principles of object-oriented programming, such as classes, inheritance, and polymorphy.* - *Practical Python experience: Previous experience solving problems with Python, and the ability to write functional scripts and programs in Python.*	Inheritance, polymorphism, generators and iterators, decorators, collection, exception, poo

Specific course objectives (OBJ):
OBJ 1 : *Advanced mastery of object-oriented programming: Deepen OOP concepts to create flexible and modular software structures, exploiting inheritance, polymorphism and abstract classes.* ***OBJ 2 :*** *Exploring functional programming: Understand the principles of functional programming to write more elegant Python code, using higher order functions and lambda expressions.*

OBJ 3 : *Advanced use of modules and packages: Leverage advanced features of Python modules, create custom modules, manage selective imports, and apply context managers for better code organization.*

OBJ 4 : *Advanced Exception and Error Handling: Delve deeper into error handling in Python using advanced try-except blocks, define custom exceptions, and handle complex error situations.*

OBJ 5 : *Performance and Algorithm Optimization: Apply code optimization techniques in Python, use efficient data structures and efficient algorithms to improve the speed and efficiency of programs.*

OBJ 6 : *Introduction to concurrent programming: Discover the basics of concurrent programming with Python, working on the creation of threads, processes or using libraries like asyncio to manage concurrent tasks.*

Necessary material :

- *A computer with a Python development environment such as PyCharm, Visual Studio Code, Atom.*
- *Internet access for additional resources, Python documentation, and updates.*
- *A Python reference manual for quick reference of concepts.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Advanced handling of classes and inheritance** - *Deep dive into Python classes* - *Advanced exploration of inheritance, polymorphism and methods.*	6	- *Master the advanced use of classes, inheritance and polymorphism in Python.*
03	**Advanced exception handling** - *Advanced use of exceptions* - *Creating custom exceptions and handling complex errors.*	3	- *Apply advanced exception management in complex practical cases.*
04-05	**Exploring functional programming** - *Understanding the principles of functional programming in Python* - *Using advanced functions.*	6	- *Understand and practice functional programming concepts in Python.*
06-07	**Advanced use of modules and packages** - *Advanced use of Python modules* - *Creation and management of personalized modules and selective imports.*	6	- *Leverage advanced modules and packages to efficiently structure Python code.*
08-09	**Performance and algorithm optimization** - *Code Optimization Techniques* - *Use of efficient algorithms and efficient data structures.*	6	- *Explore techniques for optimizing Python code to improve performance.*

11-12	**Advanced file and stream manipulation** - *Management of advanced reading, writing and manipulation of files and I/O data streams.*	6	- *Delve deeper into advanced file and data flow manipulation in Python.*
12-13	**Introduction to concurrent programming** - *Basic notion of concurrent programming in Python* - *Using specific threads or libraries.* - ***General revision*** - *General revision and preparation for the TP exam*	6	- *Discover the basics of concurrent programming in Python with practical exercises.* - *Review concepts taught and prepare students for the final practical exam.*
14	**Partial examination** - *Practical exam session*	3	- *Evaluate the knowledge acquired through a practical exercise*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Web references (useful links):

- *Real Python: realpython.com - Articles, tutorials, and resources for all Python skill levels, covering advanced topics like asynchronous programming and best coding practices.*
- *Stack Overflow: https://stackoverflow.com/questions/tagged/python - A community of programmers where you can ask questions, find answers, and explore discussions about Python-related issues.*
- *LeetCode: https://leetcode.com/problemset/all/?search=python - A platform providing practical problems and challenges in Python to strengthen problem-solving and algorithmic skills.*
- *[book] Advanced Python Programming - Second Edition, Author: Quan Nguyen, Year: 2022, Pages: 606*
- *[book] Fluent Python: Clear, Concise, and Effective Programming, Author: Luciano Ramalho, Year: 2022, Pages: 1014*
- *[book] Effective Python: 90 Specific Ways to Write Better Python, Author: Brett Slatkin, Year: 2019, Pages: 480*
- *[book] Python Cookbook, Authors: David Beazley and Brian K. Jones, Year: 2013, Pages: 706*

- *[Scientific Article] Array Programming with NumPy, Authors: Charles R. Harris, K. Jarrod Millman, Stéfan J. van der Walt, et Al. Year: 2020, Pages: 26*
  This article discusses the fundamental concepts of array programming using NumPy, a core library for scientific computing in Python.
- *[Scientific Article] Python for Parallel Python Programming, Authors: Chansup Byun, William Arcand, David Bestor, et al. Year: 2022, Pages: 15*
  This paper introduces pPython, a parallel programming framework designed to enhance Python's performance in high-performance computing environments.

5- Working environment (Facilities necessary for learning)

- *Programming Language: Download and install Python from python.org.*
- *Development Environment: Using an integrated development environment (IDE) such as PyCharm from JetBrains, Visual Studio Code (VSCode) with the Python extension, or Jupyter Notebook to code and run Python code.*
- *Package Manager: Using pip, the Python package manager, to install third-party libraries.*

Course Specification

Advanced web development

1. General

Coded	IoT4.S1.05	Level/Semester	4/S1	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Nahla Baccar					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	30
Module	Advanced web development (FrameWork)					Version	08/2023

Course description (Course objective):

The Advanced Web Development with Angular course aims to deepen your mastery of the Angular framework for creating advanced and interactive web applications. Focused on advanced features such as modules, routes, responsive forms handling, and HTTP services, this course empowers learners to design modern, high-performance user interfaces. It also explores deployment and testing best practices for building robust and scalable web applications.

Prerequisites:	Keywords :
- *Basic knowledge of HTML, CSS and JavaScript: Understanding of fundamental web development concepts, including HTML for structure, CSS for presentation and JavaScript for logic and interaction.* - *Understanding of basic TypeScript concepts: Prior knowledge of TypeScript, the programming language used by Angular, would be an asset in understanding and writing Angular code.* - *Knowledge of responsive web design principles: A basic understanding of responsive design principles would be helpful in taking full advantage of Angular's responsive features.*	*Routes, Services, Modules, Dependency Injection, Directives, Angular CLI*

Specific course objectives (OBJ):

OBJ 1 : *Master advanced Angular features: Understand and use advanced features of the Angular framework such as advanced directives, advanced services, guards and pipes.*

OBJ 2 : *Design modular and scalable applications: Know how to structure modular web applications using Angular modules for increased maintainability, scalability and reusability of the code.*

OBJ 3 : *Integrate services and HTTP requests: Know how to integrate and interact with external services via HTTP requests to retrieve, manipulate and display data in Angular applications.*

OBJ 4 : *Create responsive user interfaces: Effectively use Angular's responsive features to design dynamic and responsive user interfaces, including advanced form handling and the use of observables.*

OBJ 5 : *Develop applications with solid architecture: Apply best practices to create robust, maintainable and testable applications using Angular directives, components, services and navigation management.*

OBJ 6 : *Practice unit and integration testing: Acquire skills to write unit and integration tests to ensure code quality and ensure stable and reliable applications.*

Necessary material :

- *A laptop or desktop computer with sufficient specifications to run a web development environment.*
- *Internet access for additional resources, Angular documentation and updates.*
- *Node.js and npm: Installation of Node.js, which includes npm (Node Package Manager), to manage dependencies and install the tools necessary for development with Angular.*
- *Angular CLI: Installation of the Angular CLI (Command Line Interface) to generate, create and manage Angular projects.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to Angular and basic configuration** - *Angular Installation: Download, install and configure the Angular environment.* - *Fundamental Concepts: components, modules and structure of an application.*	3	- *Install Angular, configure the environment and understand the basic concepts.*
02-03	**Creating Angular components** - *Creation of Components: the creation, management and use of components to structure an application.* - *Communication between Components.*	6	- *Master the creation and use of components to structure an application.*
04	**Route management and navigation** - *Route Configuration: Setting up routes to manage navigation between different components.* - *Navigation Event Management: Manage navigation events and customize application navigation.*	3	- *Set up navigation between components using Angular routes.*
05	**Advanced use of Angular services**	3	- *Leverage services to share*

			data between components
	- *Creation of Services: Creation and advanced use of services to share data and encapsulate business logic.* - *Dependency Injections: the dependency injection mechanism to efficiently use services.*		*and manage business logic.*
06-07	**Managing Responsive Forms** - *Responsive Form Creation: Using responsive forms to dynamically collect and validate user data.* - *Form Event Management: Handling events and actions associated with responsive forms.*	6	- *Apply responsive forms to collect and validate user data.*
08-09	**Integration of HTTP requests** - *Using HTTP Requests: Integration of HTTP services to interact with external APIs and retrieve data.* - *HTTP Response Processing: Management of responses and manipulation of data obtained via HTTP requests.*	6	- *Integrate HTTP requests to retrieve external data and display it in the Angular application.*
10	**Creating modular applications** - *Structuring in Modules: Creation of modules to organize the application and promote code reusability.* - *Feature Sharing: Sharing of features between modules to optimize the application architecture.*	3	- *Structure the application into modules to promote reusability and maintainability of the code.*
11	**Unit and integration testing** - *Writing Unit Tests: Learning how to write and run unit tests to verify the functioning of components.* - *Integration Testing: Practice integration testing to guarantee the consistency and compatibility of the different parts of the application.*	3	- *Perform unit and integration testing to ensure the reliability and quality of Angular code.*
12-13	**Development of the mini-project** - *Practical Application of Learned Concepts: Concrete application of all concepts*	6	- *Put into practice all the concepts learned to design*
	previously taught within the framework of		*and develop a mini-project*

	the development of a mini-project. - *Application Architecture and Design: Planning, development and structuring of the project using Angular.*		*in Angular.*
14	**Evaluation of the mini-project** - *Mini-project evaluation: Detailed evaluation of the mini-project developed in previous weeks.*	3	- *Evaluate the completed mini-project, by testing the functionalities, structure and quality of the code developed.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *Angular Official Documentation: angular.io - The official Angular documentation containing comprehensive guides, tutorials and references for learning and mastering Angular.*
- *Angular University: angular-university.io - Online courses and advanced resources on Angular, covering a variety of topics, including best practices, recent updates, and advanced features.*
- *[Book] Mastering Front-End Web Development: 14 Books in 1. Introducing 200+ Extensions. An Advanced Guide., Author: Chong Lip Phang, Year: 2020*
- *[Book] Web Application Architecture: Principles, Protocols and Practices, Authors: Leon Shklar and Richard Rosen*
- *[Scientific Article] Advancing Web Development: Enhancing Component-Based Software Engineering and Design Systems through HTML5 Customized Built-in Elements, Authors: Hardik Shah, Year: 2023*
- *[Scientific Article] Cross-Tier Web Programming for Curated Databases: A Case Study, Authors: Simon Fowler, Simon D. Harding, Joanna Sharman, James Cheney, Year: 2020*

6- Working environment (Facilities necessary for learning)

- *Node.js: Download and install Node.js from nodejs.org.*
- *Angular CLI: Installing the Angular CLI via npm with the following command:*
- *Code Editor: Using a code editor such as Visual Studio Code, Sublime Text, Atom, or WebStorm to write and manage Angular code*

Course Specification

Cloud Computing and IoT Services

1. General

Coded	IoT4.S1.06	Level/Semester	4/S1	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Fakher Ben Ftima					Vol. H. (TP)	21
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	24
Module	Cloud computing and IoT services					Version	08/2023

Course description (Course objective):
This course aims to provide students with an in-depth understanding of the convergence between cloud computing and the Internet of Things (IoT). With a focus on platforms like AWS and IoT services, this course explores how the cloud facilitates connectivity, management, and analysis of IoT devices at scale. Goals include learning cloud architectures for IoT applications, securing data, and mastering deployment tools to create efficient and scalable IoT solutions.

Prerequisites:	Keywords :
- *Fundamentals of Computer Science and Networking: Understanding of basic computer science principles, including operating systems, computer networks, and communications protocols.* - *Basic IoT knowledge: Familiarity with key Internet of Things (IoT) concepts, such as device connectivity, sensors, IoT communication protocols, and typical IoT system architectures.* - *Cloud Computing Basics: Knowledge of fundamental cloud computing concepts, including cloud storage, on-demand computing services, virtualization, as well as understanding deployment models and types of cloud services.*	*IoT Cloud, AWS, Connectivity, IoT Data Management, IoT Security, Real-Time Data Analytics, Cloud Architecture for IoT, Cloud Services for IoT, IoT Application Deployment, Scalability and Performance*

Specific course objectives (OBJ):
OBJ 1 : *Deep understanding of the connection between cloud computing and IoT: Explore how the cloud facilitates connectivity, processing and data management for IoT devices.* ***OBJ 2 :*** *Mastery of cloud platforms such as AWS for IoT applications: Learn how to use specific cloud*

services to build, deploy and manage IoT solutions.

OBJ 3 : *Securing IoT Data: Understand appropriate security strategies to protect data passing between IoT devices and cloud platforms.*

OBJ 4 : *Analysis and use of IoT data: Acquire skills to collect, analyze and derive relevant insights from data streams generated by connected devices.*

OBJ 5 : *Developing Scalable Architectures for IoT Applications: Design flexible and scalable cloud architectures to meet the growing requirements of large-scale IoT deployments.*

Necessary material :

- *Computer: For practical work, programming and access to cloud platforms.*
- *IoT development boards: Like Arduino, Raspberry Pi or other microcontrollers, for experimenting with IoT devices.*
- *IoT sensors and peripherals: To carry out concrete and experimental projects.*
- *Reliable Internet Connection: Essential for accessing cloud platforms and testing IoT applications.*
- *Laboratory environment: Spaces dedicated to experimentation and implementation of IoT projects.*
- *Development software and tools: Integrated development environments (IDE), simulation tools, programming software.*
- *Access to cloud platforms: Such as AWS, Azure, to put learned concepts into practice and deploy IoT solutions.*
- *Electronic components: Resistors, LEDs, cables, etc., for the creation of IoT prototypes.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to Cloud Computing and IoT** - *Definitions and fundamental concepts of Cloud Computing and the Internet of Things.*	1.5	- *Understand the basics of Cloud and IoT*
02-03	**Fundamentals of Cloud Architecture for IoT** - *Architectural patterns for cloud-based IoT systems.* - *Case studies and practical examples.*	3	- *Understanding Cloud Architectures Adapted to IoT*
04-05	**Using AWS Services for IoT** - *Exploring AWS IoT Core, AWS IoT Greengrass, and more services.* - *Configuring IoT solutions on AWS..*	3	- *Master AWS Services for IoT Applications*
06	**Security in Cloud and IoT** - *Security protocols for cloud-based IoT solutions.*	1.5	- *Understand security issues and measures*

	- *Identity and access management.*		
07	**Guarded duty**	1.5	- *Assessment of knowledge acquired through a supervised assignment*
08	**IoT data management** - *Collection, storage and processing of data generated by IoT devices.*	1.5	- *Learn to effectively manage IoT data*
09	**Real-time IoT data analysis** - *Tools and techniques for real-time analysis of IoT data streams.*	1.5	- *Know how to analyze IoT data in real time*
10-11	**IoT application development** - *Programming for IoT devices.* - *Creating simple applications for specific scenarios.*	3	- *Learn to develop IoT applications.*
12	**Case study and practical work** - *Practical work on real scenarios and miniature projects.*	1.5	- *Application of acquired knowledge*
13	**Deployment and management of IoT solutions** - *Deployment techniques and management of updates for IoT devices.*	1.5	- *Learn to deploy and manage IoT solutions*
14	**Exam** - *Exam assessing understanding of course concepts*	1.5	- *Evaluation of acquired knowledge*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *AWS IoT: https://aws.amazon.com/fr/iot/ - AWS platform dedicated to the Internet of Things offering a range of services for developing IoT applications.*
- *Microsoft Azure IoT: https://azure.microsoft.com/en-us/overview/iot/ - Azure platform offering*

IoT services to connect, monitor and manage IoT devices.

- *IoT for All: https://www.iotforall.com/ - Platform offering IoT articles, guides and news for all skill levels.*
- *GitHub - IoT Resources: https://github.com/HQarroum/awesome-iot - A collection of IoT-related open-source resources, tools and projects on GitHub.*
- *[Book] Cloud Computing: Concepts, Technology & Architecture, Authors: Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Year: 2013, Pages: 528*
- *[Book] Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy, Editors: Alex Khang, Vugar Abdullayev, Vladimir Hahanov, and Vrushank Shah, Year: 2023, Pages: 400*
- *[Book] Programming the Internet of Things: An Introduction to Building Integrated, Device-to-Cloud IoT Solutions, Author: Andy King, Year: 2021, Pages: 350*
- *[Book] Advanced Cloud Computing Security Techniques and Applications, Editor: Lei Chen, Year: 2019, Pages: 300*
- *[Book] Advanced IoT Sensors, Networks and Systems*
- *Editors: Gourab Sen Gupta, Sergei Kruk, and Harsha Kalutarage, Year: 2023, Pages: 350*
- *[Scientific Article] Cloud Computing - Architecture and Applications, Authors: Jaydip Sen et al., Year: 2017*
- *[Scientific Article] Internet of Things: Technology, Applications and Standardization, Authors: Jaydip Sen et al., Year: 2018*
- *[Scientific Article] An Internet of Things Service Roadmap, Authors: Athman Bouguettaya et al, Year: 2021*

5- Working environment (Facilities necessary for learning)

- *Computer: To access cloud platforms, run development tools and complete projects.*
- *Stable Internet Connection: Essential for accessing cloud resources, online tutorials, development tools, and deploying IoT applications.*
- *Integrated development environment (IDE): suitable for IoT development and compatible with required programming languages.*
- *Cloud Platform: Access to a cloud platform like AWS, Google Cloud Platform, Azure, etc., to create instances, IoT services, store data and deploy applications.*
- *IoT simulators: Simulation tools such as AWS IoT Core simulator, Microsoft Azure IoT Explorer, or third-party simulators to simulate IoT devices and data streams.*
- *IoT Development Kits: Hardware development boards like Arduino, Raspberry Pi or other specific kits for performing IoT experiments.*
- *IoT Sensors and Devices: Assortment of sensors (temperature, motion, light, etc.), actuators and peripherals compatible with development kits to create real-world projects.*
- *Modeling and design software: For modeling IoT architectures and designing solutions, tools like L*

Course Specification

Databases and Data Storage for IoT

1. General

Coded	IoT4.S1.07	Level/Semester	4/S1	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Bochra Rabbouche					Vol. H. (TP)	21
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	28
Module	Databases and Data Storage for IoT					Version	08/2023

Course description (Course objective):
Databases are designed to store and manage massive volumes of data generated by connected devices. They offer an architecture adapted to the variety and continuous flow of IoT data. These databases use flexible data models to handle the diversity of IoT data. They ensure horizontal scalability to accommodate rapid data growth. IoT storage solutions integrate real-time processing capabilities, advanced analytical capabilities and security mechanisms to efficiently manage IoT data streams while ensuring their integrity and availability.

Prerequisites:	Keywords :
- *Database knowledge: Understanding of fundamental concepts of relational databases.* - *Familiarity with IoT technologies: A basic knowledge of the principles and protocols used in the Internet of Things.* - *Understanding data storage needs: Know the specific requirements of collecting, analyzing and storing IoT data, including scalability and variety of data.*	*NoSQL, Horizontal scalability, data storage*

Specific course objectives (OBJ):
OBJ 1 : *Understanding storage technologies for IoT: Understand different storage technologies, such as NoSQL databases and distributed file systems, suited to the variety and volume of IoT data.* ***OBJ 2 :*** *Mastery of big data management techniques: Gain skills to manage and manipulate massive data sets generated by IoT devices, with an emphasis on scalability and performance.*

OBJ 3 : *Analysis of real-time storage and processing requirements: Identify and meet requirements for real-time storage and analysis of data streams generated by IoT devices for reactive applications.*

OBJ 4 : *Exploring Distributed Storage Solutions: Examine and evaluate distributed storage systems to efficiently manage geographically distributed data from multiple IoT devices.*

OBJ 5 : *Integration of data analysis and visualization concepts: Apply data analysis and visualization techniques to extract* actionable insights from large volumes of stored IoT data.

Necessary material :

- *A laptop or desktop computer to attend classes, run code examples, and complete hands-on exercises. Hardware with reasonable specifications to support the necessary development environments and software.*
- *Internet access to view online documentation, access additional resources, and possibly download course-related software or tools.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Introduction to Databases for IoT** - *Understand the fundamentals of IoT-enabled databases.* - *Examine appropriate data models to effectively manage massive streams of data from connected devices.*	3	- *Understand IoT-enabled databases and data models to manage massive data flows.*
03-04	**Exploring storage technologies** - *Study the different NoSQL databases and their applications in the context of IoT.* - *Learn about distributed storage solutions and their use to manage massive data generated by IoT.*	3	- *Learn about NoSQL databases, distributed storage solutions and IoT big data management.*
05-06	**IoT Data Security and Management** - *Learn security practices to protect IoT data from threats.* - *Understand how to manage and analyze data in real time for better responsiveness.*	3	- *Learning security practices and techniques to analyze data in real time.*
07-09	**Practical implementation** - *Apply acquired knowledge to design storage solutions specific to real-world IoT scenarios.* - *Implement practical cases for a better understanding of concepts.*	4.5	- *Applying knowledge through case studies to design IoT storage solutions.*

10-11	**Advanced Information Extraction Techniques** - *Use advanced statistical tools to extract actionable insights from IoT data.* - *Exploring distributed architectures for big data analysis.*	3	- *Use of statistical tools and advanced analysis techniques to extract meaningful information.*
12-13	**Integration and optimization** - *Explore methods for integrating data from multiple IoT sources.* - *Optimize database performance to meet IoT needs.*	3	- *Study of data integration and database performance optimization cases.*
14	**Practical exam** - *A hands-on exercise involving different aspects of databases for IoT. This assessment could include questions about data modeling, security, performance optimization, and data integration in an IoT context.*	1.5	- *Assessment of practical skills in applying acquired knowledge in real-world scenarios.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *MongoDB University: university.mongodb.com - Online courses and tutorials to learn MongoDB, a popular NoSQL database used in IoT.*
- *Redis Labs: redislabs.com - Advanced resources and tutorials on Redis, an in-memory database that can be used to store IoT data in real time.*
- *[Book] MySQL for the Internet of Things, Author: Charles Bell,Year: 2016, Pages: 329*
- *[Book] Advanced Implementation of IoT Systems: Leveraging MQTT and Node-RED for Real-Time Data Management, Author: S. M. Mohi Us Sunnat, Year: 2022, Pages: 200*
- *[Book] Handbook of IoT and Big Data, Editors: Vijender Kumar Solanki, M.D. Singh, and Poonam Tanwar, Year: 2019, Pages: 352*

- *[Book] Cloud Databases for Internet-of-Things Data, Authors: Sherif Sakr and Mohamed Gaber, Year: 2014, Pages: 80*
- *[Book] Storage Method for Real-Time Big Data on the Internet of Things*
- *Editors: Various, Year: 2023*
- *[Scientific Article] IoT-Based Data Storage for Cloud Computing Applications, Authors: S. S. Manvi and P. Venkataram, Year: 2020*
- *[Scientific Article] IoT Data Security in Outsourced Databases: A Survey of Verifiable Database Solutions, Authors: Various, Year: 2023*
- *[Scientific Article] SciTS: A Benchmark for Time-Series Databases in Scientific Experiments and Industrial Internet of Things, Authors: Jalal Mostafa, Sara Wehbi, Suren Chilingaryan, Andreas Kopmann, Year: 2022*

5- Working environment (Facilities necessary for learning)

- *Database management system (DBMS): MongoDB, Cassandra, R*

Course Specification

Integration project

1. General

Coded	IoT4.S1.08	Level/Semester	4/S1	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	21
Responsible	Montassar Ben Saad					Vol. H. (TP)	0
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	30
Module	Integration project					Version	08/2023

Course description (Course objective):
This course aims to allow students to put into practice all the knowledge and skills acquired during their course by carrying out a concrete IoT project, individually or in pairs. This project involves the creation of a detailed scientific educational report describing the different stages of completion. The teacher acts as a supervisor, providing advice and feedback to guide the development of the project, thus promoting the practical application of skills and the preparation of students for real-life situations in the area studied

Prerequisites:	Keywords :
- *Prior knowledge of the area of study: A prior understanding of the specific area the project focuses on is essential to develop appropriate and relevant solutions.* - *Mastery of relevant technical skills: Practical skills in the tools, programming languages or methodologies necessary to complete the project are required.* - *Ability to work in a team (if applicable): If the project takes place in pairs, the ability to work effectively in a team, share tasks and collaborate is essential.* - *Writing skills for scientific report: The ability to write a scientific report describing in detail the different stages of the project is essential.*	*Project, Teamwork, Design, Production, IoT, Writing a report, Work methodology*

Specific course objectives (OBJ):
OBJ 1 : *Application of acquired knowledge: Put into practice the theoretical and practical knowledge acquired throughout the course in carrying out a concrete project.*
OBJ 2 : *Development of transversal skills: Promote the development of not only technical skills, but also*

project management, communication and teamwork.

OBJ 3 : *Creation of a detailed scientific report: Develop an exhaustive and methodical report describing the different stages of the project, from the technical choices to the results obtained.*

OBJ 4 : *Supervision and advice for the progress of the project: Benefit from the support and constructive feedback from the teacher-supervisor to guide and improve the completion of the project.*

Necessary material :

- *Project-specific hardware: Any project-specific hardware, such as sensors, electronic devices, components, development platforms, etc.*
- *Communication and collaboration tools: Online platforms, software or communication tools to facilitate collaboration between team members if the project is carried out as a group.*
- *Writing and presentation equipment: presentation creation, text editing and modeling software for the preparation of the scientific report.*

2- Content elements (Course)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Discussion of student project areas of interest** - *Presentation of the different possible themes for the projects.* - *Discussions about students' interests and opportunities in these areas.*	3	- *Identifying areas of interest and project topics*
03-04	**Analysis and preliminary design of the project** - *Identification of project needs, functionalities and constraints.* - *Creation of the first design documents (specifications, UML diagrams, etc.).*	3	- *Development of the first phases of analysis and design.*
05-06	**Choice of technologies and tools** - *Research on the different technologies relevant to the project.* - *Choice of development tools and explanation of the reasons for these choices.*	3	- *Selection and justification of technologies to be used in the project.*
07-08	**Implementation of the first modules** - *Start of the creation of the different parts of the project.* - *Implementation of the first modules or functionalities*	3	- *Initial development of specific parts of the project*

09-10	**Mid-term review and adjustments** - *Analysis of progress made and possible problems encountered.* - *Corrections, adjustments and directions for the rest of the project.*	3	- *Review, adjustments and resolution of problems encountered.*
11-12	**Integration of modules and tests** - *Integration of the components produced and performance of integration tests.* - *Validation of functionalities and correction of anomalies.*	3	- *Integration of the different parts of the project and functional tests*
13	**Finalization and preparation for evaluation** - *Finalization of the remaining elements of the project.* - *Preparation of documentation and materials for the evaluation.*	1.5	- *Finalization of the project and preparation for the final evaluation.*
14	**Project evaluation** - *Presentation of projects followed by evaluation by peers or the teacher.*	1.5	- *Evaluation of projects carried out by each student or group.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- References

- *GitHub: https://github.com/ - Platform for hosting and collaborating software projects. Students can find code examples, similar projects, and version management tools for their project.*
- *IEEE*
- *Stack Overflow: https://stackoverflow.com/ - Developer community where students can ask technical questions, find answers, and solve problems specific to their project.*
- *Céline Martinet Sanchez , "Gérez votre projet informatique facilement", 2023 https://openclassrooms.com/fr/courses/4192086-gerez-votre-projet-informatique-facilement*

- *Openmind Tech, "Les 6 étapes d'un projet informatique : De l'idée au produit technologique en ligne" https://www.openmindt.com/fr/ressources/6-etapes-projet-informatique-idee-au-produit-technologique/*
- *Samantha Mur, "Devenez un pro de la gestion de projet informatique en 7 étapes", 2022 https://www.appvizer.fr/magazine/operations/gestion-de-projet/gestion-projet-informatique*
- *Gauthier, L. (2022). Développer un projet informatique : De l'idée à la mise en production. Dunod.*
- *Clément, M., & Dupont, L. (2021). La gestion d'un projet informatique pour les débutants. Eyrolles.*
- *Levine, J., & Rahimi, S. (2023). The Complete Beginner's Guide to Software Development: From Idea to Deployment. Packt Publishing.*
- *Smith, T., & Young, A. (2022). Building Your First Web Application: A Practical Guide for Beginners. O'Reilly.*

5- Working environment (Facilities necessary for learning)

- *Development software: Integrated development environments (IDE) such as Visual Studio Code, Eclipse, or specialized editors depending on the nature of the project (Python, Java, etc.).*
- *Version management tools: Using version control systems like Git for collaborative management of code versions and project documents.*
- *Communication tools: Online communication tools like Google Meet, Microsoft Teams, or messaging platforms to facilitate team collaboration.*
- *Modeling or design software: Software for UML modeling, graphic design, database modeling, etc., depending on the specific needs of the project.*
- *Libraries and References: Access to online libraries, academic sites and databases for researching references for the scientific report.*
- *Document Sharing Platforms: Using platforms like Google Drive, Dropbox, or GitHub to store, share, and collaborate on project documents.*
- *Presentation tools: Presentation software such as PowerPoint, Prezi, or Google Slides to prepare project-related presentations.*
- *Specialized Hardware: Any specific hardware needed to complete the project, such as IoT devices, sensors, development kits, etc.*

Course Specification

IoT communication protocols

1. General

Coded	IoT4.S1.09	Level/Semester	4/S1	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mouhieddine Belghith					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	60
Module	IoT communication protocols (MQTT, CoAP, LoRa, etc.)					Version	08/2023

Course description (Course objective):
The IoT Communication Protocols course aims to explore and understand the main protocols such as MQTT, CoAP, LoRa, among others, used in the Internet of Things (IoT). This program aims to provide an in-depth understanding of these protocols, their functionality, their implementation, as well as their impact on communication between connected devices, in varied and low-power environments.

Prerequisites:	Keywords :
- *Basic networking knowledge: Understand fundamental computer networking concepts, such as OSI and TCP/IP models.* - *Familiarity with the Internet of Things (IoT): Have a general knowledge of IoT concepts, architectures and applications.* - *Basic programming skills: A basic understanding of programming languages like Python, C, or Java can be helpful in grasping the technical aspects of the course.* - *Understanding of Embedded Systems: Having a basic knowledge of embedded systems and sensors used in IoT devices can make understanding communication protocols easier.*	*MQTT, Lora, http, Communication protocol, CoAP*

Specific course objectives (OBJ):
OBJ 1 : *In-depth understanding of communications protocols: Gain in-depth knowledge of IoT communications protocols such as MQTT, CoAP and LoRa, examining their structures, functionalities and use cases.* ***OBJ 2 :*** *Mastery of practical implementation: Be able to implement these protocols in real-world IoT*

scenarios, understanding the configurations, messages exchanged and interactions between connected devices.

OBJ 3 : *Protocol Benchmarking: Evaluate and compare the advantages, disadvantages and performance of different protocols based on specific criteria such as power consumption, reliability and range.*

OBJ 4 : *Exploration of challenges and solutions: Study the challenges related to IoT communication, such as security, scalability and compatibility, and explore possible solutions to solve them, focusing on real-world examples and case studies*

Necessary material :

- *IoT development boards: Arduino, Raspberry Pi, ESP8266, ESP32, or other specific boards depending on the protocols to be studied.*
- *Sensors and communication modules: Temperature, humidity sensors, accelerometers, gyroscopes, as well as WiFi, Bluetooth, LoRa modules, etc.*
- *Laptop or Desktop: Necessary for developing, programming, and simulating IoT protocols.*
- *Breadboards, wires and electronic components: For setting up circuits, connecting sensors and modules to development boards.*
- *Connectivity accessories: Routers, WiFi access points, USB dongles, or other equipment for creating networks and testing protocols.*
- *Measuring equipment: Multimeters, oscilloscopes, logic analyzers, used to troubleshoot and test circuits.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Introduction to IoT protocols** - *Theoretical presentation of IoT protocols.* - *Comparison of features and use cases of MQTT, CoAP and LoRa.*	6	- *Understanding of the main IoT communication protocols (MQTT, CoAP, LoRa, etc.).*
03-04	**Setting up an MQTT network** - *Installation and configuration of an MQTT server.* - *Created MQTT clients for publishing and subscribing messages.*	6	- *Proficiency in configuring and exchanging messages via MQTT*
05-06	**Using CoAP for IoT communications** - *Configuration and deployment of a CoAP server.* - *Using CoAP to send requests and receive responses.*	6	- *Learning how to implement and interact with CoAP.*

07-08	**Experimenting with LoRaWAN** - *Configuring LoRaWAN gateways.* - *Creation of nodes capable of communicating via LoRaWAN.*	6	- *Understanding of LoRaWAN features and scope.*
09-10	**Security in IoT protocols** - *Implementation of security measures for MQTT, CoAP and LoRaWAN.* - *Exploring encryption and authentication strategies.*	6	- *Applying security principles in IoT communications*
11-13	**Practical case study** - *Realization of an IoT project using several communication protocols.* - *Analysis of challenges and solutions when integrating protocols in a real case.*	9	- *Putting acquired knowledge into practice on real use cases*
14	**Evaluation of a mini-project** - *Presentation and evaluation of projects carried out by students.*	3	- *Individual evaluation of a mini-project using the protocols studied.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *The Things Network: https://www.thethingsnetwork.org/docs/ - Complete documentation on LoRaWAN and how to get started with The Things Network.*
- *OASIS Open: https://www.oasis-open.org/standards#iot - Open standards and specifications for IoT developed by OASIS Open.*
- *MQTT.org: https://mqtt.org/documentation/ - Official MQTT protocol documentation with technical specifications and how-to guides.*
- *IETF CoRE Working Group: https://datatracker.ietf.org/wg/core/about/ - Documents and work of the IETF Core Working Group regarding the CoAP protocol.*
- *[Book] IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Authors: David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,*

Year: 2017, Pages: 624

- *[Book] Fundamentals of IoT Communication Technologies, Authors: Rolando Herrero, Lei Shu, Beatriz Sainz, Juan José Villacorta, Year: 2021, Pages: 204*
- *[Book] Internet of Things: Architectures, Protocols and Standards, Author: Qin Zhihong, Year: 2018, Pages: 350*
- *[Scientific Article] A Study of Communication Protocols for Internet of Things (IoT) Devices: Review, Authors: S. S. Al-Sarawi, M. Anbar, K. Alieyan, M. Alzubaidi, Year: 2017, Pages: 8*
- *[Scientific Article] Comparative Analysis of IoT Communication Protocols, Authors: S. Pal, A. K. Paul, S. R. S. Kumar, Year: 2018, Pages: 5*
- *[Scientific Article] Internet of Things: A Comprehensive Overview on Protocols, Standards, and Applications, Authors: M. R. Palattella, N. Accettura, X. Vilajosana, et al., Year: 2023, Pages: 30*

5- Working environment (Facilities necessary for learning)

- *Computer with a recent operating system: A PC or laptop with Windows, MacOS or a Linux distribution.*
- *Development and editing software: Install a text editor or integrated development environment (IDE) such as Visual Studio Code, Eclipse, or Atom to write code and manage projects.*
- *Programming languages: Make sure you have the necessary programming languages like Python, JavaScript, or C depending on the specific protocols you will study.*
- *IoT simulators and emulators: Download IoT simulators such as Mosquitto for MQTT, Copper for CoAP, or emulators for LoRa networks to simulate IoT devices.*
- *IoT development platforms: Access IoT development platforms like Arduino, Raspberry Pi, or development kits*

Course Specification

IoT System Security and Cybersecurity

1. General

Coded	IoT4.S1.10	Level/Semester	4/S1	Coefficient	1.5	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	21
Responsible	Seifeddine Khelifi					Vol. H. (TP)	0
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	Security of IoT systems and Cybersecurity					Version	08/2023

Course description (Course objective):
The “IoT Systems Security and Cybersecurity” course aims to provide an in-depth understanding of security principles specific to IoT devices and the protection of exchanged data. Focusing on threats, vulnerabilities, and securing techniques, this course aims to prepare students to design, implement, and maintain secure IoT systems. The goal is to develop the skills needed to assess risks, apply protective measures, and ensure the confidentiality, integrity, and availability of IoT systems in connected environments.

Prerequisites:	Keywords :
- *Basic knowledge of computer networks: Understanding of fundamental concepts of networks, communication protocols and computer systems architecture.* - *Computer Security Concepts: Familiarity with basic computer security principles, including cryptography concepts, common attacks and protection mechanisms.* - *Knowledge of IoT: Understanding of the basic principles of the Internet of Things, connected devices and how they work.* - *Mastery of operating systems and programming languages: Skills in using operating systems (such as Linux, Windows) and programming in common languages (Python, C/C++, Java) used in the field of security.* - *Risk Analysis and Security Management: Ability to assess security risks, implement security policies and understand the principles of information security management.*	*IoT, Cybersecurity, Networks, Cryptography, Vulnerabilities, Security, Threats, Protection, Data Security, Risks*

Specific course objectives (OBJ):

OBJ 1 : *Understanding IoT Risks: Analyze and identify security risks specific to IoT devices and assess their potential impact on systems.*

OBJ 2 : *Mastery of security protocols: Master security protocols such as TLS, DTLS, and encryption mechanisms to guarantee the confidentiality and integrity of data exchanged in IoT networks.*

OBJ 3 : *Vulnerability Management: Learn how to detect, assess and remediate common vulnerabilities in IoT systems to improve their security.*

OBJ 4 : *Applying security best practices: Put into practice best practices for securing networks, interfaces and IoT devices to reduce the risk of attacks.*

OBJ 5 : *Design of secure systems: Acquire the skills to design secure IoT systems by integrating security measures from the design stage.*

OBJ 6 : *Privacy Protection: Understand the issues related to privacy protection in IoT systems and apply appropriate measures to ensure the confidentiality of personal data.*

OBJ 7 : *Security Incident Management: Develop skills to respond to security incidents, develop response plans, and restore security after an attack.*

Necessary material :

- *Network and security simulation software: used to illustrate attack or defense scenarios.*
- *Access to case studies: Documents, case studies or research reports on IoT security incidents for analysis and classroom discussion.*
- *Course materials: Slides, PDF documents or course materials provided by the teacher to follow the lessons.*

2- Content elements (Course)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to IoT Security and Cyber Threats**	1.5	- *Overview of basic IoT security concepts and common threats*
02-03	**IoT system vulnerabilities and common attacks** - *Case studies of major attacks and their consequences.* - *Discussion of detection and prevention methods*	1.5	- *In-depth analysis of typical vulnerabilities and attacks encountered in IoT systems*
04-05	**Security protocols and cryptography for IoT** - *Examples of secure protocol implementations.*	1.5	- *Study of secure protocols and cryptography*

	- *Demonstrations of encryption techniques adapted to IoT.*		*mechanisms used to protect IoT systems.*
06	**Threat models and risk assessment** - *Threat modeling exercises.* - *Analysis of risk assessment methodologies.*	1.5	- *Understanding IoT-specific threat models and methods to assess associated risks*
07	**Guarded duty**		- *Assessment of knowledge acquired through a supervised assignment*
08-09	**IoT network security and secure architectures** - *Case studies on secure architectures.* - *Presentation of IoT network security solutions.*	1.5	- *Design and implementation of secure architectures for IoT networks*
10-11	**Best security practices and compliance** - *Study of safety standards and regulations.* - *Practical applications of good practices*	1.5	- *Exploring security best practices and regulatory compliance for IoT systems*
12-13	**Incident management and response strategies** - *Security incident simulation and response exercises*	1.5	- *Preparedness for security incident management and response strategies.*
14	**Mini-project**	1.5	- *Overall assessment of skills acquired during the final exam.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- References

- *OWASP: https://owasp.org/ - The Open Web Application Security Project (OWASP) Foundation provides resources, tools, and best practices for web application security, including IoT-specific guides.*

- *Security Affairs: https://securityaffairs.co/ - A blog covering cybersecurity news, analysis on the latest threats, vulnerabilities and attacks, providing recent insights on IoT security.*
- *Cisco IoT Security: https://www.cisco.com/c/en/us/solutions/internet-of-things/iot-security.html - Cisco provides guides and resources specific to security for the Internet of Things Objects.*
- *IoT Security Foundation: https://iotsecurityfoundation.org/ - An organization providing resources, guidelines and best practices for securing IoT systems.*
- *[Book] Introduction to Cybersecurity in the Internet of Things, Authors: Keke Gai, Meikang Qiu, Year: 2023,*
- *[Book] Practical IoT Hacking, Authors: Fotios Chantzis, Aditya Gupta, Year: 2020,*
- *[Book] Click Here to Kill Everybody: Security and Survival in a Hyper-connected World, Author: Bruce Schneier, Year: 2018,*
- *[Scientific Article] Analysis of IoT Security Challenges and Its Solutions Using Artificial Intelligence, Year: 2023*
- *[Scientific Article] Cybersecurity Risk Analysis in the IoT: A Systematic Review, Year: 2022*
- *[Scientific Article] A Decade of Research on Patterns and Architectures for IoT Security, Year: 2020,*

5- Working environment (Facilities necessary for learning)

- *Security Software: Installation of adequate security software such as firewalls, antivirus/antimalware tools to protect the computer from potential online threats.*
- *Virtualization environment: Using a virtualization platform like VirtualBox, VMware or Docker to create isolated environments and practice security without risk to the host system.*
- *Security and Analysis Tools: Installation of security and analysis tools such as Wireshark (protocol analyzer), Metasploit (operating framework), Nmap (network scanner) for understanding the concepts covered.*
- *Access to online laboratories: If available, access to online virtual laboratories or expert simulators*

Course Specification

IoT system architecture and design

1. General

Coded	IoT4.S1.11	Level/Semester	4/S1	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mokhtar Harrabi					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	IoT system architecture and design (IoT programming primer)					Version	08/2023

Course description (Course objective):
This course introduces students to the world of the Internet of Things (IoT) by providing a hands-on introduction to the design and programming of IoT systems. Through the study of different programmable boards, sensors and actuators, learners gain a fundamental understanding of IoT technology and basic programming skills to create simple applications and interact with connected devices

Prerequisites:	Keywords :
- *Basic Computer Knowledge: A general understanding of computer science and programming concepts is beneficial in tackling the fundamentals of programming in IoT.* - *Electronics: Basic knowledge of electronics and circuits can be helpful in understanding the hardware components used in IoT systems.* - *Interest in emerging technologies: A curiosity and interest in new technologies, particularly in the area of Internet of Things, is essential to grasp the concepts and practical applications of the course*	*IoT, Embedded Programming, Sensors, Actuators, IoT Cards, Wireless Connectivity, IoT Protocols, Embedded Systems, Interfacing*

Specific course objectives (OBJ):
OBJ 1 : *Understanding of IoT: Gain an in-depth understanding of the fundamental concepts of the Internet of Things, including its applications, challenges and opportunities.* ***OBJ 2 :*** *Mastery of IoT components: Learn to identify, use and integrate different sensors, actuators and hardware boards to create simple IoT systems.* ***OBJ 3 :*** *IoT Application Programming: Develop basic programming skills to create simple applications and*

interact with connected devices.

OBJ 4 : *IoT System Design: Design and plan simple IoT systems using hardware and software components tailored to meet specific needs.*

Necessary material :

- *IoT development boards: Arduino Uno, Raspberry Pi, ESP8266, ESP32, etc., to experiment with different microcontrollers and hardware platforms.*
- *Various sensors and actuators: Temperature, humidity, movement, light sensors, actuators such as LEDs, motors, relays, to understand their operation and integration.*
- *Breadboards and electronic components: Starter kits with breadboards, resistors, capacitors, connection wires, to create prototypes and simple circuits.*
- *Wireless Communication Modules: Wi-Fi, Bluetooth, Zigbee, LoRa modules, etc., to experiment with different wireless communication technologies used in IoT systems.*
- *Laptop or Desktop: For software development, programming, and interacting with IoT devices.*
- *Basic accessories and tools: Connection cables, soldering tools (if applicable), multimeter, and other basic tools for electronic manipulations.*
- *IoT Starter Kits: Ready-to-use kits providing a variety of sensors, actuators, and components to quickly experiment and understand basic concepts.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to IoT and basic concepts** - *Understanding of IoT fundamentals.* - *Exploring IoT applications and use case examples.*	3	- *Getting to know the fundamentals of IoT, exploring real-world applications and use case examples*
02-03	**Exploring microcontrollers and IoT boards** - *Presentation and handling of various microcontrollers (Arduino, etc.).* - *Practical implementation with hardware platforms.*	6	- *Overview of different hardware platforms, handling and practical implementation with microcontrollers such as Arduino or Raspberry Pi*
04	**Introduction to embedded programming** - *Learning the basics of programming for embedded devices.* - *Creation of simple programs to control hardware components.*	3	- *Learning the basics of programming for embedded devices, creating simple programs to control hardware components*

05	**Using IoT sensors** - *Identification and manipulation of various types of IoT sensors.* - *Experimentation to collect data with different sensors.*	3	- *Discovering sensors used in IoT systems, experimenting with different types of sensors to collect data.*
06-07	**Interfacing with actuators** - *Practice controlling actuators in response to sensor data.* - *Manipulation and control of actuators to perform actions.*	6	- *Practice controlling actuators to perform actions in response to data captured by sensors.*
08	**Wireless Connectivity for IoT** - *Exploring and configuring wireless technologies for IoT.* - *Data transmission using wireless communication protocols.*	3	- *Exploration of wireless communication technologies used in IoT, configuration and use of these protocols for data transmission.*
09	**Advanced programming of IoT devices** - *Deepening IoT programming skills.* - *Integration of advanced functionalities into IoT applications.*	3	- *Deepening programming skills to create more complex IoT applications, integrating advanced features.*
10	**Power and energy management** - *Understanding of energy management strategies for IoT devices.* - *Optimization of energy consumption to improve system efficiency.*	3	- *Understanding of energy management strategies to extend the life of devices and improve their energy efficiency.*
11-12	**Design of simple IoT projects** - *Application of knowledge to design and implement IoT projects.* - *Integration of sensors, actuators and connectivity for simple projects.*	6	- *Exploring the basics of IoT security, identifying vulnerabilities, and methods for protecting systems.*
13	**Testing and debugging IoT systems** - *Use of testing methods to verify the operation of systems.* - *Identification and resolution of potential problems.*	3	- *Application of test methods to verify the operation of IoT devices, identification and resolution of potential problems.*

14	**Evaluation of the final IoT project** - *Presentation, demonstration and evaluation of final IoT projects.* - *Putting into practice the skills and knowledge acquired in the course.*	3	- *Evaluation, presentation and demonstration of the final project, putting into practice all the skills acquired during the course*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *The Things Network: https://www.thethingsnetwork.org/ - Community platform for IoT, offering resources, tutorials and tools for building and connecting LoRaWAN networks.*
- *IoT For All: https://www.iotforall.com/ - Platform dedicated to IoT, offering articles, use cases, guides and resources for IoT professionals.*
- *Embedded Artistry: https://embeddedartistry.com/ - Blog and resources focused on embedded and IoT, covering topics such as software development, hardware design, and best practices.*
- *IoT Security Foundation: https://www.iotsecurityfoundation.org/ - Organization focused on IoT security, providing best practices, guidelines and resources for securing IoT systems.*
- *[Book] Internet of Things for Architects: Architecting IoT Solutions, Authors: Perry Lea, Year: 2018, Pages: 514*
- *[Book] Architectural Patterns and Techniques for Developing IoT Solutions, Authors: Dr. Jagannath Singh, Year: 2023, Pages: 350*
- *[Book] Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies, Authors: Dimitrios Serpanos, Marilyn Wolf, Year: 2017, Pages: 300*
- *[Scientific Article] Internet of Things Architecture: Recent Advances, Taxonomy, Requirements, and Open Challenges, Authors: S. Aman, M. Sethi, Year: 2017, Pages: 20*
- *[Scientific Article] Landscape of Architecture and Design Patterns for IoT Systems, Authors: M. Weyrich, C. Ebert, Year: 2019, Pages: 15*
- *[Scientific Article] System Architecture Design of IoT-Based Smart Cities, Authors: A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, M. Ayyash, Year: 2023, Pages: 25*

6- Working environment (Facilities necessary for learning)

Material :

- *Microcontrollers like Arduino, Raspberry Pi, ESP32/ESP8266.*
- *Various sensors (temperature, humidity, movement sensors, etc.).*
- *Actuators (motors, relays, LEDs, etc.).*
- *Breadboards, connection wires, electronic components.*

Software:

- *Integrated development environment (IDE) adapted to the microcontroller used (Arduino IDE, PlatformIO, Thonny, etc.).*
- *Software for modeling and simulation of IoT systems (like Fritzing, Tinkercad, or cer-specific simulators*

Course Specification

AI and Machine Learning applied to IoT

1. General

Coded	IoT4.S2.03	Level/Semester	4/S2	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Marwa Ben Jabra					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	32
Module	AI and Machine Learning applied to IoT (AIoT)					Version	08/2023

Course description (Course objective):
AI and Machine Learning applied to IoT focuses on the integration of Artificial Intelligence (AI) and Machine Learning (ML) in the Internet of Things (IoT). It aims to teach the practical application of AI and ML concepts to process and analyze data generated by IoT devices. This course focuses on the implementation of machine learning models and AI algorithms to improve decision-making, prediction and optimization of IoT systems, thus promoting the resolution of real-world problems encountered in this domain.

Prerequisites:	Keywords :
- *Proficiency in Python: Advanced ability to program in Python, including advanced manipulation of data structures, advanced string operations, advanced functions, exception handling, etc.* - *Understanding Python Libraries for AI/ML* - *OOP Experience: Thorough understanding of OOP concepts, including modeling and creating classes, inheritance, polymorphism, encapsulation, etc., to effectively organize and structure code.* - *Familiarity with IoT principles: In-depth knowledge of IoT components, communication protocols, data collection, connectivity, security and management of IoT devices.* - *Practical Experience: Previous experience with real-world IoT and software development projects, including projects where IoT data was collected, stored and analyzed.*	*Python, Machine Learning (ML), Deep Learning, Neural Networks, Data Processing, IoT (Internet of Things) TensorFlow, Keras, Prediction Models, Data Analysis, Supervised and Unsupervised Learning Algorithms, IoT Data Security, Model Optimization, Data Collection*

Specific course objectives (OBJ):
OBJ 1 : *Optimizing ML Model Performance for Constrained IoT Resources: Adapt machine learning models to operate efficiently in IoT environments with resource constraints such as computing power and energy consumption.* ***OBJ 2 :*** *Integrate prediction and anomaly detection techniques: Develop anomaly detection algorithms and predictive models to monitor and predict abnormal behaviors of IoT devices, ensuring reliability and proactive maintenance.* ***OBJ 3 :*** *Leverage real-time data for real-time decisions: Use real-time data from IoT devices for instant decision-making by implementing ML models capable of processing this data responsively.* ***OBJ 4 :*** *Develop distributed AI architectures for IoT: Design distributed architectures that enable the deployment of AI models directly on IoT devices or at the edge (edge computing) for reduced latency and improved data privacy. data.* **OBJ 5 :** *Continuously evaluate and improve ML models: Establish model evaluation methodologies and continuous improvement processes to adapt and refine AI models based on evolving IoT and data needs available.*

Necessary material :
- *IoT development boards: Raspberry Pi, Arduino, ESP32/ESP8266, Jetson Nano, etc., to experiment and deploy IoT solutions.* - *IoT sensors and devices: Sensors for temperature, humidity, motion, light, etc., as well as actuators to create realistic IoT scenarios.* - *Communication equipment: Wireless communication modules (Wi-Fi, Bluetooth, Zigbee, LoRa, etc.) to connect IoT devices.* - *Laptops or PCs: For software development, AI/ML model implementation and data analysis.* - *Electronics Starter Kits and Components: IoT starter kits containing a variety of sensors, cables, resistors, LEDs, and more.* - *microSD cards, cables, and accessories: To configure and power development boards.* - *Laboratory equipment: Equipment for prototyping and electronic manipulation, such as breadboards, jumper wires, multimeters, oscilloscopes (if available), etc.* - *Access to cloud platforms: Subscriptions or access to cloud platforms such as AWS, Azure, Google Cloud, or specific IoT services for data storage and processing.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**IoT Fundamentals and Data Preprocessing** - *Overview of IoT and IoT data types.* - *Introduction to IoT data cleaning and preprocessing techniques.*	6	- *Understand the basics of IoT and gain skills to prepare IoT data for AI/ML models*
03-04	**Machine Learning Models for IoT** - *Supervised and unsupervised learning applied to IoT.* - *Implementing prediction models for IoT data*	6	- *Apply ML concepts to IoT data for prediction and classification*
05-06	**Deep Learning for IoT** - *Introduction to Neural Networks and Deep Learning for IoT.* - *Building and training neural networks for complex IoT data*	6	- *Understand and implement deep learning models for IoT data*
07-08	**Real-time data processing and Edge Computing** - *Real-time data processing and edge computing architectures for IoT.* - *Deploying ML models to IoT devices*	6	- *Understand the challenges of real-time IoT data processing and optimization for Edge devices*
09-10	**Security and Ethics in IoT and AI** - *IoT data security, privacy and ethical aspects.* - *Study of best practices to ensure the security of connected IoT devices.*	6	- *Raising awareness about security and ethics regarding the use of AI in IoT*
11-12	**Optimization and evaluation of IoT models** - *Methods for optimizing ML models for IoT environments.* - *Model evaluation and continuous improvement*	6	- *Know how to evaluate and improve models for better performance in an IoT context*
13	**Finalization of projects and preparation for final evaluation** - *Finalizing and refining projects.* - *Preparing presentations for the final evaluation*	3	- *Prepare projects for evaluation and organize documentation for presentation*
14	**Evaluation of IoT mini-projects and final presentations** - *Presentation of projects and evaluation.* - *Discussions and feedback on projects*	3	- *Evaluate completed IoT projects and provide a platform for final presentations and feedback*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *Machine Learning Mastery: https://machinelearningmastery.com/ - Comprehensive resources for understanding Machine Learning concepts and techniques.*
- *TensorFlow: https://www.tensorflow.org/ - Open-source platform for Machine Learning and Deep Learning, with tutorials and guides for IoT application.*
- *Towards Data Science: https://towardsdatascience.com/ - Online publication with articles and practical tutorials on applied machine learning.*
- *Kaggle: https://www.kaggle.com/ - Data science platform offering datasets, competitions and learning resources for Machine Learning.*
- *Coursera - IoT Specialization: https://www.coursera.org/specializations/internet-of-things - IoT Specialization offered by Coursera, including courses covering different aspects of IoT and its integration with AI.*
- *[Book] Integration of Artificial Intelligence and Machine Learning Methods for Smart Internet of Things Systems and Its Applications, Year: 2024,*
- *[Book] Harnessing AI, Machine Learning, and IoT for Intelligent Business,, Year: 2025,*
- *[Book] Hands-On Artificial Intelligence for IoT, Authors: Amita Kapoor, Year: 2019, Pages: 390*
- *[Scientific Article] Edge Machine Learning for AI-Enabled IoT Devices: A Review, Authors: Not specified, Year: 2020,*
- *[Scientific Article] Using Machine Learning Algorithms to Enhance IoT System Security, Year: 2024,*
- *[Scientific Article] Applications of Distributed Machine Learning for the Internet-of-Things: A Comprehensive Survey, Authors: Mai Le, Thien Huynh-The, Tan Do-Duy, Thai-Hoc Vu, Won-Joo Hwang, Quoc-Viet Pham, Year: 2023*

5- Working environment (Facilities necessary for learning)

- *Python development environment: Install Python and use virtual environments to manage dependencies.*
- *Python Libraries:*
    - *Pandas, NumPy for data manipulation.*

- *Scikit-learn, TensorFlow, Keras or PyTorch for Machine Learning and Deep Learning.*
- *Matplotlib, Seaborn for data visualization.*

- *IDE (Integrated Development Environment):*
  - *Jupyter Notebook or JupyterLab to experiment with code and create interactive notebooks.*
  - *PyCharm, VSCode or Spyder for developing scripts and templates.*
- *Tools for IoT:*
  - *IoT development platforms like Arduino IDE, Raspberry Pi OS, or Eclipse IoT.*
  - *IoT simulation tools such as Node-RED, IoTIFY, or ThingWorx.*
- *Cloud environment:*
  - *Access to cloud services like AWS IoT, Google Cloud IoT or Azure IoT Hub to store and process IoT data.*
- *Operating system :*
  - *An operating system compatible with IoT developments (Raspberry Pi OS, Linux, etc.) for hardware experiments.*
- *Dataset:*
  - *Relevant IoT datasets for experimenting and training the models.*

Course Specification

Mobile development and web services

1. General

Coded	IoT4.S2.04	Level/Semester	4/S2	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Firas Hmila					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	28
Module	Mobile Development and Web Services (React Native)					Version	08/2023

Course description (Course objective):
This subject aims to teach about designing cross-platform mobile applications using React Native. Practically oriented, this course provides learners with hands-on experience in developing applications compatible with iOS and Android, using React Native. It focuses on integrating Web Services to ensure efficient connectivity with servers, thereby strengthening modern mobile application development skills

Prerequisites:	Keywords :
- *Basic programming knowledge: Understanding of fundamental programming concepts (JavaScript, HTML, CSS).* - *Experience with JavaScript: Familiarity with JavaScript is essential for working with React Native.* - *Understanding of application development: Prior knowledge of mobile or web application development would be beneficial.* - *Web Services Basics: Understanding the fundamentals of web services (RESTful APIs, JSON, etc.).* - *Development environment: Familiarity with development environments such as Node.js, NPM (Node Package Manager), and JavaScript development tools.*	*React Native, JS, Cross-platform mobile apps, Web services, RESTful API, GraphQL, Reusable components, Server connectivity*

Specific course objectives (OBJ):
OBJ 1 : *Master React Native: Gain a deep understanding of React Native to develop cross-platform mobile applications.* ***OBJ 2 :*** *Web service integration: Know how to integrate and use web services via RESTful or GraphQL APIs in mobile applications.*

OBJ 3 : *Cross-platform application development: Be able to design mobile applications compatible with both iOS and Android using React Native.*

OBJ 4 : *Creation of reusable components: Learn to design reusable and modular components to optimize user interface development.*

Necessary material :
- *Computer: A computer (PC, Mac or Linux) for software development.* - *Smartphones: Smartphones for testing developed applications on real devices (iOS and Android) for efficient validation and debugging.* - *Internet Connection: A stable Internet connection to access documentation, tutorials and online resources.* - *Development environment: Install Node.js, NPM (Node Package Manager), and text editors such as Visual Studio Code, Atom, or Sublime Text to write code.* - *Cloud services account (optional): An account on a cloud platform (AWS, Firebase, etc.) to test and deploy web services used in applications.* - *Optionally: Some projects may require additional accessories or specific peripherals depending on the functionalities developed.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to React Native** - *Presentation of React Native and its ecosystem.* - *Installation of the development environment.* - *Creation of a first simple application*	3	- *Understand the basics of React Native and set up the development environment*
02	**Component management** - *Use of basic components (View, Text, Button, etc.)* - *Creating and using custom components*	3	- *Know how to manipulate basic components and create custom components*
03	**Navigation and Routing** - *Implementation of navigation between screens.* - *Using different routing types*	3	- *Master navigation and routing techniques in a React Native application*
04	**State management with Redux** - *Introduction to Redux for state management.* - *Implementing a Redux store in an application*	3	- *Understanding and using Redux for state management*

05	**Integration of web services (RESTful APIs)** - *Calling RESTful APIs from a React Native application.* - *Viewing retrieved data in the app*	3	- *Know how to integrate web services via RESTful APIs into a mobile application*
06	**Security and authentication** - *Implementation of authentication mechanisms.* - *Management of the security of data exchanged with web services*	3	- *Understand and implement security and authentication mechanisms*
07-09	**Advanced projects and practical work** - *Sessions dedicated to the development of advanced projects.* - *Practical: Development, implementation and debugging of real projects*	9	- *Put into practice the skills acquired through advanced projects*
10	**Finalization of advanced projects** - *Final sessions to finalize projects.* - *Preparing presentations*	3	- *Finalize and refine projects before evaluation*
11	**Preparing for assessment** - *Preparation of project presentations.* - *Review of key concepts and best practices*	3	- *Prepare students for the final assessment*
12	**Project evaluation** - *Presentation and evaluation of advanced projects*	3	- *Evaluate projects carried out by students*
13	**Retrospective and final discussions** - *Project discussions and feedback.* - *Final Thoughts on Skills Learned*	3	- *Analyze projects, receive feedback and conclude the course.*
14	**Assessment session** - *Final evaluation and course closure*	3	- *Conclude the course with the final evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *React Native: https://reactnative.dev/ - Official React Native documentation for developers.*
- *Node.js: https://nodejs.org/ - Server-side JavaScript platform used to run JavaScript code.*
- *Redux: https://redux.js.org/ - Complete Redux documentation for state management in JavaScript applications.*
- *RESTful APIs: https://restfulapi.net/ - Resources and guides for understanding and creating RESTful APIs.*
- *Firebase: https://firebase.google.com/ - Mobile and web development platform offering cloud tools for the backend.*
- *GitHub: https://github.com/ - Collaborative development platform, useful for accessing open source projects and sharing code.*
- *[Book] Integration of Artificial Intelligence and Machine Learning Methods for Smart Internet of Things Systems and Its Applications, Editors: Not specified, Year: 2024,*
- *[Book] Harnessing AI, Machine Learning, and IoT for Intelligent Business, Editors: Not specified, Year: 2025,*
- *[Book] Hands-On Artificial Intelligence for IoT, Author: Amita Kapoor, Year: 2019, Pages: 390*
- *[Scientific Article] Edge Machine Learning for AI-Enabled IoT Devices: A Review, Authors: Not specified, Year: 2020,*
- *[Scientific Article] Using Machine Learning Algorithms to Enhance IoT System Security, Authors: Not specified, Year: 2024,*
- *[Scientific Article] Applications of Distributed Machine Learning for the Internet-of-Things: A Comprehensive Survey, Authors: Mai Le, Thien Huynh-The, Tan Do-Duy, Thai-Hoc Vu, Won-Joo Hwang, Quoc-Viet Pham, Year: 2023,*

5- Working environment (Facilities necessary for learning)

- *Node.js: Installation of Node.js to use the npm package manager (Node Package Manager) which is necessary for development with React Native.*
- *React Native CLI: Installation of React Native CLI (Command Line Interface) to create, develop and manage React Native projects.*
- *Code Editor: Choosing a code editor such as Visual Studio Code, Atom, or Sublime Text for writing and editing React Native code.*
- *Simulators or devices: Installing simulators (like Android Studio for Android or Xcode for iOS) or using physical devices to test developed applications.*
- *Firebase or other cloud services: Creating an account on a cloud platform like Firebase to implement cloud features in apps*

Course Specification

Advanced Iot Projects

1. General

Coded	IoT4.S2.06	Level/Semester	4/S2	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mouhieddine Belghith					Vol. H. (TP)	42
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	60
Module	Advanced IoT Projects ((Smart Healthcare, Smart Agricultur,…)					Version	08/2023

Course description (Course objective):
The subject "Advanced IoT Projects" focuses on the exploration and implementation of sophisticated IoT projects such as Smart Healthcare, Smart Agriculture, Smart City, Smart Home, Smart Car, etc. This workshop aims to enable students to consolidate their IoT skills by applying them to specific areas via detailed specifications. The main goal is to provide learners with hands-on experience in designing, deploying and managing advanced IoT solutions, while preparing them to tackle the real-world challenges of these application areas.

Prerequisites:	Keywords :
- *Knowledge of IoT Basics: Understanding of fundamental Internet of Things concepts, including sensors, wireless communications and IoT protocols.* - *Proficiency in IoT technologies: Familiarity with IoT platforms such as Raspberry Pi, Arduino, or other microcontrollers, as well as programming in languages like Python, C/C++, or Java.* - *Understanding of application areas: Prior knowledge of specific areas like healthcare, agriculture, smart cities, smart homes, connected vehicles, etc., would be beneficial.* - *Ability to design specifications: Skills in defining needs and specifications for carrying out complex IoT projects.* - *IoT Security Basics: Understanding the basics of security in IoT systems to ensure data and connected devices are protected.*	*Advanced IoT, Sensors, Wireless Connectivity, IoT Platforms, Data Analytics, Cloud Computing, Data Security, Hardware/Software Integration, Deployment and Management, Performance Optimization*

Specific course objectives (OBJ):
OBJ 1 : *Apply advanced IoT skills: Use in-depth IoT knowledge to design, develop and implement advanced solutions in areas such as healthcare, agriculture, smart cities, etc.* ***OBJ 2 :*** *Develop detailed specifications: Acquire the ability to create precise and complete specifications for IoT projects, identifying the specific needs of advanced applications.* ***OBJ 3 :*** *Implement secure and advanced solutions: Integrate robust security protocols to protect data and ensure the reliability of advanced IoT systems.* **OBJ 4 :** *Manage Deployment and Optimization: Be able to effectively deploy and manage sophisticated IoT solutions, optimizing them for maximum* performance in real-world environments.

Necessary material :
- *IoT development boards: Raspberry Pi, Arduino, ESP32, or other microcontrollers suited to the specific IoT projects envisioned.* - *Miscellaneous sensors: Temperature, humidity, movement, light, pressure sensors, etc., depending on the needs of the project.* - *Electronic components: Resistors, capacitors, transistors, LEDs, radio modules, relays, and other components for creating IoT circuits and systems.* - *Wireless communication modules: Wi-Fi, Bluetooth, LoRa, GSM, or other modules to establish connectivity for IoT devices.* - *Prototyping plates and cables: To facilitate prototyping and connection of different electronic components.* - *Soldering tools and related equipment: Soldering irons, soldering wire, printed circuit board holder, etc., for assembling electronic circuits if necessary.* - *Batteries and power supplies: Rechargeable batteries, batteries, stabilized power supplies to power IoT devices.* - *Computers and Software: Computers with necessary software such as IDEs (Integrated Development Environments) for programming and circuit board design software.* - *Safety elements: Personal protective equipment for operations involving electrical tools or appliances.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals

01	**Introduction to Advanced IoT Projects** - *Presentation of application areas (Smart Healthcare, Smart Agriculture, etc.).*	3	- *Provide an overview of course plans and expectations.*
	- *Clarification of course objectives and IoT project expectations.*		
02	**Definition and development of specifications** - *Detailed establishment of needs, constraints and objectives for each IoT project.* - *Clarification of the success criteria and scope of each project.*	3	- *Creation of complete specifications to guide the development of projects*
03	**Training and distribution of project teams** - *Formation of multidisciplinary teams to encourage diversity of skills.* - *Assignment of roles and distribution of responsibilities within each team*	3	- *Build effective and well-structured teams for each project*
04	**Review and validation of specifications** - *Critical evaluation of the specifications submitted by the teams.* - *Providing feedback and improvements for better goal accuracy.*	3	- *Validate and refine specifications to guide further development*
05	**Research workshop on IoT technologies** - *Exploration and analysis of technologies adapted to each project.* - *Thorough discussion of pros and cons for proper selection*	3	- *Select the technologies best suited to the specific needs of the projects*
06	**Initial design of IoT architectures** - *Development of the first architectural plans for each IoT project.* - *Identifying key hardware and software components*	3	- *Define the architectural bases of IoT projects to realize the concepts*
07	**Analysis of risks and technical challenges** - *Assessment of potential risks associated with each project.* - *Planning strategies to address technical challenges*	3	- *Identify and anticipate obstacles to ensure project success*
08	**Progress review and discussion** - *Evaluation of the progress made by the teams.* - *Dialogue on the challenges encountered and identification of solutions.*	3	- *Evaluate the progress of projects and resolve problems encountered*

09	**Development of detailed operational plans** - *Development of detailed execution plans for each IoT project.* - *Inclusion of specific steps and required resources.*	3	- *Develop detailed action plans to guide the completion of projects*
10	**Prototyping and initial development** - *Start of the prototyping phase to bring the concepts to life.* - *Creating preliminary versions of projects*	3	- *Transform concepts into functional prototypes for validation*
11	**Interim assessment of progress** - *Interim evaluation of progress made.* - *Adjusting plans to achieve set goals*	3	- *Evaluate current progress and adjust plans if necessary.*
12	**Testing and improving prototypes** - *Extensive testing of prototypes to identify gaps.* - *Improvement and optimization of prototypes based on test results.*	3	- *Refine prototypes for optimal performance.*
13	**Finalization and preparation for presentation** - *Finalization of advanced IoT solutions.* - *Preparing projects for final presentation*	3	- *Finalize projects and prepare them for presentation*
14	**Final presentation and evaluation of projects** - *Presentation of projects completed by each team.* - *Evaluation of results and discussion of learning*	3	- *Highlight achievements and evaluate acquired skills.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *AWS IoT: https://aws.amazon.com/fr/iot/ - AWS platform dedicated to the Internet of Things offering a range of services for developing IoT applications.*
- *Arduino: https://www.arduino.cc/ - Open-source hardware and software platform for rapid prototyping of electronic projects.*
- *Raspberry Pi: https://www.raspberrypi.org/ - Single board computer used in many IoT projects*

for its versatility and ease of use.

- *Altium Designer: https://www.altium.com/fr - PCB design software with a comprehensive suite of tools for creating printed circuit boards.*
- *ThingSpeak: https://thingspeak.com/ - IoT platform to collect, analyze and visualize data from sensors.*
- *[Book] Practical Python Programming for IoT: Build Advanced IoT Projects Using a Raspberry Pi 4, MQTT, RESTful APIs, WebSockets, and Python 3, Author: Gary Smart, Year: 2020,*
- *[Book] Internet of Things Programming Projects, Author: Colin Dow, Year: 2018,*
- *[Book] Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry, Author: Maciej Kranz, Year: 2016,*
- *[Scientific Article] Advanced IoT Technology and Protocols: Review and Future Perspectives, Authors: Not specified, Year: 2023,*
- *[Scientific Article] The Manufacturing Data and Machine Learning Platform: Enabling Real-time Monitoring and Control of Scientific Experiments via IoT, Authors: Jakob R. Elias, Ryan Chard, Joseph A. Libera, Ian Foster, Santanu Chaudhuri, Year: 2020*
- *[Scientific Article] An IoT System for a Smart Campus: Challenges and Solutions Illustrated Over Several Real-World Use Cases, Authors: Tomás Domínguez-Bolaño, Valentín Barral, Carlos J. Escudero, José A. García-Naya, Year: 2024*

6- Working environment (Facilities necessary for learning)

Material :

- *Laptop or desktop computer with sufficient specifications for software development.*
- *IoT development boards such as Arduino, Raspberry Pi, or other boards compatible with specific projects.*

Software:

- *Integrated development environment (IDE) adapted to the development boards used (Arduino IDE, Python IDE, etc.).*
- *PCB design software (like Altium Designer, KiCad, Eagle, etc.).*
- *Simulation tools for modeling IoT systems.*

Internet connection :

- *A stable internet connection to access online resources, tutorials, documentations and cloud development platforms (if applicable).*

Electronic components :

- *Sensors, actuators and other electronic components specific to the IoT projects envisaged.*

IoT platforms:

- *Access to IoT platforms such as AWS IoT, ThingSpeak or platforms specific to project needs.*

Workspace :

- *A comfortable, well-lit workspace for experimenting, prototyping and developing projects.*

Course Specification

Robotics and cobotics

1. General

Coded	IoT4.S2.07	Level/Semester	4/S2	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Anouar Ben Amor					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	36
Module	Robotics and Cobotics (collaborative robot)					Version	08/2023

Course description (Course objective):
The “Robotics and Cobotics (collaborative robot)” course aims to familiarize students with the fundamental principles, practical applications and recent advances in the field of collaborative robotics. With a focus on the use of cloud technologies such as AWS and IoT services, this course explores the design, programming, and deployment of collaborative robots capable of interacting with their environment and cooperating with humans. Objectives include acquiring skills to integrate robotic systems with cloud services, facilitating real-time control, data collection and decision-making for diverse applications.

Prerequisites:	Keywords :
- *Programming knowledge: Understanding of basic programming concepts, preferably in languages commonly used for robotics such as Python, C++, or scripting languages.* - *Electronics Fundamentals: Understanding basic electronic components, circuits and basic electronic design concepts.* - *General knowledge about robots and automation: General knowledge about different types of robots, their applications, as well as industrial automation and process control concepts.* - *Familiarity with basic concepts of cloud computing and IoT services: Understanding of fundamental concepts of cloud computing, IoT services, and their use to connect and manage devices remotely.*	*Collaborative robotics, Cobotics, Collaborative automation, AI in robotics, Sensors and actuators, Robot programming, Human-machine interaction, Safety of collaborative robots, Industrial and domestic applications*

Specific course objectives (OBJ):
OBJ 1 : *Mastery of Collaborative Robotics Concepts: Understand the fundamental principles, technologies, and standards governing collaborative robots, with emphasis on their safe and effective interaction with humans.* ***OBJ 2 :*** *Integrating Cloud and IoT Technologies into Robotics: Gain the skills to connect and manage robots through cloud services and IoT technologies, enabling remote control, real-time data collection and analysis.* **OBJ 3 :** *Development of practical skills: Learn to design, program and deploy collaborative robots in varied environments, combining knowledge of electronics, mechanics and IT for industrial or domestic applications*

Necessary material :
- *Collaborative robots: Robots designed to interact safely with humans. Examples: 4WD Robots, Robot Arm.* - *Robotics development kits: Kits including microcontrollers, sensors, actuators and components needed to build small robots.* - *Computers and Software: Computers with sufficient specifications to run modeling, programming, and simulation software* - *Sensors and actuators: A variety of sensors (distance, vision, force sensors, etc.) and actuators (motors, pneumatic cylinders, etc.) to allow robots to perceive and act on their environment.* - *Electronic equipment: Electronic component kits for building circuits (resistors, capacitors, integrated circuits, etc.).* - *DIY Tools and Equipment: Basic tools such as screwdrivers, pliers, drills, etc.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to collaborative robotics**	3	- *Understand the basic principles and applications of collaborative robotics*
02	**Fundamentals of electronics for robots** - *Key electronic components for robotics* - *How circuits work in robots*	3	- *Acquire knowledge of electronic components used in robots*
03	**Sensors and actuators in robots** - *Using sensors for perception* - *Control of actuators for actuation*	3	- *Understand the different types of sensors and actuators used in robotics*

04	**Security in Cloud and IoT** - *Security protocols for cloud-based IoT solutions.* - *Identity and access management.*	3	- *Understand security issues and measures*
07	**Robot programming** - *Programming languages for robotics* - *Control and navigation algorithms*	3	- *Learn to program robots for specific tasks*
08	**Integration of cloud technologies** - *Connection and communication with the cloud* - *Data storage and analysis.*	3	- *Understanding the integration of cloud services in robotics*
09	**Real-time IoT data analysis** - *Tools and techniques for real-time analysis of IoT data streams.*	3	- *Know how to analyze IoT data in real time*
10-11	**Robot modeling and design** - *Mechanical design of robots* - *3D modeling for robot design*	3	- *Learn to model and design robots for various applications*
12	**Safety and standards in robotics** - *Safety standards for cobots* - *Security protocols in human-robot interaction*	3	- *Know the safety standards and best practices in collaborative robotics*
13	**Human-robot interaction** - *User interfaces for robotics* - *Human-robot communication methods*	3	- *Understand methods for safe and effective interaction*
14	**Industrial applications of cobots** - *Examples of industrial implementation* - *Analysis of benefits and challenges*	1	- *Explore the applications and use cases of collaborative robots in industry*
14	**Domestic applications of cobots** - *Use of robots in daily life* - *Advantages and limitations of domestic cobots*	1	- *Examine use cases for collaborative robots in home environments*
14	**Robot control and supervision** - *Real-time monitoring systems* - *Control techniques for different applications*	1	- *Learn control and supervision techniques for collaborative robots*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *ROS - Robot Operating System: https://www.ros.org/ - Open-source operating system for robotics, offering libraries, tools and resources for developing robotic applications.*
- *Cobot Intel: https://www.intel.fr/content/www/fr/fr/robotics/collaborative-robots.html - Resources from Intel on collaborative robots with information on technologies, use cases and the tools.*
- *RobotShop: https://www.robotshop.com/community/forum/ - Online forum and community dedicated to robotics offering discussions, tutorials and advice for amateurs and professionals.*
- *GitHub - Robotics Resources: https://github.com/topics/robotics - Collection of open-source robotics-related resources, projects and tools on GitHub.*
- *[Book] Automation and Collaborative Robotics: A Guide to the Future of Work, Authors: Peter Matthews, Steven Greenspan, Year: 2022,*
- *[Book] Robot Modeling and Control, Authors: Mark W. Spong, Seth Hutchinson, M. Vidyasagar, Year: 2005,*
- *[Book] Modern Robotics: Mechanics, Planning, and Control, Authors: Kevin M. Lynch, Frank C. Park, Year: 2017,*
- *[Scientific Article] Cobotics: The Evolving Roles and Prospects of Next-Generation Collaborative Robots in Industry 5.0, Authors: Not specified, Year: 2024,*
- *[Scientific Article] Advances and Perspectives in Collaborative Robotics: A Review of Key Technologies and Applications, Authors: Not specified, Year: 2023,*
- *[Scientific Article] Robotics and Cobotics: A Comprehensive Review of Technological Advancements, Applications, and Collaborative Robotics in Industry, Year: 2023*

5- Working environment (Facilities necessary for learning)

- *Computer: A laptop or desktop computer with adequate specifications to run modeling, programming and simulation software. It is recommended to have a powerful processor, sufficient memory and ample storage space.*
- *Modeling and simulation software: Software such as Robot Operating System (ROS), Gazebo, CoppeliaSim (formerly V-REP) or 3D design tools (SolidWorks, Fusion 360) for robot modeling and simulation.*

- *Development environment: Programming environments adapted to robotics, such as Visual Studio Code, Eclipse, or IDEs specific to certain robots, to develop and debug code.*
- *Cloud platform: Access to cloud platforms such as AWS, Google Cloud or Microsoft Azure for the integration of cloud services in robotics and data storage.*
- *Hardware Robotics: Robotics development kits, microcontrollers, sensors, actuators and development boards (Arduino, Raspberry Pi) for building and programming real robots.*
- *DIY Tools: Basic tools such as screwdrivers, pliers, etc., for assembling and handling electronic and mechanical components.*
- *Dedicated workspace: An organized workspace dedicated to practicing, assembling and experimenting, with enough space for my*

Course Specification

PCB Design Fundamentals

1. General

Coded	IoT4.S2.08	Level/Semester	4/S2	Coefficient	1.5	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mohamed Ali Bouhlel					Vol. H. (TP)	21
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	The fundamentals of PCB (Printed Circuit Board) design					Version	08/2023

Course description (Course objective):

The PCB Design Fundamentals course aims to familiarize students with the essential principles and practices of printed circuit board design. With a focus on schematic creation, trace routing, and the use of computer-aided design (CAD) tools, this course explores PCB design methodology for transforming electronic schematics into functional printed boards. The aim is to acquire the skills necessary to design efficient and functional printed circuit boards, by understanding technical requirements and good design practices.

Prerequisites:	Keywords :
- *Electronics Knowledge: Understanding of fundamental principles of electronics, electronic components, electrical diagrams and circuits.* - *Technical Drawing Basics: Familiarity with technical drawing concepts and the ability to interpret diagrams and plans.* - *Computer Proficiency: Basic computer skills, including navigation and manipulation of computer-aided design (CAD) software or printed circuit board design tools.* - *Understanding of materials used in printed circuit boards: Knowledge of the characteristics of materials used for manufacturing PCBs, such as FR-4, copper, etc.*	*Printed Circuit Board (PCB), Computer-Aided Design (CAD), Track Routing, Electrical Schematic, PCB Fabrication, Electronic Components, Multi-Layer Printed Circuits, PCB Design Software, Electromagnetic Compliance (EMC), Surface Mount Technology (SMT)*

Specific course objectives (OBJ):

OBJ 1 : *Understanding of Fundamental Concepts: Gain an in-depth knowledge of the basic principles related to printed circuit board design and manufacturing.*

OBJ 2 : *Mastery of computer-aided design (CAD) tools: Learn to effectively use specialized software to* *create electrical diagrams and design PCBs.*

OBJ 3 : *Track Routing Techniques: Develop skills to efficiently route electrical tracks while optimizing circuit performance and reliability.*

OBJ 4 : *Understanding technical constraints: Learn to manage constraints such as size, impedance, thermal constraints and manufacturing standards in PCB design.*

OBJ 5 : *Application of best design practices: Apply best design practices to ensure functional, reliable, industry-standard printed circuit boards.*

Necessary material :

- *Collaborative robots: Robots designed to interact safely with humans. Examples: 4WD Robots, Robot Arm.*
- *Robotics development kits: Kits including microcontrollers, sensors, actuators and components needed to build small robots.*
- *Computers and Software: Computers with sufficient specifications to run modeling, programming, and simulation software*
- *Sensors and actuators: A variety of sensors (distance, vision, force sensors, etc.) and actuators (motors, pneumatic cylinders, etc.) to allow robots to perceive and act on their environment.*
- *Electronic equipment: Electronic component kits for building circuits (resistors, capacitors, integrated circuits, etc.).*
- *DIY Tools and Equipment: Basic tools such as screwdrivers, pliers, drills, etc.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to PCB Design**	1.5	- *Understand the basics and goals of PCB design*
02	**Electronic components and electrical diagrams** - *Understand the function and use of common electronic components.* - *Creation and reading of electrical diagrams to represent simple circuits.*	1.5	- *Familiarization with key components and acquisition of diagramming skills.*
03	**CAD Software for PCB Design** - *Exploration of CAD software used for PCB design.* - *Familiarization with the interface and basic functionalities of the software.*	1.5	- *Mastery of CAD software tools specific to PCB design*
04-05	**Schematic and creation of electrical diagrams** - *Creation of more complex electrical diagrams.* - *Use of CAD software to draw and annotate*	3	- *Ability to design and interpret advanced electronic schematics*

	diagrams.		
06-07	**Principles of routing and placement of components** - *Study of methods for optimal placement of components on the PCB.* - *Introduction to Lead Routing Strategies*	3	- *Understanding the basics of placement and routing to optimize PCBs*
08	**Multi-layer design and signal management** - *Understanding the benefits and challenges of multi-layer design.* - *Analog and digital signal management*	1.5	- *Ability to design and manage complex multilayer PCBs.*
09	**Design constraints and rules** - *Identification and management of design constraints.* - *Application of design rules*	1.5	- *Mastery of constraints and rules for reliable and efficient designs.*
10	**Simulation and verification** - *Use of simulation tools to evaluate performance.* - *Checking designs to detect and correct errors.*	1.5	- *Ability to verify and improve designs through simulations*
11	**Advanced routing methods** - *Deepening of advanced routing techniques.* - *Optimization of signal paths.*	1.5	- *Mastery of advanced routing methods for high-performance PCBs*
12	**Electromagnetic Compliance (EMC)** - *Understanding of standards to ensure electromagnetic compliance.* - *Minimizing electromagnetic interference*	1.5	- *EMC-compliant PCB design for robust circuits*
13-14	**PCB manufacturing techniques** - *Study of PCB manufacturing and assembly processes.* - *Selection of appropriate materials*	3	- *Knowledge of manufacturing processes for feasible designs.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *Altium Designer: https://www.altium.com/fr - PCB design software with a comprehensive suite of tools for creating printed circuit boards.*
- *Eagle - Autodesk: https://www.autodesk.com/products/eagle - Autodesk - CAD software for PCB design, offering advanced features for electronic designers.*
- *KiCad: https://www.kicad.org/ - Open-source software suite for electronics design, including PCB design and schematic tools.*

5- Working environment (Facilities necessary for learning)

- *PCB design software: Install PCB design software such as Altium Designer, Eagle, KiCad, or PCBWeb, based on preference and availability.*
- *Adequate computer: A computer with suitable specifications to run the chosen PCB design software without problems. It is recommended to have a computer with good graphics performance and enough memory to work smoothly.*
- *Optionally, a circuit simulator: Depending on the needs of the course or project, an electronic circuit simulator might be necessary to test and validate PCB designs.*
- *Dedicated workspace: An organized workspace dedicated to practice, assembly and experimentation.*

Course Specification

Design of smart sensors and actuators for IoT

1. General

Coded	IoT4.S2.09	Level/Semester	4/S2	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Souha Boukadida					Vol. H. (TP)	21
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	30
Module	Design of smart sensors and actuators for IoT					Version	08/2023

Course description (Course objective):
This subject focuses on the theory and fundamental principles of creating detection and action devices suitable for the Internet of Things. With a focus on design concepts and methodologies, this course aims to familiarize students with the essential elements for designing innovative sensors and actuators relevant to IoT applications. The goal is to provide learners with a deep understanding of the underlying technologies, architectures, and key considerations for creating these components.

Prerequisites:	Keywords :
- *Electronics Fundamentals: A basic understanding of electronic components such as resistors, capacitors, diodes, etc.* - *IoT Knowledge: Familiarity with basic Internet of Things concepts, including architectures, communication protocols and typical applications.* - *Sensor and Actuator Basics: Rudimentary knowledge of the types of sensors and actuators commonly used in IoT applications.* - *Programming skills: Basic knowledge of programming languages, such as C, Python or other languages used for IoT, to understand software interfaces.* - *Understanding of Networks: Familiarity with the basic principles of computer networks to understand connectivity in the context of IoT.*	*Sensors, Actuators, IoT, Design, Electronics, Communication, Networks, Protocols, Interfaces, Applications*

Specific course objectives (OBJ):

OBJ 1 : *Understand the fundamentals of designing IoT-enabled sensors and actuators, exploring their specifications and functionalities.*

OBJ 2 : *Examine the key architectures and technologies used in the design of IoT devices to ensure effective* *interoperability.*

OBJ 3 : *Evaluate design constraints and considerations related to energy efficiency, connectivity and security to ensure optimal performance.*

OBJ 4 : *Analyze communication protocols and data transmission methods for efficient integration of sensors and actuators into IoT networks.*

OBJ 5 : *Apply acquired theoretical knowledge to evaluate and recommend solutions tailored to the specific requirements of various IoT applications.*

Necessary material :

- *Electronic prototyping boards: Allow you to experiment and connect different electronic components to create prototypes of sensors and actuators.*
- *Various sensors and actuators: A selection of sensors (temperature, movement, light, etc.) and actuators (motors, relays, actuators) for design and experimentation.*
- *Basic electronic components: Resistors, capacitors, transistors, diodes, etc., for the construction of the circuits necessary for the creation of sensors and actuators.*
- *Microcontrollers and IoT development boards: Arduino, Raspberry Pi, ESP32, or other boards compatible with IoT features to prototype and interconnect devices.*
- *Measurement and diagnostic tools: Multimeters, oscilloscopes, and other measurement tools for testing, analyzing, and debugging electronic circuits.*
- *Circuit design software: Electronic CAD software such as Altium Designer, KiCad, Eagle, to design sensor and actuator schematics.*
- *Connectivity hardware: Wi-Fi, Bluetooth, Zigbee or other modules allowing wireless communication to integrate devices into an IoT network.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	*Goals*
01	**Introduction to IoT and Sensors** - *Definition of IoT and its evolution.* - *Overview of sensors and their roles in IoT systems.*	1.5	- *Understand the foundations of IoT and the importance of sensors*
02	**Principles of operation of sensors** - *Types of sensors and their working mechanisms.* - *Characteristics and choice of sensors for specific applications.*	1.5	- *Understand the operation and selection of sensors for IoT applications*
03	**Design of sensors for IoT (theoretical part)**	1.5	- *Explore design methods for IoT-ready sensors*

	- *Basic elements for designing intelligent sensors.* - *Design Approaches to Optimize Sensor Performance*		
04	**Communication protocols for IoT sensors** - *Study of communication protocols (Bluetooth, Zigbee, MQTT, etc.).* - *Integration of sensors into an IoT network*	1.5	- *Understanding communication protocols and their application for IoT sensors*
05	**Introduction to IoT Actuators** - *Overview of actuator types used in IoT systems.* - *Operating mechanisms and selection criteria*	1.5	- *Understanding actuators and their applications in IoT*
06	**Design of actuators for IoT (theoretical part)** - *Fundamentals of smart actuator design.* - *Design Factors for Optimal Performance*	1.5	- *Explore design methods for actuators in the context of IoT*
07	**Sensor-actuator interactions in IoT systems** - *Study of use scenarios and interactions between sensors and actuators.* - *Examples of IoT systems using sensors and actuators*	1.5	- *Understand how sensors and actuators interact in IoT applications*
08	**Energy optimization for IoT devices** - *Strategies to optimize the energy consumption of sensors and actuators.* - *Energy saving techniques to extend the life of appliances*	1.5	- *Learn how to design energy-efficient devices for IoT*
09	**Architecture of IoT sensor and actuator systems** - *Architectural patterns for distributed IoT systems.* - *Design of complex systems based on sensors and actuators*	1.5	- *Understanding architectures for advanced IoT systems*
10	**Security in IoT sensors and actuators** - *Safety considerations for connected sensors and actuators.* - *Methods for protecting data and IoT devices*	1.5	- *Learn to secure sensors and actuators in IoT environments*

11	**Specific applications of IoT sensors and actuators** - *Case study on industrial, medical, domestic applications, etc.* - *Analysis of innovative solutions using IoT sensors and actuators*	1.5	- *Understand the practical applications of sensors and actuators in different fields*
12	**Development of IoT sensor and actuator projects (theoretical part)** - *IoT project development methodology.* - *Design and planning process for concrete projects.*	1.5	- *Prepare students to develop sensor and actuator projects for IoT*
13	**Deepening Key Concepts (Q&A)** - *Interactive question-and-answer and discussion session on the concepts covered.* - *Clarification of important points and review before the final exam*	1.5	- *Consolidate the knowledge acquired before the final evaluation*
14	**Final exam and evaluation of theoretical projects** - *Assessment of theoretical knowledge by an exam.* - *Evaluation of sensor and actuator projects developed as part of the course*	1.5	- *Evaluate the understanding and skills acquired during the course*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *Adafruit Industries: https://www.adafruit.com/ - A resource for sensors, electronic components and tutorials for IoT projects.*
- *Arduino: https://www.arduino.cc/ - Hardware and software platform for rapid prototyping of IoT applications.*

- *Raspberry Pi Foundation: https://www.raspberrypi.org/ - Resources for Raspberry Pi boards used in IoT and electronic design projects.*
- *IoT For All: https://www.iotforall.com/ - Articles, tutorials and case studies on IoT applications and connected devices.*
- *SparkFun Electronics: https://www.sparkfun.com/ - Supplier of electronic components, sensors and kits for IoT projects.*
- *[Book] High-Speed Digital Design: A Handbook of Black Magic, Authors: Howard Johnson, Martin Graham, Year: 1993, Pages: 447*
- *[Book] PCB Design and Layout Fundamentals for EMC, Author: Roger Hubing, Year: 2019, Pages: 108*
- *[Book] Coombs' Printed Circuits Handbook, Editor: Clyde F. Coombs Jr., Year: 2007, Pages: 1633*
- *[Scientific Article] PCB Design Process and Fabrication Challenges, Author: Nikola Zlatanov, Year: 2011, Pages: 6*
- *[Scientific Article] 56 Gbps PCB Design Strategies for Clean, Low-Skew Channels, Authors: Michael J. Degerstrom, Chad M. Smutzer, Barry K. Gilbert, Erik S. Daniel, Year: 2023, Pages: 10*
- *[Scientific Article] Net Separation-Oriented Printed Circuit Board Placement via Margin Maximization, Authors: Chung-Kuan Cheng, Chia-Tung Ho, Chester Holtz, Year: 2022, Pages: 12*

5- Working environment (Facilities necessary for learning)

- *Computer: A laptop or desktop computer equipped with an operating system such as Windows, macOS or Linux.*
- *Electronic CAD software: PCB design tools like Altium Designer, KiCad, Eagle, or electronic simulation software like LTspice.*
- *Programming environment: IDE (integrated development environment) for microcontrollers used in IoT projects, such as the Arduino IDE, PlatformIO, or environments specific to each microcontroller (such as ESP-IDF for ESP32).*
- *Prototyping equipment: Breadboards, breadboards, electronic components (resistors, capacitors, sensors, etc.), microcontrollers (Arduino, Raspberry Pi, ESP32), various sensors and actuators.*
- *Measuring tools: Multimeters, oscilloscopes (if available), to measure, test and debug circuits.*
- *Internet Access: To access online resources, tutorials, community forums and documentation specific to the components used.*
- *Workspace: A dedicated space, well lit and equipped to allow the handling of electronic components in complete safety.*

Course Specification

Advanced microcontroller-based programming

1. General

Coded	IoT4.S2.10	Level/Semester	4/S2	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mokhtar Harrabi					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	Advanced Microcontroller-Based Programming					Version	08/2023

Course description (Course objective):
Advanced Microcontroller-Based Programming aims to deepen skills in programming and advanced manipulation of microcontrollers. Focused on practical work, this course aims to familiarize students with advanced programming techniques such as interrupt handling, serial, parallel communications, and low-level concepts to fully exploit the capabilities of microcontrollers in carrying out projects. complex.

Prerequisites:	Keywords :
- *Basic programming knowledge: Understanding of fundamental programming concepts, control structures, functions and variables.* - *Proficiency in Basic Microcontrollers: Prior understanding of microcontrollers and their basic operation is recommended.* - *Knowledge of programming languages: Familiarity with at least one programming language (such as C, C++, or Python) is beneficial for understanding advanced programming concepts.* - *Basic Electronics: A basic understanding of electronic circuits, components and their usage in projects is helpful for a better understanding of practical applications.* - *Hands-on experience with microcontroller projects: Having done simple projects with microcontrollers for a basic application can make it easier to understand advanced concepts.*	*Interrupts, Multitasking, Serial and parallel communications, Code optimization, Hardware resource management, Advanced prototyping*

Specific course objectives (OBJ):
OBJ 1 : *Mastery of advanced programming techniques: Gain an in-depth understanding of advanced programming methods to fully exploit the functionality of microcontrollers.* ***OBJ 2 :*** *Effective management of interrupts and communications: Know how to effectively manage hardware interrupts, serial and parallel communications to ensure smooth interactions between devices.* ***OBJ 3 :*** *Code and resource optimization: Learn how to optimize code to maximize efficiency and leverage hardware resources efficiently.* **OBJ 4 :** *Development of complex projects: Be able to design and carry out advanced projects based on microcontrollers, integrating advanced concepts and functionalities.*

Necessary material :
- *Advanced Microcontrollers: Advanced development boards like Raspberry Pi, Arduino Uno, Arduino Mega, STM32 Nucleo, ESP32, etc., providing extensive functionality for advanced projects.* - *Electronic components: Resistors, capacitors, diodes, transistors, various sensors (temperature, brightness, movement, etc.) for the implementation of practical projects.* - *Breadboards: To create and test electronic circuits temporarily before final manufacturing.* - *Programming tools: Computer with integrated development software (IDE) suitable for the microcontrollers used, such as Arduino IDE, PlatformIO, STM32CubeIDE, ESP-IDF, etc.* - *Measuring accessories: Multimeter, oscilloscope (if available) for debugging and verifying circuits.* - *Communication modules: WiFi, Bluetooth, RFID modules, etc., to experiment with wireless connectivity.* - *Documentation and manuals: Books, online tutorials, component datasheets, reference guides to support learning.* - *Advanced Starter Kits: Specific kits for advanced programming with microcontrollers, including various components and instructions for advanced projects.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Advanced interrupt management** - *Introduction to advanced interrupts.* - *Practical: Using Interrupts for Specific Tasks*	3	- *Understand and master advanced interrupt management.*
02	**Advanced serial communication** - *Advanced serial communication protocols (SPI, I2C, UART).* - *Practical: Using different serial communication protocols*	3	- *Know how to use and integrate advanced serial communication protocols.*

03	**Code optimization for microcontrollers** - *Memory and execution time optimization techniques.* - *Practical: Code Optimization to Improve Efficiency*	3	- *Learn to optimize code for microcontroller constraints*
04	**Managing concurrent tasks** - *Concepts of multitasking and management of concurrent tasks.* - *Practical: Implementing concurrent tasks*	3	- *Understand and apply parallel task management.*
05	**Advanced use of timers** - *Advanced features of timers and counters.* - *Practical: Advanced use of timers for various applications*	3	- *Master the use of timers for specific applications*
06	**Device driver development** - *Driver development concepts for external devices.* - *Practical: Developing Drivers for Specific Components*	3	- *Understand creating drivers for external components.*
07	**Practical project: Mini project** - *Evaluation of a practical mini project based on the skills acquired*	3	- *Apply all the skills acquired in a concrete project*
08-14	**Advanced projects and practical work** - *Sessions dedicated to the realization of advanced projects.* - *Practical: Development, implementation and debugging of advanced projects*	15	- *Develop practical projects using advanced skills*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *Microchip Technology: https://www.microchip.com/ - Resources, tools and documentation for Microchip microcontrollers.*

- *STM32 by STMicroelectronics: https://www.st.com/en/microcontrollers-microprocessors/stm32-32- bit-arm-cortex-mcus.html - Information about STM32 microcontrollers from STMicroelectronics, with documents and examples.*
- *AVR Freaks: https://www.avrfreaks.net/ - Discussion forum and resources for Atmel/Microchip AVR microcontrollers.*
- *Arduino Reference: https://www.arduino.cc/reference/en/ - Documentation and references for Arduino microcontrollers.*
- *Expressive Systems: https://www.espressif.com/ - Resources for ESP32 and ESP8266 microcontrollers.*
- *Electronics-Lab: https://www.electronics-lab.com/ - Electronics projects, tutorials and news in the field of electronics.*

5- Working environment (Facilities necessary for learning)

- *Computer: A computer (PC, Mac or Linux) with a recent operating system and Internet connectivity.*
- *Embedded development software (IDE): Depending on the microcontroller used (Arduino, STM32, ESP32, etc.), install the appropriate IDEs such as the Arduino IDE, STM32CubeIDE, PlatformIO, or other platform-specific tools.*
- *Programming Tools: Make sure you have the necessary tools to flash microcontrollers, such as programmers, USB-Serial adapters, etc.*
- *Simulators and add-on software: Circuit simulators (like Proteus, LTspice) or other add-on software for simulation and code verification can be beneficial.*
- *Documentation and references: Access to microcontroller datasheets, technical documentation and online support forums to resolve problems.*
- *Prototyping equipment: Breadboards, breadboards, connection wires, electronic components (resistors, capacitors, LEDs, etc.) for the practical implementation of projects.*
- *Measurement and analysis tools: Multimeter, oscilloscope (if available) to measure, debug and analyze circuits.*
- *Workspace: A dedicated, clean and well-lit space to comfortably work with electronic equipment.*

Course Specification

Federated project

1. General

Coded	IoT5.S1.05	Level/Semester	5/S1	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	21
Responsible	Montassar Ben Saad					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	24
Module	Federated project (agile method)					Version	08/2023

Course description (Course objective):
This course aims to teach the principles and practices of agile project management applied to the context of federated development. The main objective is to familiarize learners with agile methodologies such as Scrum or Kanban and prepare them to manage federated projects, involving distributed teams, while emphasizing collaboration, flexibility and iterative delivery. This course explores effective planning, coordination, and communication in environments where multiple interdependent teams are working toward common goals.

Prerequisites:	Keywords :
- *Understanding of project management methods: Basic knowledge of traditional or agile project management methodologies such as Scrum, Kanban or XP would be beneficial.* - *Familiarity with agile principles: An understanding of agile values such as collaboration, responsiveness to change and incremental delivery.* - *Team management knowledge: Understand the challenges of managing distributed or interdependent teams.* - *Communication and coordination: Ability to collaborate effectively with multiple teams and communicate clearly in a federated project context.* - *Technical skills related to the project area: Depending on the project area (IT, engineering, etc.), familiarity with relevant technical skills may be required.*	*Project management, Scrum, Agile method, Distributed teams, Collaboration, Communication, Iterative delivery, Coordination, Flexibility*

Specific course objectives (OBJ):
OBJ 1 : *Master agile principles adapted to federated projects: Understand and apply agile values and practices in contexts involving distributed teams.* ***OBJ 2 :*** *Effectively manage communication and coordination in distributed environments: Learn skills to facilitate seamless collaboration and smooth coordination between teams working on a federated project.* ***OBJ 3 :*** *Plan and execute iterative delivery cycles: Learn to structure and execute development iterations, promoting an incremental approach and continuous improvement.* ***OBJ 4 :*** *Apply project management techniques for interdependent teams: Use agile project management methodologies like Scrum or Kanban to coordinate interdependent teams working on common goals.* **OBJ 5 :** *Solve specific challenges related to federated projects: Be able to identify and resolve unique issues encountered in federated projects, such as cultural differences, time zones, and managing dependencies between teams.*

Necessary material :
Nothing

2- Content elements (Course)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	- *Introduction to agile methodologies*	3	- *Understand the principles and fundamental values of agile methods in a federated project context*
03-04	- *Managing distributed teams*	3	- *Learn best practices for coordinating and communicating effectively in distributed teams*
05-06	- *Iterative planning and delivery cycles*	3	- *Master the planning and execution of incremental deliveries in a federated project context*
7	- *Guarded duty*	1.5	- *Assessment of understanding of concepts covered so far*
08-09	- *Advanced agile methodologies: Scrum, Kanban*	3	- *Deepen knowledge of specific agile methodologies for federated project management*
10-11	- *Inter-team communication and collaboration*	3	- *Develop advanced skills in communication and collaboration between distributed teams*
12-13	- *Troubleshooting issues specific to federated projects*	3	- *Identify and resolve unique challenges associated with federated projects, such as cultural differences and dependency*

			management
14	- *Final exam*	1.5	- *Overall assessment of skills acquired during the course*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- References

- *Scrum.org: https://www.scrum.org/ - Platform offering training, certifications and resources on Scrum, an agile methodology.*
- *Kanbanize Blog: https://kanbanize.com/blog/ - Articles and guides on using Kanban in project management.*
- *Atlassian Agile Coach: https://www.atlassian.com/agile - Practical resources on agile methods, including articles and guides on Scrum and Kanban.*
- *PMI Agile Practice Guide: https://www.pmi.org/pmbok-guide-standards/practice-guides/agile - Project Management Institute (PMI) practical guide for applying agile principles in project management.*
- *[Book] Advanced Programming with STM32 Microcontrollers, Author: Majid Pakdel, Year: 2020,*
- *[Book] Microcontrollers: High-Performance Systems and Programming, Authors: Julio Sanchez, Maria P. Canton,*
- *[Scientific Article] Programming Microcontrollers Through High-Level Abstractions, Authors: Not specified, Year: 2019*
- *[Scientific Article] Higher-Order Concurrency for Microcontrollers, Authors: Abhiroop Sarkar, Robert Krook, Bo Joel Svensson, Mary Sheeran, Year: 2021*
- *[Scientific Article] Microcontrollers Programming Framework Based on a V-Like Language, Year: 2022,*

5- Working environment (Facilities necessary for learning)

- *Nothing*

Course Specification

Computer Vision

1. General

Coded	IoT5.S1.06	Level/Semester	5/S1	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Nedra Ben Romdhane					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	32
Module	Computer visions					Version	08/2023

Course description (Course objective):
The Computer Vision course aims to familiarize students with the fundamental principles and advanced techniques of image and video processing by computers. The main goal is to understand how machines can visually interpret and analyze the world around them, using algorithms and machine learning models. This course explores object recognition methods, motion detection, image segmentation, as well as practical applications such as computer vision in robotics, augmented reality and video surveillance.

Prerequisites:	Keywords :
- *Strong understanding of mathematics, including linear algebra, differential and integral calculus, as well as probability and statistics.* - *Basic knowledge of programming, preferably in languages such as Python, MATLAB or C++.* - *Understanding of basic concepts of machine learning and computer vision, including neural networks and image processing techniques.* - *Familiarity with image and video manipulation concepts would be an asset.* - *Ability to use software libraries such as OpenCV, TensorFlow or PyTorch would be beneficial.*	*Image processing, Object recognition, Segmentation, Motion detection, Neural networks, Computer vision algorithms, Machine learning models, OpenCV, Image analysis, Practical applications*

Specific course objectives (OBJ):
OBJ 1 : *Understand the theoretical foundations of image processing and computer vision, including segmentation, object detection and motion tracking techniques.*

OBJ 2 : *Master the use of commonly used software tools such as OpenCV, TensorFlow or PyTorch to implement computer vision algorithms and neural networks.*

OBJ 3 : *Apply the concepts learned to solve real-world problems, including facial recognition, video surveillance, augmented reality or computer vision in specific fields such as medicine or robotics.*

OBJ 4 : *Critically analyze and evaluate the performance of computer vision models and develop effective solutions for real-world scenarios using advanced machine learning techniques.*

Necessary material :

- *High-performance computer: A computer with adequate processing power to perform computationally intensive tasks. Modern setups with dedicated graphics cards (GPUs) can accelerate machine learning operations.*
- *Software and Libraries: Installing software such as Python with libraries like OpenCV, TensorFlow, PyTorch, scikit-learn, and other computer vision specific tools.*
- *Image Databases: Access to diverse datasets for training and testing models, such as ImageNet, COCO, MNIST, etc.*
- *Books and learning resources: Specialized computer vision textbooks and online resources to reinforce theoretical and practical understanding.*
- *Opportunity to work on practical projects: Access to datasets and hardware for the practical implementation of the studied concepts, for example, a webcam for experimenting with real-time vision.*
- *Optionally, specialized hardware: For specific applications, such as sensors (cameras, LiDAR) for real-time data collection in more advanced computer vision projects.*

2- Content elements (Practical Work)

Week(s)	Activities/Content elements	No. HR	Goals
01	- *Introduction to computer vision and image processing*	3	- *Understand the basic principles of computer vision and image processing techniques.*
02	- *Mathematical foundations for computer vision (linear algebra, matrix calculus)*	3	- *Strengthen understanding of mathematical concepts necessary for computer vision.*
03-04	- *Using OpenCV for Image Manipulation*	6	- *Master the software tools commonly used for image processing.*
05-06	- *Object detection and image segmentation*	6	- *Learn object detection and image segmentation techniques.*
07-08	- *Machine learning applied to computer vision*	6	- *Understand how to apply machine learning concepts to computer vision.*

09-10	- *Neural networks for computer vision*	6	- *Exploring the use of neural networks for computer vision tasks.*
11-12	- *Advanced applications: facial recognition, augmented reality*	6	- *Examine practical applications of computer vision in various fields.*
13	- *Practical project: implementation of a mini project in computer vision*	3	- *Put the acquired knowledge into practice in a concrete project.*
14	- *Evaluation of the mini-project and conclusion of the course*	3	- *Evaluate the skills acquired through the project and conclude the course.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *OpenCV: https://opencv.org/ - Official website of OpenCV, a popular library for image processing and computer vision.*
- *TensorFlow: https://www.tensorflow.org/ - Official documentation of TensorFlow, a widely used machine learning framework for computer vision.*
- *PyTorch: https://pytorch.org/ - Official site of PyTorch, a deep learning library for Python often used in computer vision.*
- *Papers with Code: https://paperswithcode.com/ - Online platform that references scientific articles with code related to computer vision and machine learning.*
- *GitHub - Awesome Computer Vision: https://github.com/jbhuang0604/awesome-computer-vision - A curated list on GitHub of useful resources, projects and articles related to computer vision.*
- *[Book] Computer Vision: Algorithms and Applications, Author: Richard Szeliski, Year: 2010, Pages: 812*
- *[Book] Deep Learning for Computer Vision, Author: Rajalingappaa Shanmugamani, Year: 2018, Pages: 320*
- *[Book] Advanced Methods and Deep Learning in Computer Vision, Editors: E. R. Davies, Matthew*

Turk, Year: 2020, Pages: 584

- *[Scientific Article] Recent Advances of Local Mechanisms in Computer Vision: A Survey and Outlook of Recent Work, Authors: Qiangchang Wang, Yilong Yin, Year: 2023, Pages: 35*
- *[Scientific Article] Integration and Performance Analysis of Artificial Intelligence and Computer Vision Based on Deep Learning Algorithms, Authors: Bo Liu, Liqiang Yu, Chang Che, Qunwei Lin, Hao Hu, Xinyu Zhao, Year: 2023, Pages: 15*
- *[Scientific Article] Deep Learning to See: Towards New Foundations of Computer Vision, Authors: Alessandro Betti, Marco Gori, Stefano Melacci, Year: 2022, Pages: 20*

5- Working environment (Facilities necessary for learning)

- *Python: Download and install Python from the official website (https://www.python.org/) – Python is widely used for computer vision due to its versatility and numerous libraries.*
- *Virtual environment: Use virtualenv or conda to create a virtual Python environment dedicated to your computer vision project. This helps separate dependencies and libraries to avoid conflicts.*
- *Libraries:*
  - *OpenCV: Install OpenCV using pip install opencv-python.*
  - *TensorFlow: Install TensorFlow with pip install tensorflow.*
  - *PyTorch: For PyTorch, follow the instructions specific to your system from the official website (https://pytorch.org/).*
  - *scikit-learn: A library for machine learning, useful for data preparation and model evaluation. Install it via pip install scikit-learn.*
- *Code editor: Choose a suitable code editor like VSCode, PyCharm, Sublime Text or Atom to write and run your Python scripts.*
- *Jupyter Notebook: Makes it easier to experiment and visualize results. Install it with pip install jupyterlab.*
- *Hardware: A computer with adequate hardware resources, preferably equipped with a dedicated graphics card to speed up calculation operations.*
- *Training Data: Download datasets for training and testing. For example, MNIST, CIFAR-10, or datasets*

Course Specification

Introduction to industry 4.0

1. General

Coded	IoT5.S1.07	Level/Semester	5/S1	Coefficient	1.5	Credits	2
Course	Internet of Things (IoT)					Vol. H. (CI)	21
Responsible	Mokhtar Harrabi					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	30
Module	Introduction to Industry 4.0					Version	08/2023

Course description (Course objective):
This course aims to familiarize students with the fundamental principles of digital transformation in the industrial field. By highlighting concepts such as advanced automation, integration of sensors and connected devices, and real-time data analysis, it aims to provide an overview of the revolutionary technologies used in environments modern manufacturing. This course also explores the implications of this revolution on production processes, business models and the workforce, providing a solid foundation for understanding and evolving in the Industry 4.0 landscape.

Prerequisites:	Keywords :
- *Basic science knowledge: A basic understanding of physics, mathematics and chemistry principles is recommended to grasp key technology concepts.* - *Computers and Technology: Basic computer skills, such as navigating operating systems and a rudimentary understanding of programming, can make understanding technical aspects easier.* - *Basic knowledge of IoT and automation: Basic knowledge of the Internet of Things (IoT), industrial automation or cyber-physical systems can help understand the technological foundations of Industry 4.0.* - *Critical thinking and curiosity: Openness to learning, curiosity about new technologies and critical thinking are important qualities for exploring and understanding developments in the industry.*	*IoT, Automation, Cyber-physics, Big data - Massive data, AI - Artificial intelligence, Robotics, Smart manufacturing, Connectivity, Interoperability, Digital transformation*

Specific course objectives (OBJ):
OBJ 1 : *Understand key concepts: Assimilate the fundamentals of Industry 4.0, including IoT, advanced automation, and system connectivity.* ***OBJ 2 :*** *Analyze industrial implications: Assess the impacts of digital transformation on production processes, business models, and supply chain management.* ***OBJ 3 :*** *Apply emerging technologies: Harness cutting-edge tools such as AI, Big Data and robotics to optimize industrial operations.* **OBJ 4 :** *Understand human and social issues: Examine the socio-economic and ethical implications of Industry 4.0 on workers, consumers and* society as a whole.

Necessary material :
Nothing

2- Content elements (Course)

Week(s)	Activities/Content elements	No. HR	Goals
01-06	**Introduction to Industry 4.0** - *Fundamental concepts of the fourth industrial revolution.* - *Technological and economic implications.* - *Impact on industrial processes.*	9	- *Understanding of the basics of Industry 4.0, awareness of technological changes*
07	**Assessment/Proctored Assignment** - *Evaluative test on the concepts covered.*	1.5	- *Assess understanding and assimilation of knowledge up to this point*
08-13	**Internet of Things (IoT), Automation, Artificial Intelligence (AI), Big Data, etc.** - *Practical application of these technologies in industry*	9	- *In-depth understanding of emerging technologies, application in industrial scenarios*
14	**Final project** - *Comprehensive assessment of acquired knowledge*	1.5	- *Assess overall understanding of the course and Industry 4.0 concepts.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- References

- *[Book] Industry 4.0: The Industrial Internet of Things, Author: Alasdair Gilchrist, Year: 2016, Pages: 250*
- *[Book] Industry 4.0: A Sustainable Industrial Approach, Author: Sultan Chand & Sons, Year: 2020,*
- *[Book] Industry 4.0 Driven Manufacturing Technologies, Editors: Not specified, Year: 2023, Pages: 400*
- *[Scientific Article] Industry 4.0: Clustering of Concepts and Characteristics, Year: 2022,*

5- Working environment (Facilities necessary for learning)

- *Nothing*

Course Specification

IoT data analysis

1. General

Coded	IoT5.S1.08	Level/Semester	5/S1	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Marwa Ben Jabra					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	60
Module	IoT Data Analysis					Version	08/2023

Course description (Course objective):
The IoT Data Analysis course aims to familiarize students with the fundamental principles of analyzing data generated by the Internet of Things (IoT). The main objective is to understand how to efficiently collect, preprocess and analyze data from sensors and connected devices to extract relevant information. This course explores data mining techniques specific to IoT, the use of analytics and machine learning tools to interpret this data, and the practical applications of this analysis in areas such as home automation , connected health or industrial management.

Prerequisites:	Keywords :
- *Knowledge of fundamental IoT concepts: Understanding of the basics of the Internet of Things, communication protocols and architectures used in IoT networks.* - *Familiarity with data collection technologies: Knowledge of sensors and IoT devices, as well as methods of collecting, transmitting and storing data.* - *Proficiency with data analysis tools: Familiarity with data analysis techniques, including data manipulation, descriptive statistics, data mining methods, and visualization.* - *Programming and software tools skills: A basic understanding of programming languages such as Python or R, as well as the ability to use software tools for data analysis.* - *Machine learning knowledge: A knowledge base on machine learning concepts is beneficial for understanding advanced IoT data analysis and prediction techniques.*	*IoT, Data Collection, Sensors, Data Analysis, Data Mining, Visualization, Preprocessing, Predictive Models, IoT Security, Machine Learning*

Specific course objectives (OBJ):

OBJ 1 : *Understanding IoT Data: Gain in-depth knowledge of IoT data sources, sensors used and communication protocols, in order to understand the diversity and nature of data generated by the Internet of Things.*

OBJ 2 : *Mastery of data analysis techniques: Learn to preprocess, clean, explore and visualize IoT data using specific techniques to extract relevant and actionable insights.*

OBJ 3 : *Application of predictive models: Be able to apply machine learning models and statistical analysis techniques to predict trends, detect anomalies or make decisions based on IoT data.*

OBJ 4 : *Understanding Security and Privacy Challenges: Understand issues related to IoT data security, including privacy, authentication, and protection of sensitive data in IoT environments.*

Necessary material :

- *IoT devices: IoT sensors and devices to collect real-world data. This may include sensors for temperature, humidity, motion, etc.*
- *Computer and software: A powerful computer with data analysis software such as Python (with libraries like Pandas, NumPy, Scikit-learn), R or other data processing and analysis tools.*
- *Integrated Development Environment (IDE): Use of IDE such as Jupyter Notebook, Spyder, RStudio or any other programming environment suitable for data analysis.*
- *IoT and Cloud Platforms: Access to IoT platforms or cloud services for storing and managing IoT data, such as AWS IoT, Azure IoT Hub, Google Cloud IoT, etc.*
- *Connectivity Hardware: Access to a stable internet connection to access online resources, tutorials and learning platforms.*
- *Datasets: IoT data sets relevant to hands-on exercises and projects, such as simulated or real sensor data from various IoT sources.*
- *Additional hardware: Additional hardware components or development kits for experimenting with real-world IoT projects, if necessary*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-03	**Introduction to the Internet of Things (IoT) and Data Collection** - *IoT data collection and transmission.* - *Types of sensors and devices used.* - *IoT communication protocols.*	9	- *Understand the basics of IoT, the technologies used and methods of data collection in an IoT context*

04-06	**IoT Data Preprocessing and Exploration** - *Cleaning and preprocessing IoT data.* - *Exploring IoT data.* - *Visualizing trends and patterns*	9	- *Gain skills to effectively preprocess IoT data and explore trends using visualization techniques*
07-09	**Statistical Analysis for IoT** - *Using statistical methods in IoT data analysis.* - *Application of specific statistical tests.* - *Results interpretation*	9	- *Master statistical techniques to analyze and interpret IoT data accurately*
10-12	**Predictive Models for IoT** - *Predictive models for IoT data (regression, classification).* - *Evaluation of model performance.* - *Application of prediction models*	9	- *Understand and apply predictive models to anticipate trends or behaviors based on IoT data*
13	**Security and Privacy in IoT** - *IoT security challenges.* - *IoT data protection methods.*	3	- *Understand IoT data security and privacy issues*
14	**Practical exam**	3	- *Evaluate acquired skills through a practical exam.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *IoT Analytics: https://iot-analytics.com/ - A source for market analysis, reports and resources on IoT trends and statistics.*
- *IEEE Internet of Things Journal: https://iot.ieee.org/ - IEEE journal dedicated to research and advancements in the field of IoT.*
- *Microsoft Azure IoT: https://azure.microsoft.com/en-us/overview/iot/ - Official Microsoft Azure IoT documentation, providing resources and tutorials for IoT developers.*
- *GitHub - Awesome IoT: https://github.com/HQarroum/awesome-iot - Curated list on GitHub of IoT resources, projects, and articles.*
- *[Book] An Introduction to IoT Analytics, Author: Harry G. Perros, Year: 2021, Pages: 368*
- *[Book] Internet of Things and Data Analytics Handbook, Editor: Hwaiyu Geng, Year: 2017, Pages:*

816

- *[Book] Empowering IoT with Big Data Analytics, Editors: Mohamed Adel Serhani, Mohamed Hamdi, Year: 2023, Pages: 400*
- *[Scientific Article] Internet of Things is a Revolutionary Approach for Future Technology Enhancement: A Review, Authors: Ovidiu Vermesan, Peter Friess, Year: 2019, Pages: 22*
- *[Scientific Article] Internet of Thing (IoT) and Data Analytics with Challenges and Future Applications, Authors: S. K. Sharma, X. Wang, Year: 2022, Pages: 8*

5- Working environment (Facilities necessary for learning)

Programming languages :

- *Python: Install Python from the official website (https://www.python.org/) and make sure you have version 3.x.*
- *A: Download and install R from the official website (https://www.r-project.org/) if you intend to use R for statistical analysis.*

Integrated Development Environment (IDE):

- *Jupyter Notebook: Install Jupyter Notebook via Python distribution installation or use pip install jupyterlab to install JupyterLab.*
- *RStudio: If you use R, download and install RStudio for an R-friendly environment (https://www.rstudio.com/).*

Libraries and tools:

- *Pandas: Python library for data manipulation. Install it via pip install pandas.*
- *NumPy: Library for numerical calculations in Python. Install it via pip install numpy.*
- *Scikit-learn: For machine learning in Python. Install it via pip install scikit-learn.*
- *TensorFlow or PyTorch: For deep learning in Python, install one of these libraries based on your preferences.*
- *ggplot2: R library for data visualization. Install it from RStudio.*

IoT platforms and specific software:

- *Cloud Platforms: Create accounts on cloud platforms such as AWS IoT, Azure IoT, or Google Cloud IoT to experiment with IoT data.*
- *IoT simulation software: Sometimes IoT device simulation software like ThingWorx, Eclipse IoT, or Particle can be used to simulate IoT devices.*
- *Training data:*
- *Obtain relevant IoT datasets from online sources or dedicated IoT platforms, such as Kaggle, UCI Machine Learning Repository, or cloud platforms.*

Course Specification

IoT and Virtual Reality

1. General

Coded	IoT5.S1.09	Level/Semester	5/S1	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Montassar Ben Saad					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	IoT and Virtual Reality (VR)					Version	08/2023

Course description (Course objective):
The course on “IoT and Virtual Reality (VR)” aims to explore the convergence between the Internet of Things (IoT) and Virtual Reality (VR), with a focus on the integration and combined applications of these technologies . The main objective is to familiarize learners with the interactions and synergies between IoT and VR, highlighting the possibilities of merging physical and virtual environments to create immersive experiences. This course explores the fundamental concepts, use cases, and challenges of uniting these areas for innovation and advanced application development.

Prerequisites:	Keywords :
- *Basic IoT Knowledge: Understanding of basic Internet of Things (IoT) concepts, including sensors, connected devices and communication protocols.* - *Familiarity with Virtual Reality (VR): A basic understanding of the principles and technologies used in virtual reality, such as VR headsets, virtual environments and user interfaces.* - *Programming and software development skills: Preliminary knowledge of programming (like Python, C++, JavaScript) and application development can be helpful in manipulating IoT data and creating VR applications.* - *Knowledge of data capture technologies: Familiarity with data capture technologies for IoT (sensors, transmission protocols) and their potential integration into virtual reality environments.* - *Understanding of IoT applications: Knowledge of IoT application areas (healthcare, home automation, industrial, etc.) can be beneficial in exploring intersections with VR.*	*IoT, Virtual Reality (VR), Technology Fusion, Human-Computer Interaction, Immersive Experiences, Connected Sensors, Virtual Environments, Physical and Virtual Interactions*

Specific course objectives (OBJ):
OBJ 1 : *Understand the intersection between IoT and VR: Explain the synergies between the Internet of Things and Virtual Reality to create interactive and immersive environments.* ***OBJ 2 :*** *Explore combined use cases: Analyze and evaluate potential scenarios where the integration of IoT and VR can generate value, including in healthcare, education, industry, etc.* ***OBJ 3 :*** *Master integration technologies: Acquire practical skills to combine IoT sensors with virtual reality environments, using appropriate development tools.* **OBJ 4 :** *Develop integrated IoT-VR applications: Design and carry out concrete projects that exploit the combination of IoT and VR to create immersive and innovative user experiences.*

Necessary material :
- *IoT devices: Various sensors (temperature, movement, light, etc.) to collect data from the physical environment.* - *VR Devices: VR headsets such as Oculus Rift, HTC Vive, Oculus Quest, etc., with their necessary accessories.* - *Powerful computers: Machines with suitable specifications for designing and developing VR applications, including a decent graphics card, a good amount of RAM, and a robust processor.* - *Smartphones and Tablets: To test IoT and VR applications on compatible mobile devices.* - *IoT Development Kits: Hardware kits for experimenting with IoT solutions, e.g. Arduino, Raspberry Pi, ESP8266, etc.* - *VR development tools: Software such as Unity, Unreal Engine or other VR development platforms for creating virtual environments.* - *VR motion sensors and accessories: Such as motion controllers, tracking cameras, etc., for more immersive interaction with VR environments.* - *Data capture equipment: Cameras, microphones, or other capture devices for real-world data acquisition that can be used in virtual environments.*

2- Content elements (Course)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Fundamentals of IoT and VR** - *Understanding of basic concepts of IoT and VR.* - *Exploring potential synergies between IoT and VR.*	6	- *Establish the conceptual foundation to understand the integration possibilities between IoT and VR*

03-04	**IoT Sensors and VR Applications** - *In-depth study of IoT sensors used in various contexts.* - *Applications of IoT sensors in Virtual Reality environments.*	6	- *Analyze the different applications of IoT sensors in VR scenarios to create immersive experiences*
05-06	**Development of IoT-VR Applications** - *Practice in developing applications combining IoT and Virtual Reality data.* - *Creation of interactive scenarios and immersive user experiences*	6	- *Acquire practical skills to design and develop interactive IoT-VR applications*
07-08	**Practical Experiments with VR Devices** - *Experimentation and manipulation of VR devices to understand human-machine interactions.* - *Exploration of the possibilities offered by VR devices in IoT contexts.*	6	- *Understanding user interactions and immersive experiences enabled by VR devices*
09-10	**Fusion of IoT Data and VR Environments** - *Integration of data collected by IoT into Virtual Reality environments.* - *Visualization and interpretation of IoT data in VR scenarios*	6	- *Master the integration of IoT data into VR spaces to create immersive and informative experiences*
11-12	**Design of IoT-VR Projects** - *Design and development of concrete projects combining IoT and VR.* - *Creation of innovative and interactive user experiences*	6	- *Apply knowledge to design and develop interactive IoT-VR projects*
13	**Testing and Optimization of IoT-VR Applications** - *Application of testing and optimization methods to ensure the reliability of IoT-VR applications.* - *Identifying and resolving problems for optimal performance*	3	- *Master test and optimization procedures for stable and efficient IoT-VR applications*
14	**Evaluation and Presentation of IoT-VR Projects** - *Evaluation of completed projects and presentation of final results.* - *Demonstration of skills acquired throughout the course*	3	- *Evaluate acquired skills and demonstrate understanding of concepts through concrete IoT-VR projects*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- References

- *VRScout: https://vrscout.com/ - Platform dedicated to news and the latest innovations in Virtual Reality.*
- *Oculus Developer: https://developer.oculus.com/ - Resources for VR developers, including tutorials, getting started guides, and development information for Oculus products.*
- *Unity Learn - VR and AR Development: https://learn.unity.com/ - Unity learning platform offering courses and resources for VR and AR development.*
- *[Book] Immersive Virtual and Augmented Reality in Healthcare: An IoT and Blockchain Perspective, Editors: Rajendra Kumar, Vishal Jain, Garry Tan Wei Han, Adberezak Touzene, Year: 2023,*
- *[Book] Immersive Technology in Smart Cities: Augmented and Virtual Reality Applications, Editors: Sagaya Aurelia, Jenny Stanley, Year: 2021,*
- *[Book] Handbook of Augmented and Virtual Reality, Year: 2022,*
- *[Scientific Article] Virtual Reality: A Survey of Enabling Technologies and Its Applications in IoT, Authors: Miao Hu, Xianzhuo Luo, Jiawen Chen, Young Choon Lee, Yipeng Zhou, Di Wu, Year: 2021,*
- *[Scientific Article] How Virtual Reality Meets the Industrial IoT: Technologies and Applications, Year: 2020,*
- *[Scientific Article] Performance Analysis of an IoT Platform with Virtual Reality and Cloud Computing Integration, Year: 2020*

5- Working environment (Facilities necessary for learning)

- *Powerful computer: A computer with specifications robust enough to support VR and IoT development software, including a decent graphics card, a good amount of RAM, and a capable processor.*
- *VR headset: A virtual reality headset such as the Oculus Rift, HTC Vive, Oculus Quest, or any other compatible VR headset.*
- *Development software: VR development software such as Unity, Unreal Engine, or other VR content creation platforms. For IoT, IDEs (Integrated Development Environments) like Arduino IDE can be useful.*
- *IoT Sensors and Devices: IoT sensor kits (Arduino, Raspberry Pi, etc.) for data collection and real-world experimentation.*

- *Modeling tools: 3D modeling software for creating VR environments, if necessary.*
- *Network connectivity: A stable internet connection to access online resources, download software and view tutorials.*
- *Clear workspace: A dedicated space for experimenting with VR devices and IoT sensors, with plenty of room to move around safely when using VR devices.*

Course Specification

Long-range communications technologies

1. General

Coded	IoT5.S1.10	Level/Semester	5/S1	Coefficient	3	Credits	4
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Mouhieddine Belghith					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	50
Module	Long Range Communication Technologies: LoRaWAN/ThingSat					Version	08/2023

Course description (Course objective):
The course on “Long Range Communication Technologies: LoRaWAN/ThingSat” aims to familiarize learners with the fundamental concepts of long range IoT communications. The main objective is to explore emerging technologies such as LoRaWAN and ThingSat, with emphasis on remote data transmission, low-power connectivity and practical applications in the Internet of Things domain. Objects (IoT). This course aims to provide an in-depth understanding of these technologies to design and deploy robust and scalable IoT solutions.

Prerequisites:	Keywords :
- *Basic knowledge of Networks and Protocols: Understand the fundamental concepts of communications networks, data transmission protocols and wireless connectivity technologies.* - *Internet of Things (IoT) Fundamentals: Have a basic understanding of IoT principles, including data collection, device connectivity, and IoT applications.* - *Notions in Electronics and Sensors: Basic knowledge of electronics and sensors would be useful to understand the functioning of IoT devices and sensors connected via LoRaWAN/ThingSat.* - *Programming Skills: Basic programming knowledge can be beneficial in understanding data and message management in IoT environments.* - *Understanding of Wireless Communications: Knowledge of wireless communication technologies, their advantages and limitations, will be useful in understanding the principles of LoRaWAN and ThingSat.*	*LoRaWAN, ThingSat, IoT, Long Range Connectivity, Low Power Consumption, Wireless Sensors, IoT Networks, Data Transmission*

Specific course objectives (OBJ):

OBJ 1 : *Understand the Principles of LoRaWAN and ThingSat: Gain in-depth knowledge of the specific architectures, protocols and functionalities of LoRaWAN and ThingSat in the context of IoT.*

OBJ 2 : *Master Practical Applications: Be able to design, develop and implement practical solutions using LoRaWAN and ThingSat for various IoT applications.*

OBJ 3 : *Analyze Long-Range Connectivity: Evaluate the benefits and limitations of long-range communications technologies such as LoRaWAN/ThingSat for specific use cases.*

OBJ 4 : *Optimize Energy Usage: Understand strategies to optimize energy consumption in LoRaWAN/ThingSat-based IoT networks for* low-power applications.

Necessary material :

- *LoRaWAN/ThingSat Modules: LoRaWAN/ThingSat compatible devices and modules for experimenting and testing long-range connectivity.*
- *IoT Development Boards: Development platforms (like Arduino, Raspberry Pi, ESP32/ESP8266) for integrating and testing LoRaWAN/ThingSat features.*
- *Wireless sensors: LoRaWAN/ThingSat compatible sensors for data collection, e.g. temperature, humidity, motion sensors, etc.*
- *Antennas and transmission equipment: LoRaWAN antennas and transmission equipment to create long-range IoT networks.*
- *Computers and Software: Computers equipped with the software necessary for programming and deploying IoT applications, as well as configuring LoRaWAN/ThingSat devices.*
- *Documentation and Manuals: Educational resources, manuals and user guides for LoRaWAN/ThingSat to provide detailed instructions on installation, configuration and use.*
- *Connection accessories: Cables, adapters and components necessary to connect and integrate the different elements of the IoT system.*
- *Suitable workspace: A dedicated space with adequate electrical installations for experimentation with IoT devices and long-range transmissions.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Introduction to Long Range IoT Communications** - *Presentation of LoRaWAN and ThingSat technologies, architecture and fundamental principles.*	6	- *Understand the basics of long-range communications for IoT, understand the concepts of LoRaWAN and ThingSat*

03-04	**LoRaWAN Architecture and Protocols** - *In-depth study of LoRaWAN protocol layers, network management and security.*	6	- *Understand the detailed architecture of LoRaWAN, assimilate the protocols and associated security mechanisms*
05-06	**ThingSat: Applications and Features** - *Exploration of ThingSat capabilities, focus on specific applications and advanced features*	6	- *Master the possibilities offered by ThingSat and identify specific use cases*
07-08	**Integration of IoT Sensors and Devices** - *Connection and use of LoRaWAN/ThingSat compatible sensors, experimentation with the collected data.*	6	- *Learn how to integrate IoT sensors and devices for data collection via LoRaWAN/ThingSat technologies*
09-10	**Practical LoRaWAN Network Configurations** - *Convenient configuration and deployment of LoRaWAN networks, coverage and performance analysis*	6	- *Gain practical skills to configure and optimize LoRaWAN networks in real-world environments.*
11-12	**Case Studies and Practical Projects** - *Real case studies and practical project development using LoRaWAN/ThingSat*	6	- *Apply acquired knowledge through practical projects and real-world usage scenarios*
13	**Testing and Simulation of Scenarios** - *Simulation of IoT scenarios, communication and data integrity tests*	3	- *Master testing and simulation techniques to ensure the proper functioning of LoRaWAN/ThingSat-based IoT systems*
14	**Final Evaluation and Presentation of Projects** - *Evaluation of skills acquired through tests and presentation of final projects*	3	- *Assess learners' overall understanding of LoRaWAN/ThingSat and their ability to apply this knowledge to practical projects*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *LoRa Alliance: https://lora-alliance.org/ - Official resources, technical specifications, and use cases for LoRaWAN by the LoRa Alliance.*
- *The Things Network: https://www.thethingsnetwork.org/ - Community and documentation for development with LoRaWAN.*
- *[Book] Mobile and Wireless: Communication and Technology, Author: Grant Harper, Year: 2018, Pages: 290*
- *This book elucidates concepts and innovative models around prospective developments in mobile and wireless communication technology.*
- *[Book] 4G Roadmap and Emerging Communication Technologies, Year: 2009, Pages: 350*
- *[Book] Fundamentals of Wireless Communication, Author: David Tse, Year: 2005, Pages: 564*
- *[Scientific Article] Long-Range Wireless Radio Technologies: A Survey, Year: 2020, Pages: 25*
- *[Scientific Article] Long Range Technology for Internet of Things: Review, Challenges, and Future Directions, Year: 2022, Pages: 30*
- *[Scientific Article] Improving the Reliability of Long-Range Communication against Interference in Urban Environments, Year: 2022, Pages: 15*

6- Working environment (Facilities necessary for learning)

- *Development Software: Install the software necessary for programming and configuring LoRaWAN/ThingSat devices. This may include specific IDEs (Integrated Development Environments), programming tools, SDKs (Software Development Kits), and configuration interfaces.*
- *IoT Development Boards: Use platforms such as Arduino, Raspberry Pi or dedicated LoRaWAN/ThingSat modules to create and test IoT applications.*
- *Connection Hardware: Acquire LoRaWAN/ThingSat-enabled sensors to collect data, as well as antennas and communications modules to establish long-range wireless connections.*
- *Computers and Internet Connection: Have computers or laptops with an internet connection to download software, access online resources, and view documentation.*
- *Physical Workspace: Set up a dedicated workspace with adequate power supply for plugging in and testing IoT devices, as well as basic tools for mounting and connecting equipment.*

Course Specification

Graphical programming language

1. General

Coded	IoT5.S1.11	Level/Semester	5/S1	Coefficient	3	Credits	3
Course	Internet of Things (IoT)					Vol. H. (CI)	0
Responsible	Kais Bouzrara					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	32
Module	Graphical programming language (LabView/Node-Red)					Version	08/2023

Course description (Course objective):
This subject aims to familiarize students with the fundamentals of visual programming languages, such as LabVIEW and Node-RED. The main objective is to teach programming logic based on graphical blocks and explore their use in the development of industrial and automation applications. This course focuses on understanding the features and capabilities of these languages to create effective solutions in various fields of engineering and IoT.

Prerequisites:	Keywords :
- *Fundamentals of Programming: A basic understanding of programming concepts, such as variables, loops, conditions, and functions, would be beneficial for understanding programming logics, although this course focuses on visual programming.* - *Basic knowledge of electronics and sensors: Basic knowledge of electronics, such as circuits, sensors and their operations, can help understand the practical applications of visual programming languages in sensor and automation contexts.* - *Familiarity with automation and control concepts: A basic understanding of automation and control concepts can make it easier to understand the industrial applications of these languages in automation systems.* - *Basic knowledge of networks and communication protocols: A basic understanding of networks and communication protocols can be useful, especially when using Node-RED in IoT applications where communication between devices is essential.*	*Visual programming, LabVIEW, Node-RED, Industrial automation, Sensors and actuators, Systems engineering, Graphical interface, Data processing*

Specific course objectives (OBJ):

OBJ 1 : *Master visual programming concepts: Understand the fundamentals of visual programming languages such as LabVIEW and Node-RED to develop skills in block programming logic.*

OBJ 2 : *Apply languages in industrial environments: Use LabVIEW and Node-RED to design and develop solutions in automation and control contexts, with an emphasis on industrial applications.*

OBJ 3 : *Integrate Sensors and Actuators: Learn how to integrate sensors and actuators into applications using these languages, understanding data flows and control processes.*

OBJ 4 : *Design User-Friendly GUIs: Develop skills to create user-friendly, interactive GUIs for visualizing and controlling systems using LabVIEW and Node-RED.*

Necessary material :

- *Computers: Computers with configurations powerful enough to run LabVIEW and Node-RED software smoothly.*
- *Sensors and actuators: Sensor kits (like those used with Arduino or Raspberry Pi) to allow learners to experiment with real data.*
- *Hardware platforms: Platforms compatible with LabVIEW and Node-RED for hands-on experiments and projects, such as IoT development kits.*
- *Laboratory equipment (industrial environment): If available, simulators or laboratory equipment for demonstrations of industrial applications with LabVIEW.*
- *Connectivity Accessories: Cables, adapters and other accessories needed to connect sensors, actuators and devices to computers.*
- *Manuals and Guides: Educational resources such as manuals, user guides and tutorials to support the learning of graphical programming languages.*

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01-02	**Introduction to Graphics Programming Languages** - *Introduction to visual programming concepts, overview of LabVIEW and Node-RED.*	6	- *Understanding of the basics of graphical programming languages and familiarization with development environments*
03-04	**LabVIEW Fundamentals** - *Exploration of the main functionalities of LabVIEW, creation of simple*	6	- *Acquisition of basic skills for programming in LabVIEW, understanding of graphic data*

	programs. - *Applications of IoT sensors in Virtual Reality environments.*		*structures.*
05-06	**Introduction to Node-RED** - *Overview of the Node-RED interface, creating simple data flows*	6	- *Familiarization with the Node-RED interface, introduction to creating data flows*
07-08	**Industrial Applications with LabVIEW** - *Practical experiments with LabVIEW in industrial contexts, control of virtual equipment.*	6	- *Understanding of industrial applications of LabVIEW, development of skills for simulation and control.*
09-10	**Using Node-RED for IoT** - *Integration of IoT sensors, creation of data feeds for IoT*	6	- *Experimenting with Node-RED in IoT scenarios, sensor integration and data flow*
11-12	**Practical Projects** - *Directed practical work, development of projects applying LabVIEW/Node-RED*	6	- *Practical application of the knowledge acquired through the realization of concrete projects*
13	**Testing and Debugging** - *Testing techniques, identifying and solving common problems*	3	- *Mastery of LabVIEW/Node-RED specific testing and debugging methods to ensure optimal performance*
14	**Evaluation and Presentation of Projects** - *Evaluation of completed projects, presentation of final results*	3	- *Evaluate the skills acquired by learners through the completion of projects and the presentation of results.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4-References

- *National Instruments (LabVIEW): https://www.ni.com/fr-fr/shop/labview.html - Official resources, tutorials and support for LabVIEW by National Instruments.*
- *Node-RED: https://nodered.org/ - Official Node-RED site, offering guides, examples and extensive documentation for learning and using Node-RED.*

- *[Book] LabVIEW Graphical Programming, Authors: Richard Jennings, Year: 2019,*
- *[Book] The LabVIEW Style Book, Author: Peter A. Blume, Year: 2007,*
- *[Book] Visual Programming Languages: Principles and Practices, Editors: Shi-Kuo Chang, Tadao Ichikawa, P.A. Ligomenides, Year: 1990,*
- *[Scientific Article] Visual Programming Languages: A Survey, Authors: T. R. G. Green, M. Petre, Year: 1996,*
- *[Scientific Article] A Graphical Programming Language and Its Supporting Tool for Developing Intelligent Building Applications, Year: 2020,*
- *[Scientific Article] Automated Code Development Based on Genetic Programming in Graphical Programming Environments, Year: 2023*

5- Working environment (Facilities necessary for learning)

- *LabVIEW/Node-RED software: Installation of LabVIEW and Node-RED development environments on each learner workstation or laptop.*
- *Computers: Computers compatible with the minimum specifications required to run LabVIEW/Node-RED software without performance issues.*
- *Sensors and Electronic Boards (optional): Sensor kits or electronic boards like Arduino or Raspberry Pi for practical integration experiments with Node-RED.*
- *Virtual Reality Headsets (if applicable): For VR experiences if the course includes applications related to virtual reality.*
- *Dedicated workspace: A dedicated space, if possible, to allow learners to experiment, work together and solve problems*

Subject Sheets Specialty: Virtual reality and game engineering

Course Specification

Integration project

1. General

Coded	*Inf-RV 4 1 03*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Montassar Ben Saad*					Vol. H. (TP)	
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*Integration project*					Version	*08/2023*

Course description (Course objective):
The "integration project" course aims to guide students in carrying out a complete IT project, from research to presentation, including planning, development, testing and writing a report. Indeed, this subject aims to develop students' skills in project management, collaboration and communication, as well as to allow them to apply the knowledge acquired in other subjects to a concrete project.

Prerequisites:	*Keywords :*
- *Mastery of at least one programming language commonly used in the field of video games, such as C++, C#, or Python.* - *Knowledge of Virtual Reality (VR), Graphics and Modeling 3D:* - *Knowledge Basics ofData in particular for the project involves the storage and management of data related to gaming or virtual reality.* - *Management SkillsProject, Communication and Teamwork* - *Understanding of video game design principles, including user experience (UX) design specific to virtual reality.*	*C++, C#, or Python. Virtual reality, Unity3D, Unreal Engine, Blender, Maya, Video Game Design.*

Specific course objectives (OBJi):
OBJ 1 : *Apply the technical skills acquired during previous years of computer science studies to a concrete project in the field of virtual reality and gaming.* ***OBJ 2 :*** *Design and develop a virtual reality/gaming project from start to finish, putting into practice concepts such as 3D modeling, interactive programming and performance optimization.* ***OBJ 3 :*** *Develop teamwork skills, including effective collaboration, conflict resolution, and division of tasks within a development team.* ***OBJ 4 :*** *Identify, analyze and resolve technical problems that may arise during the development of a virtual*

reality or gaming project.

OBJ 5 : *Be able to present and defend a project in front of an audience, demonstrating a thorough understanding of the work accomplished.*

OBJ 6 : *Be able to write a project report according to scientific and academic standards, and present the results obtained as well as the conclusions.*

Hardware and software required:
- *Virtual reality headsets compatible with the development platforms used (Oculus Rift, HTC Vive, Oculus Quest, etc.).* - *Integrated development environments (IDE) such as Unity3D or Unreal Engine.* - *3D modeling tools such as Blender, Maya, or 3ds Max.* - *Project management software such as Jira, Trello, or Microsoft Project.* - *Online communication and collaboration software such as Slack, Microsoft Teams, or Discord, to facilitate team collaboration.* - *Video capture devices for recording virtual reality test sessions.*

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1 :Introduction to the integration project* - *Introduction to the integration project* - *Presentation of the project and the team* - *Definition of project objectives and expectations*	*3h*	- *Choose a project.* - *Train the teams.* - *Set the main objectives.*
3-4	*Chapter2: Research and planning* - *Research on the project topic* - *Development of a detailed work plan* - *Methodological choice of work*	*3h*	- *Establishing a timetable and work plan* - *Analysis and specifications of project needs* - *Definition of objectives to achieve*
5-6	*Chapter3: Project Design* - *System modeling* - *Software design techniques* - *Choice of technologies and tools*	*3h*	- *Development of different design diagrams.* - *Discussion and validation of the design with the teacher.*
7-8	*Chapter 4:Project development* - *Realizationof the different stages of the project following the work plan*	*3h*	- *Collaboration and communication between team members*

	-		- Checking and monitoring project progress
9-10	Chapter 5:: Preparation of the report - Writing the project report - Presentation of results and conclusions	3h	- Analysis of errors and opportunities for improvement - Review and validation of the report with the teacher
11-12	Chapter 6: Preparing presentations	3h	- Establishing a presentation plan - Discussion and validation with the teacher
13-14	Practical exam, mini-project defense, …	3h	- Presentation of the project and its results to the class - Evaluation of projects and reports - Feedback and discussions

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	20%
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	80%

4-References

- Pressman, R. S., & Maxim, B. R. (2019). Software Engineering: A Practitioner's Approach (9th ed.). McGraw-Hill.
- Arvanitou, E.-M., Ampatzoglou, A., Chatzigeorgiou, A., & Carver, J. C. (2020). Software Engineering Practices for Scientific Software Development: A Systematic Mapping Study.
- Koi-Akrofi, G. Y., Koi-Akrofi, J., & Matey, H. A. (2019). Understanding the Characteristics, Benefits and Challenges of Agile IT Project Management: A Literature Based Perspective.
- https://www.pmi.org/: "Project Management Institute (PMI)» Resources and articles on project management.
- https://www.atlassian.com/en/agile/project-management: "Atlassian Project Management Guide" - Practical advice and guides for project management.
- https://docs.unity3d.com/: "Unity3D Documentation» - Complete documentation for the Unity game engine, often used in the development of games and virtual reality projects.
- https://docs.unrealengine.com/: "Unreal Engine Documentation» - Documentation for the

Unreal Engine, another popular choice for game development.

- *https://www.agilealliance.org/: "Agile Alliance» - Resources on Agile methodologies, useful for project management in software engineering*
- *https://www.scrum.org/resources/scrum-guide: "Scrum Guide» - Official Scrum Guide, a widely used Agile methodology.*
- *https://www.markdownguide.org/: "Markdown Guide» - Guide to using Markdown for writing documentation.*
- *https://www.latex-tutorial.com/: «LaTeX Tutorial» - Tutorial on using LaTeX, a document composition system commonly used in academic and technical circles.*
- *https://www.uxdesigninstitute.com/: "UX Design Institute» - User experience design resources.*
- *https://developer.oculus.com/design/latest/concepts/bp_intro/: "VR Design Best Practices» - Virtual Reality Design Best Practice Guidelines.*

6- Working environment (Facilities necessary for learning)

Development Software:

- *Integrated Development Environment (IDE):Unity3DOrUnreal Engine, depending on course preferences.*
- *Visual StudioOrVisual Studio Codefor code development. 3D Modeling Tools:*
- *blender- Free and open source 3D modeling tool.*
- *Autodesk Maya- Professional solution for 3D modeling (may require an academic license).*

Virtual Reality Environment:

- *VR headsets:Oculus RiftOrOculus Questfor Oculus apps.*
- *SteamVR- Platform for virtual reality applications compatible with various headsets.*
- *Communication and Collaboration Software:*
- *Microsoft Teams- Integrated collaboration platform.*

Project Management Tools:

- *Jira- For Agile project management.*
- *Trello- Simple kanban board for project management.*
- *Microsoft Project- For more complex projects.*

Documentation and Writing:

- *MSWord orLatex- For writing technical documents and reports.*
- *Version Control Systems:*
- *Git- For tracking changes in source code.*
- *Code hosting platforms such asGitHubOrGitLabfor storage and collaboration on projects.*

Web Development Environment (if applicable):

- *Node.js- Platform for running server-side JavaScript code.*
- *ReactOrAngularfor the development of web user interfaces.*

Course Specification

Advanced OOP

1. General

Coded	*Inf-RV 4 1 04*	Level/Semester	4/S1	Coefficient	3	Credits	3
Course	VIRTUAL REALITY AND GAME ENGINEERING					Vol. H. (CI)	0
Responsible	Mouhieddine Belghith					Vol. H. (TP)	42
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	30
Module	Advanced OOP					Version	08/2023

Course description (Course objective):
This advanced Object Oriented Programming course in Java expands OOP skills. It explores advanced concepts such as GUIs, events, databases, threads and advanced collections. Students will learn sophisticated programming techniques, designing robust software architectures, and solving complex problems with Java. Practical work and case studies are integrated to reinforce advanced OOP skills and encourage the development of concrete projects.

Prerequisites:	Keywords :
- *In-depth knowledge of fundamental concepts of object-oriented programming (classes, objects, inheritance, polymorphism, interfaces, and collections in Java).* - *Advanced understanding of basic Java programming concepts, including data manipulation and control structures.* - *Hands-on experience with Java language fundamentals.*	*Interface Graphics, database, thread, collection, exception, event, mvc*

Specific course objectives (OBJ):
OBJ 1 : *Deepen students' understanding of advanced object-oriented programming concepts in Java.* ***OBJ 2 :*** *Explain in detail advanced aspects such as GUIs, events, system interaction, databases, threads and advanced collections.* ***OBJ 3 :*** *Provide students with advanced Java programming skills to design robust software architectures.* ***OBJ 4 :*** *Teach sophisticated techniques for solving complex problems using object-oriented programming.* ***OBJ 5 :*** *Encourage practical application through practical work, case studies and concrete projects to consolidate the skills acquired.*

Necessary material :
- *A computer with a Java development environment such as IntelliJ IDEA, Eclipse or NetBeans.*
- *Internet access for additional resources, Java documentation and updates.* - *A Java reference manual for quick reference of concepts.*

2- Content elements (Practical work)

Week(s)	*Activities/Content elements*	No. HR	*Goals*
01-02	***Graphic interface (GUI - Graphical User Interface)*** - *Introduction to graphical interfaces in Java.* - *Use of graphic components: buttons, text fields, menus, etc.* - *Creating windows and panels for user interface design.* - *Using layouts to organize graphic components.*	6	- *Understanding the basics of GUIs in Java, creating windows, adding components and layout*
03-04	***Event Handling*** - *Understanding the event model in Java.* - *Handling user events: mouse clicks, keyboard touches, etc.* - *Attaching event listeners to widgets.* - *Implementing responses to events.*	6	- *Proficient in handling user events (mouse clicks, keyboard touches) and binding event listeners*
05-06	***Databases*** - *Connection to a database from Java.* - *Using JDBC (Java Database Connectivity) to perform read and write operations in a database.* - *Management of transactions and advanced SQL queries.*	6	- *Connecting to a database, using JDBC to perform read/write operations and manipulating data*
07-08	***Threads*** - *Introduction to multi-threaded programming in Java.* - *Creation and management of threads.* - *Synchronization and conflict management in multi-threaded programs*	6	- *Learn multi-threaded programming, creation, thread management and synchronization to prevent conflicts*

09-10	***Collections***	6	- *Advanced use of Java data structures to store and*
	- *Presentation of the different data structures provided by Java: lists, sets, maps, etc.* - *Using collections to store, manipulate, and organize data efficiently.*		*manipulate information efficiently*
11	***Graphics*** - *Using drawing and graphics rendering features in Java.* - *Creating simple and complex graphics.* - *Manipulation of images and graphics.*	3	- *Image manipulation, graphics rendering, and 2D chart creation*
12	***Model-View-Controller (MVC)*** - *Introduction to MVC software architecture.* - *Application of MVC pattern in Java application development.*	3	- *Introduction to MVC software architecture and application in Java application development*
13	***Mini-project*** - *Evaluation of mini projects*	3	- *The main goal of an advanced OOP mini-project could be to create a simple graphical application to demonstrate understanding of basic Java programming and user interface concepts with Swing*
14	***Exam*** - *Practical exam*	3	- *An advanced OOP practice exam generally aims to assess students' practical skills in advanced Java programming.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

5-References

- *Oracle Java Documentation: https://docs.oracle.com/javase/ - The official Java documentation provided by Oracle, containing tutorials, guides and references for Java SE.*
- *Vogella Java Tutorials: http://www.vogella.com/tutorials/java.html - Comprehensive and detailed tutorials on Java, including object-oriented programming.*
- *JavaTpoint: https://www.javatpoint.com/ - A site offering tutorials, code samples, articles and Q&As about Java and OOP.*
- *Baeldung: https://www.baeldung.com/ - A site with articles and how-to tutorials on many Java topics, including OOP.*
- *JournalDev Java Tutorials: https://www.journaldev.com/java-tutorials-example - A collection of tutorials, examples and articles on different aspects of Java.*
- *Stack Overflow: https://stackoverflow.com/questions/tagged/java - A Q&A platform where you can find answers to specific questions about Java and OOP, as well as ask your own questions.*

6- Working environment (Facilities necessary for learning)

- *Software and Tools: Access to integrated development environments (IDE) such as IntelliJ IDEA, Eclipse or NetBeans for Java programming.*
- *Libraries and Frameworks: Where applicable, access to specific libraries or frameworks used in the course, such as JavaFX for GUIs.*

Course Specification

Advanced web development

1. General

Coded	*Inf-RV 4 1 05*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Nahla Baccar*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*30*
Module	*Advanced web development (Angular)*					Version	*08/2023*

Course description (Course objective):
The course aims to train fourth-year engineering students in advanced concepts of web development with Angular. They are expected to gain a deep understanding of the Angular framework and develop advanced skills to create dynamic, responsive and high-performing web applications.

Prerequisites:	*Keywords :*
- *Mastery of basic web languages: HTML, CSS, JavaScript.* - *Prior knowledge of basic web development concepts.*	*Angular, Angular Modules, Angular Services, Angular Directives, NgRx, Redux, Performance Optimization, Lazy Loading, HttpClient, Unit and Integration Testing, Angular Deployment.*

Specific course objectives (OBJi):

OBJ 1 : *Advanced Understanding of Angular.*

OBJ 2 : *Mastery of NgRx for State Management.*

OBJ 3 : *Integration of Backend Services.*

OBJ 4 : *Unit and Integration Testing.*

OBJ 5 : *Angular Application Deployment.*

OBJ 6 : *Application of Skills:*

OBJ 7 : *Develop a functional, responsive and well-optimized Angular web application.*

Necessary material :

- *A computer with a compatible operating system (Windows, macOS or Linux).*
- *A development environment (IDE) for programming.*
- *Internet access to download additional software and resources.*

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	- Goals
1-2	*Chapter 1: Introduction to Angular / Installation* *- Presentation of the Angular framework*	*6h*	*- Installing and configuring Angular CLI* *- Creation of a first Angular project*
3-4	*Chapter2: Creation of modules/Components/Models*	*6h*	*- Structuring an Angular application into modules.* *- Creating components and models*
5-6	*Chapter 3: Data Binding and Structural Guidelines*	*6h*	*- Exploring data binding.* *- Using structural directives to manipulate the DOM.*
7-8	*Chapter 4: Communication between Components and Routing*	*6h*	*- Putting communication between components into practice.* *- Using services to share data between components.* *- Implementation of the routing system for navigation.* *- Using routing parameters.*
9-10	*Chapter 5: Angular Services and Forms Management*	*6h*	*- Creation and use of Angular services.* *- Managing forms with ReactiveFormsModule.*
11-12	*Chapter 6: HttpClient, Observables and Mock JSON Server*	*6h*	*- Using HttpClient to make HTTP requests.* *- Configuring a mock JSON server with the Mock Server.* *- Final Project: Launch of a mini-project integrating all the concepts learned.*
13-14	*Practical exam, mini-project defense, …*	*6h*	*- Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-

EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Concepts (4 points).*
- *Criterion 2: Code quality (4 points).*
- *Criterion 3: Putting it into Practice (4 points).*
- *Criterion 4: Project Management (4 points).*
- *Criterion 5: Communication and Documentation (2 points).*
- *Criterion 6: Participation and Collaboration (2 points).*

5- References

- *Almeida, F., & Monteiro, J. (2017). "Angular and the Trending Frameworks of Mobile and Web-based Applications." Future Technologies Conference (FTC) 2017, pp. 1281-1286*
- *Sharma, S., & Sinha, A. (2020). "An Interpretation and Anatomization of Angular." International Research Journal of Engineering and Technology (IRJET), 7(5), 3691-3695.*
- *Kreider, D. (2020). The 13 Best Angular Books of 2023 (In-Depth Review).*
- *Kumar, A., & Kumar, P. (2021). "Web Development Using Angular: A Case Study." International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 7(5), 245-250.*
- *Angular Team, Angular Documentation, Continuous update. Available: https://angular.io/docs.*
- *NgRx Team, NgRx Documentation, Continuous update. Available: https://ngrx.io/docs.*
- *ReactiveX, RxJS Documentation, Continuous update. Available: https://rxjs.dev/.*
- *V. Hazenkamp, Angular University - Comprehensive Angular Courses, Continuous update. Available: https://angular-university.io/.*
- *Various Contributors, Angular In Depth - Advanced Angular Articles, Continuous update. Available: https://indepth.dev/.*
- *Typicode, Mock JSON Server - JSONPlaceholder, Continuous update. Available: https://jsonplaceholder.typicode.com/.*
- *Various Contributors, Angular Testing Guide - Jasmine & Karma, Continuous update. (URL à préciser si disponible).*
- *F. Almeida and J. Monteiro, "Angular and the Trending Frameworks of Mobile and Web-based Applications," in Future Technologies Conference (FTC), 2017, pp. 1281-1286. Available:*

6- Working environment (Facilities necessary for learning)

- *Node.js and npm:*
  Install Node.js, which includes npm (Node Package Manager). URL: https://nodejs.org/
- *Angular CLI:*
  Install Angular CLI globally using npm.
- *Code Editor:*
  Choose a code editor such as Visual Studio Code, Atom, or Sublime Text. Visual Studio Code URL: https://code.visualstudio.com/
- *Web browsers:*
  Make sure you have one or more web browsers installed, such as Google Chrome, Mozilla Firefox, or Microsoft Edge.
- *Git (Optional):*
  Git can be useful for version tracking and source code management. URL:https://git-scm.com/
- *GitHub Account (Optional): URL: https://github.com/*

Course Specification

Artificial intelligence

1. General

Coded	*Inf-RV 4 1 06*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Boutheina Ben Ismail*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*34*
Module	*Artificial intelligence*					Version	*08/2023*

Course description (Course objective):

This course aims to equip students with essential skills in artificial intelligence by enabling them to master fundamental concepts, AI approaches in video games and virtual reality, as well as machine learning and Big Data techniques. Students will develop programming skills using languages like Python, apply AI algorithms to real datasets, and evaluate model performance using appropriate metrics. They will also explore the ethical implications of AI and propose solutions to mitigate risks. Emphasis will be placed on hands-on practice through real-world case studies, fostering their ability to design intelligent solutions. Additionally, students will be encouraged to stay updated on emerging AI trends and engage in continuous learning to adapt to the field's rapid evolution.

Prerequisites:	*Keywords :*
- *Basic notions of artificial intelligence such as machine learning and knowledge base construction.*	*Artificial intelligence, Python, learning, machine learning, deep learning, Big data, knowledge base, intelligent agent, expert system……*

Specific course objectives (OBJi):

OBJ 1 : *Introduction to AI (Definitions, histories, fields of application, programming languages).*

OBJ 2 : *Recognize the role of AI in video games and virtual reality.*

OBJ 3 : *Familiarization with the concept of intelligent agent (programming and architecture).*

OBJ 4 : *Fundamentals of Python for AI(advanced data structures, functions and modules and file and data manipulation)*

OBJ 5 : *Machine Learning with Python (Introduction to Machine Learning: Types of Learning, General Process, Popular Libraries, and Data Preparation)*

OBJ 6 : *Supervised learning (linear regression and classification algorithms and evaluation of learning models)*

OBJ 7 : *Unsupervised learning (clustering and dimension reduction algorithms)*

OBJ 8 : *Neural networks and deep learning (Introduction to artificial neural networks and deep neural networks)*

Necessary material :
- *A computer equipped with a configuration suitable for resource-intensive tasks, such as a Gaming PC, is highly recommended for working efficiently on Google Colab using Python.* - *PC has a robust internet connection to ensure fast data downloads and uploads while using Colab.*

2- Content elements (Practical work)

Week(s)	*Activities/Content Items*	No. HR	Goals
1	***Introduction to AI****:* - *Basics of artificial intelligence.* - *Definitions and histories.* - *Main areas of application.* ***Programming languages for AI*** - *Presentation of languages commonly used in AI (Python).* - *Practical exercises in Python for a quick introduction.*	*3h*	*OBJ1*
2	***LAB 1: Application of AI in video games*** - *Case study on the use of AI in video games.* - *Simple programming of game mechanics using AI concepts.*	*3h*	*OBJ2*
3	***LAB 2: AI in virtual reality*** - *Exploring the role of AI in creating virtual environments.* - *Implementation of simple algorithms for managing virtual agents.*	*3h*	*OBJ2*
4	***LAB 3: Programming intelligent agents*** - *Introduction to intelligent agent programming.* - *Use of a programming language (Python) to simulate agent behaviors.*	*3h*	*OBJ3*
5	***LAB 4: Architecture of intelligent agents*** - *Understanding of intelligent agent architectures.* - *Design and implementation of a simple architecture.*	*3h*	*OBJ3*
6	***Lab 5: Advanced data structures in Python*** - *Manipulation of lists, tuples, dictionaries, and sets.* - *Practical exercises on data structures.*	*3h*	*OBJ4*
7	***LAB 6: Functions and modules in Python*** - *Creation of functions and modules in Python.* - *Using functions to solve problemsspecific themes.*	*3h*	*OBJ4*

8	***LAB 7: Manipulating files and data in Python*** - *Reading and writing files.* - *Data manipulation with libraries like Pandas.*	*3h*	*OBJ4*
9	***Lab 8: Introduction to machine learning*** - *Fundamental concepts of machine learning.*	*3h*	*OBJ5*
	- *Exploration of types of learning (supervised, unsupervised).* ***Lab 9: Popular Libraries for Machine Learning in Python*** - *Using libraries such as Scikit-Learn and TensorFlow.* - *Application of machine learning concepts on simple datasets.*		
10-11	***LAB 10: Supervised learning - Linear regression and classification*** - *Implementation of linear regression and classification models.* - *Evaluation of model performance.* ***LAB 11: Unsupervised learning - Clustering and dimension reduction*** - *Use of clustering algorithms (K-means) and dimension reduction.* - *Results analysis.*	*6h*	*OBJ6* *OBJ7*
12-13	***LAB 12: Introduction to neural networks*** - *Understanding the basic concepts of neural networks.* - *Simple programming of a neural network using a library like TensorFlow.*	*6h*	*OBJ8*
14	- *Practical exam*	*3h*	*Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Mastery of programming in python with Google Colab (4 points)*
- *Criterion 2:Effective use of machine learning(8 points)*

- *Criterion 3:Big Data management and implementation of unsupervised learning algorithms (8 points)*
- *Criterion 4: Quiz and test for assessing theoretical knowledge in AI. (40% rating)*

5- References

- Russell, S. J., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (2nd ed.). O'Reilly Media.
- Murphy, K. P. (2012). Machine Learning: A Probabilistic Perspective. MIT Press.
- Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
- LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-444.
- Schmidhuber, J. (2015). Deep Learning in Neural Networks: An Overview. Neural Networks, 61, 85-117.
- Silver, D., et al. (2016). Mastering the game of Go with deep neural networks and tree search. Nature, 529(7587), 484-489.
- Chollet, F. (2017). Xception: Deep Learning with Depthwise Separable Convolutions. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR).
- Bostrom, N. (2014). Ethical Issues in Advanced Artificial Intelligence. Cambridge Handbook of Artificial Intelligence, 316-334.
- TensorFlow: https://www.tensorflow.org/
- PyTorch: https://pytorch.org/
- Scikit-learn: https://scikit-learn.org/
- Towards Data Science (Blog IA et Machine Learning) : https://towardsdatascience.com/
- OpenAI Blog: https://openai.com/research/
- Google AI: https://ai.google/
- MIT Artificial Intelligence Lab: https://www.csail.mit.edu/

6- Working environment (Facilities necessary for learning)

- *Use Google Colab to install Python: https://colab.research.google.com/*
- *https://jupyter.org/*

Course Specification

Advanced databases

1. General

Coded	*Inf-RV 4 1 07*	Level	*4/S1*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Bochra Rabbouch*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Advanced databases*					Version	*08/2023*

Course description (Course objective):
This course aims to equip engineers with the technical skills needed to efficiently administer databases, transition from the relational model to the object-oriented model using the Relational Object Model, and master advanced SQL3 concepts. Students will develop expertise in database management, optimization, and migration while gaining a deep understanding of modern database architectures to enhance data integrity, scalability, and performance.

Prerequisites:	*Keywords :*
Relational model (structure, constraints, SQL 2, PL/SQL)	*Database administration* *Relational Object Databases*

2- Content elements (TP)

Week(s)	Activities/Content Items	No. HR	Goals
1, 2	*TP1/* *Reminder: Creation of tables, insertion into tables, addition of constraints* *Creating simple views* *Querying the data dictionary to consult the different integrity constraints and views*	*3*	- *Reminder + first consultation of the data dictionary*
3.4	*TP2/* *Migration between the SYSTEM user (the administrator) and a newly created user (with profiles) and injection of privileges according to the latter's needs.*	*3*	- *Know the difference between a newly created user (without privileges) and between the administrator.*

	Creation of synonyms for a view of TP 1 and reception of object privileges by the administrator for this view. *Inserting into a simple view and the result showing in the original table*		
5.6.7	*TP3/* *Creation of complex views and knowing the conditions for modifying these views (querying the system view (USER_UPDATABLE_COLUMNS) to find out if these views are modifiable or not* *Querying the data dictionary and administering the database using information collected from system views (USER_VIEW, USER_CONSTRAINTS, USER_SYNONYMS, All_USERS, USER_TABLES, etc.)*	*4.5*	- *Know the structure of the data dictionary and how to use it to obtain the appropriate system views to administer your database.* - *Know the differences between system views according to their prefixes (USER_.., ALL_.., DBA_...)* - *The differences between simple and complex views* - *Transaction management*
8,9,10	*TP4 / Modeling an object database from a textual description* *Creating abstract data types* *Creation of object tables* *Insertion into object tables*	*4.5*	- *Modeling an object database with the minimum of tables* - *Adding different abstract data types (VARRAY, NESTED TABLE, OBJECT) and arguing the choices.* - *Creating Object tables* - *Insertion into object tables*
11,12,13	*TP5 / Querying object tables and extracting information* *Modifying abstract data types and adding methods and implementations of their bodies using PL-SQL functions and procedures*	*4.5*	- *Implementation of TAD methods and querying the object database*
14	*Practical exam, mini-project defense, …*	*1.5h*	- *Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*

DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: creation of users (using profiles) and adding privileges (3 points)*
- *Criterion 2: Views, transactions and querying the data dictionary (5 points)*
- *Criterion 3: Creation of abstract data types and creation of object tables + data insertion (6 points)*
- *Criterion 4: Methods of abstract data types and data querying (6 points)*

5- References

- *Oracle. (n.d.). Oracle Database Documentation. Retrieved from https://docs.oracle.com/en/database/*
- *PostgreSQL. (n.d.). PostgreSQL Documentation. Retrieved from https://www.postgresql.org/docs/*
- *IBM. (n.d.). IBM Db2 Database Documentation. Retrieved from https://www.ibm.com/docs/en/db2/*
- *MySQL. (n.d.). MySQL Reference Manual. Retrieved from https://dev.mysql.com/doc/*
- *W3Schoo*ls. (n.d.). SQL Tutorial. Retrieved from https://www.w3schools.com/sql/
- Elmasri, R., & Navathe, S. B. (2020). Fundamentals of Database Systems (7th ed.). Pearson.
- Silberschatz, A., Korth, H. F., & Sudarshan, S. (2020). Database System Concepts (7th ed.). McGraw-Hill.
- Date, C. J. (2019). An Introduction to Database Systems (8th ed.). Pearson.
- Connolly, T., & Begg, C. (2014). Database Systems: A Practical Approach to Design, Implementation, and Management (6th ed.). Pearson.
- Cattell, R. (2011). Relational Databases and Object-Oriented Extensions. Addison-Wesley.
- Ullman, J. D., & Widom, J. (2008). A First Course in Database Systems (3rd ed.). Pearson.
- Stonebraker, M., & Hellerstein, J. M. (2005). *What Goes Around Comes Around*. *Readings in Database Systems*, 5th ed., MIT Press.

6- Working environment (Facilities necessary for learning)

- *Oracle, 18g, https://www.oracle.com/*

Course Specification

Big Data

1. General

Coded	*Inf-RV 4 1 08*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Marwa Ben Jabra*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Big Data*					Version	*08/2023*

Course description (Course objective):
The "Big Data and Related Technologies for Gaming Engineers" course aims to provide game engineering students with an in-depth understanding of Big Data technologies and their application in the gaming industry. Students will be exposed to tools and essential skills for managing, processing and analyzing massive data, with emphasis on Docker, Hadoop, MongoDB, HBase and Spark technologies.

Prerequisites:	*Keywords :*
- *Basic knowledge of programming (preferably Java and/or Python).* - *General understanding of relational databases.* - *Familiarity with operating systems and the command line.* - *A computer with enough resources to run virtual machines and Big Data clusters.*	*Big Data, Docker, Hadoop, HDFS, MapReduce, MongoDB, NoSQL, HBase, Spark, Real-time storage, Real-time analytics.*

Specific course objectives (OBJi):

OBJ 1 : *Understand the key concepts of Big Data, its benefits and challenges in the video game industry.*

OBJ 2 : *Master the use of Docker for creating and managing Big Data application containers.*

OBJ 3 : *Acquire skills in Hadoop HDFS and MapReduce for storing and processing massive data.*

OBJ 4 : *Know how to use MongoDB as a NoSQL database to manage and analyze game data.*

OBJ 5 : *Be able to design real-time storage systems using HBase for video game needs.*

OBJ 6 : *Explore Spark and its use in real-time analysis of gaming data, focusing on performance optimization.*

Necessary material :
- *A computer with a compatible operating system (Windows, macOS or Linux).* - *A development environment (IDE) for programming in Java and/or Python.* - *Internet access to download additional software and resources.* - *Ability to run virtual machines (e.g. VirtualBox) to configure Docker, Hadoop, and Spark environments.* - *A Big Data cluster for practical work, which can be configured locally or on a cloud infrastructure.* - *Documentation, manuals and online learning resources for Docker, Hadoop, MongoDB, HBase and Spark technologies.*

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Big Data and Docker* - *Introduction to Big Data and its implications for video game engineering.* - *Overview of Docker and its use in Big Data development.*	*3h*	- *Understand Big Data concepts.* - *Master the use of Docker for Big Data applications.*
3-4	*Chapter2: Hadoop HDFS and MapReduce* - *Hadoop HDFS: distributed data storage.* - *MapReduce: batch programming model.* -	*3h*	- *Acquire skills in big data storage with Hadoop.* - *Know how to use MapReduce for data processing.*
5-6	*Chapter 3: NoSQL Databases with MongoDB* - *Introduction to MongoDB and its JSON data model.* - *CRUD (Create, Read, Update, Delete) operations with MongoDB.*	*3h*	- *Understand the use of MongoDB as a NoSQL database.* - *Be able to manage and analyze game data with MongoDB.*
7-8-9	*Chapter 4: HBase for real-time data storage* - *Presentation of HBase, architecture and data model.* - *Using HBase for real-time storage.*	*4.5h*	- *Know HBase and its applications for real-time storage.*
10-11-12	*Chapter 5: Real-Time Data Processing with Apache Spark* - *Introduction to Spark, RDDs, transformations and actions.* - *Using Spark for real-time analysis of game data.*	*4.5h*	- *Learn how to use Spark for real-time analysis of gaming data.*
13-14	- *Practical exam, mini-project defense, …*	*3h*	- *Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Big Data concepts (3 points)*
- *Criterion 2: Mastery of using Docker (3 points)*
- *Criterion 3: Skill in Hadoop HDFS and MapReduce (4 points)*
- *Criterion 4: Use of MongoDB (3 points)*
- *Criterion 5: Knowledge of HBase (3 points)*
- *Criterion 6: Use of Spark for real-time analysis (4 points)*

5- References

- *Marr, B. (2017). Data Strategy: How to Profit from a World of Big Data, Analytics and Artificial Intelligence. Kogan Page.*
- *Karau, H., & Warren, R. (2017). High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark. O'Reilly Media.*
- *Chodorow, K. (2019). MongoDB: The Definitive Guide (3rd ed.). O'Reilly Media.*
- *Madiraju, M. (2023). Hello HBase World from Spark World. Medium.*
- *Cheema, A. (2025). Your Gaming PC Could Help Train AI Models. The Wall Street Journal.*
- *Globant. (2024). AI and Data: The Game Changers Transforming Gaming Today.*
- *"Apache Hadoop Documentation" - Official Apache Hadoop documentation:*

  - Author: Apache Software Foundation

  - URL:https://hadoop.apache.org/docs/

  - Year: Consult the most recent documentation.
- *"MongoDB Documentation" - Official MongoDB documentation:*

  - Author: MongoDB, Inc.

  - URL:https://docs.mongodb.com/

  - Year: Consult the most recent documentation.
- *"Apache HBase Documentation" - Official Apache HBase documentation:*

  - Author: Apache Software Foundation

  - URL:https://hbase.apache.org/book.html

  - Year: Consult the most recent documentation.

- *"Apache Spark Documentation" - Official Apache Spark documentation:*

  - Author: Apache Software Foundation

  - URL:https://spark.apache.org/docs/latest/

  - Year: Consult the most recent documentation.
- *"Docker Documentation" - Official Docker documentation:*

  - Author: Docker, Inc.

  - URL:https://docs.docker.com/

  - Year: Consult the most recent documentation.
- *"Introduction to Big Data" - Introduction to Big Data by IBM Developer:*

  - Author: IBM

  - URL:https://developer.ibm.com/technologies/big-data/

  - Year: View resources updated by IBM.
- *"NoSQL Databases" - Presentation of NoSQL databases by Oracle:*

  - Author: Oracle Corporation

  - URL:https://www.oracle.com/database/what-is-nosql.html

  - Year: See the most recent information provided by Oracle.

6- Working environment (Facilities necessary for learning)

- *1. Docker:*

  - Version: The latest stable version of Docker.

  - URL:https://www.docker.com/get-started

  - Description: Docker is essential for managing Big Data application containers. Students must install Docker on their system.

- *2. Hadoop:*

  - Version: Apache Hadoop 3.x

  - URL:https://hadoop.apache.org/

  - Description: Students can configure a Hadoop cluster on their own machine or use a cloud Hadoop cluster for practical work.

- *3. MongoDB:*

  - Version: The latest stable version of MongoDB.

  - URL:https://www.mongodb.com/try/download/community

  - Description: MongoDB will be used as a NoSQL database in the course. Students must install MongoDB.

- *4. HBase:*

  - Version: Apache HBase 2.x

  - URL:https://hbase.apache.org/

  - Description: HBase will be used for real-time storage. Students can configure HBase locally or

on a Hadoop cluster.

- *5. Apache Spark:*
  - Version: Apache Spark 3.x
  - URL:https://spark.apache.org/downloads.html
  - Description: Apache Spark will be used for real-time data processing. Students must install Spark locally or on a cluster.

- *6. IDE (Integrated Development Environment):*
  - Recommendation: IntelliJ IDEA, Eclipse, or PyCharm (depending on the programming language used).
  - URL: According to the choice of the IDE.
  - Description: An IDE is essential for programming and development in Java and Python languages.

Course Specification

Mathematics applied to geometry and 3D modeling

1. General

Coded	*Inf-RV 4 1 09*	Level/Semester	*4/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Malika Jellouli*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Mathematics applied to geometry and 3D modeling*					Version	*08/2023*

Course description (Course objective):

3D modeling is a recent part of computer science and which continues to develop thanks to the scientific progress from which computer science benefits; it is essentially based on complex mathematical laws. The modeling of 3D objects can be handled by numerous methods, each of which is well suited to a specific field of application.

So, this course addresses mathematical notions allowing you to achieve these objectives by defining: vector, affine and projective spaces, parametric and implicit surfaces, applications allowing you to modify these surfaces in order to be able to place them wherever you want in space.

Prerequisites:	*Keywords :*
- *Understanding of basic concepts of geometry, vectors, and transformations.* - *Knowledge of basic algebraic concepts, including equations and functions.* - *Skill in using computer tools, such as 3D modeling software.*	*3D Modeling, Vector Spaces, Parametric Surfaces, Mathematical Geometry, Mathematical Modeling, Object Positioning*

Specific course objectives (OBJi):

OBJ 1 : *Gain an in-depth understanding of the mathematical concepts underlying 3D modeling, including vector spaces, affine and projective spaces.*

OBJ 2 : *Be able to model surfaces using parametric and implicit representations.*

OBJ 3 : *Learn to use specific applications that allow you to modify 3D surfaces, deforming or transforming them to meet specific needs.*

OBJ 4 : *Know how to position modeled objects in a 3D space using appropriate mathematical transformations.*

OBJ 5 : *Understand how to apply 3D modeling concepts to specific application areas, such as game design, simulation, animation, etc.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 0: introduction* - *Generality* - *Some applications* - *From acquisition to 3D modeling* - *3D modeling methods* - *3D standards and formats*	*3h*	
3-4-5	*Chapter 1: 3D object modeling* - *Introduction* - *Different modeling modes* - *Border models* - *Volume models* - *Scan Models* - *Fractal patterns* - *Polygonal models* - *Models by surface subdivision* - *Conclusion*	*4.5h*	
6-7-8	*Chapter 2: Surface representation* - *Introduction* - *Goals* - *Surface vs. Volume* - *Continuous vs Discrete* - *Volume model* - *CSG* - *Implicit surface* - *Blobtree* - *Convolution surface* - *Spatial enumeration* - *Surface model*	*4.5h*	

	- *Parametric representation* - *B-rep* - *Point clouds* - *Meshes* - *Subdivision surfaces* - *Heightfield (matrix representation)* - *Balance sheet*		
9-10-11	*Chapter 3: Meshes* - *Introduction* - *Definition: Mesh* - *Characteristics of the faces* - *Ratio of numbers of primitives* - *Tetrahedra and polyhedra* - *Feature interpolation* - *Orientation* - *Discrete topology concepts* - *Adjacency and incidence* - *Distance* - *Neighborhood* - *Valence* - *Quality of a mesh* - *Variety* - *Rationale for use* - *Rendering* - *Linear approximation* - *Mesh operations* - *Local operations* - *Global Operations* - *Data Structures* - *Why multiple structures. ?* - *Winged-edge* - *Half-edge* - *Combinatorial map* - *specific* - *Storage formats* - *XML* - *OFF* - *OBJ* - *Others*	*4.5h*	

12-13-14	*Chapter 4: Surface Reconstruction* - *Introduction* - *Point cloud operations* - *Distance* - *Neighborhood* - *Filtering* - *Calculation of normals* - *Orientation of normals* - *Triangulation* - *Mesh simplification* - *Convex hull* - *Crust algorithm* - *Extension* - *Optimal transport* - *Balance sheet* - *Neighborhood inference* - *Differential approach* - *Conclusion*	*4.5h*	

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: understanding of the generalities, applications, and methods of 3D modeling. (3 points)*
- *Criterion 2: Assessment of the ability to apply 3D object modeling concepts. (4 points)*
- *Criterion 3: Understanding of volume and surface models (2 points).*
- *Criterion 4: Assessment of the ability to analyze and compare surface and volume models. (3 points)*
- *Criterion 5: Meshes (4 points)*
- *Criterion 6: Surface reconstruction (4 points)*

5- References

- *“3D Modeling and Its Applications" Author: InTechOpen URL:https://www.intechopen.com/books/3d-modeling-and-its-applications Year: Last update not specified*
- *"Introduction to 3D Computer Graphics" Author: David M. Bourg and Bryan Bywalec URL:https://www.crcpress.com/Introduction-to-3D-Computer-Graphics/Bourg-Bywalec/p/book/9781138410319*
  Year: 2018
- *“Surface Modeling for CAD Applications: A Step-by-Step Guide”*
  Author: TV Johnson
  URL:https://www.sciencedirect.com/book/9780123884460/surface-modeling-for-cad-applications Year 2013
- *“Computational Geometry: Algorithms and Applications”*
  Authors: Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars
  URL:https://www.springer.com/gp/book/9783540656208
  Year: 1997
- *“Polygon Mesh Processing”*
  Authors: Mario Botsch, Leif Kobbelt, Mark Pauly, Pierre Alliez, Bruno Lévy
  URL:https://www.geometryprocessing.org/pmpbook/

6- Working environment (Facilities necessary for learning)

- *None.*

Course Specification

2D and 3D modeling

1. General

Coded	*Inf-RV 4 1 10*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Mahdi Mili*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*35*
Module	*2D and 3D modeling*					Version	*08/2023*

Course description (Course objective):
This course equips students with technical expertise in 2D and 3D modeling by developing key competencies in polygonal modeling, texture mapping, lighting configuration, and camera manipulation. Students will gain hands-on experience in creating complex 3D objects, optimizing materials and textures, adjusting scene illumination for realistic rendering, and producing high-quality final renders. These skills will enable them to efficiently design and visualize 3D environments for various applications, including gaming, virtual reality, and animation.

Prerequisites:	*Keywords :*
	3D modeling, polygonal editing, modifiers, lighting, camera, rendering

Specific course objectives (OBJi):
OBJ 1 : *Modeling objects: Exploring primitives and splines, Working with mesh and composite objects, Understanding editable polygons mode, Applying modifiers and understanding modifier stack management.* ***OBJ 2 :*** *Add and configure materials, textures, lighting and cameras: Use the materials library, Apply and manage textures, Generate UV mapping maps, Explore lighting types and their settings, Understand camera types and their parameters.* ***OBJ 3 :*** *Generate rendering: Configure ray tracing rendering, Apply radiosity rendering.*

Necessary material :
- *3D printer* - *Computer*

2- Content elements (Course / Practical work)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-2	*Workshop 1: Modeling 3D objects*	*6*	*- Primitives and splines* *- Mesh and Compound Objects* *- Editable polygons mode* *- Modifiers and Modifier Stacks*
3-4	*Workshop 2: Material aspect and textures of objects*	*6*	*- Material Library* *- Applying and managing textures* *- Generation of UV mapping maps*
5-6	*Workshop 3: Adding lights and cameras*	*6*	*- Types of lights* *- Shadow setting* *- Camera types and settings*
7-8	*Workshop 4: Modeling a 3D virtual scene*	*6*	*- Light and camera* *- Environment* *- Importing objects*
9-11	*Workshop 5: Configuration and rendering generation*	*9*	*- Ray tracing rendering* *- Rendered by radiosity*
12-14	*Practical exam, mini-project defense, …*	*9*	*- Summative evaluation*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of Fundamental Concepts: Assessment of understanding of basic concepts in 3D modeling, including polygonal modeling, materials, lighting, and rendering generation. (4 points)*
- *Criterion 2: Proficiency in the Use of Blender: Assessment of competence in the use of Blender software for modeling, material management, applying textures, and creating renderings. (4 points)*

- *Criterion 3: Assessment of creativity in modeling objects and staging 3D scenes, as well as originality in the application of materials and textures. (4 points)*
- *Criterion 4: Assessment of accuracy in the application and management of materials, textures, and generation of UV mapping maps. (4 points):*
- *Criterion 5: Assessment of the ability to effectively use different types of light, configure shadows, and manage cameras to obtain optimal perspectives. (4 points)*

5- References

- *Mckinley, M. (2012). The Game Artist's Guide to Maya. Pearson Education.*
- *Kerlow, I. V. (2021). The Art of 3D Computer Animation and Effects (5th ed.). Wiley.*
- *Gahan, A. (2017). 3ds Max Modeling for Games: Insider's Guide to Game Character, Vehicle, and Environment Modeling (2nd ed.). Routledge.*
- *Maestri, G. (2015). Digital Character Animation 3. New Riders.*
- *Blender - 3D modeling software Author: Blender Foundation URL: https://www.blender.org/ Year: Last update not specified*
- *Printables - Resources for 3D printing URL: https://www.printables.com/ Year: Last update not specified*
- *Creality - 3D printer manufacturer Author: Creality URL: https://www.creality.com/ Year: Last update not specified*

6- Working environment (Facilities necessary for learning)

- *Blender*
- *Creality*

Course Specification

Introduction to virtual reality (VR) and augmented reality (AR) technologies

1. General

Coded	*Inf-RV 4 1 11*	Level/Semester	*4/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	Introduction to virtual reality (VR) and augmented reality (AR) technologies					Version	*08/2023*

Course description (Course objective):
This course equips students with the technical skills necessary to design and develop virtual reality (VR) and augmented reality (AR) applications. Students will gain proficiency in fundamental VR/AR concepts, including spatial computing, interaction techniques, and immersion principles. They will learn to implement essential tasks such as 3D scene creation, motion tracking, user interaction handling, and rendering optimizations. Additionally, they will explore VR/AR development frameworks and engines, enabling them to build immersive and interactive applications across various platforms.

Prerequisites:	*Keywords :*
Basic knowledge of C# programming and object-oriented concept.	*VR, AR, immersion, VR headset (Meta Quest 2)*

Specific course objectives (OBJi):

OBJ 1 : *Understand the basic foundations of augmented and virtual reality in the context of developing an interactive application.*

OBJ 2 : *Analyze the distinctions between types of reality.*

OBJ 3 : *Be able to effectively use development tools for immersive experiences.*

OBJ 4 : *Be able to develop an Augmented Reality application.*

OBJ 5 : *Be able to develop an application allowing an immersion experience in Virtual reality.*

Necessary material :

- *A powerful PC containing a graphics card compatible with the VR headset*
- *Virtual reality headset*

- *Type C-Type C cable* - *Webcam*

2- Content elements (Course + TP)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Virtual Reality and AR* *1.1 History* *1.2 Definition of Virtual Reality and AR* *1.3 Human factors* *1.4 Virtual Reality Technology and AR* *1.5 Applications* *Chapter 2: Theoretical and pragmatic approach to virtual reality* *2.1 The problem* *2.2 Design of behavioral interfaces* *2.3 Two basic functionalities: Immersion and Interaction* *2.4 Design approach for a virtual reality system* *Chapter 3: Sensorimotor Channels and VR Interfaces* *3.1 Motor interfaces* *3.2 Sensorimotor manual interfaces (force feedback)* *3.3 Sensory interfaces* - *Sensory manual interfaces (the Skin sensitive interfaces)* - *Visual interfaces* - *Motion simulation interfaces and climate simulation interfaces* - *Olfactory interfaces* - *Sound interfaces*	*6h*	*OBJ1*
3	- *VR headsets available on the market (comparison)* - *Practical application with VR Headsets: Meta Quest 2.*	*3h*	*OBJ2*
4	- *Setting up and connecting VR headset with PC*	*3h*	*OBJ3*
5	- *- Load VR applications compatible with the Meta Quest 2 VR headset on PC and test them to experience the immersion.*	*3h*	*OBJ3*
6	- *Create an augmented reality application (1) with Unity:* - *Integration of the vuforia plugin into unity* - *Prepare the images images tracking*	*3h*	*OBJ4*

	- Add AR camera		
	- Add Target images - Assign a video to each Target frame		
7	Create an augmented reality application (2) with Unity: - Integration of the vuforia plugin into unity - Prepare the images images tracking - Add AR camera - Add Target images - Download 3D Assets (free) - Integrate assets in 3D - Assign materials to assets - Assign 3D assets to Target images	3h	OBJ4
8	- Configuration and configuration of AR applications created with Unity to publish them to an Android and iOS platform - Load and test APKs for Android and iOS	3h	OBJ4
9	Create a Virtual Reality application with Unity: - Project creation with specific choice - Import the packages related to the RV: - Open XR plugin - XR tolkit interaction - Configuring XR Plug-in Management - Test the application (with integrated 3D model by default) by connecting the Meta Quest 2 VR headset to the PC	3h	OBJ5
10	Create a Virtual Reality application with Unity (continued): - Configure right and left hand - Add 3D objects - Link objects with hand movements	3h	OGJ5
11-12	Create a Virtual reality application with Unity (continued): - Teleportation - Hover over objects - Holding objects - Interaction with objects - Test the application by connecting the Meta Quest 2 VR headset with PC	6h	OGJ5
13-14	Create a Virtual reality application with Unity (continued): - Teleportation - User interface - Custom hand pose with Unity XR Toolkit - Final rendering: APK generation - Test the application on PC with the VR headset	6h	OGJ5
	- Test the application independently With the Meta Quest 2		

	headset		

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: integration of plugins necessary for AR or VR (3 points)*
- *Criterion 2: integration of interface and/or Assets (3 points)*
- *Criterion 3: interactivity programming (7 points)*
- *Criterion 4: user interface (3)*
- *Criterion 5: APK generation (rendering) (3 points)*

5- References

- *Craig, A. B. (2018). Understanding Augmented Reality: Concepts and Applications (2nd ed.). Morgan Kaufmann.*
- *Jerald, J. (2016). The VR Book: Human-Centered Design for Virtual Reality. Morgan & Claypool.*
- *Billinghurst, M., Clark, A., & Lee, G. (2015). A Survey of Augmented Reality. Foundations and Trends in Human-Computer Interaction, 8(2-3), 73-272.*
- *Papagiannakis, G., Singh, G., & Magnenat-Thalmann, N. (2017). Mixed Reality and Gamification for Cultural Heritage. Springer.*
- *"Unity VR/AR Development" - Official Unity Documentation for VR and AR*

Author: Unity Technologies

URL: https://docs.unity3d.com/Manual/VR.html

Year: Consult the most recent documentation.

- *"Unreal Engine VR/AR Development" - Official Epic Games VR/AR Development Guide*

Author: Epic Games

URL: https://docs.unrealengine.com/5.0/en-US/virtual-reality-development-in-unreal-engine/

Year: Consult the most recent documentation.

- *"Microsoft HoloLens and Mixed Reality Documentation" - Guide for AR/VR application development*

Author: Microsoft

URL: https://learn.microsoft.com/en-us/windows/mixed-reality/develop/

Year: Consult the most recent documentation.

- *"WebXR API Documentation" - Guide for developing browser-based AR/VR applications*

Author: Mozilla Developer Network (MDN)

URL: https://developer.mozilla.org/en-US/docs/Web/API/WebXR_Device_API

Year: Consult the most recent documentation.

6- Working environment (Facilities necessary for learning)

- *Unity Hub*
- *Unity 2022.3.8*
- *Oculus*

Course Specification

Mobile development

1. General

Coded	*Inf-RV 4 2 04*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Firas Hmila*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Mobile development*					Version	*08/2023*

Course description (Course objective):
This course enables students to acquire the technical skills necessary for designing, developing, and deploying mobile applications integrating Virtual Reality (VR) and Augmented Reality (AR). Students will master mobile development frameworks (Unity, Unreal Engine), AR/VR SDKs (ARCore, ARKit, Vuforia), and optimization techniques for immersive applications on Android and iOS. They will develop skills in 3D rendering, spatial computing, motion tracking, real-time interactions, and UI/UX design for mobile AR/VR applications. Additionally, they will learn best practices for integrating AR/VR content, optimizing performance for mobile hardware, and deploying applications to app stores.

Prerequisites:	*Keywords :*
- *Prior knowledge of mobile development.* - *Understanding of basic concepts of virtual and augmented reality.*	

Specific course objectives (OBJi):

OBJ 1 : *Introduction to mobile development and Virtual Reality: Present a cross-platform development framework.*

OBJ 2 : *Learn the basics of mobile development. Create simple mobile apps with basic functionality.*

OBJ 3 : *Explore augmented reality libraries compatible with mobile apps. Integrate augmented reality elements into mobile applications.*

OBJ 4 : *Design intuitive user interfaces for VR/AR applications.*

OBJ 5 : *Implement advanced user interactions.*

Necessary material :
- *Computers.* - *Mobile virtual reality headsets.* - *Augmented reality development tools compatible with the framework used.*

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1 Introduction to Mobile and VR*	*6*	- *Installation and configuration of the development environment* - *Creation of a first application.*
3-5	*Chapter 2: Mobile application development*	*9*	- *Master the basics of mobile development* - *Creation of simple mobile applications.*
6-8	*Chapter 3: Introduction to Augmented Reality in mobile*	*9*	- *Discover and integrate AR libraries into mobile.* - *Creating a simple AR experience.*
9-11	*Chapter 4 Advanced Interaction in Virtual and Augmented Reality.*	*9*	- *Design and develop intuitive and advanced user interactions for VR/AR applications.* - *Optimization of interactions.*
12-14	*Practical Mobile Development Projects. Concrete application of the concepts learned*	*9*	- *Realization of concrete projects for VR/AR.* - *Presentation of the projects.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: In-depth assessment of understanding of fundamental concepts of Flutter. (4 points)*

- *Criterion 2: Assessment of the ability to use advanced features such as animations, advanced routing, and API calls. (4 points)*
- *Criterion 3: Assessment of understanding of basic concepts of virtual and augmented reality. (4 points)*
- *Criterion 4: Assessment of understanding of the integration of virtual and augmented reality elements into mobile applications. (4 points)*
- *Criterion 5: Assessment of the ability to apply VR/AR concepts in advanced application scenarios. (4 points)*

5- References

- *Schmalstieg, D., & Hollerer, T. (2016). Augmented Reality: Principles & Practice. Addison-Wesley.*
- *Heller, M. (2020). ARKit Developer Guide: Building Augmented Reality Experiences for iOS. Apress.*
- *Kim, J. (2021). Mastering ARKit: Augmented Reality App Development for iOS. Packt Publishing.*
- *. Papagiannakis, G., Singh, G., & Magnenat-Thalmann, N. (2017). Mixed Reality and Gamification for Cultural Heritage. Springer.*

- *Flutter Documentation Author :Google*
  URL: https://flutter.dev/docs
- *Google AR & VR Developer Resources Author :Google URL:https://developers.google.com/ar*
- *ARCore - Google's Platform for Building Augmented Reality Experiences for Android Author :Google*
  URL: https://developers.google.com/ar
- *Flutter ARCore Plugin on pub.dev Author :Flutter Community*
  URL: https://pub.dev/packages/arcore_flutter
- *Flutter ARKit Plugin on pub.dev Author :Flutter Community*
  URL: https://pub.dev/packages/arkit_flutter Unity - VR/AR Documentation:
- *Unity Documentation - VR & AR Development Author :Unity Technologies*
  URL:https://docs.unity3d.com/Manual/XR.html Year :Latest update available
- *Apple ARKit - Documentation: Name :ARKit Documentation Author :Apple*
  URL:https://developer.apple.com/documentation/arkit Year :Latest update available
- *Unreal Engine - Virtual and Augmented Reality: Name :Unreal Engine – VR & AR*
  Author :Epic Games
  URL: Unreal Engine VR & AR
  Year :Latest update available
- *Android Documentation - VR Development: Name :Android Developer - Virtual Reality Author :Google*
  URL: Android VR Documentation
  Year :Latest update available

6- Working environment (Facilities necessary for learning)

- *IDE (recommended: Visual Studio Code)*

- *ARCore Development Tools (for Android)*
- *ARKit Development Tools (for iOS)*
- *Virtual Reality Devices (optional)*
- *Emulators and Simulators*
- *Flutter packages for VR/AR*

Course Specification

Cloud computing

1. General

Coded	*Inf-RV 4 2 05*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Fakher Ben Ftima*					Vol. H. (TP)	*21*
Teaching methods	*Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*50*
Module	*Cloud computing*					Version	*08/2023*

Course description (Course objective):
The "Cloud Computing" course aims to familiarize students with the fundamental concepts of cloud computing and to develop their skills to apply these concepts in the context of virtual reality (VR) and gaming. Students will explore cloud services, architectures, and best practices for deploying VR applications and games in the cloud.

Prerequisites:	*Keywords :*
- *In-depth understanding of the fundamentals of virtual reality.* - *Understanding of the basics of computer networking, including protocols, network security and communication principles.* - *Knowledge of operating systems, particularly those used in VR game and application development.* - *Understanding of fundamental cloud computing concepts, including service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid cloud).* - *Knowledge of basic IT security principles, with particular awareness of security aspects related to cloud computing.*	*Cloud Computing, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Cloud Deployment, Scalability, Cloud Security, Cloud Gaming*

Specific course objectives (OBJi):
OBJ 1 : *Define the fundamental concepts of cloud computing and explain the benefits of its adoption. Identify and differentiate service models (IaaS, PaaS, SaaS) and cloud deployment models.* ***OBJ 2 :*** *Explain the specific benefits of cloud computing in the context of virtual reality and gaming.* ***OBJ 3 :*** *Evaluate cloud computing usage scenarios to optimize the development and deployment of VR and gaming applications.*

OBJ 4 : *Understand the challenges of scalability in the context of VR and gaming and Apply scalability solutions to manage the varying workload of VR applications and games.*

OBJ 5 : *Identify security risks specific to virtual reality and gaming applications.*

OBJ 6 : *Implement security practices to protect data and ensure user privacy.*

Necessary material :
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2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Cloud Computing*	*3h*	- *Define the fundamental concepts of cloud computing.* - *Explain the specific benefits of VR and gaming.* - *Identify cloud service and deployment models.*
3-5	*Chapter2: Application of Cloud Computing in VR and Gaming*	*4.5h*	- *Analyze the benefits of the cloud for VR and gaming.* - *Evaluate cloud usage scenarios.* - *Optimize development with cloud services.*
6-8	*Chapter 3: Deploying VR Applications and Games in the Cloud*	*4.5h*	- *Configure cloud deployment environments.* - *Implement effective deployment strategies.* - *Maximize performance and availability.*
9-11	*Chapter 4: Scalability in the Cloud for VR and Gaming*	*4.5h*	- *Understand the challenges of scalability in VR and gaming.* - *Apply appropriate scalability solutions.* - *Manage variable workload.*
12-14	*Chapter 5: Security and Privacy in the Cloud*	*4.5h*	- *Identify specific security risks.* - *Implement appropriate security practices.* - *Ensure user privacy.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: The ability to explain fundamental concepts of cloud computing. (3 points)*
- *Criterion 2: The ability to configure cloud deployment environments (4 points).*
- *Criterion 3: Successful application of scalability solutions adapted to VR and gaming. (3 points)*
- *Criterion 4: Understanding of service models (IaaS, PaaS, SaaS) and deployment models (4 points).*
- *Criterion 5: The ability to apply cloud computing concepts specifically to virtual reality and gaming. (4 points).*
- *Criterion 6: The ability to maximize the performance of VR/Gaming applications in the cloud. (2 points)*

5- References

- *. Hwang, K., & Dong, D. (2017). Cloud Computing for Virtual Reality and Gaming. Wiley.*
- *Reinders, J., & Han, J. (2019). Cloud Computing: Concepts, Technology & Architecture. Pearson Education.*
- *Barr, J., & Ros, P. (2017). AWS for Game Developers: Cloud-based Game Development for Performance and Scalability. O'Reilly Media.*
- *Menascé, D. A. (2017). Cloud Computing: Theory and Practice. Elsevier.*

- *Amazon Web Services (AWS) - Documentation Author :Amazon Web Services URL: https://docs.aws.amazon.com/ Year :Continuously updated*
- *Microsoft Azure - Cloud Computing for VR and Gaming Author: Microsoft URL: https://azure.microsoft.com/en-us/solutions/gaming/ Year :Continuously updated*
- *Google Cloud - Solutions for VR and Gaming Author: Google Cloud URL: https://cloud.google.com/solutions/gaming/ Year :Continuously updated*
- *Cloud Security Alliance - VR Security Guidance Author: Cloud Security Alliance URL: https://cloudsecurityalliance.org/artifacts/virtual-reality-vr-security-guidance/ Year :2023*
- *Unity3D - Cloud Build Documentation Author: Unity Technologies URL: https://docs.unity3d.com/560/Documentation/Manual/cloud-buil Year :Continuously updated*

6- Working environment (Facilities necessary for learning)

- *Integrated Development Environment (IDE).*
- *Cloud Service Providers: AWS, Microsoft Azure, Google Cloud.*
- *Cloud SDKs and Development Kits.*
- *Online resources and cloud documentation (AWS, Azure, Google Cloud).*

Course Specification

Video game programming with Unity

1. General

Coded	*Inf-RV 4 2 06*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*3*
Course	*Virtual Reality and Gaming*					Vol. H. (CI)	
Responsible	*Mahdi Mili*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*36*
Module	*Video game programming with Unity*					Version	*08/2023*

Course description (Course objective):
The "Video Game Programming with Unity" course is designed to equip students with the essential skills required to develop video games using the Unity engine and C# programming language. Students will gain proficiency in key game development concepts such as game mechanics, object-oriented programming, physics simulation, and interactive environments. They will master Unity's interface, scripting tools, and asset management to efficiently code game features, implement game logic, and optimize performance for both 2D and 3D environments. Additionally, students will learn how to integrate audio, animations, and user interfaces, preparing them for the development of fully functional video games.

Prerequisites:	*Keywords :*
Knowledge of programming	*Unity, C#, GamePlay*

Specific course objectives (OBJi):

OBJ 1 : *Know the different genres of video games, the concept of gameplay and its characteristics in order to apply them in the analysis of video games or in the creation of video game design.*

OBJ 2 : *Manipulating the video game engine: Unity Engine*

OBJ 3 : *Study Unity C# programming.*

OBJ 4 : *Learn how to create a 2D video game: programming character movements, enemies and animations*

OBJ 5 : *Develop different game elements such as platforms or keys, Create the game interface or HUD*

OBJ 6 : *Learn how to create a 3D video game:Unity 3D Engine*

Necessary material :
A powerful PC allows game developers to work smoothly and efficiently.

2- Content elements (Course / Practical Work)

Week(s)	- *Chapters/Content Items*	No. HR	Goals
1	- *Understanding the domain* - *Know the different genres of video games* - *Gameplay concept and its features*	*3h*	*OBJ1*
2	- *Installation and Manipulation of the Unity interface*	*3h*	*OBJ2*
3-5	- *Unity C# programming.*	*9h*	*OBJ3*
6-9	*Creation of a 2D video game:* - *1.1. Create a scene and import an object* - *1.2. Ground* *1.2.1. Terrain I: create terrain and mountains 1.2.2. Land II: trees and flowers.* *1.2.3. Terrain III: Water and Skybox* - *1.3. Creation of 2D Characters* *1.3.1. Collisions* *1.3.2. Collisions* *1.3.3. Trigger* - *1.4. Gameplay I* *1.4.1. Programming: attack skill 1.4.2. Programming: Jump Skill* *1.4.3. Programming: shooting skill* - *1.5. Gameplay II* *1.5.1. Programming: weapons* *1.5.2. Programming: Ítems* *1.5.3. Programming: Checkpoint* - *1.6. Programming elements: articles and platforms* *1.6.1. Platform movement* *1.6.2. Pumps* - *1.7. Animation of characters and particles in 2D* *1.7.1. Import animations* *1.7.2. Animation programming* *1.7.3. Particles* - *1.8. Creation of the HUD and interface* *1.8.1. Creation of life* *1.8.2. Creation of texts and dialogues : Creating text, Creating dialogs, Selection of responses*	*12h*	*OBJ4*

10-11	*- Develop different game elements such as platforms or keys, Create the game interface or HUD*	*6h*	*OBJ5*
12-14	*- Learn how to create a 3D video game:Unity 3D Engine*	*9h*	*OBJ6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: integration of Assets (4 points)*
- *Criterion 2: Interface programming, movement (10 points)*
- *Criterion 3: GamePlay (3 points)*
- *Criterion 4: Render Generation (export of the game) (3 points)*

5- References

- *Nystrom, R. (2017). Game Programming Patterns. Genever Benning.*
- *Stovold, D. (2020). Unity Game Development in 24 Hours. Sams Publishing.*
- *O'Connor, B., & Roberts, T. (2020). Learning C# by Developing Games with Unity 2020. Packt Publishing.*
- *Simon, S., & Sillers, M. (2021). Unity Game Development Cookbook: Essentials for Every Game. Packt Publishing.*
- *"Unity Documentation"*

Author: Unity Technologies

URL: https://docs.unity3d.com/

Year: Consult the most recent documentation.

- *"Learn Unity" - Official Unity Learn platform for tutorials and courses*

Author: Unity Technologies

URL: https://learn.unity.com/

Year: Consult the most recent content.

- *"Unity Scripting API"*

Author: Unity Technologies

URL: https://docs.unity3d.com/ScriptReference/

Year: Consult the most recent documentation.

6- Working environment (Facilities necessary for learning)

- *Unity Hub*
- *Unity 2022.3.8*

Course Specification

Game Design

1. General

Coded	*Inf-RV 4 2 07*	Level/Semester	*4/S2*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Boutheina Ben Ismail*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*50*
Module	*Game Design*					Version	*08/2023*

Course description (Course objective):

The "Game Design" course is focused on equipping students with the essential skills needed to design and develop immersive video games, with a particular emphasis on integrating virtual reality (VR) technologies. Students will master the principles of game design, including gameplay mechanics, level design, user experience (UX) for immersive environments, and storyboarding for narrative-driven games. They will learn how to create engaging game worlds, design interactive VR experiences, and optimize game flow to ensure an immersive and compelling player experience. The course will also cover the application of VR tools and techniques in creating realistic, interactive game worlds.

Prerequisites:	*Keywords :*
- *Basic knowledge of programming languages suitable for game development (for example, C++, C#, Python).* - *Understanding of the Fundamentals of Virtual Reality including how it works, its applications and its challenges.* - *Prior understanding of the operating principles of game engines such as Unity or Unreal Engine, including asset creation, scene management and game logic.*	*Game Mechanics, Level Design, Narrative Design, Virtual Reality, Immersive Experiences, Game Prototyping, User Experience) Game Assets, Game Testing and Iteration, Project-based Learning*

Specific course objectives (OBJi):

OBJ 1 : *Master Game Mechanics in Virtual Reality (VR): Understand the fundamental principles of game mechanics specific to virtual reality. Apply these mechanics to create engaging and immersive gaming experiences.*

OBJ 2 : *Develop In-Depth VR Storytelling and Screenwriting Skills: Create interactive scenarios adapted to virtual reality. Use VR-specific storytelling techniques to immerse players in captivating virtual* *worlds.*

OBJ 3 : *Master VR Level Design Techniques: Create challenging, well-designed levels suited to virtual reality. Understand the relationship between level design and user experience in a virtual reality context.*

OBJ 4 : *Design Levels for Intuitive Navigation in Virtual Reality: Apply design techniques to create virtual game environments that allow for smooth navigation. Consider the specifics of VR to ensure a frictionless user experience.*

OBJ 5 : *Exploring Immersive Experience Design: Understand advanced design techniques to create sensory and emotional experiences. Apply methods to maximize player immersion and create memorable memories.*

Necessary material :
-

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Game Design in VR*	*3h*	- *Understand the fundamentals of Game Design.* - *Explore the basic concepts of Virtual Reality (VR).*
3-4	*Chapter2: VR Game Mechanics*	*3h*	- *Analyze game mechanics adapted to VR.* - *Create simple prototypes of mechanics in VR.*
5-6	*Chapter 3: Narration and Screenwriting in VR*	*3h*	- *Understand VR-specific storytelling techniques.* - *Develop interactive scenarios for VR.*
7-8	*Chapter 4: Visual and Audio Design in VR*	*3h*	- *Apply visual design principles for VR.* - *Integrate audio for an immersive experience.*
9-10	*Chapter 5: Level Design in VR*	*3h*	- *Master level design techniques for VR.* - *Design levels suitable for navigation in VR.*
11-12	*Chapter 6: Designing Immersive Experiences*	*3h*	- *Explore techniques for sensory experiences in VR.* - *Apply methods to maximize immersion.*

13-14	*Practical Projects and Final Evaluation*	*3H*	- *Application of the concepts learned on concrete projects in class.* - *Finalize practical projects in class.* - *Presentation of final projects to the class.*
			- *Evaluation of projects and acquired skills.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Understanding of Game Design Concepts (4 points)*
- *Criterion 2: Understanding of the principles of level design (3 points)*
- *Criterion 3: Critical Analysis of the Games (3 points)*
- *Criterion 4: Creativity and Innovation (4 points)*
- *Criterion 5: Narration and Screenwriting (3 points)*
- *Criterion 6: Visual and Audio Design (3 points)*

5- References

- *Schell, J. (2008). The Art of Game Design: A Book of Lenses. CRC Press.*
- *Koster, R. (2013). A Theory of Fun for Game Design. O'Reilly Media.*
- *Salen, K., & Zimmerman, E. (2004). Rules of Play: Game Design Fundamentals. MIT Press.*
- *Adams, E., & Rollings, A. (2014). Fundamentals of Game Design. Pearson Education.*
- *"Game Design Theory and Practice" - Game Design Online Course*

- *Game Design Concepts Author: Various authors*
  URL: https://www.gamasutra.com/
  Year: View the most recent documentation
- *Oculus Developer Blog Author: Oculus*
  URL: https://developer.oculus.com/blog/ Year: View the most recent documentation
- *Unity3D VR Documentation Author :Unity Technologies*

URL: https://docs.unity3d.com/Manual/VROverview.html Year: View the most recent documentation

- *The Level Design Lobby Author: Various contributors*

  URL: https://leveldesignlobby.blogspot.com/ Year: View the most recent documentation
- *Interactive Storytelling: The Art and Technique of Digital Narrative*
  Author: Not specified

  URL: https://www.amazon.com/Interactive-Storytelling-Technique-Digital-Narrative Year: View the most recent documentation

6- Working environment (Facilities necessary for learning)

- *None.*

Course Specification

Team virtual reality project

1. General

Coded	*Inf-RV 4 2 08*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Foued Elkamel*					Vol. H. (TP)	*42*
Teaching methods	*Direct Instruction, Project Based, Field Work*					Self-study H.	*60*
Module	*Team virtual reality project*					Version	*08/2023*

Course description (Course objective):
The "Team Virtual Reality" project is designed to provide students with hands-on experience in collaborative virtual and augmented reality (VR/AR) and gaming projects. Students will enhance their skills in design, development, and project management while working as part of a team. They will focus on creating interactive, immersive VR/AR experiences, emphasizing technical aspects such as 3D modeling, real-time interaction, and system integration. The course encourages effective teamwork, problem-solving, and communication skills, preparing students to manage and execute complex VR/AR projects in a professional setting.

Prerequisites:	*Keywords :*
- *Mastery of a VR/AR Game Engine.* - *In-depth knowledge of VR/AR Technologies.* - *3D Programming Skills.* - *Familiarity with VR/AR Peripherals.* - *Advanced Notions of UX/UI Design for Virtual Reality.* - *Experience in Game Development.* - *Knowledge of project management methodologies adapted to the development of VR/AR games.*	Virtual Reality (VR), Immersive 3D Environment, VR Headsets, Augmented Reality (AR), Game Engines, UX/UI VR/AR Design, Git, Version Management, Team Collaboration, Game design, VR Headsets, Management tools project (Jira, Trello), Iterative planning, 3D modeling, VR/AR performance.

Specific course objectives (OBJi):
OBJ 1 : *Apply design principles specific to virtual reality.*
OBJ 2 : *Create interactive scenarios offering an immersive user experience.*

OBJ 3 :	*Evaluate and choose the technologies appropriate to the project (engines, frameworks, tools).*
OBJ 4 :	*Seamlessly integrate technical components into a cohesive experience.*
OBJ 5 :	*Work as a team in a collaborative development environment.*
OBJ 6 :	*Effectively manage source code and project resources.*
OBJ 7 :	*Identify and resolve potential latency and refresh issues.*
OBJ 8 :	*Implement comprehensive testing strategies for the entire VR/AR experience.*
OBJ 9 :	*Validate the quality of the project through user testing sessions.*

Necessary material :
-

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to the VR/AR Project*	*3h*	- *Present the collaborative project in VR/AR.* - *Discuss project expectations and objectives.*
2	*Immersive Design and Brainstorming*	*3h*	- *Explain the principles of immersive design.* - *Facilitate a brainstorming session to generate project ideas.*
3	*Evaluation of VR/AR Technologies*	*3h*	- *Review the technologies available in VR/AR.* - *Make decisions about which tools and frameworks to use.*
4	*Planning and Resources*	*3h*	- *Plan the project: tasks, schedule.* - *Assign roles and responsibilities in the team.*
5	*Start of Development*	*3h*	- *Configure the development environment.* - *Begin coding the project.*
6	*Design of Interfaces and Interactions*	*3h*	- *Develop the first user interfaces.* - *- Integrate the first interactions.*
7	*Iteration and Feedback*	*3H*	- *Perform the first iteration cycle on the prototypes.* - *Collect feedback as a team and make adjustments.*
8	*Preliminary Tests*	*3h*	- *Perform preliminary tests on the developed functionalities.* - *Identify initial problems.*
9	*Performance Optimization*	*3h*	- *Apply optimization techniques to ensure smooth performance.* - *Profile code and resources.*
10	*Component Integration*	*3h*	- *Harmoniously integrate the different parts of the project.* - *Manage dependencies and interfaces.*

11	*User Testing*	*3h*	- *Prepare comprehensive test scenarios.* - *Collect user feedback.*
12	*Fixing Problems*	*3h*	- *-Correct issues identified during testing.* - *Perform the final iterations before the final phase.*
13	*Finalization of the Project*	*3H*	- *Make final polishes to the project.* - *Prepare final demonstrations.*
14	*Final Presentation*	*3H*	- *Perform demonstrations and technical presentations of the project.* - *Evaluate the project as a team.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- …

5- References

- *McMahan, R. P., & Bowman, D. A. (2015). Virtual Reality: A Survey of Applications in Industry. CRC Press.*
- *Jerald, J. (2016). The VR Book: Human-Centered Design for Virtual Reality. ACM Books.*
- *Burdea, G., & Coiffet, P. (2003). Virtual Reality Technology. Wiley-Interscience.*
- *"Virtual Reality and Augmented Reality in Gaming" - Course on Collaborative VR/AR Design*

Author: Coursera

URL: https://www.coursera.org/

Year: Consult the most recent course content.

- *"Unity VR/AR Developer Certification"*

Author: Unity Technologies

URL: https://unity.com/

Year: Consult the most recent certification.

- *"Collaborative VR Design for Teams" - VR Project-Based Learning Course*

Author: Udemy

URL: https://www.udemy.com/

Year: Consult the most recent course content.

- *GameDesign Concepts Author: Various authors*
  URL: https://www.gamasutra.com/
- *Unity Documentation - VR Development: Author :Unity Technologies*
  URL:https://docs.unity3d.com/560/Documentation/Manual/VROverview.html Year :Updated regularly
- *Unreal Engine VR Documentation: Author :Epic Games*
  URL:https://docs.unrealengine.com/4.27/en-US/Platforms/VR/ Year :Updated regularly
- *Oculus Developer Documentation: Author :Oculus*
  URL:https://developer.oculus.com/documentation/ Year :Updated regularly

6- Working environment (Facilities necessary for learning)

- *Integrated Development Environment (IDE): Unity, Unreal Engine.:*
- *Versioning and Collaboration Tools: Git, Collaboration Platform (GitHub, GitLab, Bitbucket).*
- *3D Modeling Software: Blender, Autodesk Maya.*
- *Virtual Reality headsets.*
- *Control Peripherals (VR Controllers, Controllers).*
- *Image Editor (Optional): GIMP or Adobe Photoshop (Optional).*
- *Test Environment.*

Course Specification

Advanced programming in VR

1. General

Coded	*Inf-RV 4 2 09*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*4*
Course	*Virtual Reality and Gaming*					Vol. H. (CI)	
Responsible	*Sami Ben Amor*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	Advanced programming in VR					Version	*08/2023*

Course description (Course objective):
The objective of this module is to equip students with the core and advanced skills in Virtual Reality (VR) programming using the Unity game engine. Through hands-on projects, students will gain proficiency in C#, asset integration, and VR development techniques. They will learn how to design and develop fully immersive VR scenes and applications for various platforms, such as Oculus (Meta Quest), HTC Vive, and others. The course emphasizes practical skills, from scene creation to optimizing applications for performance and user experience in virtual reality environments.

Prerequisites:	*Keywords :*
- *Basic knowledge of C# programming and object-oriented concept.* - *Knowledge of 3D (axes, materials, geometry).*	*VR, C#, immersion, VR headset (Meta Quest 2), 3D*

Specific course objectives (OBJi):

OBJ 1 : *Identify the role of virtual reality in a project*

OBJ 2 : *Understand the advanced principles of virtual reality with the Unity game engine*

OBJ 3 : *Acquire programming in a game engine*

OBJ 4 : *Create a complete scene in virtual reality*

OBJ 5 : *Export your project depending on the media*

Necessary material :

- *A powerful PC containing a graphics card compatible with the VR headset*
- *Virtual reality headset*
- *Cable Type C-Type C or Type C - USB 3.0*

2- Content elements (Course / Practical work)

Week(s)	*Chapters/Content Items*	No. HR	Goals
1	*CH1: identify the role of virtual reality in a project* - *Identify the interaction between the virtual space and the user*	*3h*	*OBJ1*
2	- *Script the evolution of the user in the virtual environment*	*3h*	*OBJ1*
3	- *Case study: project analysis*	*3h*	*OBJ1*
4	*CH2: Understand the advanced principles of virtual reality with the Unity game engine.* - *Identify the connection between the virtual and real world (actor/scene interaction)* - *Understand the different distribution media (Oculus, HTC, HTML5, etc.)* - *Create specifications for 3D elements and "assets" to prepare*	*3h*	*OBJ2*
5	- *Apply the basics of building a virtual project* - *Create a virtual scene project by customizing the parameters ("player", quality, media type, etc.)* - *Import an object into the project* - *Create an interaction using an "asset"* - *Launch the "player" to test the virtual reality project*	*3h*	*OBJ2*
6	- *Application: carry out a virtual reality project*	*3h*	*OBJ2*
7-8	*CH3: Acquire advanced programming in a game engine* - *Understand the basics of C# programming* - *Use existing assets to develop the project* - *Create a virtual observer behavior (example of Oculus or HTC virtual glasses)* - *Build a 2D/3D interface for the user* - *Leverage JavaScript programming for simple interactions* - *Edit assets for dynamic interaction* - *Test behaviors and scenarios on different media* - *Correct and adjust assets*	*6h*	*OBJ3*
9-10	- *Application: developing interactive behaviors*	*6h*	*OBJ3*
11-12	*CH4: Create a complete scene in virtual reality* - *Configure the project* - *Edit the project settings (player, graphics quality, physics engine, network, language, etc.)* - *Organize the project directory and assets* - *Validate the "player" and the specific "build" type* - *Use 3D objects* - *Import objects in FBX format* - *Edit file hierarchy* - *Understanding game engine constraints*	*6h*	*OBJ4*

	- *Edit materials natively for export to Unity* - *Edit materials in the game engine*		
13	- *The environment and the lights* - *Manage lights and environment* - *Edit a skybox* - *Change the rendering of lights* - *Imagine the interactions between the virtual environment and the user* - *Build an interaction with the keyboard, mouse, controller* - *Using programs and combining them* - *Finalize the project* - *Perform testing based on support* - *Adjust viewing quality based on targeted media* - *Debug the project*	*3h*	*OBJ4*
14	*CH5: Export your project depending on the media* - *Edit a project specific to virtual glasses (Google Cardboard, Oculus Rift or HTC Vive)* - *Modify an existing project to make it cross-platform compatible* - *Structuring a specification* - *Finalize a project for a "Web" browser* - *Create build models*	*3h*	*OBJ5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Modeling and integration of 3D environment (3 points)*
- *Criterion 2: integration of interface and/or Assets (3 points)*
- *Criterion 3: interactivity and control programming (7 points)*
- *Criterion 4: user interface (3)*
- *Criterion 5: Export the project according to the media (3 points)*

5- References

- *MacDonald, D. (2018). Unity Virtual Reality Projects: Learn to Build Virtual Reality Games and*

Experiences with Unity. Packt Publishing.

- *Miller, J., & Wilkes, A. (2017). Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile. O'Reilly Media.*
- *Gallo, S. (2019). Virtual Reality with Unity: A Developer's Guide to Building Immersive Applications. Apress.*
- *"Unity VR Development" - Unity's official VR development resources*

Author: Unity Technologies

URL: https://learn.unity.com/

Year: Consult the latest Unity tutorials.

- *"Oculus Developer Documentation"*

Author: Oculus VR

URL: https://developer.oculus.com/

Year: Consult the most recent documentation.

- *"HTC Vive Developer Resources"*

Author: HTC

URL: https://developer.vive.com/

Year: Consult the most recent resources.

6- Working environment (Facilities necessary for learning)

- *Unity Hub, Unity 2022.3.8, Oculus*

Course Specification

Interactive 3D web development

1. General

Coded	*Inf-RV 4 2 10*	Level/Semester	*4/S2*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Marwa Ben Jabra*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*36*
Module	*3D web development*					Version	*08/2023*

Course description (Course objective):
The "3D Web Development" course is designed to equip students with the skills needed to develop immersive, interactive 3D experiences for the web. Students will gain an in-depth understanding of key concepts, techniques, and tools used in 3D web development, with a focus on frameworks such as Three.js and A-Frame. The course emphasizes hands-on experience, enabling students to design and implement fully functional 3D web applications, from rendering 3D models to creating interactive scenes that run seamlessly in web browsers.

Prerequisites:	*Keywords :*
- *Mastery of HTML, CSS, and JavaScript languages.* - *Understanding of basic concepts of 3D modeling.* - *Understanding of Advanced Web Technologies*	*3D Web Development, Three.js, A-Frame, Virtual Reality (VR), 3D Modeling, WebGL, Interactive Experiences, Virtual Reality in the Browser (WebVR), 3D Scenes*

Specific course objectives (OBJi):
OBJ 1 : *Mastery and understanding of the fundamental principles of 3D web development. Using Three.js to create interactive 3D scenes.* ***OBJ 2 :*** *Proficient in advanced manipulation of 3D models, including importing and animation, using Three.js.* ***OBJ 3 :*** *Ability to handle the complexity of 3D scenes while maintaining optimal performance.* ***OBJ 4 :*** *Skills to design immersive user interfaces by integrating virtual reality features through the use of WebVR.*

Necessary material :

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to 3D Web Development*	*6h*	- *Understand the fundamentals of 3D web development* - *Explore virtual reality applications and trends*
3-4	*Chapter 2: Three.js Fundamentals*	*6h*	- *Master using Three.js to create 3D scenes* - *Apply advanced 3D modeling concepts*
5-6	*Chapter 3: Animation and Interaction with Three.js*	*6h*	- *Animate 3D objects and manage user interactions* - *Use external libraries for advanced functionality*
7-8	*Chapter 4: Integration of Virtual Reality (WebVR)*	*6h*	- *Implement virtual reality features* - *Design immersive experiences compatible with WebVR*
9-10	*Chapter 5: Performance Optimization in 3D Development*	*6h*	- *Apply advanced optimization techniques* - *Manage the complexity of 3D scenes for optimal performance*
11-12	*Chapter 6: Introduction to A-Frame and Rapid Development*	*6h*	- *Understanding the simplicity of A-Frame for rapid creation* - *Create 3D experiences with A-Frame*
13-14	*Practical 3D Web Development Project*	*6h*	- *Work on a practical project integrating the skills acquired*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Understanding of the fundamentals of 3D web development, Three.js and A-Frame. .(4 points)*
- *Criterion 2: Practical Skills with Three.js and A-Frame.(4 points)*
- *Criterion 3: Performance Optimization. (2 points)*
- *Criterion 4:VSability to manage the complexity of 3D scenes in advanced projects. (4 points)*
- *Criterion 5: Integration of Virtual Reality: (4 points)*
- *Criterion 6: Creativity and Innovation: (2 points)*

5- References

- *Ray, R. (2018). WebGL: Up and Running: Building 3D Graphics for the Web. O'Reilly Media.*
- *Hamo, I., & Boulanger, P. (2020). Learning Three.js: The JavaScript 3D Library for WebGL. Packt Publishing.*
- *Gaiduk, M., & Shurin, D. (2019). Mastering A-Frame: WebVR 3D Development for the Web. Apress.*

- *Three.js Official Documentation Author: Three.js Development Team URL:https://threejs.org/docs/*
- *A-Frame Official Documentation Author: A-Frame Development Team URL:https://aframe.io/docs/*
- *Mozilla Developer Network (MDN) - WebGL Author: Mozilla Developers URL:https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API*
- *Mozilla Developer Network (MDN) - WebVR Author: Mozilla Developers URL:https://developer.mozilla.org/en-US/docs/Web/API/WebVR_API*
- *WebGL Fundamentals Author: Gregg Tavares URL:https://webgfundamentals.org/*
- *A Guide to WebGL and Three.js Author: Discover Three.js URL:https://discoverthreejs.com/*
- *A-Frame School - Tutorials and Guides Author: A-Frame Development Team URL:https://aframe.io/aframe-school/*

6- Working environment (Facilities necessary for learning)

- …

Course Specification

Project Management and Agile Methodologies

1. General

Coded	*Inf-RV 5 1 05*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*3*
Course	*Virtual Reality and Game Engineering*					Vol. H. (CI)	
Responsible	*Marwen ben Moussa*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Field Work*					Self-study H.	*55*
Module	*Project Management and Agile Methodologies*					Version	*08/2023*

Course description (Course objective):
The "Project Management for Gaming and Virtual Reality Engineers" course is designed to equip students with the essential skills and knowledge required to manage projects within the gaming and virtual reality sectors. Students will explore the entire project lifecycle, focusing on planning, execution, monitoring, and completion. The course emphasizes different roles and responsibilities within a project team and highlights the use of agile methodologies to adapt to the dynamic nature of gaming and VR projects. By working on real-world case studies, students will gain hands-on experience in applying project management principles effectively in their field.

Prerequisites:	*Keywords :*
- *A basic understanding of project management concepts*	*Phases of a project, Roles and responsibilities, Agile methodologies, Scrum, Kanban, Lean Startup, Agile planning, Agile execution, Agile risk management*

Specific course objectives (OBJi):
OBJ 1 : *Define project management and describe the different phases of a project.* ***OBJ 2 :*** *Identify the different roles and responsibilities in a project.* ***OBJ 3 :*** *Describe the fundamental principles of agile methodologies.* ***OBJ 4 :*** *Compare the different agile methodologies.* ***OBJ 5 :*** *Put the principles of agile planning into practice.* ***OBJ 6 :*** *Put the principles of agile execution into practice.*

Necessary material :
- *No specific equipment*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to project management:* - *Definition of project management* - *The different phases of a project* - *Roles and responsibilities in a project*	*1h30*	*OBJ1, OBJ2*
2	*The launch phase:* - *The objectives of the launch* - *Launch deliverables* - *Launch activities*	*1h30*	*OBJ2*
3	*The planning phase* - *Planning objectives* - *Planning deliverables* - *Planning activities*	*1h30*	*OBJ1, OBJ3*
4	*The execution phase* - *The objectives of execution* - *Execution deliverables* - *Execution activities*	*1h30*	*OBJ5, OBJ6*
5	*Risk management* - *The different types of risks* - *Risk management within a project*	*1h30*	*OBJ4*
6	*Communication in a project* - *The different types of communication* - *Effective communication in a project*	*1h30*	*OBJ2*
7	*The principle of agile methodologies*	*1h30*	*OBJ3*
8	*The different agile methodologies* - *Scrum* - *Kanban* - *Lean Startup*	*1h30*	*OBJ3*
9	*The advantages and disadvantages of agile methodologies* - *The advantages of agile methodologies* - *The disadvantages of agile methodologies*	*1h30*	*OBJ3*
10	*Agile planning* - *The principles of agile planning* - *Agile planning tools*	*1h30*	*OBJ5*

11-12	Agile execution - The principles of agile execution - Agile execution tools	3h	OBJ6
13-14	Agile risk management	3h	OBJ4
	- The principles of agile risk management - Agile risk management tools		

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	20%
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	80%

4- Evaluation criteria

- *Criterion 1: Understanding of the Fundamentals of Project Management (4 points)*
- *Criterion 2: Application of Project Phases (5 points)*
- *Criterion 3: Efficient Allocation of Resources (3 points)*
- *Criterion 4: Risk Management (3 points)*
- *Criterion 5: Agile Adaptation (3 points)*
- *Criterion 6: Project Closure and Lessons Learned (2 points)*

5- References

- *Sommerville, I. (2011). Software Engineering (9th Edition). Addison-Wesley.*
- *Highsmith, J. (2013). Agile Project Management: Creating Innovative Products. Pearson Education.*
- *Schwalbe, K. (2019). Information Technology Project Management (8th Edition). Cengage Learning.*
- *Association for Project Management (APM) - Guide to Project Management:*
  - Author: Association for Project Management
  - Title: APM Body of Knowledge
  - URL:https://www.apm.org.uk/resources/
- *Scrum.org - Scrum Guide:*
  - Author: Scrum.org
  - Title: The Scrum Guide
  - URL:https://scrumguides.org/
- *Project Management Institute (PMI) – Agile Practice Guide:*
  - Author: Project Management Institute (PMI)
  - Title: Agile Practice Guide

- URL:https://www.pmi.org/pmbok-guide-standards/practice-guides/agile

6- Working environment (Facilities necessary for learning)

- *Jira (Latest stable version), https://www.atlassian.com/software/jir*
- *Agile Development Environment*

Course Specification

Emerging Technologies in VR

1. General

Coded	*Inf-RV 5 1 06*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Montassar Ben Saad*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based, Field Work*					Self-study H.	*32*
Module	*Emerging Technologies in VR*					Version	*08/2023*

Course description (Course objective):

The "Emerging Technologies in Virtual Reality and Gaming" course is designed to provide students with a comprehensive understanding of the latest developments in virtual reality and gaming technologies. Students will explore recent advancements, with a focus on industrial applications, technological innovations, and emerging trends within the gaming sector. By engaging with cutting-edge VR tools and platforms, students will deepen their knowledge of how these technologies are shaping the future of immersive experiences and interactive entertainment..

Prerequisites:	*Keywords :*
- *Basic programming skills are essential for understanding and implementing VR applications* - *Prior understanding of fundamental concepts of virtual reality, including the notions of tracking, immersion, and interaction.* - *Practical understanding of immersive experiences.*	*Virtual Reality (VR), Eye-Tracking, Haptics, VR Development, Virtual Reality Gaming, Security and Ethics, New VR Technologies, Industrial Applications, User Experience (UX), Emerging Trends.*

Specific course objectives (OBJi):

OBJ 1 : *Gain in-depth knowledge of the latest technologies in virtual reality, including eye-tracking, haptic interfaces, and other emerging advances.*

OBJ 2 : *Develop practical skills in the use of these new technologies by designing and implementing concrete projects and interactive experiences.*

OBJ 3 : *Explore how these technologies can be integrated into specific sectors such as engineering, healthcare, training, gaming, with a focus on real-world applications.*

OBJ 4 : *Track and analyze emerging trends in the VR gaming industry, highlighting immersive games, innovative interactions, and market developments.*
OBJ 5 : *Address ethical issues related to the use of these technologies, including data privacy, and promote security awareness in the development and use of VR solutions.*

Necessary material :
…

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Foundations of Virtual Reality*	*6*	- *Introduction to Virtual Reality (VR) and its evolution.* - *Basic principles: monitoring, immersion, interaction.* - *Current applications and emerging trends.*
3-4	*Chapter 2: Latest Advances in VR Hardware*	*6*	- *Next generation VR headsets.* - *Advanced tracking devices.* - *Integration of eye-tracking and its applications.*
5-6	*Chapter 3: Chapter 3: Haptic Experience*	*6*	- *Introduction to haptic technologies.* - *Haptic gloves and tactile feedback.* - *Integration of haptic experience in virtual reality.*
7-8	*Chapter 4: New Horizons in Motion Tracking*	*6*	- *Advanced motion tracking sensors.* - *Integration of gesture recognition.* - *Practical applications in industry and gaming.*
9-10	*Chapter 5: Virtual Reality and Gaming* *Emerging trends in the VR gaming industry.*	*6*	- *Immersive games and innovative experiences.* - *Impacts on interactive entertainment.*
11-12	*Chapter 6: Industrial Applications of VR*	*6*	- *Use of VR in engineering, healthcare, training, etc.* - *Virtual simulations for learning and problem solving.* - *Case studies on successful applications.*

13-14	*Practical Project -*	*6*	*-*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- References

- *Lanier, J. (2017). Dawn of the New Everything: Encounters with Reality and Virtual Reality. Henry Holt and Company.*
- *Cummings, J. J., & Bailenson, J. N. (2016). How Immersive is Enough? A Psychophysical Scale of Presence in Virtual Reality. Presence: Teleoperators and Virtual Environments, 25(4), 3-13.*
- *Whelan, A. (2019). The VR Book: Human-Centered Design for Virtual Reality. ACM Books.*

- *Oculus Forum: VR Development: Name: Oculus Developer Forums, 2023 Author: Oculus Community URL: https://forums.oculusvr.com/developer/*
- *Unity Security Guide for XR (Virtual and Augmented Reality): Name :Unity Manual - XR Security, 2023*
  Author :Unity Technologies URL:https://docs.unity3d.com/Manual/XRSecurity.html
- *Open Web XR Forum (W3C):*
  Name :Immersive Web Working Group, 2023 Author :W3C
  URL: https://immersive-web.github.io/webxr-security/
- *Oculus Security Documentation:*
  Name :Oculus Developer Documentation, 2023 Author :Oculus
  URL: https://developer.oculus.com/documentation/native/android/security/
- *SteamVR Security Documentation:*
  Name :Steamworks Documentation, 2023 Author :Steam
  URL:https://partner.steamgames.com/doc/features/security

5- Working environment (Facilities necessary for learning)

Course Specification

Gesture interaction and body tracking

1. General

Coded	*Inf-RV 5 1 07*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Montassar Ben Saad*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Gesture interaction and body tracking*					Version	*08/2023*

Course description (Course objective):

The "Gesture Interaction and Body Tracking" course aims to equip students with the skills to design advanced interaction systems that utilize gesture recognition and body tracking within virtual reality environments. Emphasizing ergonomics, user immersion, and experience, students will learn to create intuitive and effective interactive systems that enhance the VR user experience through the use of physical movements and body gestures.

Prerequisites:	*Keywords :*
Technical Prerequisites: - *Good command of at least one programming language (C++, C#, Python).* - *Understanding of the basic principles of virtual reality.* - *Experience with development environments such as Unity, Unreal Engine.* *Conceptual Prerequisites:* - *Knowledge of the fundamental principles of human-computer interaction.* - *Understanding of image processing algorithms for gesture detection.* - *Familiarity with ergonomics and user experience concepts.*	*Gesture Interaction, Body Tracking, Inertial Sensors, Gesture Detection, Neural Network,* *Human-Machine Interfaces,* *Virtual Reality,* *Image Processing, Ergonomics,* *User Experience,*

Specific course objectives (OBJi):

OBJ 1 : *Thoroughly understand body tracking technologies, including sensors, cameras, and tracking methods, for effective integration into virtual reality environments.*

OBJ 2 : *Acquire advanced programming skills for detecting and interpreting gestures, enabling the creation* *of intuitive and immersive interfaces.*

OBJ 3 : *Apply ergonomics principles to design natural, intuitive and comfortable gesture interactions, thereby improving the user experience in virtual reality.*

OBJ 4 : *Identify and solve complex challenges related to gesture detection, real-time body tracking and latency minimization, ensuring smooth and realistic interactions.*

OBJ 5 : *Apply the knowledge acquired in concrete projects, demonstrating the ability to design and develop virtual reality applications integrating gesture interactions and body tracking.*

Necessary material :

- *Powerful Computer.*
- *Virtual Reality Headset.*
- *Sensors and Cameras.*
- *Motion controllers, haptic gloves or any other gesture interaction device.*
- *Audio Equipment: Headphones or audio earphones.*

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Gesture Interfaces* *History, types of gesture interfaces, advantages and challenges.*	*6*	*Understand the fundamental principles of gesture interactions and their importance in virtual reality.*
3-4	*Chapter 2: Sensors and Body Tracking Devices* *Sensors, cameras, infrared technologies, inertial sensors.*	*6*	*Explore body and gesture tracking technologies.*
5-6	*Chapter 3: Programming for Gestures and Body Tracking* *Use of API, sensor data processing, detection algorithms.*	*6*	*Learn programming skills for gesture detection and body tracking.*
7-8	*Chapter 4: Ergonomics and Design of Gestural Interfaces* *Ergonomics, user feedback, user-centered design*	*6*	*Learn design principles for effective gesture interaction.*
9-10	*Chapter 5: Use Cases and Practical Applications* *Case studies, demonstrations, practical projects.*	*6*	*Explore concrete applications of gesture interaction and body tracking.*
11-12	*Chapter 6: Advanced Challenges and Solutions* *Recognition of complex gestures, real-time body tracking, issues related to latency.*	*6*	*Understand advanced challenges and solutions for complex gesture interfaces.*

13-14	*End of Course Project* *Planning, development, presentation of*	*6*	*Apply the knowledge acquired to* *design and develop a complete*
	projects		*gestural interaction project.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*20%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*20%*

4- Evaluation criteria

- *Criterion 1: Practical Projects (5 points): Quality and complexity of individual and team projects implementing gesture interaction and body tracking technologies.*
- *Criterion 2: Theoretical Understanding (5 points): Assessment of theoretical knowledge, including understanding of technologies, detection algorithms, and ergonomic principles.*
- *Criterion 3: Innovation and Creativity (5 points): Assessment of innovation and creativity demonstrated in the design and implementation of gesture interactions.*
- *Criterion 4: Presentations (5 points): Quality of presentations on specific topics related to gesture interaction, including clarity, relevance and mastery of the subject.*

5- References

- *Jönsson, G., & Olofsson, A. (2016). Body-Computer Interaction: A Hands-On Guide for Design and Development. Springer.*
- *Gugenheimer, J., & Rehm, M. (2018). Gesture and Touch: Designing Interaction in Virtual Reality. Springer.*
- *Oulasvirta, A., et al. (2011). Gestural Interaction in Virtual Environments: A Cognitive Approach. Proceedings of the ACM Symposium on User Interface Software and Technology (UIST).*

- *"Programming for Motion: Interactivity with Kinect"*

  Name :Programming for Motion: Interactivity with Kinect, 2012

  Author :Joshua Noble

  URL: https://www.amazon.com/Programming-Motion-Interactivity-Joshua-Noble/dp/1449311547
- *"Designing Gestural Interfaces: Touchscreens and Interactive Devices"*

  Name :Designing Gestural Interfaces: Touchscreens and Interactive Devices, 2008

  Author :Dan Saffer

  URL: https://www.oreilly.com/library/view/designing-gestural-interfaces/9781449382914/
- *"Human-Computer Interaction: An Empirical Research Perspective"*

  Name :Human-Computer Interaction: An Empirical Research Perspective, 2013

Authors:I. Scott MacKenzie, William Arthur, and Andrew Monk
URL:https://www.amazon.com/Human-Computer-Interaction-Empirical-Interactive-Technologies/dp/0124058652

- *"The Art of Human-Computer Interface Design"*
  Name :The Art of Human-Computer Interface Design, 1990
  Authors:Brenda Laurel
  URL: https://www.amazon.com/Art-Human-Computer-Interface-Design/dp/0201517973
- *"Virtual Reality and Augmented Reality: Myths and Realities"*
  Name :Virtual Reality and Augmented Reality: Myths and Realities,
  2018 Author :Philippe Fuchs
  URL: https://www.amazon.com/Virtual-Reality-Augmented-Myths-Realities/dp/1848218995

6- Working environment (Facilities necessary for learning)

- *Integrated Development Environment (EDI):*
  Unity or Unreal Engine installed, depending on course preferences and specific requirements.
- *Additional Software:*
  The plugins or modules necessary for virtual reality development in the chosen IDE.
- *VR SDK (Software Development Kit):*
  Appropriate SDK for the virtual reality headset used (e.g. Oculus SDK, SteamVR SDK).
- *Virtual Reality Headset:*
  Installation and configuration of the VR headset with the latest drivers and software.
- *Sensors and Cameras:*
  Installation of sensors and cameras necessary for body tracking, with optimal positioning.
- *Input Devices:*
  Configuring input devices such as motion controllers according to course specifications.
- *Debugging Tools:*
  Use of IDE-compatible debugging tools to identify and resolve programming issues.
- *3D Modeling tools (optional):*
  Tools such as Blender or Autodesk Maya may be required for creating 3D assets or props.

Course Specification

Virtual reality safety

1. General

Coded	*Inf-RV 5 1 08*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	*21*
Responsible	*Bayrem Triki*					Vol. H. (TP)	
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*50*
Module	*Virtual reality safety*					Version	*08/2023*

Course description (Course objective):
The "Virtual Reality Security" course aims to equip students with the expertise needed to develop, assess, and implement tailored security strategies for virtual reality (VR) environments. Students will gain a comprehensive understanding of the unique risks and vulnerabilities associated with VR, while learning how to ensure the confidentiality, integrity, and availability of data within these immersive spaces. Additionally, the course will foster a proactive security culture, emphasizing the importance of securing virtual environments and the systems that support them.

Prerequisites:	*Keywords :*
- *Understanding of the fundamentals of computing, networking and data communications.* - *Mastery of operating systems, particularly with regard to administration and management of access authorizations.* - *An understanding of the basic principles of IT security, including identity management, authentication mechanisms and security protocols.* - *Familiarity with basic cryptography concepts, particularly as they relate to encryption and securing communications.*	*Computer Security, VR Vulnerabilities,* *VR Cryptography, VR Authentication* *VR Identity Management, Virtual Networks,* *VR Security Standards, VR Anomaly Detection* *VR Data Security*

Specific course objectives (OBJi):
OBJ 1 : *Understand, design and implement robust authentication mechanisms specifically adapted to virtual reality. This includes exploring biometric methods, security keys, and other means of ensuring secure user identification.*

OBJ 2 : *Apply appropriate cryptography techniques to virtual environments to ensure the confidentiality of data exchanged between users, servers and virtual reality devices.*

OBJ 3 : *Develop skills to identify, assess and mitigate vulnerabilities specific to virtual reality environments, with an emphasis on protecting against potential attacks.*

OBJ 4 : *Implement intrusion detection mechanisms.*

OBJ 5 : *Understand and implement security measures to protect virtual reality devices such as headsets, controllers and sensors.*

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Virtual Reality Security*	*3h*	- *Understand the basic concepts of virtual reality.* - *Identify specific security challenges in virtual environments.* - *Recognize the importance of a secure approach in the development and use of virtual reality.*
3-4	*Chapter 2:* Technical Foundations of Virtual Reality and Risks	*3h*	- *Analyze risks related to virtual reality sensors, devices and applications.* - *Understand security implications for users and systems.*
5-6	*Chapter 3: Basic Principles of Computer Security and VR*	*3h*	- *Adapt the fundamental principles of computer security to the specificities of virtual reality.* - *Protection mechanisms against common threats.*
7-8	*Chapter 4: Authentication Mechanisms and Cryptography in VR*	*3h*	- *Exploring authentication mechanisms specific to virtual reality.* - *Apply cryptography techniques to ensure data confidentiality in virtual environments.*
9-10	*Chapter 5: Identity Management, Penetration Testing and Network Security*	*3h*	- *Deepen identity and access management in the context of realityVirtual.* - *Implement security measures to protect networks used by virtual reality applications.*
11-14	*Practical Project and Future Perspectives*	*6h*	- *Apply the acquired knowledge to the design of a secure VR application.* - *Explore emerging trends and future challenges in virtual reality security.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Identification and understanding of the risks specific to virtual reality. (4 points)*
- *Criterion 2: Implementation of strong authentication mechanisms in VR. (4 points)*
- *Criterion 3: Carrying out penetration tests specific to virtual reality. (4 points)*
- *Criterion 4: Application of identity and access management principles in a virtual reality context. (4 points)*
- *Criterion 5: Implementation of security measures in practical projects. (4 points)*

5- References

- *Radziwill, N. M., & Benton, M. (2021). Virtual Reality Security: Concepts and Applications. Wiley.*
- *Maynard, S. B., & Haller, P. (2019). Security in Virtual and Augmented Reality: Protecting Immersive Systems. Springer.*
- *Pierce, M. E., & Smith, G. R. (2020). Cybersecurity for Virtual Environments: A Practitioner's Guide. Routledge.*

- *Open Web XR Forum (W3C):*
  Author: W3C Immersive Web Working Group URL:https://immersive-web.github.io/webxr-security/
- *Oculus Security Documentation: Author: Oculus (group owned by Meta)*
  URL:https://developer.oculus.com/documentation/native/android/security/
- *SteamVR Security Documentation: Author: Valve Corporation*
  URL:https://partner.steamgames.com/doc/features/security
- *Unity Security Guide for XR: Author: Unity Technologies*
  URL:https://docs.unity3d.com/Manual/XRSecurity.html

6- Working environment (Facilities necessary for learning)

- …

Course Specification

Unreal Engine

1. General

Coded	*Inf-RV 5 1 09*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*4*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Mahdi Mili*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*50*
Module	*Unreal Engine*					Version	*08/2023*

Course description (Course objective):

The "Video Game Development with Unreal Engine" course aims to equip virtual reality and gaming engineering students with advanced game development techniques using Unreal Engine. Students will master the design, development, and optimization of interactive games, leveraging the advanced tools and features provided by Unreal Engine to create high-quality, immersive gaming experiences.

Prerequisites:	*Keywords :*
- *Basic knowledge of programming (C++ is a plus).* - *Understanding of basic concepts in mathematics applied to the game.* - *Familiarity with the principles of video game design.* - *Have taken prerequisite courses on the fundamentals of virtual reality.*	*Unreal Engine, Video Game Development C++, Level Design, Immersive Experiences, Video Game Scripting, Virtual Reality, Game Mechanics, Virtual Reality Headset*

Specific course objectives (OBJi):

OBJ 1 : *Mastery of Unreal Engine*

OBJ 2 : *Game Programming with C++*

OBJ 3 : *Designed interactive and engaging levels using Unreal Engine level design tools.*

OBJ 4 : *Performance optimization to guarantee smooth and efficient games.*

OBJ 5 : *Will explore and design virtual reality techniques for maximum immersion in games.*

OBJ 6 : *Screenwriting and Narration by integrating narrative elements into the game environment in a coherent manner.*

Necessary material :
- *Powerful Computer Configured for video game development with Unreal Engine.* - *Unreal Engine: Latest version of Unreal Engine installed.* - *Code Editor (Visual Studio recommended for C++).* - *Access to Unreal Engine documentation and online tutorials.* - *Virtual Reality Headset.*

2- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to Unreal Engine*	*6h*	- *Understand the Unreal Engine interface and features.* - *Install and configure the development environment.*
3-4	*Chapter 2 : Fundamentals of Development with Unreal Engine*	*6h*	- *Explore the basics of development with Unreal Engine. .* - *Understand the role of Blueprints for visual programming.*
5-6	*Chapter 3: Level Design with Unreal Editor*	*6h*	- *Learn the principles of level design in Unreal Engine.* - *Using Unreal Editor to design levels.* - *Create interactive and engaging levels.*
7-8	*Chapter 4: Performance Optimization in Unreal Engine*	*6h*	- *Understand optimization techniques specific to Unreal Engine.* - *Using Unreal Engine profiling tools.* - *Apply strategies to improve performance.*
9-10	*Chapter 5: Immersive Experiences with Unreal Engine*	*6h*	- *Explore creating immersive experiences with Unreal Engine.* - *Integration of virtual reality into Unreal Engine.*
11-12	*Chapter 6: Scripting and Blueprints in Unreal Engine*	*6h*	- *Master the use of visual scripts with Blueprints.* - *Use of Blueprints for scriptwriting and Integration of narrative elements into the game environment.-*
13-14	*Practical Project - Game Development with Unreal Engine*	*6h*	- *Apply the skills acquired on a concrete project, a complete game with Unreal Engine.* - *Demonstration of final project features and game code.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Assessment of understanding of the interface and functionality of Unreal Engine. (4 points)*
- *Criterion 2: Skills in Programming and Using Blueprints (4 points).*
- *Criterion 3: Level Design: Effective use of Unreal Editor (4 points).*
- *Criterion 4: Design of Immersive Experiences (3 points).*
- *Criterion 5: Scripting and Blueprints (3 points)*
- *Criterion 6: Design of Immersive Experiences (2 points).*

5- References

- *Sweeney, T. (2018). Unreal Engine 4 for Game Development. Packt Publishing.*
- *Makepeace, M. (2019). Mastering Unreal Engine 4.x. Wiley.*
- *Oram, A., & Lopez, P. (2020). Unreal Engine Game Development Essentials. Apress.*
- *Unreal Engine Documentation Author: Epic Games*
  URL: https://docs.unrealengine.com/
- *Unreal Engine Marketplace Author: Epic Games*
  URL: https://www.unrealengine.com/marketplace
- *Unreal Engine Virtual Production Learning Path Author: Unreal Engine Education*
  URL: https://www.unrealengine.com/en-US/onlinelearning-courses/virtual-production-learning-path
- *Unreal Engine Roadmap Author: Epic Games*
  URL: https://trello.com/b/GzeIrwAN/ue4-roadmap
- *Unreal Engine AI and Machine Learning*
  Documentation Author: Epic Games
  URL: https://docs.unrealengine.com/4.27/en-US/GettingStarted/AI/
- *Ray Wenderlich - Unreal Engine*
  Tutorials Author: Ray Wenderlich
  Team
  URL: https://www.raywenderlich.com/unreal-engine
- *Unreal Engine Virtual Production Hub on Epic Games Website*

Author: Epic Games

URL: https://www.unrealengine.com/virtual-production

6- Working environment (Facilities necessary for learning)

- *Powerful Computer:*
- *Virtual Reality headset: Unreal Engine VR compatible headset.*
- *Unreal Engine: Latest stable version downloadable fromUnreal Engine official website.*
- *Integrated development environment (IDE) for programming in C++.*
- *3D Modeling Tools (Blender, Maya, 3ds Max, etc.)*

Course Specification

Virtual Reality and IoT

1. General

Coded	*Inf-RV 5 1 10*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Mouhieddine Belghith*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Virtual Reality and IoT*					Version	*08/2023*

Course description (Course objective):

The "Virtual Reality and Internet of Things" course aims to equip students with the skills to integrate and develop applications that harness the combined power of virtual reality (VR) and Internet of Things (IoT) technologies. Through a hands-on approach, students will design and implement interactive VR applications that seamlessly interact with IoT devices, fostering an understanding of the synergy between these cutting-edge fields..

Prerequisites:	*Keywords :*
- *Understanding of the basic principles of virtual reality development.* - *Knowledge of fundamental concepts of the Internet of Things and connected devices.* - *Mastery of at least one programming language suitable for VR development and IoT (C++, C#, Python, etc.).* - *Knowledge of communication protocols and network architectures, particularly in the context of IoT.*	*Virtual Reality, Internet of Things (IoT), Interconnectivity, Immersive Experiences,* *Security of Connected Systems,* *Development of VR-IoT Applications,*

Specific course objectives (OBJi):

OBJ 1 : *Gain a holistic understanding of how virtual reality and the Internet of Things interact to create immersive, connected environments.*

OBJ 2 : *Develop practical skills to design, develop and deploy interconnected applications leveraging virtual reality and IoT devices.*

OBJ 3 : *Encourage creativity by exploring the different ways VR and IoT can be used to create innovative experiences.*

OBJ 4 : *Understand the specific performance challenges related to VR and IoT, and develop skills to optimize these interconnected systems.*	
OBJ 5 : *Integrate robust security principles into application development to ensure data confidentiality and integrity in connected virtual environments.*	

Necessary material :

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to VR and IoT* - *Definitions and fundamental concepts.* - *Recent developments and trends.* - *Initial case studies.*	*6*	- *Understand the basics of virtual reality and the Internet of Things.* - *Identify points of convergence between VR and IoT.*
3-4	*Chapter 2: Concrete Use Cases* - *In-depth case studies.* - *Brainstorming on usage scenarios.*	*6*	- *Explore practical examples of VR-IoT applications.* - *Analyze the benefits and challenges.*
5-6	*Chapter 3: VR-IoT Development Principles* - *Suitable programming languages.* - *Development tools (Unity, Unreal Engine).* - *Design principles for interactivity.*	*6*	- *Understand the basics of VR-IoT application development.* - *Familiarization with development tools.*
7-8	- *Practical Workshop - Connected Virtual Environment.* - *Creation of a basic virtual environment.* - *Integration of simulated IoT sensors.* - *First interactions*	*6*	- *Apply VR-IoT development principles in a practical project.*
9-10	*Chapter 4: Performance Optimization* - *Analysis of hardware resources.* - *Graphics and code optimization techniques.* - *Latency management strategies.*	*6*	- *Understand performance challenges specific to VR-IoT.* - *Learn how to optimize applications.*
11-12	*Chapter 5: Security and Privacy* - *Security principles (encryption, authentication).* - *Management of sensitive data.* - *Security Breach Case Studies*	*6*	- *Examine security aspects related to VR-IoT systems.* - *Integrate security measures.*

13-14	*Case Study - Exemplary Projects* *- In-depth case studies.* *- Discussion of best practices.*	*6*	*- Analyze exemplary projects combining VR and IoT.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*-*
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Theoretical Understanding (10 points):*
  Chapter Content: Assessment of understanding of the theoretical concepts taught in the course chapters.
  Criteria: Accuracy in defining concepts, ability to explain technical terms, demonstration of in-depth knowledge.
- *Criterion 2: Practical Projects (10 points):*
  Application of Concepts: Assessment of the ability to apply theoretical knowledge in practical projects. Criteria: Creativity in the application of concepts, quality of implementation, demonstration of practical understanding.

5- References

- *Allam, Z., & Jones, A. (2019). Virtual Reality and the Internet of Things: Synergies in the Modern World. Springer.*
- *Jacobson, D. (2020). The Internet of Things: A Hands-On Approach to Virtual Reality and IoT Integration. Wiley.*
- *Mukherjee, A., & Singh, D. (2021). Combining IoT and Virtual Reality for Real-Time Interaction. Elsevier.*
- *Immersive Web - W3C (World Wide Web Consortium): Name :Immersive Web XR*
  Author :W3C
  URL: https://immersive-web.github.io/webxr-security/
- *Oculus Security Documentation:*
  Name :Oculus Developer - Security Documentation Author :Oculus
  URL: https://developer.oculus.com/documentation/native/android/security/
- *SteamVR Security Documentation:*

Name :SteamVR Partner Documentation - Security Author :Valve Corporation

URL: https://partner.steamgames.com/doc/features/security

- *Unity Security Guide for XR (Virtual and Augmented Reality):*
  Name :Unity - XR Security Author :Unity Technologies

  URL: https://docs.unity3d.com/Manual/XRSecurity.html

6- Working environment (Facilities necessary for learning)

- *VR Development Software: Unity:Popular VR development platform.*

  UnrealEngine:Game engine with VR features.
- *IoT Tools and Simulators:*

  Arduino IDE:For programming Arduino boards. Raspberry Pi OS:Operating system for Raspberry Pi.
- *Virtual Reality Headset:*
- *IoT hardware:Arduino boards, Raspberry Pi, IoT sensors, etc. :*
- *3D Modeling Tools (Optional):*

Course Specification

Sound and Visual Design for VR and AR Experiences

1. General

Coded	*Inf-RV 5 1 11*	Level/Semester	*5/S1*	Coefficient	*3*	Credits	*3*
Course	*Gaming and Virtual Reality*					Vol. H. (CI)	
Responsible	*Boutheina Ben Ismail*					Vol. H. (TP)	*42*
Teaching methods	*Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Sound and Visual Design for VR and AR Experiences*					Version	*08/2023*

Course description (Course objective):

The "Immersive VR/AR Experience Design" course aims to equip students with the skills needed to create visually and audibly captivating immersive environments in both virtual reality (VR) and augmented reality (AR). Students will gain hands-on experience in designing and implementing engaging visual elements and dynamic soundscapes, with applications in fields such as gaming, training, and simulation.

Prerequisites:	*Keywords :*
- *Basic knowledge of the principles of virtual and augmented reality.* - *Basic graphic design and sound processing skills.* - *Familiarity with computer-aided design (CAD) tools and audio/video editing software.*	*Virtual Reality, Augmented Reality, 3D Modeling, Immersive Visual Design, Virtual Environments, Soundscapes, Audiovisual Synchronization, VR/AR User Experience*

Specific course objectives (OBJi):

OBJ 1 : *Gain an in-depth understanding of the fundamentals of virtual (VR) and augmented (AR) reality. Identify key differences between the two technologies and their implications for sound and visual design.*

OBJ 2 : *Master visual design techniques adapted to immersive experiences in VR and AR.*

OBJ 3 : *Explore sound design principles to create immersive soundscapes. Use audio processing software to manipulate and integrate sounds into virtual environments.*

OBJ 4 : *Learn how to effectively integrate visual and audio elements into VR and AR experiences.*

OBJ 5 : *Implement design principles to create an optimal user experience in VR or AR.*

Necessary material :

2- Content elements (Course / Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: Introduction to VR and AR*	*6*	- *Gain an in-depth understanding of VR and AR technologies.* - *Identify key differences and their implications for sound and visual design.*
3-6	*Chapter 2 :* Immersive Visual Design	*12*	- *Master visual design techniques adapted to VR and AR.* - *Use 3D modeling tools to create engaging visual environments.*
7-10	*Chapter 3: Soundscapes*	*12*	- *Explore the principles of sound design for immersive environments.* - *Use audio processing software to create immersive soundscapes.*
11-12	*Chapter 4:*Audiovisual Integration	*6*	- *Learn to effectively integrate visual and audio elements.* - *Optimize synchronization between sound and image for maximum immersion.*
13-14	*Practical Project - VR/AR Experience*	*6*	- *Design and implement a complete VR or AR experience.* - *Present the final project with justification of visual and sound choices.*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Assessment of understanding of VR and AR fundamentals. (4 points)*
- *Criterion 2: Assessing the quality of visual design for VR and AR experiences. (4 points)*
- *Criterion 3: Assessing the quality of sound design for immersive environments. (4 points)*

- *Criterion 4: Assessment of how effectively visual and audio elements are integrated. (4 points)*
- *Criterion 5: Evaluating creating an optimal user experience in VR or AR. (4 points)*

5-Web references (useful links)

- *Chen, K., & Lin, F. (2021). Designing Immersive Experiences for VR and AR. CRC Press.*
- *Johnson, B. (2019). The Art of Immersive Soundscapes in Virtual Reality. Routledge.*
- *Lee, T. (2020). Interactive Environments: Visual and Audio Design for Virtual Reality. Springer.*

- *Unity Learn - VR/AR Development Name: Unity Technologies https://learn.unity.com/specializations/vr*
- *Designing Sound - Interactive Sound Design for VR Name: Designing Sound https://designingsound.org/2016/04/interactive-sound-design-for-vr/*
- *Google AR & VR Developers Name: Google https://developers.google.com/ar*
- *Ambisonics for VR - A Primer Name: Ambisonics for VR https://www.ambisonics4vr.com/*
- *Sound on Sound - Spatial Audio for Virtual Reality Name: Sound on Sound https://www.soundonsound.com/techniques/spatial-audio-virtual-reality*
- *Kadenze - Introduction to 3D Spatial Audio Name: Kadenze https://www.kadenze.com/courses/introduction-to-3d-audio-for-virtual-reality*
- *Virtual Reality Society Name: Virtual Reality Society https://www.vrs.org.uk/*

5- Working environment (Facilities necessary for learning)

- *Powerful Computer*
- *Virtual Reality headset: Unreal Engine VR compatible headset.*
- *3D Modeling Tools (Blender, Maya, 3ds Max, etc.)*
- *Audio Processing Software.*
- *Video Editing Tools: Adobe Premiere, Final Cut Pro, or any other video editing software for audiovisual integration.*

Common cross-curricular subject sheets

These subjects are taught at the level of the first semester of the 5th year

Course Specification

Minor 1 - ESB Certification

Entrepreneurship and Small Business

1. General

Coded	*TSV 5 1 01*	Level	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*All*					Vol. H. (CI)	*21*
Responsible	*Soumaya Hasnaoui*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Minor BSE*					Version	*08/2023*

Course description (Course objective):

The objective of the course is to master small business entrepreneurial skills and understand its different functions. The ESB certification is designed to test and validate fundamental concepts and knowledge in entrepreneurship and small business management. These fundamental concepts include:

- *Entrepreneurship;*
- *Recognize and evaluate opportunities;*
- *Plan, start and operate a business;*
- *Marketing and sales;*
- *and finance and business financing.*

Prerequisites:	*Keywords :*
None	*Entrepreneurship, management, business environment, accounting, commerce, finance*

Specific course objectives (OBJi):

1. *Analyze the key traits of successful entrepreneurs and assess the risks, benefits, opportunities, and challenges associated with entrepreneurship.*
2. *Evaluate different business opportunities, identifying the advantages and disadvantages of each, and make informed decisions about pursuing them.*
3. *Understand the importance of a business plan, including setting clear objectives, determining business value, and selecting the appropriate legal structure for a startup.*

4. *Evaluate various sources of startup financing, analyzing their advantages and disadvantages to determine the most suitable option for business growth.*
5. *Identify critical business operations such as human capital needs, intellectual property management, and standard operating procedures, and integrate them into business planning.*
6. *Develop an effective sales strategy by analyzing the costs and benefits of customer acquisition, creating strategies for customer retention, and determining communication methods to enhance business relationships.*
7. *Interpret financial statements, analyze cash flows, and calculate the company's break-even point to inform financial decision-making and ensure business sustainability.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1..2	***The entrepreneur:*** *Identify the characteristics of entrepreneurs* *Given a scenario including a self-assessment result, identify the strengths, weaknesses, and risk tolerance the self-assessment identifies and how to compensate with services* *Given a scenario, recognize a business opportunity* *Identify the risks, benefits, opportunities and disadvantages of being an entrepreneur*	*3h*	*OBJ 1*
3..4	***Opportunity recognition:*** *Identify the advantages and disadvantages of different types of opportunities (for example, starting a new business, purchasing an existing business, and purchasing a franchise)* *Given a scenario, analyze the demand for the good or service and opportunities in an environment* *Given a scenario, identify customers or potential customers for a business* *Given a scenario, recognize a value proposition*	*3h*	*OBJ 2*
5..6	***Start a business:*** *Identify the objectives and value of a business plan* *Identify the appropriate legal structure, advantages and disadvantages for different legal structures for a business* *Given a scenario, identify different types of licenses and regulations needed*	*3h*	*OBJ 3* *OBJ 4*

	Identify the pros and cons of various sources of startup funding: equity (friends/family, angel investors, venture capital), debt (bank, credit		
	cards, personal loans), and grants (government, foundation, business) In a given scenario, identify the support available to the business at the local, state, and federal levels Identify ethical practices and social responsibilities of a company Identify potential exit strategies for a business		
7.8	**Commercial operations:** Based on a scenario, identify key positions and human capital needs (including compensation and benefits) Given a scenario, determine if the work can be done by the owner or if employees or service providers are needed In a given scenario, identify the required taxes Using a scenario, identify intellectual property issues related to trademarks, copyrights and patents. In a given scenario, identify standard operating procedures (e.g., setup, conduct, internal controls, segregation of duties) Based on a scenario, identify the factors that led to sustainability	3h	OBJ 5
9.10	**Marketing and sales:** Based on a scenario, develop a sales strategy and identify the characteristics of a successful sale Given a scenario, identify and analyze the costs/benefits of finding customers Based on a scenario, identify how to retain customers and develop a relationship with loyal customers Based on a scenario, determine the value and methods of communication, including: websites, brochures, social media and advertising.	3h	OBJ 6
11.12	**Financial management:** Given a scenario, interpret basic financial statements such as income statements and balance sheets Using a scenario, identify the factors that influence credit ratings and the importance of a positive credit rating From a list of expenses, identify which ones are fixed or variable Given a scenario, identify the factors that impact the price for the customer Given a scenario, identify and analyze cash flows, including accounts receivable, accounts payable, inventory and debt. Given a scenario, create a cash budget Given a scenario, identify the company's break-even point	3h	OBJ 7

13-14	*Assessment test, Knowledge assessment and consolidation*	*3h*	*OBJ 1..7*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
EE - Written test (MCQ)	*100%*
Certification exam (Microsoft Azure Fundamentals - AZ900)	-

4- Evaluation criteria

- *Criterion 1: The entrepreneur (4 points)*
- *Criterion 2: Recognition of opportunities (3 points)*
- *Criterion 3: Start a business (4 points)*
- *Criterion 4: Commercial operations (3 points)*
- *Criterion 5: Marketing and sales (3 points)*
- *Criterion 6: Financial management (3 points)*

5- Bibliographic and Online References

- *Entrepreneurship and Small Business Certification, Certiport* *https://certiport.pearsonvue.com/Certifications/ESB/Certification/Overview*
- *Exam Objectives for ESB, Certiport - Marketing Resource Library* *https://certiport.filecamp.com/s/i/EJboz3aWoXgDQZpl*
- *Benoît, A., & Dupont, P. (2022). Entrepreneuriat et création d'entreprise : Stratégies et outils pour réussir. Dunod.*
- *Lemoine, J., & Garcia, A. (2023). Réussir dans l'entrepreneuriat : Les clés du succès pour les petites entreprises. Eyrolles.*
- *Timmons, J. A., & Spinelli, S. (2022). New Venture Creation: Entrepreneurship for the 21st Century (11th ed.). McGraw-Hill.*
- *Scarborough, N. M. (2023). Essentials of Entrepreneurship and Small Business Management (9th ed.). Pearson.*

6- Working environment (Facilities necessary for learning)

- *Gmetri, Skills Management System https://www.gmetrix.net/Login.aspx*
- *Certiport Portal (Creating a Certiport account)* *https://www.certiport.com/portal/Pages/Registration.aspx?defaultlang=enu*

Course Specification

Minor 2 - IT law

1. General

Coded	*TSV 5 1 02*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*All*					Vol. H. (CI)	*21*
Responsible	*Fatah Ben Letaifa*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Minor in computer law*					Version	*08/2023*

Course description (Course objective):
Guarantee dual disciplinary skills in law and IT with learning of legal and legal aspects, IT and information systems

Prerequisites:	*Keywords :*
None	*Principles and sources of law, Justice, Electronic contract, Cybercrimes, Intellectual property*

Specific course objectives (OBJi):

1. *Understand and apply the principles of intellectual property, computer criminal law (including cybercrime and data protection), computer contracts, and computer security, ensuring legal compliance in digital environments.*
2. *Legally qualify technological innovations linked to digital technology, and apply appropriate legal standards, such as data law, e-commerce law, intellectual property law, and audiovisual law, from a multidisciplinary perspective.*
3. *Analyze legal texts, prioritize relevant data, identify legal issues, and construct well-argued responses using appropriate legal vocabulary, providing solutions to complex legal challenges in the digital space.*

Necessary material :

Video projector

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	***Chapter 1: General Introduction*** *Definitions (law and IT)* *Branches of law* *Sources of IT law* *Purposes and areas of IT law*	*1h30*	*OBJ 1*
2-3-4-5	***Chapter 2: Cybercrime*** *THESystems and data breaches* *Offenses against the person* *Content crimes* *Investigation process and legal proceedings* *Criminal sanctions*	*6h*	*OBJ 2*
6-7-8-9	***Chapter 3: The law ofintellectual property*** *1- Literary and artistic property copyright (duration, procedures, etc.) neighboring rights* *2- Industrial property* *protection of innovations (invention patent) protection of identification signs (the brand)*	*6h*	*OBJ 2*
10-11-12-13	***Chapter 4: The electronic contract*** *Training (common validity conditions, specific validity conditions)* *Electronic payment and electronic signature Execution of a contract (obligations of the parties, interpretation)* *Types of contracts (related to IT goods/IT services)* *End of contract*	*6h*	*OBJ 3*
14	*Knowledge assessment and consolidation*	*1h30*	*OBJ 1 .. OBJ 3*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*-*
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Evaluation criteria

- *Criterion 1: understanding (03 points)*
- *Criterion 2: relevance and originality (07 points)*
- *Criterion 3: consistency (03 points)*
- *Criterion 4: completeness and development (05 points)*
- *Criterion 5: language and care of presentation (02 points)*

5- Bibliographic and Online References

- *"Computer law course Sheets/Courses", https://cours-de-droit.net/cours-de-droit-de-linformatique/*
- *"National authority for the protection of personal data", https://www.inpdp.tn*
- *Law No. 2009-33 of June 23, 2009, amending and supplementing Law No. 94-36 of February 24, 1994, relating to literary and artistic property*
- *Organic law 2004-63 of July 27, 2004, relating to the protection of personal data*
- *Decree-law No. 2022-54 of September 13, 2022, relating to the fight against offenses relating to information and communication systems*
- *Gilles, F., & Deschamps, M. (2022). Droit de l'informatique et des nouvelles technologies. Dunod.*
- *Kerr, I., & Reidy, S. (2022). Information Technology Law: The Law and Society (5th ed.). Oxford University Press.*

6- Working environment (Facilities necessary for learning)

- *None.*

Course Specification

Minor 3 - Digital Marketing

1. General

Coded	*TSV 5 1 03*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*All*					Vol. H. (CI)	*0*
Responsible	*Yasmine Mzergui*					Vol. H. (TP)	*21*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*30*
Module	*Minor in Digital Marketing*					Version	*08/2023*

Course description (Course objective):
The objective of the course is to analyze and influence consumer needs to adapt the offer and develop sales on a digital level

Prerequisites:	*Keywords :*
Have an idea for a project to market!	*unsatisfied need/ market/ B to B/ B to c/ Buyer persona/ customer job/ purchasing journey/ SEO/ SMO/ competitive intelligence*

Specific course objectives (OBJi):

1. *Analyze and assess the targeted market to identify trends, needs, and opportunities for strategic marketing.*
2. *Develop a comprehensive marketing strategy that aligns with business goals and leverages the most effective tools and channels.*
3. *Select appropriate marketing actions and create a detailed plan for execution, ensuring alignment with strategic objectives.*
4. *Implement digital marketing actions across platforms, utilizing online tools and techniques to engage with the target audience effectively.*
5. *Evaluate the performance of marketing activities, making necessary adjustments to optimize results and improve effectiveness.*

Necessary material :
PC and internet connection

2- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Understanding the marketing context*	*3h*	*OBJ 1*
3-4	*Market analysis*	*3h*	*OBJ 2*
5-6	*Developing a 4P plan*	*3h*	*OBJ3*
7-8	*Identification of the buyer persona and their customer Job*	*3h*	*OBJ 4*
9-10	*Writing the ideal purchasing journey and inbound marketing*	*3h*	*OBJ 5*
11-12-13-14	*Implementation of a Digital Marketing project (supervision & consolidation)*	*6h*	*OBJ 1 .. OBJ 5*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*20%*
DS - Supervised Duty	-
EE - Written test (Final exam)	-
EP - Practical test (Practical work exam or Mini project)	*80%*

4- Evaluation criteria

- *Criterion 1: Creativity (5points)*
- *Criterion 2: Methodology (5points)*
- *Criterion 3: Buyer persona (5points)*
- *Criterion 4: Purchasing journey (5points)*

5- Bibliographic and Online References

- *What is digital marketing? Types, strategies and best practices. Novak. J, Forbes advisor, 2023*
- *Inbound marketing blog for SaaS: software as a service, Sauvage. M, 2018*
- *Boullier, A. (2022). Marketing digital : Stratégies, outils et techniques. Dunod.*
- *Dufresne, C. (2023). Le marketing digital : Le guide complet pour réussir sa stratégie web. Eyrolles.*
- *Ryan, D. (2022). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation (5th ed.). Kogan Page.*
- *Chaffey, D., & Ellis-Chadwick, F. (2023). Digital Marketing: Strategy, Implementation, and Practice (8th ed.). Pearson.*

6- Working environment (Facilities necessary for learning)

- *No special environment!*

Minor 4 - Finance for engineers

1. General

Coded	*TSV 5 1 04*	Level/Semester	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*All*					Vol. H. (CI)	*21*
Responsible	*Nihel Fhaiel*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction*					Self-study H.	*24*
Module	*Minor in finance for engineers*					Version	*08/2023*

Course description (Course objective):
At the end of the course, students will have the skills necessary to: - *Understanding the sources of financing for a new business* - *Understanding "cash flow"* - *Make the necessary calculations in the financial mathematics module* - *Interpret basic financial statements such as the income statement and balance sheet* - *Identify and analyze cash flow, including: accounts receivable, accounts payable, inventory and payable.* - *From a list of expenses, identify which ones are fixed or variable* - *Identify the company's break-even point*

Prerequisites:	*Keywords :*
None	*Financing, Profitability, Fixed expenses, variable expenses, Accounts receivable, Accounts payable, Income statement, Balance sheet, Cash flow, etc.*

Specific course objectives (OBJi):
1. *Identify various sources of financing and define the concept of "cash flow," understanding its significance in business management.* 2. *Apply financial mathematics to solve calculations related to business finance, including interest rates, returns, and other key financial metrics.* 3. *Interpret and analyze financial statements, such as the income statement and balance sheet, to evaluate the financial health of a business.* 4. *Identify and analyze cash flows, distinguishing between operating, investing, and financing activities, to make informed financial decisions.* 5. *Distinguish between fixed and variable expenses, and assess their impact on profitability and cost management.* 6. *Calculate and interpret the break-even point, understanding its role in determining the minimum sales required to cover business costs.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter 1: General Introduction* - *Introduction to the course* - *Business cycles and sources of financing*	*3h*	*OBJ 1*
3-4-5-6	*Chapter 2: Financial mathematics* - *Simple interest* - *Discount* - *Compound interest* - *Exercises/Questions*	*6h*	*OBJ 2*
7-8-9	*Chapter 3: Basic financial statements* - *The balance sheet* - *The income statement* - *Exercises/Questions*	*4h:30*	*OBJ 3* *OBJ 4*
10-11-12	*Chapter 3: The break-even point* - *Fixed and variable costs* - *Profitable level* - *Exercises/Questions*	*4h:30*	*OBJ 5* *OBJ 6*
13-14	*Synthetic Case Study, Correction of an old exam, Knowledge assessment and consolidation*	*3h*	*OBJ 1 .. OBJ 6*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria

- *Criterion 1: Sources of financing (3 points)*
- *Criterion 2: Financial mathematics (7 points)*
- *Criterion 3: Basic financial statements (5 points)*
- *Criterion 4: The break-even point (5 points)*

5- Bibliographic and Online References

- *Cohen, E. (1991). Company financial management and financial development. Edicef.*
- *Lemoine, J., & Richard, D. (2022). Les finances pour l'ingénieur : Concepts et pratiques. Dunod.*
- *Brigham, E. F., & Ehrhardt, M. C. (2023). Financial Management: Theory & Practice (16th ed.). Cengage Learning.*

6- Working environment (Facilities necessary for learning)

- *None*

Subject Sheets
Languages

Course Specification

French A

1. General

Coded	*EN-A*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course						Vol. H. (CI)	*21*
Responsible	*Sami Mzoughi*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*French level A*					Version	*08/2023*

Course description (Course objective):
A-level French courses aim to develop the student's ability to understand the essential points of a message written in clear, standard language. The course materials are taken from Inspire 3, a DELF manual. They also aim to prepare the student to produce simple and coherent speeches on familiar subjects. Oral is preferred in all sessions.

Prerequisites:	*Keywords :*
Understand simple, decontextualized sentences. *Communicate in a simple way.*	*Understand, listen, communicate, react*

Specific course objectives (OBJi):
1) Understand the materials and respond to instructions. *2) Participate orally in debates around the proposed subject.* *3) Form a personal opinion.*

Necessary material :
Sound recording / JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*1st unit: Is it possible to be*	*3 hours*	*- talking about oneself* *- understand others.*

	different and live together?		*- explain cultural differences.*
3-4	*2nd Unit: Are we all journalists?*	*3 hours*	*- talk about information professions.*
			- transmit information. *- question the information.*
5-6	*3rd Unit: Why do we travel?*	*3 hours*	*Tell about an experience.* *- talk about tourism* *- think about the trip.*
7-8	*4th Unit: Describing a profession*	*3 hours*	*- collect information about a profession.* *- talk about responsibilities.* *- the skills required for each profession.*
9-10-11	5th Unit: Organize a remote activity	4.5 hours	- discuss teleworking. - understand the advantages and challenges of managing remote activities.
12-13-14	6th Unit: Can we fight inequalities?	4.5 hours	- tell about a commitment. - to give his opinion. - talk about inequalities.

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria (of written production)

- *Criterion 1: Understanding of the instructions: (8 points)*
- *Criterion 2: Relevance of ideas: (4 points)*
- *Criterion 3: Linguistic correction: (6 points)*
- *Criterion 4: Originality: (2 points)*

5- References

- *Learn.TV5Monde*

6- Working environment (Facilities necessary for learning)

- *Nothing to report.*

Course Specification

French B

1. General

Coded	*FR-B*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course	*-*					Vol. H. (CI)	*21*
Responsible	*Sami Mzoughi*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*French level B*					Version	*08/2023*

Course description (Course objective):
Level B courses set the objectives of understanding audio documents, understanding press articles and other authentic texts. Written production sessions are also on the program to introduce the student to the code of writing by inviting them to write various texts. The course materials are taken from Inspire 4, a DELF manual.

Prerequisites:	*Keywords :*
The student can understand isolated sentences and frequently used expressions. He can also communicate orally and describe his training using simple means, and address some subjects that concern him closely.	*Understand, communicate, describe, discuss subjects.*

Specific course objectives (OBJi):
1) *Understand the educational documents specific to each lesson.* 2) *Take a position on the subjects or problems raised by the materials.* 3) *Imagine other ways of acting.*

Necessary material :
Paper version documents / Sound recordings / JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*Does work have the same meaning today?*	*3 hours*	- *explain professional trends* - *0analyze the workplace.*

			- reveal professional taboos.
3-4	How is technology transforming our lives?	3 hours	- improve a living space. - take a position on virtual meetings. - imagine new worlds.
5-6	Can we still save the planet?	3 hours	- make an inventory of pollution. - alert the public to a risk. - propose solutions
7-8	Is politics everyone's business?	3 hours	- define rights and duties. - defend a commitment. - question the right to vote.
9-10-11	Are we prisoners of our appearance?	4.5 hours	- tell of discrimination. - imagine the human of the future. - talk about your appearance.
12-13-14	Is happiness utopian?	4.5 hours	- give a definition of happiness. - analyze preconceived ideas. - envision happiness.

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	40%
EE - Written test (Final exam)	60%
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria (of written production)

- Criterion 1: Understanding of the subject and organization of the text: (8 points)
- Criterion 2: Care given to expression (6 points)
- Criterion 3: Knowledge of the subject: (4 points)
- Criterion 4: Originality of ideas: (2 points)

5- WebReferences (useful links):

- Learn.TV5Monde

Course Specification

French C

1. General

Coded	*FR-C*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course	-					Vol. H. (CI)	*21*
Responsible	*Sami Mzoughi*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*20*
Module	*French level C*					Version	*08/2023*

Course description (Course objective):
The French Communication Techniques course, at level C, aims to develop three skills in the student: Comprehension of writing (CE), Oral production (PO) and Written production (PE), with a view to preparing them for the DELF exam. *The course material is generally a paper version document which offers various educational activities, relating to the materials. The role of the teacher is to provide the student with a certain autonomy in the search for answers. The supports are those of DELF B2, 2nd Edition - 100% SUCCESS.*

Prerequisites:	*Keywords :*
In principle, the student should have the following abilities: understand the essential points of a discussion, a text, a press article when the language used is clear and standard and when it concerns familiar subjects having relates to the daily life of the student.	*Understand, listen well, interact*

Specific course objectives (OBJi):
1) *Make reading hypotheses and generally understand the content of a document.* *2)* Enter message scopes. *3)* React to messages. *4)* For PE, acquire a methodology allowing successful written productions.

Necessary material :
Paper version documents - Sound recordings - JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*CE: How to read a text? / A set of short texts.* *PE: Analysis of the instructions / Different statements of written production*	*3 hours*	*Help the student understand various texts.* *Understand what is required by the instructions.*
3-4	*CE: Analysis of positions/testimonies* *PE: Learn to present a situation, facts / Various texts.*	*3 hours*	*Identification of tone, point of view.* *Learn to identify a situation, facts*
5-6	*CE: Search for relevant information / Various texts.* *PE: Expression of personal opinion / PE topics.*	*3 hours*	*Identification of the content of a text.* *Help to formulate ideas, to qualify your comments, to formulate proposals*
7-8	*CE: The informative text: its content, its characteristics.* *PE: Text production / Writing workshop.*	*3 hours*	*Enter the content of a text and report it in writing.* *PE: Master the structure of the text to be produced.*
9-10-11	*CE: The argumentative text / Various texts* *PE: Writing a formal letter. / Written production instructions.*	*4.5 hours*	*CE: Learn to recognize an argumentative text and grasp its specific features.* *PE: Learn the formal characteristics of the letter.*
12-13-14	*CE: Analysis of points of view / Written testimonies*	*4.5 hours*	*Recognize the different positions and their nuances.* *Assign each speaker their point of view*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	-
DS - Supervised Duty	*40%*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Evaluation criteria (of written production)

- *Criterion 1: Understanding of the subject structuring of the text: (8 points)*
- *Criterion 2: Relevance of the argument: (6 points)*
- *Criterion 3: Linguistic correction: (4 points)*
- *Criterion 4: Originality of ideas: (2 points)*

5- WebReferences (useful links)

- *Learn.TV5Monde*

6-Working environment (Facilities necessary for learning)

- *Nothing to report.*

Course Specification

English A

1. General

Coded	*ENG-A*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course	-					Vol. H. (CI)	*21*
Responsible	*Saoussen Laamiri*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*English level A*					Version	*08/2023*

Course description (Course objective):

Whether you already have some basic English or are completely new to it, our English program is divided into three levels (A, B and C). At the start of the academic year, your teacher will define your objectives with you and test your level during an initial assessment in order to help you integrate one of the three levels.

- *You will be able to acquire or strengthen your basics in business English as well as your self-confidence.*
- *You will review and learn the grammatical, oral and written basics.*
- *You will learn to communicate orally and in writing and you will enrich your vocabulary.*
- *You will be able to respond orally and follow a conversation.*

Prerequisites:	*Keywords :*
***Level A**: No specific knowledge necessary*	*Business English*

Specific course objectives (OBJ):

1) *Oral expression: acquisition of vocabulary relating to working English (Business English)*
2) *The written expression: writing letters, messages, formats, references, abbreviations…*
3) *The fundamentals: tenses, auxiliaries, adjectives, comparatives, pronouns*

Necessary material :

The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*The working day*	*3h*	*Vocab: Company departments (ex: HR, PR, finance) and job titles (ex: production manager)* *Gr: present simple and present continuous*
3-4	*Corporate culture*	*3h*	*Vocab: corporate culture vocabulary and asking for information* *Gr: collocations*
5-6	*Developing contacts*	*3h*	*Networking vocabulary, present perfect and past simple tenses*
7-8	*Cultural issues*	*3h*	*Cultural awareness, marketing in china and business in Finland vocabulary*
9-10	*Teamwork*	*3h*	*Describing a team, slogans, team-building and verbs with their corresponding nouns and adjectives*
11-12	*Job applications*	*3h*	*How to write a CV, a letter of application and wait for an interview*
13-14	*Revision*	*3h*	*Tenses and vocabulary of all chapters*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*40%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Digital teaching resources

- *Duolingo: A language learning application offering interactive lessons for beginners in English.*
- *BBC Learning English: A website providing a range of audio and written resources for beginners in English, including videos, articles, and exercises.*
- *EnglishClub: A website offering English lessons for beginners, featuring structured courses, interactive games, and discussion forums for language practice*

5- Evaluation criteria

- *Criterion for Continuous Assessment (40%):*
  - *PowerPoint (PPT) Projects: Students are evaluated on their ability to create and present*

presentations in English. They are graded on the clarity of content, visual quality, and their ability to communicate effectively.

  - *Oral Tests: Oral assessments are regularly conducted to evaluate students' proficiency in oral expression. They are graded on pronunciation, grammar, and their ability to articulate ideas coherently.*
  - *Debates: Students participate in debates in English, where they are evaluated on their ability to argue, refute opposing arguments, and express themselves persuasively.*
  - *Language Practice: This category evaluates classroom participation, grammar exercises, written assignments, and other language learning-related activities.*

- *Criterion for Written test (60%):*
  - *The final written exam evaluates students' overall understanding of the English language. It may include sections such as reading comprehension, written production (essays, letters, etc.), grammar, and vocabulary.*
  - *Questions may vary in complexity, ranging from fill-in-the-blank exercises to longer and more analytical writing prompts.*
  - *Students are graded on their ability to use the language accurately, organize their ideas logically, and demonstrate a deep understanding of the concepts studied throughout the course.*

Course Specification

English B

1. General

Coded	*ENG-B*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course						Vol. H. (CI)	*21*
Responsible	*Saoussen Laamiri*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*English level B*					Version	*08/2023*

Course description (Course objective):
Whether you already have some basic English or are completely new to it, our English program is divided into three levels (A, B and C). At the start of the academic year, your teacher will define your objectives with you and test your level during an initial assessment in order to help you integrate one of the three levels. You will thus be able to acquire or strengthen your basics in business English as well as as your self-confidence. You will review and learn the grammatical, oral and written basics. You will learn to communicate orally and in writing and you will enrich your vocabulary. You will be able to respond orally and follow a conversation.

Prerequisites:	*Keywords :*
***Level B**: No specific knowledge necessary*	*Business English*

Specific course objectives (OBJ):
1) *Oral expression: acquisition of vocabulary relating to working English (Business English)* 2) *The written expression: writing letters, messages, formats, references, abbreviations…* 3) *The fundamentals: tenses, auxiliaries, adjectives, comparatives, pronouns*

Necessary material :
The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Job description and job satisfaction*	*3h*	*Vocab: Company departments, corporate culture vocabulary* *Gr: asking questions at a job interview*
3-4	*Letters of inquiry and applications*	*3h*	*Vocab: How to write a letter of inquiry and an email of application* *Gr: complex questions*
5-6	*Promotional activities and branding*	*3h*	*The 15 different promotional activities, the power of brands, supermarkets' own brands*
7-8	*Presenting your business idea*	*3h*	*Vocab: Structuring a presentation, signaling the parts of a presentation, making the most presentations* *Gr: modal verbs*
9-10	*Business meetings*	*3h*	*Vocab: Why have meetings? purpose, benefits, importance of team discussions* *Gr: use of "too" and "enough"*
11-12	*Customer loyalty*	*3h*	*Vocab: the factors which make customers loyal to a company, words and definitions* *Gr: relative pronouns*
13-14	*Revision*	*3h*	*Revision of the tenses and vocabulary of all chapters*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*40%*
DS - Supervised Duty	*-*
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	*-*

4- Digital teaching resources

- *Rosetta Stone: A language learning program that uses an immersive approach to help learners develop their English skills at the intermediate level.*
- *Cambridge English: Textbooks and educational resources developed by the University of Cambridge to prepare learners for successful integration into professional life.*

- *FluentU: An English learning platform based on authentic videos, with interactive features to enhance language comprehension at the intermediate level.*

5- Evaluation criteria

- *Criterion for Continuous Assessment (40%):*
  - *PowerPoint (PPT) Projects: Students are evaluated on their ability to create and present presentations in English. They are graded on the clarity of content, visual quality, and their ability to communicate effectively.*
  - *Oral Tests: Oral assessments are regularly conducted to evaluate students' proficiency in oral expression. They are graded on pronunciation, grammar, and their ability to articulate ideas coherently.*
  - *Debates: Students participate in debates in English, where they are evaluated on their ability to argue, refute opposing arguments, and express themselves persuasively.*
  - *Language Practice: This category evaluates classroom participation, grammar exercises, written assignments, and other language learning-related activities.*

- *Criterion for Written test (60%):*
  - *The final written exam evaluates students' overall understanding of the English language. It may include sections such as reading comprehension, written production (essays, letters, etc.), grammar, and vocabulary.*
  - *Questions may vary in complexity, ranging from fill-in-the-blank exercises to longer and more analytical writing prompts.*
  - *Students are graded on their ability to use the language accurately, organize their ideas logically, and demonstrate a deep understanding of the concepts studied throughout the course.*

Course Specification

English C

1. General

Coded	*ENG C*	Level/Semester		Coefficient	*1.5*	Credits	*2*
Course						Vol. H. (CI)	*21*
Responsible	*Saoussen Laamiri*					Vol. H. (TP)	*0*
Teaching methods	*Lecture, Interactive, Direct Instruction, Project Based*					Self-study H.	*24*
Module	*English level C*					Version	*08/2023*

Course description (Course objective):

Improve your English to communicate in writing and orally in a professional classroom context, and prepare for the TOEIC test (Test of English for International Communication). Prepare to improve your TOEIC score in 18 hours of lessons.

TOEIC teaching resources and methods:
Table, internet access. Interactivity with the teacher. Refresher, time management strategy, practical exercises, mini tests targeted to student needs, detailed corrections. Review of progress made. Tips and revision strategy before the exam.

Composition: *200 multiple choice questions (MCQ)*

- *100 oral comprehension questions with audio support (4 exercises, duration 45 minutes)*
- *100 written comprehension questions (3 exercises, duration 75 minutes)*
- *The TOEIC is based on authentic examples taken from international professional situations (meetings, travel, telephone, etc.)*

Results: *a distinct assessment of oral comprehension and written comprehension*

- *a score of 5 to 495 points for each*
- *a total score between 10 and 990 points*

Prerequisites:	*Keywords :*
This course is intended for all students registered at level C in order to take the TOEIC exam	*TOEIC, time management, oral and written*

Specific course objectives (OBJ):

1) *Prepare in the best conditions for taking the TOEIC*
2) *Master the essential points of grammar and conjugation*
3) *Enrich your vocabulary*
4) *Improve your oral and written comprehension*

Necessary material :

The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Detailed overview of the exam*	*3*	*General presentation of the test and its objectives.* *Detailed breakdown of the test: written part/oral part.* *Complete mock test in real time, complete and detailed correction*
3-4	*Assessment of student level and revisions*	*3*	*Review of current knowledge, strengths and areas for improvement.* *Consolidation at the level of fundamental grammatical structures* *Fill-in-the-blank exercises, multiple choice questions, reformulation exercises*
5-6-7-8	*Preparation for the oral comprehension part*	*6*	*Listening and reconstitution of professional dialogues.* *Improved oral comprehension.* *Vocabulary recognition* *Understand the story of a current event or a news item: know how to distinguish the main elements (date, place, actions, etc.).*
9-10-11-12	*Improvement of written comprehension*	*6*	*Work on enriching everyday vocabulary* *Work to enrich professional and commercial vocabulary.*

			Know how to read and analyze documents used in professional situations: e-mails, summaries, reports, notices, etc.
13-14	*Final mock test*	*3*	*Real exam situation to evaluate and validate your progress. Detailed correction*

3- Evaluation methods & Distribution of marks

Type of assessment	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*40%*
DS - Supervised Duty	-
EE - Written test (Final exam)	*60%*
EP - Practical test (Practical work exam or Mini project)	-

4- Digital teaching resources

- *Oxford Online English: Online English courses designed for advanced learners, with a focus on enhancing communication skills in professional and academic contexts.*
- *TED Talks: English-language lectures on a variety of topics, providing advanced learners with the opportunity to improve their listening and comprehension skills while engaging with interesting and relevant content.*
- *TOEIC Prep: A website for thorough TOEIC preparation.*
  https://www.examenglish.com/TOEIC/toeic_listening_and_reading.htm
- *ETS Global Exam: The site that provides tools for TOEIC test preparation.*

5- Evaluation criteria

- *Criterion for Continuous Assessment (40%):*
  - *PowerPoint (PPT) Projects: Students are evaluated on their ability to create and present presentations in English. They are graded on the clarity of content, visual quality, and their ability to communicate effectively.*
  - *Oral Tests: Oral assessments are regularly conducted to evaluate students' proficiency in oral expression. They are graded on pronunciation, grammar, and their ability to articulate ideas coherently.*
  - *Debates: Students participate in debates in English, where they are evaluated on their ability to argue, refute opposing arguments, and express themselves persuasively.*
  - *Language Practice: This category evaluates classroom participation, grammar exercises, written assignments, and other language learning-related activities.*

- *Criterion for Written test (60%):*
    - *The exam consists of a multiple-choice questionnaire (MCQ) that includes questions on listening comprehension, grammar, vocabulary, and other linguistic skills relevant to the TOEIC.*
    - *Once the MCQ is completed, students' responses are evaluated and graded, and each question is assigned a predetermined number of points based on its difficulty and importance in the TOEIC.*

Subject Sheets Projects and internships

Importance of Internships

Internships in companies are an integral part of the EPI Group's training. These internships in companies are mandatory for obtaining the diploma. Also, the EPI Group pays particular attention to their progress.

During these internships, students develop their personal qualities, learn to work in a team and carry out projects.

Professional internships must be validated at the end of a defense.

Types of Internships

Internships in companies are of three types:

- **Introductory Internship**: they concern 3rd year students
  - ✓ Objective: To give students the opportunity to discover the professional world and join the company.
  - ✓ Minimum duration: 1 month
- **Professional internships** (design and/or implementation of projects linked to the specialty): they concern 4th year students
  - ✓ Objective: The student is expected to carry out the design and/or implementation of projects related to his specialty
  - ✓ Minimum duration: 1 month
- **PFE internships**: they concern 5th year students
  - ✓ Objective: Implementation of all the skills acquired during schooling to carry out a project allowing one to project oneself into the professional world
  - ✓ Minimum duration: 4 months

The EPI Group supports its students during these internships and provides them with the Internship Service for coordination with the different departments and host companies (choice, validation, etc.).

Evaluation of the Internships

The internship results in the writing of a report, which must be presented before a jury. This jury must be composed of at least two members:

- A president who must be a teacher from the EPI Group.
- An examiner: who must be a teacher from the EPI Group.
- The university supervisor who must be a teacher from the EPI Group.

- An internship tutor who must represent the host structure.

All internships must be validated at the end of a defense.

For this, each student is required to submit to the internship service:

- A connection form (to download from the “Internship forms” menu on our website episup.com)
- An internship certificate obtained from the company and duly completed and signed.
- Supervision monitoring sheet duly completed by the educational supervisor
- Company appreciation form: duly completed by the professional supervisor
- The internship report bearing the EPI Group cover page (to be downloaded from the “Internship forms” menu) in at least two copies (depending on the number of jury members) and one scanned copy.

Course Specification

Introductory Internship

1. General

Coded	Inf-Int 3	Level/Semester	*3/2*	Coefficient	*10*	Credits	*3*
Course	*Engineering course*					vol. H. (CI)	
responsible	Internships department					vol. H. (TP)	
Teaching methods	*Field Work*					Self-study H.	
Module	*Introductory Internship*					Version	*08/2023*

Course description (Course objective):

It is an internship for discovering the company

the student spend time observing and shadowing experienced professionals within various departments or teams. This allows them to gain insights into different aspects of the organization's operations and understand the roles and responsibilities of various team members.

As the internship progresses, the student is gradually given more opportunities to participate in hands-on tasks and projects under the guidance and supervision of mentors or supervisors. These tasks may be relatively simple or routine at first but gradually increase in complexity as the student gains confidence and demonstrates competence.

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ):

OBJ 1 : *Help students explore different career paths within their field of study or industry by exposing them to various departments, roles, and responsibilities*

OBJ 2 : *Provide students with opportunities to develop fundamental skills relevant to their field, such as communication, teamwork, problem-solving, and time management*

OBJ 3 : *Offer students practical, hands-on experience through tasks, projects, and assignments that contribute to the organization's goals and objectives.*

OBJ 4 : *Facilitate networking opportunities for students to connect with professionals in their field,*

OBJ 5 : *Prepare students for future internships or employment opportunities by equipping them with essential skills, experiences, and insights into the professional world.*

Course Specification

Professional Internship

1. General

Coded	Inf-Int 4	Level/Semester	*4/2*	Coefficient	*10*	Credits	*3*
Course	*Engineering course*					vol. H. (CI)	
responsible	Internships department					vol. H. (TP)	
Teaching methods	*Field Work*					Self-study H.	
Module	Professional internships					Version	*08/2023*

Course description (Course objective):
During his professional internship, the student, who has achieved his 4th year succesfully, must complete a practical case whose theme depends on his specialization *The student works full-time within the company but is not supervised by a teacher.* *It's a period of practical training or work experience undertaken by a student in a professional setting relevant to his field of study and career goals.* *It provides the intern with the opportunity to apply theoretical knowledge gained in academic settings to real-world scenarios, gaining practical skills and insights into their chosen profession.* *Interns may also have the opportunity to network with professionals in their field, build valuable connections, and sometimes even secure PFE opportunities upon completion of the internship.*

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ):

OBJ 1 : *Providing students with practical, real-world experience in their field of study or desired career path.*

OBJ 2 : *Develop and refine technical skills, soft skills, and industry-specific competencies necessary for future success in the profession.*

OBJ 3 : *Receive constructive feedback from supervisors and mentors to identify strengths, areas for improvement, and opportunities for further growth.*

OBJ 4 : *Gain insights into the expectations and realities of the workforce, facilitating a smoother transition from student life to professional employment post-graduation.*

OBJ 5 : *Write a professional internship report.*

2- Evaluation methods & Marks Distribution

- *The student must submit a professional internship report with a Internship certificate and Company appreciation form duly completed and signed in order to validate authorization for submission on time.*
- *In the absence of an internship certificate on the day of the defense, the jury will not accept the student and consequently the student will have a zero (unless the student brings back an authorization signed by the internship service)*
- *The evaluation is carried out by at two members of the jury.*
- *The evaluation is also done by assigning grades on a well-detailed report which is validated by the department head and the director.*
- *Among the evaluation criteria: Oral Expression, Rigor of the approach, content of the presentation, Discussion, Behavior and attendance, structure and content of the report, etc.*

Course Specification

PFE

1. General

Coded	Inf-Int 5	Level/Semester	*5/2*	Coefficient	*10*	Credits	*26*
Course	*Engineering course*					vol. H. (CI)	
responsible	Internships department					vol. H. (TP)	
Teaching methods	*Field Work*					Self-study H.	
Module	*PFE*					Version	*08/2023*

Course description (Course objective):
This involves the implementation of all the skills acquired during schooling to carry out a project, generally proposed by a company, allowing one to project oneself into the professional world. The student works full-time within the company and is supervised by a teacher. *During an End of Study Project (PFE), the student is led to develop a problem based on a specific professional situation.* *The main objective of this last internship is to affirm the skills of our future engineers and to prepare them effectively for their entry into professional life.* *The subject of the PFE internship generally leads the future engineer to encounter challenges and allows him to learn to act accordingly.*

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ):
OBJ 1 : *The PFE ideally allows the intern to carry out a project from A to Z…* ***OBJ 2 :*** *Go through all the stages necessary for its realization, from the study of specifications to final delivery* ***OBJ 3 :*** *Participate in technical studies: definition of problems, acquisition, compilation and analysis of data, formulation of hypotheses and recommendations;* ***OBJ 4 :*** *Put the student in the position of an engineer,* ***OBJ 5 :*** *Refine their first career orientations,* ***OBJ 6 :*** *Measure the role of the company's different engineers,* ***OBJ 7 :*** *Discover the different functions and their relationships,* ***OBJ 8 :*** *Write an end-of-studies report.*

Necessary material :
…

2- Content elements

Chapters/Content Items	Goals
Discover society (observation and learning)	Read all documents relevant to the internship related to the company and the project Learn the tools and software used in the business. Meeting with the team and supervisor Introduction to projects and internship objectives
Establishing project objectives	Clearly define the objectives to be achieved with the project. Observe operations in the field Make a project schedule Establish a Problem
Project planning and design	project delivery , including specific steps to follow and resources required. Design potential solutions to meet project objectives
Data collection and situation analysis	Collect relevant data necessary to carry out the project. Analyze data to understand the causes of the problem using analytics tools
Project implementation	Implement the solutions designed within the project framework .
Autonomy and responsibility	Take more responsibility in the project Work more independently Regularly take into account the progress of tasks Work collaboratively with other team members
Testing and validation	Test the developed solutions and ensure that they meet the specifications and needs of the project. Validate the results obtained with the internship supervisor or the team responsible for the project in the company.
Close the work and propose forecasts	*Prepare an internship report*

3- Evaluation methods & Marks Distribution

- *The student must submit a PFE report with a monitoring sheet signed by their educational supervisor in order to validate authorization for submission on time.*
- *In the absence of an internship certificate on the day of the defense, the jury will not accept the student and consequently the student will have a zero (unless the student brings back an authorization signed by the internship service)*
- *The evaluation is carried out by at least three members of the jury (supervisor, president of the*

jury and rapporteur)

- *The evaluation is also done by assigning grades on a well-detailed report which is validated by the department head and the director.*
- *Among the evaluation criteria: Oral Expression, Rigor of the approach, content of the presentation, Discussion, Behavior and attendance, structure and content of the report, etc.*

4- Evaluation criteria

Criteria	
Oral Expression: - Ability to keep the audience attentive - Judicious use and quality of transparencies. - Vocabulary, use of appropriate technical terms - Respect the planned time.	/04
Steps : - Rigor of the approach: choice, tools, method and synthesis	/04
Content of the presentation: - Level of know-how, technicality... - Personal work carried out. - Presentation of objectives achieved	/08
Discussion : - Mastery of aspects related to the subject, justifications, etc.	/04
Behavior, Attendance, Punctuality and Motivation	.. /04
Personal contribution and initiative	.. /06
Scientific and technological knowledge	.. /05
Level of know-how , technicality, creativity and functionality	.. /05
Report Structure -Acknowledgements, summary, introduction, presentation of the company, specifications, technical content, conclusion - Balanced ratio (Volume) - Clear and progressive presentation of information - Reasonable use and definition of technical terms, standardization	.. /06
Content of the Report - Presentation of the work requested (specifications) then of the entire made work. - Technical content - Meets standards -Importance of personal work (volume and level) - Justification for the choice of solutions adopted. - Comparison of the objectives achieved with the content of the specifications - Appendices, Bibliographies	.. /08
Presentation of the report -Pagination, layout -Spelling, grammar, style. - Clarity and quality of figures, diagrams, etc.	.. /06