ROMANIAN ACADEMY
School of Advanced Studies of the Romanian Academy
(SCOSAAR)

SUMMARY OF THE COURSE: "ELEMENTS OF MECHANICS, MECHATRONICS AND ROBOTICS"

1. Program data

1.1 Department	Department Engineering, Mechanical and Computer Sciences
1.2 Institution	Romanian Academy
1.3 Field of study	Mechanical Engineering
1.4 Study Cycles	PHD Doctoral study

2. Discipline data

2.1 Name of discipline			Elements of mechanics, mechatronics and robotics				
2.2 Titular of course activities			CSI dr. DHC Veturia Chiroiu, CSI Ligia Munteanu				
2.3 Titular of seminar activities			CSI dr. DHC Veturia Chiroiu				
2.4 Titular of lab activities			-				
2.5 Year of study	1	**2.6 Semester**	2	**2.7 Type of assessment**	E	**2.8 Discipline regime**	DS

3. Estimated total workload (hours per semester of didactic activities)

3.1 Number of hours per week	15	**From which:**			
3.2 cours	9	**3.3 seminar**	3	**3.4 laboratory**	3
3.5 Total hours from the curriculum	210	**From which:**			
3.6 cours	126	**3.7 seminar**	42	**3.8 laboratory**	42
3.9 Number of hours per semester	210				
3.10 Number of credits	15				

4. Course content

1. Knowing and mastering the general principles of mechanics, me
2. Elements of kinematics, dynamics and statics of the material point, central forces, direct and inverse kinematics.
3. Dynamics of material point systems, canonical equations, dynamic models of systems, rigid-body systems, classification of constrained motion control concepts.
4. Dynamics and statics of the rigid solid, passive compliance methods, adaptive compliance methods.
5. Robot kinematics: position analysis, active motion control methods.
6. Dynamic analysis of robots, impedance control, position/force hybrid control, impedance-force control, unified force-position control.
7. Trajectory planning, motion planning concepts, sampling-based planning,
8. Intelligent control of structures. Estimation and identification of parameters.
9. The robustness of the control. Robot modeling with contact tasks.
10. Kinematic and dynamic control of a robot. Dynamic identification using ground reaction forces.
11. Intelligent control techniques. Visual servoing/Visual tracking. Sensory and perception.
12. Obstacle detection methods. Stability and balance of robots.
13. Dynamics and robust control of robot-environment interaction. Inertial sensors. GPS, Odometry.
14. Planning through potential fields, road maps in higher dimension, differential constraints, constraint discretization them.
15. Applications. Robust control of human-robot interaction in haptic systems. Intelligent control of contact tasks in humanoid robotics. Stability and balance of humanoid robots.

*E = Examen. C = Colocvium.
**DF = Fundamental Discipline. DS = Specialized Discipline

5. Objectives of the discipline and the specific acquired skills

1. The general objective of the discipline: Knowledge and acquisition of the general principles of mechanics, mechatronics and robotics.
2. Specific objectives:
- Acquiring the specific knowledge to the study of mechanics, mechatronics and robotics.
- Study of dynamic modeling of mechanical, mechatronic, robotic systems, trajectory planning, intelligent control of structures and control robustness, intelligent control techniques, obstacle detection methods, potential field planning.
- Knowledge and skills acquired in this discipline will form the basis of future scientific and didactic research activities

6. References

1. C.Iacob, Mecanica teoretică, Editura Academiei, Bucureşti, 1972.
2. L.Dragoş, Principiile mecanicii analitice, Editura Tehnică, Bucureşti, 1976.
3. A. Carabineanu Mecabica teoretică, Editura Matrix Rom, Bucureşti, 2006.
4. Bruno Siciliano, Oussama Khatib, Editors, Springer Handbook of Robotics, Editura Springer.
5. Spong M.W.,Vidyasagnar M.,Robot Dynamics and Control,John Wiley&Sons, INC., New-York, 1989.
6. Fu K.S., Gonzalez R.C.,Robotics: Control,Sensing, Vision and Intelligence,McGraw-Hill Book Company, Singapore, 1987.
7. Wolovich W.A.,Robotics: Basic Analysis and Design,U.S.A., 1987.
8. Spong M.W., Lewis F., Abdallah C.,Robot Control: Dynamics, Motion Planning and Analysis,IEEE Pres, 1992.
9. Bruno Siciliano, Oussama Khatib, Editors, Springer Handbook of Robotics, Editura Springer.
10. Peter Stone, Intelligent Autonomous Robotics, Editura Morgan & Claypool,
11. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison-Wesley Publishing Company.
12. Maria Letizia Corradini, Andreea Cristofaro, Fabio Giannoni, Giuseppe Orlando, Control Systems with Saturating inputs, Springer.
13. B. Roffel, B.H.L. Betlem, Advanced Practical Process Control, 309 pag, Editura Springer, ISBN 3-54040480-5.
14. Salvatore Pennacchio, Editor, International Society for Advanced Research, Emerging Technologies, Robotics and Control Systems Volume 1, Universita degli Studi Palermo, Italy, ISBN: 978-88-901928-1-4.
15. Theodor Borangiu, Advanced Robot Motion Control, Editura AGIR, Editura Academiei Române, ISBN 973-8130-98-0 (Editura AGIR), ISBN 973-27-0976-6 (Editura Academiei Române).
16. Venturia Chiroiu, Tudor Sireteanu, Topics in Applied Mechanics, 509 pag, Editura Academiei Române, ISBN 973-27-1245-7, ISBN 973-27-1004-7.
17. Miomir Vukobratovic, Vejko Potkonjak, Vladimir Matijevic, Microprocessor-based and intelligent systems engineering, 246 pag., Editura Kluwer Academic, ISBN 1-4020-1809-6.

7. Assessment

Activity type	5.1 Evaluation Criterias	5.2 Evaluation methods	5.3 Weight of the final grade
5.4 Cours	Acquired Knowledge	Oral Exam	50%
5.5 Seminar+laborator	Activity	Study cases	50%

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5.6 Minimum performance standard: Knowledge of 80% of the information contained in the course

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Course structure

June 2023 – September 2023 – Didactic activity - Laboratory of Mechanics of Deformable Media, IMSAR

Exam

October 2023

Course owner: Dr. Veturia Chiroiu

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