Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Departament	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Codul disciplinei	35.20

2. Data about the subject

2.1 Subject name	***Knowledge-based Systems***				
2.2 Course responsible/lecturer	Conf.dr.ing. Rusu-Both Roxana – roxana.both@aut.utcluj.ro				
2.3 Teachers in charge of applications	Conf.dr.ing. Rusu-Both Roxana – roxana.both@aut.utcluj.ro				
2.4 Year of study	3	2.5 Semester	1	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DS
	DI – compulsory, DO – elective, Dfac – optional				D0

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar	0	Laboratory	1	Project	1
3.2 Number of hours per semester	125	of which:	course	28	Seminar	0	Laboratory	14	Project	14
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										28
(b) Supplementary study in the library, online and in the field										10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										28
(d) Tutoring										
(e) Exams and tests										3
(f) Other activities:										
3.4 Total hours of individual study (sum of (3.3(a)…3.3(f)))										69
3.5 Total hours per semester (3.2+3.4)										125
3.6 Number of credit points										5

4. Pre-requisites (where appropriate)

4.1 Curriculum	• Special mathematics in engineering • Measurements and transducers • Signals and systems • Process modeling
4.2 Competence	• Sensors and transducers • Elementary electrical and electronic circuits • Elements of linear algebra and mathematical analysis • Algorithms and circuits for implementing elementary signal processing methods • Analog and discrete signal parameters • Mathematical modeling elements

5. Requirements (where appropriate)

5.1. For the course	The lectures are interactive, using multimedia technology: blackboard, projector, computer. Going through the bibliographic materials indicated for the course. Attendance at classes is not mandatory, but is recorded by the course responsible.
5.2. For the applications	Specific equipment, computers, specific software. Attendance at the lab and project is mandatory.

	Preliminary preparation of laboratories.

6. Specific competences

6.1 Professional competences	C2 Operation with fundamental concepts from computer science, information and communication technology. C2.2 Reasoned use of concepts from informatics and computer technology in solving well-defined problems in systems engineering and in applications that require the use of hardware and software in industrial systems or in computer systems. C3 Use of automation fundamentals, modeling, simulation, process identification and analysis methods, computer-aided design techniques. C3.1 Identification of the fundamental concepts of systems theory, automatic control engineering, basic principles of modeling and simulation, as well as process analysis methods, in order to explain the basic problems in the field. C3.2 Explaining and interpreting the automation problems of some types of processes by applying the fundamentals of automation, methods of modeling, identification, simulation and analysis of processes, as well as computer-aided design techniques. C3.3 Solving some types of management problems by: using modeling methods and principles, developing simulation scenarios, applying identification and analysis methods of some processes (including technological processes) and systems.
6.2 Cross competences	

7. Course objectives

7.1 General objective	The objective of this course is to learn to effectively use data in the analysis and modeling of complex, real-world problems by understanding and mastering the elementary methods of representing, manipulating signals and describing their parameters.
7.2 Specific objectives	• Acquisition of analog and digital signals from sensors • Calculation of analog and discrete signal parameters • Signal processing methods • Modeling techniques • Validation methods and metrics

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Introduction to data driven system development. Application domains and examples.	2	Teaching using laptop, projector and blackboard; Systematic exposure; Interactive course, debate; Case Study.	On-site
Data understanding: aquisition, exploration (statistics), visualization techiques	2		
Data understanding: data quality analysis, time-frequency analysis	2		
Data pre-processing: denoising (filtering techniques), dimensionality reduction	2		
Data pre-processing: detrending , interpolation of missing samples, outlier removal	2		
Data pre-processing: feature extraction, feature selection	2		
Modeling: modeling techniques	2		
Modeling: time-series segmentation and semantic labeling	2		
Modeling: prediction models I	2		
Modeling: prediction models II	2		
Modeling: anomaly detection methods	2		
Modeling: models for multivariate time series	2		
Evaluation and validation: methods and metrics	2		
Evaluation and validation: model validation framework	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. Sisteme bazate pe cunoaștere, note de curs, distribuite electronic

8.2 Aplications (laboratory)	No.hours	Teaching methods	Notes
Data aquisition - experimental	2	Presentation of examples. Practical application. Case Study. Discussions.	Mandatory attendance
Data understanding: descriptive statistics, visual analytics, correlation analysis, data quality check	2		
Data pre-processing: filtering, principal component analysis	2		
Predictive modeling I	2		
Predictive modeling II	2		
Anomaly detection	2		
Activity recognition	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. Sisteme bazate pe cunoaștere, note de laborator, distribuite electronic

8.3 Aplications (project)	No.hours	Teaching methods	Notes
Topic assignment: Experimental Setup and data aquisition	2	Presentation of examples. Practical application. Case Study. Discussions.	Mandatory attendance
Data analysis: vizualization, quality analysis	2		
Data preprocessing: denoising, detrending, etc.	2		
Data modeling	2		
Data modeling	2		
Model evaluation	2		
Final Presentation/ Final Report	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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9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The content of the discipline, together with the acquired skills and abilities, was discussed with other universities and important companies from Romania, Europe and the USA and corresponds to the expectations of professional organizations, companies, as well as national and international quality assurance bodies (ARACIS). It also ensures the adoption of ethical standards appropriate to engineering practice.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Assessment of knowledge through a test based on the knowledge gained following participation in the course	Written exam	50%
Seminar			
Laboratory	Examination of the skills and knowledge acquired through the participation in the laboratory.	Practical assessment	25%
Project	Project presentation	Practical presentation	25%
Minimum standard of performance: Written exam grade > 5 and practical assessment grade > 5 and practical presentation grade > 5 N=0.6E+0.2*L+0.2P, N>5, E>5, L>5, P>5			

Date of filling in:		**Title Firstname NAME**	**Signature**
21.03.2023	Course	Assoc. Prof. eng. Roxana BOTH, PhD	
	Applications	Assoc. Prof. eng. Roxana BOTH, PhD	

Date of approval by the Department Board ……..

Head of Departament .....
Prof.dr.ing. Honoriu VĂLEAN

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Date of approval by the Faculty Council ……

Dean
Prof.dr.ing. Liviu Cristian MICLEA

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