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	Bachelor of Science
1.6 Program of study / Qualification	Computer science / Engineer
1.7 Form of education	Full time
1.8 Subject code	104.

2. Data about the subject

2.1 Subject name				***Mechanics***	
2.2 Course responsible / lecturer				Șef lucr. dr. ing. Sergiu-Dan Stan - Sergiu.Stan@mdm.utcluj.ro	
2.3 Teachers in charge of seminars / laboratory / project				Șef lucr. dr. ing. Sergiu-Dan Stan - Sergiu.Stan@mdm.utcluj.ro	
2.4 Year of study	II	2.5 Semester	2	2.6 Type of assessment (E - exam, C - colloquium, V - verification)	C
2.7 Subject category	*DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară*				DF
	DI – Impusă, DOp – opțională, DFac – facultativă				DFac

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars	2	Laboratory	-	Project	-
3.2 Number of hours per semester	56	of which:	Course	28	Seminars	28	Laboratory	-	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										15
(b) Supplementary study in the library, online and in the field										5
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										16
(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)))	44
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	• Physics, Mathematics
4.2 Competence	• Mathematics, Physics,

5. Requirements (where appropriate)

5.1. For the course	Whiteboard, projector, computer
5.2. For the applications	Reading and understanding of the lecture notes.

6. Specific competence

6.1 Professional competences	C1 – Operating with basic Mathematical, Engineering and Computer Science concepts C1.1 – Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems

	C1.2 – Using specific theories and tools (algorithms, schemes, models, protocols, etc.) for explaining the structure and the functioning of hardware, software and communication systems C1.4 – Formal evaluation of the functional and non-functional characteristics of computing systems C1.5 – Providing a theoretical background for the characteristics of the designed systems
6.2 Cross competences	N/A

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

7.1 General objective	• The general objective of the course is to introduce the fundamental principles of mechanical systems, to know the structure, functioning, design fundamentals of mechanical systems that integrates mechanical components, electrical and software technology. • To know the main types of mobile mechanical systems (mechanisms), fundamentals of theory of mechanisms, robot mechanisms and flexible fabrication systems, basic problems in the study of them, used terminology as well as CAD methods of approaching them.
7.2 Specific objectives	The specific objectives are to acquire the knowledge and techniques related to: • usage of methods to determine the functional parameters of different mechanical systems; • to use the mathematical formulae, software package to simulate the different mechanical systems, robot mechanisms, • to analyse and evaluate the experimental data used in mechanical engineering; • to understand, to analyse and compare technical solutions specific to mechanical engineering.

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
1. Introduction to mechanical engineering, design and realization of mechatronics systems. V-model as the standard process model for mechatronic system development, mechatronics design methodology.	2	Lecture, visual presentations, demonstrations	
2. Structural analysis of linkages. Degree of Freedom, Classification of Mechanisms.	2		
3. Position Analysis of Mechanisms. Joint variables, Loop Closure Equations, Solution Techniques for Loop Closure Equations.	2		
4. Kinematic analysis of linkages. Transfer function method.	2		
5. Dynamic analysis of linkages.	2		
6. Mechanical Power Transmission. Bar Linkages.	2		
7. Variators. Continuously variable transmission (CVT). Belt drives. Chain drive.	2		
8. Couplings, gearbox, gears, reducers and timing belts. Simple Gear Trains, Planetary Gear Trains.	2		
9. The role of dynamics and kinematics of robotic devices in design of mechatronics systems. Kinematics and dynamics of robotic type devices, articulation, speed, accuracy, bandwidth, inertia, vibration, static and dynamic loading, materials, integration of design requirements.	2		
10. Serial robots. Introduction. Direct and inverse kinematics problems, Examples of kinematics of common serial robots, workspace of a serial robot.	2		
11. Parallel robots. Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-	2		

closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics several parallel robots.			
12. Robot Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel robots.	2		
13. Exoskeleton systems. Hardware Design of the Exoskeleton systems. Mechanical Design. Actuators.	2		
14. Flexible systems of fabrication.	2		
Bibliography 1. Handra-Luca, V., Mecanisme, Ed.UT Pres, Cluj-Napoca, 1981. 2. Handra-Luca, V., ş.a.– Introducere în teoria mecanismelor, Editura Dacia, Cluj-Napoca, vol. I-II, 1982, 1983. 3. Maros, D., ş.a. – Mecanisme, Indrumător de lucrări, Lito. I.P.C-N, Cluj-Napoca, 1984. 4. **** journals (library of TU Cluj-Napoca) 5. **** internet			
8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
1. Identification of basic elements from the structure of mechanical systems (linkages). Kinematic schema and construction design.	2		
2. Elements of CAD design, modelling and simulation of mechanical structures. Construction variants of mechanical systems. Specific materials from the mechanical systems.	2		
3. Position analysis linkages. Problems.	2		
4. Kinematic analysis of linkages. Problems.	2		
5. Dynamic analysis of linkages.	2		
6 Study of Mechanical Power Transmission.	2		
7. Variators. Continuously variable transmission, gear trains problems.	2		
8. Kinematics and dynamics of robotic systems.	2		
9. Examples of kinematics of common serial robots, workspace of a serial robot.	2		
10. Inverse kinematics of parallel manipulators and mechanisms, workspace of several parallel robots.	2		
11. Inverse kinematics of parallel robots.	2		
12. Singularity analysis for serial and parallel robots.	2		
13. Study of the hardware Design of the Exoskeleton systems. Mechanical Design.	2		
14. Study of flexible systems of fabrication.	2		
Bibliography 1. Handra-Luca, V., Mecanisme, Ed.UT Pres, Cluj-Napoca, 1981. 2. Handra-Luca, V., ş.a.– Introducere în teoria mecanismelor, Editura Dacia, Cluj-Napoca, vol. I-II, 1982, 1983. 3. Maros, D., ş.a. – Mecanisme, Indrumător de lucrări, Lito. I.P.C-N, Cluj-Napoca, 1984. 4. **** journals (library of TU Cluj-Napoca) 5. **** internet			

**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

Application of the mechanical engineering concepts are specific to most of the engineering disciplines. The course level is introductory and the intent is to motivate and prepare students for further study in mechanical engineering areas and to conduct projects in real-life applications.

The course content combines theoretical knowledge with applications and focuses on the formulation and solution of specific problems that may occur in various engineering fields.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Knowledge Knowledge	Midterm exam Final exam	40% 60%
Seminar	Answer simple questions from the topic of the lab applications Submitting and defending a miniproject on a given subject	Lab tests (optional) Individual student report (optional)	20% 20%
Laboratory	-	-	-
Project	-	-	-
Minimum standard of performance: Solution of simple exercises applying the knowledge and techniques presented in the course.			

Date of filling in: 26.02.2025	**Titulari**	**Titlu Prenume NUME**	**Semnătura**
	Course	Șef lucr. dr. ing. Sergiu-Dan Stan	
	Applications	Șef lucr. dr. ing. Sergiu-Dan Stan	

Date of approval in the department	Head of department, Prof.dr.ing. Rodica Potolea
Date of approval in the Faculty Council	Dean, Prof.dr.ing. Vlad Muresan