a) General			
School	ENGINEERING		
Academic unit	MECHANICAL ENGINEERING		
Level of studies	Undergraduate		
Course code	MM908E04	*Semester*	8
Course title	**Artificial neural networks & machine learning**		
Independent teaching activities		*Weekly teaching hours*	*ECTS*
Lectures		2	4
Laboratory exercises		2	
Course type		Deepening / Consolidation	
Course category		Compulsory Elective for Direction 1 & 2	
Prerequisite courses		-	
Language of instruction and examinations		Greek	
Is the course offered to Erasmus students		Yes	
Course website (url)		Under Construction	

b) Learning outcomes and general competences

b1. Learning outcomes

Upon successful completion of this course, the student will be able to:

- Distinguish, interpret and clearly explain concepts and issues related to Artificial Neural Networks (ANNs) & Machine Learning (ML) techniques.
- Be able to perceive, interpret and clearly explain issues related to ANNs & ML, to generalize the problem, to correctly appreciate in order to make right conclusions.
- Use all the concepts related to ANNs & ML, to provide new calculations, to be able to correctly classify the causes of the various problems and generate new knowledge, while gaining implementation experience.
- Have proven ability to create and manage large data files, which are necessary for ANNs & ML models training and development.
- Make new calculations, to be able to correctly classify the issues that cause the various relevant problems and to generate new knowledge, while gaining experience in applying ANNs & ML modeling techniques.
- Have the ability to distinguish and analyze in their potential components the issues that will be modeled with the use and application of ANNs and ML, so that they can combine, design, develop and implement older and innovative technologies to deal with these problems/issues.
- Review initial thoughts and views related to the development, use and implementation of ANNs & ML so that they can create, as far as possible, new knowledge and be able to compose and organize working groups and propose solutions.
- To have proven judgment, to be able to compare and evaluate different situations/proposals regarding the development, use and application of ANNs and ML, concerning the modeling of different magnitudes and parameters.
- Properly plan the development and the training of ANNs and ML models in issues related to modeling/forecasting of parameters related to the science of Mechanical Engineering, such as energy production, buildings energy consumption and saving, indoor and outdoor human thermal comfort/ discomfort, indoor and outdoor air quality, air pollution management, etc.
- Have the ability to evaluate the accuracy and reliability of a developed ANNs or ML model using appropriate statistical evaluation methods.
- Work with their fellow students to create and present, both individually and in groups, a case

study from its initial stages to its final evaluation and proposal for solutions.
- Work with their fellow students, to create and present both at individual and group level a case study from its initial stages up to the final evaluation and finally to be able to propose new ideas and solutions.

b2. General competences

- Search, analysis and synthesis of data and information using and applying the required technologies
- Decision Making
- Working independently
- Individual project
- Teamwork
- Criticism and self-criticism
- Production of free, creative and inductive thinking

c) Syllabus

Introduction to ML, Introduction to training algorithms of machine learning and artificial intelligence, Introduction to ANNs, Advantages and disadvantages of ANNs, ANNs types and classification, Introduction to the MultiLayer Perceptron-MLP, ANNs training algorithms and methods, Introduction to learning rules, The back error propagation training algorithm, Radial Basis Function-RBF networks and models, Introduction to Support Vector Machine-SVM topology and techniques, Introduction to Self-Organizing Map-SOM topology and techniques, Introduction to genetic algorithms, Methods for improving the generalization ability of ANNs and ML models, ANNs development and training with the use of Matlab ANNs Toolbox, NeuroSolutions ANNs Toolbox and other free ANNs software products, Evaluation of developed ANNs and ML models using appropriate statistical methods and statistical evaluation indices, Applications of ANNs and ML modeling techniques related to the science of Mechanical Engineering.

d) Teaching and learning methods - Evaluation

Delivery	Lectures and exercises, face-to-face	
Use of information and communications technology	- Commercial/free/open source software - Multimedia applications - MS Teams/Moodle/e-class (under construction) - Open courses	
Teaching methods	*Activity*	*Semester workload*
	Lectures	26
	Tutorials	0
	Laboratory exercises	26
	Computational exercises	0
	Individual work	78
	Course total	130
Student performance evaluation	Language of evaluation: Greek for Greek students and English for ERASMUS students. **<u>Theory (70%)</u>** I. Written final exam (80%) which includes: - Theoretical questions, multiple choice questions and judgment questions -Computational problems II. Short written intermediate test (20%) which takes place at the end	

	of the lectures and includes: -Computational application problems and answers on judgment questions (takes place at least three times per semester and after completing the lectures of a specific thematic unit of the course) **Laboratory (30%)** I. Individual or group (up to a maximum of 4 students) technical report in each laboratory exercise (50%) which includes a description of the laboratory exercise and the aim of its execution, presentation of the results (calculations, diagrams, etc.) and commentary on the results by drawing conclusions and comparing with the international literature II. Written or oral examination or presentation (50%) on the subject related to each laboratory exercise

e) Suggested bibliography

1. Diamantaras, K. (2007). Artificial Neural Networks. Kleidarithmos Publications, ISBN: 978-960-461-080-8 (In Greek)
2. Vlachavas I., Kefalas P., Vasileiadis N., Kokkoras F., Sakellariou E. (2011). Artificial Intelligence. University of West Macedonia Publications, 3d Edition, ISBN: 978-960-8396-64-7 (In Greek)
3. Haykin, S. (2010). Neural Networks and Machine Learning. Papasotiriou Publications. ISBN: 978-960-7182-64-7 (Translated in Greek)
4. Russell, R. (2018). Neural Networks. Easy Guide to Artificial Neural Networks. CreateSpace Independent Publishing Platform. ISBN-10: 1718898428, ISBN-13: 978-1718898424
5. Beale, R., & Jackson, T. (1990). Neural Computing: An Introduction. N.Y.: Adam Hilger.