Course Title:	**Advanced machine learning**
Course Code:	CSE542/1
Program:	Computer science Engineering
Department:	Computer Engineering
Course coordinator:	Mohamed OTHMANI
Institution:	Private Higher School of Engineers of Gafsa (ESIP)

A. Course Identification

1. Credit hours: **3 (1.5-0.5-1)**
2. Course type **a.** College ☐ Department ■ Others ☐ **b.** Fundamental ■ Transversal ☐ Optional ☐
3. Level/year at which this course is offered: 3.1/3
4. Pre-requisites for this course (if any): CSE112, algorithm data structure, CSE432
5. Co-requisites for this course (if any)**:**

1. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Self-study	Total workload
1	**Traditional classroom**	…..	33	78
2	**Blended**	45		
3	**E-learning**	.....		
4	**Distance learning**	.....		
5	**Other ()**	.....		

2. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	15
3	**Tutorial**	-
4	**Others** (specify)	-
	Total	45

B. Course Objectives and Learning Outcomes

Course Description

The "Advanced Machine Learning" course explores modern machine learning techniques. Students will learn about meta-learning, deep neural networks (DNNs), autoencoders, probabilistic models (Deep Boltzmann Machines, Deep Belief Networks), convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transfer learning.
The course combines theory and practical application, helping students design, analyze, and improve machine learning models for real-world use. It also covers ethical issues in AI, including fairness, bias, and transparency.

Course Main Objective

By the end of this course, students will be able to:

- ✓ Understand advanced machine learning concepts, including deep learning, meta-learning, and transfer learning, and their applications.
- ✓ Apply deep learning techniques, such as autoencoders, deep Boltzmann machines, CNNs, and RNNs, to solve complex machine learning problems.
- ✓ Evaluate and optimize machine learning models, improving accuracy, efficiency, and scalability for different datasets.
- ✓ Develop hands-on experience with machine learning frameworks like TensorFlow and PyTorch to implement real-world AI solutions.
- ✓ Analyze and compare different machine learning approaches, selecting the most suitable methods for various tasks.
- ✓ Understand and address ethical considerations in AI, including fairness, bias, and transparency, ensuring responsible AI development

1. Course Learning Outcomes

	CLOs	AlignedPLOs
1	**Knowledge and Understanding**	
1.1	✓ Develop a deep comprehension of advanced machine learning concepts, including deep learning, meta-learning, and transfer learning.	PLO.K1
1.2	✓ Cultivate expertise in identifying complex research problems within the domain of machine learning and artificial intelligence.	PLO.K2
	✓ **Skills**	
1.1	✓ Foster advanced critical thinking skills to deconstruct complex computational challenges encountered in machine learning and artificial intelligence.	PLO.S1
1.2	✓ Enable students to evaluate, compare, and select appropriate machine learning solutions based on their understanding of the problem's nature	

CLOs		AlignedPLOs
	and characteristics.	
2.1	✓ Cultivate advanced communication skills, enabling students to articulate complex technical concepts clearly and persuasively through oral presentations.	PLO.S2
2.2	✓ Develop proficiency in crafting comprehensive written reports that communicate research methodologies, findings, and implications effectively.	
5.1	✓ Develop advanced analytical skills to assess the performance of hardware/software systems in the context of machine learning tasks.	PLO.S5
5.2	✓ Apply machine learning models to real-world datasets and assess their performance, including accuracy, efficiency, and scalability.	
5.3	✓ Develop the ability to adapt machine learning models and systems to address emerging challenges and evolving technologies	
6.1	✓ Develop a deep understanding of embedded systems concepts, architectures, and their role in the broader IoT ecosystem.	PLO.S6
6.1	✓ Encourage the ethical consideration of software design choices, including fairness, bias, and transparency in machine learning systems.	PLO.S7

C. Course Content

No	List of Topics	Contact Hours
1	**Chapter 1:** Advanced Machine Learning & Meta-Learning 1. Learning to Learn: Meta-Learning (Optimization-based, model-based approaches) 2. Deep Neural Networks (DNNs) & Activation Function 3. Introduction to Deep Learning Frameworks (TensorFlow, PyTorch)	7.5
2	**Chapter 2:** Convolutional & Recurrent Neural Networks 1. Convolutional Neural Networks (CNN): AlexNet, VGG, ResNet 2. Practical Applications: Image Processing with CNNs 3. Recurrent Neural Networks (RNN): LSTM, GRU for NLP	7.5
3	**Chapter 3**: Autoencoders & Probabilistic Deep Learning 1. Variational Autoencoders (VAE) 2. Deep Boltzmann Machines (DBM) 3. Deep Belief Networks (DBN)	7.5
4	**Chapter 4**: Transfer Learning & Model Optimization 1. Transfer Learning & Fine-Tuning Pretrained Models 2. Optimizing Deep Learning Models: Regularization, Dropout, Batch Normalization	7.5
Total		30

C .1Practical work Content

No	List of Topics	Contact Hours
1	Deep neural networks	3
2	Deep learning, Convolutional Neural Networks (CNN)	6
3	RecurringNeural Networks (RNN)	3
4	Transfer learning	3
Total		15

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
K.2	✓ Cultivate advanced communication skills, enabling students to articulate complex technical concepts clearly and persuasively through oral presentations.	Lecturing	Assignments, Quizzes , Exams,
	✓ Develop proficiency in crafting comprehensive written reports that communicate research methodologies, findings, and implications effectively.		
2.0	**Skills**		
S.1	✓ Foster advanced critical thinking skills to deconstruct complex computational challenges encountered in machine learning and artificial intelligence. ✓ Enable students to evaluate, compare, and select appropriate machine learning solutions based on their understanding of the problem's nature and characteristics	- Lectures - Class discussions - Assignments - projects	Assignments, Quizzes , Exams, Report,
S.2	✓ Cultivate advanced communication skills, enabling students to articulate complex technical concepts clearly and persuasively through oral presentations. ✓ Develop proficiency in crafting comprehensive written reports that communicate research methodologies, findings, and implications effectively.		
S.5	✓ Develop advanced analytical skills to assess the performance of hardware/software systems in the context of machine learning tasks. ✓ Apply machine learning models to real-world datasets and assess their performance, including accuracy, efficiency, and scalability. ✓ Develop the ability to adapt machine learning models and systems to address emerging challenges and evolving technologies		
S6	✓ Develop a deep understanding of embedded systems concepts, architectures, and their role in the broader IoT ecosystem..		
S7	✓ Encourage the ethical consideration of software design choices, including fairness, bias, and transparency in machine learning systems		

2. Assessment Tasks for Students

	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Practical Work (written or oral)	Weekly	25%
2	Quizzes, Homework assignments	Random	00%
3	First mid term exam	8	25%
4	Final Exam	16	50%

E. Student Academic Counselling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:
- Office hours - Blackboard interface - Apply projects otherwise.

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press, 2016. ISBN: 978-0262035613. 2. François Chollet – Deep Learning with Python, 2nd Edition, Manning, 2021. ISBN: 978-1617296864. 3. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras& TensorFlow, 3rd Edition, O'Reilly, 2022. ISBN: 978-1098125974. 4. Sebastian Raschka, Vahid Mirjalili – Python Machine Learning, 3rd Edition, Packt, 2020. ISBN: 978-1789955750.
Essential References Materials	Python
Electronic Materials	1. MIT OpenCourseWare: Deep Learning & AI Courses 2. PyTorch & TensorFlow Guides: Official documentation for deep learning frameworks 3. GitHub AI Projects: Open-source AI repositories for deep learning research
Other Learning Materials	NA

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**classroom board software …**
Technology Resources (AV, data show, Smart Board, software, etc.)	**data show;**

G. Course Quality Evaluation

EvaluationAreas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Students, course coordinator, Alumni, Employers	Direct/Indirect
Extent of achievement of course learning outcomes.	Faculty, Program Leaders, quality department	Direct
Quality of Learning resources	Faculty, Program Leaders,	Direct, Indirect
Teaching and learning quality and effectiveness.	Students, Faculty Program Leaders,	Direct, Indirect

H. Specification Approval Data

Council / Committee	Computer Engineering Council
Date	11/09/2023