Bachelor program,
Instrumentation Engineering (INEN) program, "Instrumentation Engineering" department

Course Unit Title	**Artificial intelligence (ML & DL)**
Course Unit Code	VTES-B07-3
Type of Course Unit	Elective
Level of Course Unit	3rd year INEN program
National Credits	0
Number of ECTS Credits Allocated	6
Theoretical (hour/week)	2
Practice (hour/week)	1
Laboratory (hour/week)	1
Year of Study	3
Semester when the course unit is delivered	5
Course Coordinator	Assoc. Prof. Ismailov Bahram
Name of Lecturer (s)	Assoc. Prof. Ismailov Bahram
Name of Assistant (s)	-
Mode of Delivery	Face to Face, Seminar.
Language of Instruction	English
Prerequisites	-
Recommended Optional Program Components	-

Course description:

In the course "Artificial Intelligence (ML&DL)" students study the capabilities of a modern technical system for simulating human intelligence in solving various problems. The range of problems solved by artificial intelligence covers the actions of collecting, sorting, calculating, analysing, visualizing, estimating parameters, making decisions, etc. Machine learning, being a subset of AI, allows machines to improve tasks with experience. Attention is paid to the subset of deep learning, which is relevant at the current stage of information technology development. Students are introduced to the benefits of using deep learning to study and apply features, patterns, images, representations and tasks directly from data for their analysis and generation of decisions or conclusions.

Objectives of the Course:

The objective of the course is to introduce students to modern technologies, methods, algorithms, software for analysing, evaluating, recognizing and managing complex systems. To provide an understanding of the capabilities of AI that imitates human intelligence to solve problems using advanced methods for using creative thinking, visual thinking and critical data analysis. During the training, students will become familiar with the capabilities of Machine Learning and then the application of Deep Learning to imitate the work of human intelligence to solve a wide range of problems.

Learning Outcomes:

At the end of the course the student will be able to		Assessment
1	Have knowledge of the technologies of the future - Artificial Intelligence and its components;	1, 3
2	Be able, based on the knowledge gained, to select and apply algorithms appropriate to the tasks to be solved;	1, 3
3	Apply knowledge to build useful algorithms based on Artificial Intelligence;	1, 3
4	Suggest the use of AI resources in production, science, healthcare, etc.;	1, 3
5	Apply the knowledge gained to solving scientific, creative and everyday problems.	1, 3

Assessment Methods: 1. Final Exam, 2. Presentation, 3. Midterms

Course's Contribution to Program

		CL
1	Ability to design models of technical devices of varying complexity using neural network algorithms.	3
2	Ability to use the fundamentals of mathematics, algorithmic principles and methods of computer technology to design devices using Artificial Intelligence.	1
3	Ability to conduct laboratory work on simulation modeling of various measuring, computing and control processes using examples of various systems.	4
4	Ability to use appropriate software to solve problems of measuring and analysing the results of measuring experiments.	1
5	Ability to creatively and responsibly approach the implementation of design tasks, as well as the ability to identify errors.	1

6	Ability to carry out correct methods for testing and adjusting the model to perform tasks on adapting algorithms to solving a given problem.	4
7	Ability to use language skills to exchange and obtain some knowledge from foreign sources.	1
8	Ability to analyse a problem, identify key requirements, justify an idea, and critically evaluate and compare results.	4
9	Ability to understand the professional, ethical, legal, and safety issues and responsibilities specific to engineering.	3
10	Ability to work productively in multidisciplinary teams, especially on projects requiring engineering skills, and to perform all work in accordance with relevant laws, regulations, standards, practices, and guidelines.	3

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)

Course Contents

Week	Chapter	Topics	Exam
1	[1] Ch.1, p.35-50 [4] Ch.1, p.1-4	**LECTURE:** Introduction to Machine Learning **SEMINAR:** Problems Machine Learning can solve	
2	[1] Ch.1, p.67-69 [5] Ch.1, p.3-23	**LECTURE:** Applications of Machine Learning **LAB -** Artificial intelligence, machine learning and deep learning	
3	[1] Ch.1, p.70-72 [1] Ch.1, p.70-74; [4] Ch.1, p.4-12	**LECTURE:** Tools Languages of Machine Learning **SEMINAR:** Tools AI. Python for AI	
4	[1] Ch.1, p.52-58; Ch.7, p.318-327 [5] Ch.4, p.93-102	**LECTURE:** Supervised Learning **LAB -** Fundamentals of machine learning	
5	[1] Ch.1, p.59-62; Ch.9, p.419-422 [4] Ch.2, p.29-69	**LECTURE:** Unsupervised learning **SEMINAR:** Supervised Machine Learning Algorithms	
6	[1] Ch.3, p.220-229 [5] Ch.2, p.25-37	**LECTURE:** Probability, Statistical Tools in Machine Learning **LAB -** Mathematical blocks of neural networks	
7	[1] Ch.5, p.230-255 [4] Ch.2, p.70-122	**LECTURE:** Random Variables, Multiple Random Variables **SEMINAR:** Decision Trees	
8	[1] Ch.1, p.62-65 [2] Ch1, p.9-40	**LECTURE:** Reinforcement learning **LAB -** Deterministic Dynamic Programming	Include Midterm exam.
9	[2] Ch1, p.126-130 [4] Ch.3, p.131-139	**LECTURE:** Reinforcement Learning and Decision/Control **SEMINAR:** Unsupervised Learning	
10	[3] Ch.1, p.37-42 [2] Ch1, p.130-134	**LECTURE:** Introduction to Deep Learning **LAB -** Machine Learning and mathematical optimization	
11	[3] Ch. 2, p.57; [5] Ch.2, p.31-32, 38-44; Ch.3, p.61-66 [4] Ch.3, p.168-207	**LECTURE:** Keras, Tensors **SEMINAR:** Clustering algorithms and Methods	
12	[3] Ch.5, p.199-217 [5] Ch.5, p.31-37	**LECTURE:** Deep Learning computation. Layers **LAB -** Data representations for neural networks	
13	[1] Ch.10, p.470-499 [5] Ch.1, p.1-55	**LECTURE:** Basics of Neural Network **SEMINAR:** Fundamentals of Deep Learning	
14	[3] Ch.3, p.89-96 [5] Ch.3, p.56-60	**LECTURE:** Linear Neural Networks **LAB -** Anatomy of a neural network	
15	[3] Ch.8, p.301-327 [5] Ch.6, p.196-206 [5] Ch.5, p.117-129	**LECTURE:** Recurrent Neural Network **LAB –** Understanding recurrent neural networks **SEMINAR:** Deep learning for computer vision	
16			Final exam

Recommended Sources:

TEXTBOOK(S)

[1] - Machine Learning. S. Dutt, S. Chandramouli, A.K. Das. Pearson. 2019, 741p.

[2] -. A Course in Reinforcement Learning. D.P. Bertsecas. Athena Scientific, *Belmont, Massachusetts*. 2023_476p.

[3] -. Dive into Deep Learning. Textbook. A. Zhang, Z.C. Lipton, Mu Li and A.J. Smola. 2020, 997p.
[4] -. Introduction to Machine Learning with Python. A Guide for Data Scientists. A.C. Müller and S.Guido. 2017, 392p.
[5] - Deep Learning with Python. FRANÇOIS CHOLLET. 2018. 386p.

Assessment

Attendance	0%	At least 75% class attendance is compulsory
Presentation	20%	
Seminars	0%	
Midterm Exam	30%	Written Exam
Final Exam	50%	Written-Exam
Total	100%	

Assessment Criteria
Final grades are determined according to the Academic Regulations of ASOIU for undergraduate studies

Course Policies

- Attendance of the course is mandatory.
- Late assignments will not be accepted unless an agreement is reached with the lecturer.
- Students cannot use calculators during the exam.
- Cheating and plagiarism will not be tolerated. Cheating will be penalized according to the Azerbaijan State Oil and Industrial University General Student Discipline Regulations

ECTS allocated based on Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Course duration in class	**14**	**3**	**42**
Presentation	1	9	9
Tutorials	14	1	14
Midterm Examination	1	3	3
Preparation for midterm exam	1	9	9
Final Examination	1	3	3
Preparation for final exam	1	18	18
Self-study	14	4	56
Total Workload			**150**
Total Workload/30(h)			**150/30**
ECTS Credit of the Course			**5**