ROBOTICS AND INTELLIGENT SYSTEMS MASTER PROGRAM
COURSE SYLLABUS

Course Details				
Code		**Academic Year**		**Semester**
RIS515		1		1
Title	**T**	**A**	**L**	**ECTS**
Robot Mechanics	3	0	0	7

Language	English					
Level	**Undergraduate**		**Graduate**	x	**Postgraduate**	
Department / Program	Robotics and Intelligent Systems					
Forms of Teaching and Learning	Formal					
Course Type	**Compulsory**		**Elective**	x		
Objectives	To introduce the kinematics and dynamics of the robotic systems to students. Students learn generalized coordinates, articulated body kinematics, transformations, DH parameters, inverse kinematics, and dynamics. Specific objectives: 1. Students will be able to calculate the mobility (number of degrees-of-freedom) of planar and spatial structures, mechanisms, and robots. 2. Students will be able to use the mathematical basis of motion description, including rotation matrices. 3. Students will be able to derive the standard Denavit-Hartenberg parameters for various robotic systems. 4. Students will be able to derive and calculate the forward kinematics solution for serial robots. 5. Students will be able to derive and calculate the inverse kinematics solution for serial robots. 6. Students will be able to derive and calculate forward and inverse velocity kinematics for serial robots, including Jacobians, static forces/torques, and singularities. 7. Students will be able to derive and calculate joint-space trajectory generation polynomials. 8. Students will be able to simulate the motion of the robotic systems using MATLAB Simulink software.					
Content	Introduction to Robotics; Spatial Transformations; Forward and Inverse Kinematics of Robots; Jacobians; Robot Dynamics, Joint and Cartesian Space, MATLAB applications for simulating the motions of the robotics systems.					
Prerequisites						
Coordinator						
Lecturer(s)	Prof.Dr. Yunus Ziya ARSLAN					
Assistant(s)						
Work Placement						
Recommended or Required Reading						

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Books / Lecture Notes	Craig, J. J. (2005). Introduction to robotics: mechanics and control.	
Other Sources		
Additional Course Material		
Documents		
Assignments	Homeworks, projects and technical readings on robot mechanics	
Exams		
Course Composition		
Mathematics und Basic Sciences		%20
Engineering		%60
Engineering Design		%20
Social Sciences		%
Educational Sciences		%
Natural Sciences		%
Health Sciences		%
Expert Knowledge		%

Assessment

Activity	Count	Percentage (%)
Midterm Exam	1	25
Quiz		
Assignments	5	20
Attendance		
Recitations		
Projects	1	15
Final Exam	1	40
	Total	**100**

ECTS Points and Work Load

Activity	Count	Duration	Work Load (Hours)
Lectures	14	2	28
Self-Study	14	7	98
Assignments	5	5	25
Presentation / Seminar Preparation			
Midterm Exam	1	2	2
Recitations	14	2	28
Laboratory			
Projects	1	10	10

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Final Exam	1	2	2
		Total Work Load	**195**
		ECTS Points (Total Work Load / Hour)	**7**

Learning Outcomes	
1	To be able to model a robot with sufficient precision
2	To be able to implement the forward and inverse kinematics of a robotic system
3	To be able to exploit the dynamics of a robot system
4	To relate the velocities of a robot system between the Cartesian and joint.
5	To relate the static forces of a robot system acting on the end effector to the joint torques
6	
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11	
12	

Weekly Content	
1	An overview on robotics systems; basic components of robot arms, robot arm types, joint types.
2	An overview on robotics systems; workspace, resolution, accuracy, repeatability. Introducing the basic concepts of actuators used in robots. AC motors, DC motors. Introducing the basic concepts of control methods used in robots. Open-loop control, closed loop control.
3	Positioning and orientation in robots; transformation matrices.
4	Derivation of the Denavit-Hartenberg parameters
5	Obtaining transformation matrices of various robot models.
6	Forward kinematics analysis
7	Inverse kinematic analysis.
8	Jacobian; velocity analysis, static force.
9	Jacobian; singularity analysis.
10	Robot dynamics; Lagrangian and Newton – Euler formulations.
11	Manipulator dynamics.
12	Obtaining equation of motions of various robot models.
13	Simulating the motion of the various robotic systems using MATLAB Simulink software
14	Simulating the motion of the various robotic systems using MATLAB Simulink software

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15	

Contribution of Learning Outcomes to Program Objectives (1-5)							
	P1	P2	P3	P4	P5	P6	P7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
Compiled by:	Prof.Dr. Yunus Ziya ARSLAN
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