SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Master
1.6 Program of study/Qualification	Data Science / Master
1.7 Form of education	Full time
1.8 Subject code	8.2

2. Data about the subject

2.1 Subject name			***Time Series Analysis***		
2.2 Course responsible/lecturer			Prof.Dr.Ing. Sebestyen-Pal Gheorghe - Gheorghe.Sebestyen@cs.utcluj.ro Conf.Dr.Ing. Hangan Lia-Anca - Anca.HANGAN@cs.utcluj.ro		
2.3 Teachers in charge of seminars/ laboratory/ project			Prof.Dr.Ing. Sebestyen-Pal Gheorghe - Gheorghe.Sebestyen@cs.utcluj.ro Conf.Dr.Ing. Hangan Lia-Anca - Anca.HANGAN@cs.utcluj.ro		
2.4 Year of study		2.5 Semester		2.6 Type of assessment (E - exam, C - colloquium, V - verification)	
2.7 Subject category	Formative category: DA – advanced, DS – speciality, DC – complementary				DA
	Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice)				DO

3.3. Estimated total time

3.1 Number of hours per week	3	of which:	Course	2	Seminars	1	Laboratory		Project	
3.2 Number of hours per semester	42	of which:	Course	28	Seminars	14	Laboratory		Project	
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										20
(b) Supplementary study in the library, online and in the field										20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										10
(d) Tutoring										5
(e) Exams and tests										3
(f) Other activities:										

3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	58
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	
4.2 Competence	Familiarity with linear algebra; Python programming languge

5. Requirements (where appropriate)

5.1. For the course	Attending min 50% of the lectures to be admitted to take the final exam
5.2. For the applications	Compulsory attendance of 100% to be admitted to take the final exam

6. Specific competence

6.1 Professional competences	Working with advanced mathematical methods and models, engineering and computing specific techniques and technologies.
6.2 Cross competences	Clear and concise description of professional activity flows, tasks and outcomes obtained by assuming the role of leader / project manager or as a member of a research team, as result of personal skills of domain specific information synthesis, global vision, communication skills with collaborators,

	ability of task stages identification.

7. Discipline objective (as results from the *key competences gained*)

7.1 General objective	The main objective of this course is to offer information that facilitate the understanding of main characteristic of time-series and gain familiarity with processing techniques.
7.2 Specific objectives	In order to achieve this objective, students will learn to: - process time series - analyse time series data with statistical tools - apply advanced engineering on time-series: forecasting, prediction

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
Time Series Basics: definition and characteristics; practical examples	2	Oral presentation, ppt support, discussions	
Stationarity: univariate/multivariate stationary/non-stationary processes	2		
Trends & Time-series seasonal decomposition	2		
Correlation	2		
Noise in time series: types of noise; noise removal methods; smoothing	2		
Feature engineering & Spectral Analysis: Periodogram, FFT	2		
Likelihood methods: Kalman Filter	2		
Bayesian Methods	2		
Time series forecasting: methods overview, metrics,	2		
Statistical Models for Time series Forecasting : ARIMA	2		
Statistical Models for Time series Forecasting : SARIMAX	2		
Vector autoregression (VAR, VMA, VARMA)	2		
ARCH theory	2		
Deep Learning for Time Series Forecasting: LSTM	2		
Bibliography Hamilton, James D. Time Series Analysis. Princeton University Press, 1994. ISBN: 9780691042893.			

8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Generate time-series: Python piloted application	2	Oral presentations, discussions	
Extract trends	2		
Correlation implementation, visualisation and discussion	2		
Extract feature from time series with FFT & classification	2		
Kalman filter application	2		
ARIMA & SARIMAX implementation in Python	2		
Python application for forecasting using LSTM	2		
Bibliography Hamilton, James D. Time Series Analysis. Princeton University Press, 1994. ISBN: 9780691042893.			

** Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	The ability to solve domain specific problems Attendance, (inter)activity during class hours	Written Exam, activity during class hours	50%
Seminar	Tasks completion Attendance	Activity grading	50%
Laboratory			
Project			
Minimum standard of performance: Lab grade >=5, Course evaluation grade >=5			

Date of filling in:	**Titulari**	**Titlu Prenume NUME**	**Semnătura**
	Curs	Prof.Dr.Ing. Sebestyen-Pal Gheorghe Conf.Dr.Ing. Hangan Lia-Anca	
	Aplicații	Prof.Dr.Ing. Sebestyen-Pal Gheorghe Conf.Dr.Ing. Hangan Lia-Anca	

Date of approval in the department 20.02.2024	Head of department Prof.dr.ing. Rodica Potolea
Date of approval in the Faculty Council 22.02.2024	Dean Prof.dr.ing. Mihaela Dinsoreanu