Course Specification

(Postgraduate Programs)

Course Title:	Robotics-I
Course Code:	2202-554
Program:	Master in Electrical Engineering
Department:	Electrical Engineering
College:	College of Engineering
Institution:	King Faisal University
Version:	2.0
Last Revision Date:	17 April 2025

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐ University	☐ College	☒ Department	☐ Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: Level 2/1st year				
4. Course General Description:				
Introduction to robotics; Rigid motions and homogeneous transformations; Forward and inverse kinematics; Velocity kinematics and manipulator Jacobian; Path and Trajectory planning; Dynamics and manipulator control; Manipulator programming; Introduction to mobile robots; Sensing, vision and motion planning.				
5. Pre-requirements for this course (if any)**:**				
2202-429: Mechatronics, 2202-430: Analog Control Systems (or equivalent)				
6. Co-requisites for this course (if any)**:**				
None				
7. Course Main Objective(s):				
To introduce the beginning graduate student to the basic principles of robotics, mechanics and control, so as to be able to read journal papers and undertake advanced research on the subject.				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)……**	
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Recognize the various kinds of robots such as manipulator, mobile and autonomous robots	K1	PPT Lectures	HWs
1.2	Learn manipulator forward kinematics and inverse kinematics using spatial transformations and homogeneous transformation matrices as well as quaternions	K1	PPT Lectures	HWs, Exams
1.3	Determine static forces, manipulator Jacobian and dynamics	K1	PPT Lectures	HWs, Exams
1.4	Perform trajectory and path planning using	K1	PPT Lectures	HWs, Exams

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	spline functions and other basis functions			
1.5	Determine manipulator feedback control using various strategies such as linear & PID control, force control, computed torque technique, nonlinear and adaptive control	K1	PPT Lectures	HWs, Exams
...				
2.0	**Skills**			
2.1	Program and simulate manipulator motion using various programming languages.	S1	PPT Lectures	HWs, Exams, Project
2.2	Use MATLAB software to design and analyze robot control systems	S2	PPT Lectures	HWs, Exams, Project
2.3	Design and control manipulator and mobile robots using microcontrollers	S1	PPT Lectures	HWs, Exams, Project
3.0	**Values, autonomy, and responsibility**			
3.1	Read journal papers on the subject and undertake advanced research in robotics, including cooperating robots, autonomous and mobile robots, robot swarms, sensing, vision, motion planning, task planning and intelligence.	V2, V3	Project	Project

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
...				

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction to Robotics and Classification of Robots	3
2.	Spatial Transformations	3
3.	Forward Kinematics	6
4.	Inverse Kinematics	6
5.	Velocities, Static Forces, and Jacobians	6
6.	Dynamics	3
7.	Trajectory Planning	3
8.	Mechanical Design of Robots	3
9.	Linear Control	3
10.	Nonlinear Control	3
11.	Force Control	3
12	Introduction to Mobile and Autonomous Robots	3
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HW#1: Topic 1 - Introduction	Week 1	0.5%
2.	HW#2: Topic 2 – Spatial Transformations	Week 2	0.5%
3.	HW#3: Topic 3 – Forward Kinematics	Week 3	1%
4.	HW# 4: Topic 4– Inverse Kinematics	Week 4	1%
5.	Exam I: Covering Topics 1, 2, 3 and 4 above	Week 5	20%
6.	HW# 5: Topic 5 – Velocities, Static Forces, and Jacobians	Week 7	1%
7.	HW# 6: Topic 6- Dynamics	Week 8	1%
8.	HW#7: Topic 7 – Trajectory Planning	Week 9	1%
9.	Exam II: Covering Topics 5, 6, and 7 above	Week 10	20%
10.	Project	Week 10	20%
11.	HW#8: Topic 8– Mechanical Design of Robots and Programming	Week 10	0.5%
12.	HW#9: Topic 9– Linear Feedback Control	Week 11	1%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
13.	HW#10: Topic 10– Nonlinear Feedback Control	Week 12	1%
14.	HW#11: Topic 11- Force Control	Week 14	1%
15.	HW#12: Topic 12- Mobile and Autonomous Robots	Week 15	0.5%
16.	Exam III: Covering Topics 8, 9, 10, 11,12 above	Week 16	30%
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*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	J. J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Prentice Hall, Upper Saddle River, NJ, USA, 2017, ISBN-13: 978-0133489798; ISBN-10: 0133489795
Supportive References	1. Robotics: Control, Sensing, Vision and Intelligence, by K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, McGraw Hill,, NY, 1987 2. Robot Dynamics (Modeling) and Control, by M. Spong S. Hutchinson, and M. Vidyasagar, Wiley, 2nd Edition, 2004
Electronic Materials	IEEE Xplore, and other Robotics Systems Journals
Other Learning Materials	Software: MATLAB-SIMULINK

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Normal Class room accommodating 36 students
Technology equipment (Projector, smart board, software)	Overhead projector and multimedia interface
Other equipment (Depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect-Online Survey

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of students' assessment	Students and Faculty	Direct and Indirect Assessment
Quality of learning resources	Students and Faculty	Indirect-Online Survey
The extent to which CLOs have been achieved	Students and Faculty	Direct and Indirect Assessment
Other	None	None

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**EE DEPARTMENT QUALITY COMMITTEE**
REFERENCE NO.	**MEETING# 10**
DATE	**APRIL 19, 2025**