COURSE SYLLABUS AND COURSE REQUIREMENTS
2025/2026 SEMESTER I.

Course title	*Intelligent Systems*
Course Code	IVM101ANMI
Hours/Week: le/pr/lab	2/2/0
Credits	6
Degree Programme	Computer Science Engineering MSc
Study Mode	*full time*
Requirements	exam
Teaching Period	fall
Prerequisites	-
Department(s)	Dept. of Technical Informatics
Course Director	Dr. Sári Zoltán
Teaching Staff	*Dr. Sári Zoltán, Mhd Mouayad Ahmad Abdallah*

COURSE DESCRIPTION

A short description of the course (max. 10 sentences).
Neptun: Instruction/Subjects/Subject Details/Basic data/Subject description

This course offers an in-depth exploration of Intelligent Systems based on a data-driven approach. Relying on modern techniques from machine learning and computational dynamics, students will learn how to model, analyze, and control complex systems using data. The course will build on foundational topics such as signal processing, dimensionality reduction, and control theory, and extend into machine learning techniques and their applications, with a brief introduction to state-of-the-art techniques like Dynamic Mode Decomposition (DMD), Sparse Identification of Nonlinear Dynamics (SINDy), and fundamental applications of neural networks. Students will develop a strong understanding of both the theoretical and practical aspects of intelligent control systems, with a focus on real-world applications.

SYLLABUS

Neptun: Instruction/Subjects/Subject Details/Syllabus

1. GOALS AND OBJECTIVES

Goals, student learning outcome.
Neptun: Instruction/Subjects/Subject Details/Syllabus/Goal of Instruction

By the end of the course, students will be equipped to apply advanced data-driven techniques to design, analyze, and implement control strategies for dynamic systems in various fields such as robotics, aerospace, and industrial automation. The course blends theoretical lectures with hands-on practice, allowing students to implement the concepts discussed in class and gain practical experience.

2. COURSE CONTENT

Neptun: Instruction/Subjects/Subject Details/Syllabus/Subject content

	TOPICS
LECTURE	1. *Introduction to Intelligent Systems* 2. *Introduction to Fourier Transform and Wavelet Transform; concepts of sparsity.* 3. *Dimensionality Reduction: SVD and PCA* 4. *Introduction to Machine Learning for Control Systems, Regression, Clustering, Classification* 5. *Fundamentals of Neural Networks* 6. *Linear Control Theory, state-space models* 7. *Advanced topics, DMD, SINDy*
PRACTICE **LABORATORY PRACTICE**	1. *Introduction to Intelligent Systems* 2. *Introduction to Fourier Transform and Wavelet Transform; concepts of sparsity.*

3. *Dimensionality Reduction: SVD and PCA*
4. *Introduction to Machine Learning for Control Systems, Regression, Clustering, Classification*
5. *Fundamentals of Neural Networks*
6. *Linear Control Theory, state-space models*
7. *Advanced topics, DMD, SINDy*

DETAILED SYLLABUS AND COURSE SCHEDULE

ACADEMIC HOLIDAYS INCLUDED

LECTURE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	Overview of control systems and their applications	[1]		
2.	Introduction to Fourier Transform and Wavelet Transform; concepts of sparsity.	[1]		
3.	Introduction to Singular Value Decomposition (SVD) and Principal Component Analysis (PCA); applications in data compression and noise reduction.	[1]		
4.	Fundamentals of machine learning, Regression techniques, and model selection.	[1]		
5.	Clustering techniques, Classification algorithms	[1]		
6.	Introduction to neural networks, Feedforward networks, Training and optimization techniques	[1]		
7.	Review of key concepts from Weeks 1-6,			
8.	**Autumn brake**			
9.	**Midterm assessment.**		**Midterm Exam**	
10.	Dynamical systems, Linear Control Theory	[1]		
11.	Closed Loop Feedback control, Controllability, Observability	[1]		
12.	Advanced topics, DMD, SINDy	[1]		
13.	Case studies			
14.	Course project presentations		**Project presentation**	
15.				

PRACTICE, LABORATORY PRACTICE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	Overview of control systems and their applications	[1]		
2.	Introduction to Fourier Transform and Wavelet Transform; concepts of sparsity.	[1]		
3.	Introduction to Singular Value Decomposition (SVD) and Principal Component Analysis (PCA); applications in data compression and noise reduction.	[1]		
4.	Fundamentals of machine learning, Regression techniques, and model selection.	[1]		
5.	Clustering techniques, Classification algorithms	[1]		
6.	Introduction to neural networks, Feedforward networks, Training and optimization techniques	[1]		

7.	Review of key concepts from Weeks 1-6,			
8.	**Autumn brake**			
9.	**Midterm assessment.**		**Midterm Exam**	
10.	Dynamical systems, Linear Control Theory	[1]		
11.	Closed Loop Feedback control, Controllability, Observability	[1]		
12.	Advanced topics, DMD, SINDy	[1]		
13.	Case studies			
14.	Course project presentations		**Project presentation**	
15.				

3. ASSESSMENT AND EVALUATION

(Neptun: Instruction/Subjects/Subject Details/Syllabus/Examination and Evaluation System)

ATTENDANCE

In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.

Method for monitoring attendance *(e.g.: attendance sheet / online test/ register, etc.)*

Attendance sheet. Maximum allowed absence: 30%.

ASSESSMENT

Cells of the appropriate type of requirement is to be filled out (course-units resulting in mid-term grade or examination). Cells of the other type can be deleted.

Course-unit with final examination

Mid-term assessments, performance evaluation and their weighting as a pre-requisite for taking the final exam

(The samples in the table to be deleted.)

Type	Assessment	*Weighting as a proportion of the pre-requisite for taking the exam*
Midterm Test	*max. 100 %*	*50 %*
Course Project	*max. 100 %*	*50 %*

Requirements for the end-of-semester signature

(Eg.: mid-term assessment of 40%)

(Midterm Test >= 40%) AND (Course Project is accepted (at least 40%))

Re-takes for the end-of-semester signature (PTE TVSz 50§(2))

The specific regulations for grade betterment and re-take must be read and applied according to the general Code of Studies and Examinations. E.g.: all the tests and the records to be submitted can be repeated/improved each at least once every semester, and the tests and home assignments can be repeated/improved at least once in the first two weeks of the examination period.

Midterm test can be retaken once during the semester.

Type of examination *(written, oral): oral*

The exam is successful if the result is minimum 40%.

Calculation of the grade *(TVSz 47§ (3))*

The mid-term performance accounts for ***50*** %, the performance at the exam accounts for ***50*** % in the calculation of the final grade.

Calculation of the final grade based on aggregate performance in percentage.

Course grade	Performance in %
excellent (5)	85 % …
good (4)	70 % ... 85 %
satisfactory (3)	55 % ... 70 %
pass (2)	40 % ... 55 %
fail (1)	below 40 %

The lower limit given at each grade belongs to that grade.

4. SPECIFIED LITERATURE

In order of relevance. (In Neptun ES: Instruction/Subject/Subject details/Syllabus/Literature)

COMPULSORY READING AND AVAILABILITY

[1.] Steven L. Brunton: Data-Driven Science and Engineering, Cambridge University Press, 2021

RECOMMENDED LITERATURE AND AVAILABILITY

[2.] A. Metin: Biomedical Signal Processing, Academic Press Inc., 1994

[3.] L. F. Chaparro: Signals and Systems using Matlab, Elsevier Inc., 2011