SYLLABUS

1. Program Information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Department of Automation
1.4 Field of study	Automation, Applied Informatics and Intelligent Systems
1.5 Cycle of studies	Bachelor
1.6 Study Programme/Qualification	Intelligent Automation Systems (dual, in English language)
1.7 Form of education	IF – full-time education
1.8 Course code	51.20

2. Course information

2.1 Course title					**Data Processing and Predictive Modeling in Industrial Automation**	
2.2 Course lecturer					*Prof.Dr.Ing. Vlad Muresan – vlad.muresan@aut.utcluj.ro*	
2.3 Seminar / Laboratory / Project Lecturer					*Drd. Ing. Eliza Olariu (Emerson)*	
2.4 Year of study	4	2.5 Semester	1	2.6 Type of assessment		E
2.7 Course status	Formative category *(DF, DS, DC)*					DS
	Optionality *(DOB, DOP, DFac)*					DOP

3.Total estimated time

3.1 Number of hours per week	5	of which:	HEI	Lecture	2	Seminar	0	Laboratory	1	Project	0
			CO		0		0		0		2
3.2 Number of hours per semester	70	of which:	HEI	Lecture	28	Seminar	0	Laboratory	14	Project	0
			CO		0		0		0		28

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes		
(b) Additional documentation in library, specialized electronic platforms, and fieldwork	5	7
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays		7
(d) Tutoring		4
(e) Examinations	3	4
(f) Other activities:		
3.4 Total individual study hours (sum (3.3(a)... 3.3(f)))	8	22
3.5 Total hours per semester (3.2+3.4)	50	50
3.6 Number of credits per semester	2	2

(HEI = Higher Education Institution, CO = Company)

4. Prerequisites (where applicable)

4.1 Curriculum Prerequisites	• Statistics and Numerical Calculus, • Measurements and transducers. • Process Modeling • Signal Procesing
4.2 Competency Prerequisites	• Basic knowledge of data analysis and statistical concepts. • Basic knowledge of process modeling.

5. Conditions (where applicable)

5.1. Course Organization Conditions	• Interactive lectures using multimedia technology (laptop, projector, blackboard) • Emphasis on practical examples and case studies from industrial contexts • Attendance at lectures is not mandatory, but is encouraged and recorded
5.2. Seminar / Laboratory / Project	• Labs and projects will be conducted in collaboration with company partners (Emerson), offering real industrial data and case studies

organization conditions	• Students will work with MATLAB, Python, and other relevant tools for data analysis and modeling • Activities will be supervised by both instructors and industry engineers • Attendance at labs and project activities is mandatory

6. Specific Competencies Acquired

Professional Competencies	• PC02 Analyse test data • PC05 Conduct quality control analysis • PC08 Design automation components • PC12 Gather technical information • PC19 Prepare production prototypes • PC26 Use information technology tools • PC27 Execute analytical mathematical calculations • PC30 Design control systems • PC32 Perform data analysis
Transversal Competen-cies	• TC01 Apply knowledge of science, technology and engineering • TC02 Think analytically • TC05 Interpret mathematical information

7. Learning outcomes

Knowledge:	• The student will be able to explain key data processing and modeling concepts in industrial contexts • The student will understand time-series data characteristics and challenges in industrial automation
Skills:	• The student will be able to apply data processing techniques (filtering, interpolation, outlier removal) • The student will be able to develop and evaluate predictive models for industrial automation
Responsibility and autonomy:	• The student will be able to work independently and in teams on data-centric industrial projects • The student will be able to document, present, and discuss data-driven solutions responsibly

8. Course Objectives

8.1 General objective of the course	• To provide students with practical and theoretical knowledge in processing industrial data and implementing predictive models for automation and optimization.
8.2 Specific objectives	• To introduce students to data-driven workflows in industrial environments • To develop skills in data acquisition, cleaning, transformation, and visualization • To introduce basic and advanced predictive modeling approaches relevant to industrial systems • To provide hands-on experience in evaluating and validating models • To enable students to analyze and interpret industrial data using modern software tools

9. Contents

9.1 Lectures	No. of hours	Teaching methods	Obs.
Introduction to data-driven industrial automation	2	Teaching using laptop,	
Data acquisition and exploration techniques	2		

Data quality and time-series analysis	2	projector and blackboard; Systematic exposure; Interactive course, debate; Case Study.	
Data filtering and noise reduction techniques	2		
Dimensionality reduction and feature selection	2		
Handling missing data and outliers	2		
Introduction to predictive modeling	2		
Time-series modeling and forecasting basics	2		
Predictive model implementation (regression/classification)	2		
Evaluation metrics and validation approaches	2		
Model refinement and performance optimization	2		
Industrial case studies and best practices	2		
Ethical considerations and data governance	2		
Review and preparation for the final assessment	2		

Bibliography

1. A.V. Oppenheim and A.S. Willsky, with S.H. Nawab, Signals and Systems, Prentice-Hall, Second Edition, 1997. (Biblioteca UTCN - 3 exemplare);
2. E.S. Gopi. Algorithm Collections for Digital Signal Processing Applications Using Matlab, Springer, 2007, ISBN 978- 1-4020-6410-4 (Biblioteca UTCN - 1 exemplar);
3. D.S.G. POLLOCK, A Handbook of Time-Series Analysis, Signal Processing and Dynamics, Academic Press, 1999,
4. Bisgaard, S., & Kulahci, M, Time series analysis and forecasting by example, John Wiley & Sons., 2011
5. Christopher M.Bishop, Pattern Recognition And Machine Learning, Springer, 2006
6. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, MIT Press, 2015
7. Roxana Rusu-Both et all. Knowledge-based systems, note de laborator, distribuite electronic

9.2.1 Laboratory	Hours HEI	Hours CO	Teaching methods	Obs.
Data acquisition and exploration	2		Presentation of examples. Practical application. Case Study. Discussions.	
Data preprocessing (filtering, feature extraction)	2			
Predictive modeling workflows (time-series)	2			
Predictive modeling workflows (classification)	2			
Predictive modeling workflows (regression)	2			
Model evaluation and refinement	2			
Final evaluation	2			

Bibliography

1. A.V. Oppenheim and A.S. Willsky, with S.H. Nawab, Signals and Systems, Prentice-Hall, Second Edition, 1997. (Biblioteca UTCN - 3 exemplare);
2. E.S. Gopi. Algorithm Collections for Digital Signal Processing Applications Using Matlab, Springer, 2007, ISBN 978- 1-4020-6410-4 (Biblioteca UTCN - 1 exemplar);
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7. Roxana Rusu-Both et all. Knowledge-based systems, note de laborator, distribuite electronic

9.2.2 Project	Hours HEI	Hours CO	Teaching methods	Obs.
End-to-end project: topic assignment, data processing, predictive modeling, and evaluation using industrial data		28	Presentation of examples. Practical application. Case Study.	

			Discussions.	

Bibliography

1. A.V. Oppenheim and A.S. Willsky, with S.H. Nawab, Signals and Systems, Prentice-Hall, Second Edition, 1997. (Biblioteca UTCN - 3 exemplare);
2. E.S. Gopi. Algorithm Collections for Digital Signal Processing Applications Using Matlab, Springer, 2007, ISBN 978- 1-4020-6410-4 (Biblioteca UTCN - 1 exemplar);
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10. Correlation of course content with the expectations of the epistemic community representatives, professional associations, and major employers in the field related to the program

The course aligns with the expectations of industrial employers and the epistemic community in industrial automation by emphasizing practical data analysis, predictive maintenance, and system optimization techniques. It ensures that students acquire competencies in handling real-world industrial data and developing predictive solutions.

11. Evaluation

Activity Type	**Evaluation criteria**	**Evaluation methods**	**Weight in final grade**
11.1 Lecture	Understanding of concepts and application ability	Written exam	40%
11.2.1 Laboratory	Practical execution, data processing, interpretation	Continuous in-lab evaluation + final report	20%
11.2.2 Project	Ability to design, document, and present data-driven solutions	Oral presentation + report	40%

11.3 Minimum Performance Standard

- Final exam >=5
- Lab grade>=5 mandatory to be able to take the final exam
- Project grade>=5 mandatory to be able to take the final exam

40% Final exam + 20% Lab Grade + 40% Project grade > 5

Date of completion: 15.09.2025	Lecturers		Signature
	Course	Prof.Dr.Ing. Vlad Muresan	

Date of approval by the Department of Automation Council 24.11.2025 Date of approval by the Faculty of Automation and Computer Science Council 28.11.2025	Director of the Department of Automation Prof.dr.ing. Honoriu VĂLEAN Dean Prof.dr.ing. Vlad MUREȘAN