DEPARTMENT OF PRODUCTION TECHNOLOGY
MADRAS INSTITUTE OF TECHNOLOGY CAMPUS
ANNA UNIVERSITY: CHENNAI – 600 044.

COURSE PLAN

COURSE DETAILS:

Degree	**M.E.**		
Programme Name	**MECHATRONICS ENGINEERING**		
Course Code & Title	**MR3251 & INDUSTRIAL ROBOTICS**		
Credits	3	**Session**	JAN 2024 – MAY 2024
Course Type	Theory	**Regulation/ SEM**	R2023/2
Name of the Faculty	**Dr.P. KARTHIKEYAN** Assistant Professor Department of Production Technology MIT, Anna University, Chennai – 600044.		

PR5701 MECHATRONICS FOR AUTOMATION

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3	0	0	3

COURSE OBJECTIVES:

- To know the basic terminologies, classification, configurations and components of serial manipulator. To understand and apply the various types of actuators and its drives for interfacing.
- To understand the mechanical design and robot arm kinematics
- To learn and understand the various linear control techniques on manipulators
- To learn and understand the various non-linear control techniques on manipulators
- To learn the robot programming and demonstrate the robot in various applications.

UNIT I INTRODUCTION TO SERIAL MANIPULATORS **9**

Types of Industrial Robots, Definitions – Classifications Based on Work Envelope – Generations Configurations and Control Loops - Coordinate Systems – Need for Robot – Basic Parts and Functions – Specifications – Robotic Sensor - Position and Proximity's Sensing – Tactile Sensing – Sensing Joint Forces.

UNIT II MECHANICAL DESIGN OF ROBOT SYSTEM **9**

Robot Motion – Linkages and Joints – Mechanism – Method for Location and Orientation of Objects - Kinematics of Robot Motion – Direct and Indirect Kinematics Homogeneous Transformations – D-H Transformation – Drive Systems – End Effectors – Types, Selection, Classification and Design of Grippers – Gripper Force Analysis.

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING **9**

Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning-control overview, Dynamic equations control - Types of Programming – Teach Pendant Programming –Robotic Cell Layouts – Inter Locks-control overview

UNIT IV MOBILE ROBOTICS **9**

Wheeled Robot and Legged Robot – Architecture - Configurations and Stability - Design Space and Mobility Issues - Teleportation and Control – Localization – Navigation – AGV – AMR

UNIT V APPLICATIONS OF ROBOTS 9

Architecture and working - Manufacturing Industries - Material Handling, Assembly, Inspection. Surgical robot – Haptics technology– Space vehicle and unmanned aerial vehicle – Underwater- ROV, AUV – Robot in Nuclear industry – Humanoid Robots – special type of robots

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications", 3rd edition, John Wiley & sons, Inc., 2019.
2. John J. Craig, "Introduction to Robotics – Mechanics and control", 3rd edition, Pearson Higher Education 2014.

REFERENCES:

1. K.S.Fu, Gonzalez, R.C. and Lee, C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.
3. Groover,M.P., Weis,M., Nagel,R.N. and Odrey,N.G., "Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int., 2012.
4. Klafter,R.D., Chmielewski, T.A. and Negin,M., "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1988.
5. Kevin M Lych and frank C. Park, Modern Robotics: Mechanics, Planning and Control, Cambridge University Press, First Edition, 2017

COURSE OUTCOME

1. State about fundamental concepts of manipulators and mobile robots
2. Describe the robot types, robot elements, numerical computation methods and the applications
3. Solve the robot kinematics, dynamics, trajectory and path planning problems
4. Analyze robot kinematics, dynamics, trajectory and path planning problems.
5. Create robot architecture, kinematic and dynamic solutions, program the robot for the given application in the environment.

COs	POs					
	1	2	3	4	5	6
1	1	1	2	2	1	1
2	1	1	2	2	1	1
3	1	1	2	2	2	1
4	1	1	2	2	2	2
5	1	1	2	2	1	2
Avg	**1**	**1**	**2**	**2**	**1.4**	**1.4**

COURSE ALIGNED PROGRAMME OUTCOMES (PO) & PROGRAMME SPECIFIC OUTCOMES (PSO)

PO	Programme Outcome
1	An ability to independently carry out research/investigation and development work to solve practical problems.
2	An ability to write and present a substantial technical report/document.
3	Students should be able to demonstrate a degree of mastery in the area of mechatronics.
4	Graduates will have a solid understanding of key concepts, methodologies, core components, and contemporary tools and techniques essential for unified mechatronics systems with intelligence.
5	Students will develop, analyze and optimize the solution for diverse engineering challenges using a mechatronics-based approach.
6	Graduates will be capable of constructing real-time or virtual mechatronic systems with considerations for industrial standards, environmental impact, ethical principles, and socio-economic factors.

COURSE TENTATIVE SCHEDULE / PLAN

SI.NO	DAY	DATE	HRS	UNIT	TOPICS	TEXT / REF.
INTRODUCTION TO SERIAL MANIPULATORS						
1				1	Types of Industrial Robots, Definitions	
2					Classifications Based on Work Envelope	
3					Generations Configurations and Control Loops	
4					Coordinate Systems	
5					Need for Robot	
6					Basic Parts and Functions – Specifications	
7					Robotic Sensor	
8					Position and Proximity's Sensing	
9					Tactile Sensing	
10					Sensing Joint Forces.	
MECHANICAL DESIGN OF ROBOT SYSTEM						
11				2	Robot Motion	
12					Linkages and Joints	
13					Mechanism	
14					Method for Location and Orientation of Objects	
15					Kinematics of Robot Motion	
16					Direct and Indirect Kinematics Homogeneous Transformations	
17					D-H Transformation	
18					Drive Systems	
19					End Effectors – Types, Selection, Classification and Design of Grippers	
20					Gripper Force Analysis.	
ROBOT DYNAMICS AND TRAJECTORY PLANNING						

21				3	Trajectory planning	
22					joint space, Cartesian space description and trajectory planning	
23					third order, fifth order - Polynomial trajectory planning	
24					control overview, Dynamic equations control	
25					Types of Programming	
26					Teach Pendant Programming	
27					Robotic Cell Layouts	
28					Inter Locks-control overview	
MOBILE ROBOTICS						
29				4	Wheeled Robot and Legged Robot	
30					Architecture	
31					Configurations and Stability	
32					Design Space and Mobility Issues	
33					Teleportation and Control	
34					Localization – Navigation	
35					AGV – AMR	
APPLICATIONS OF ROBOTS						
36				5	Architecture and working	
37					Manufacturing Industries	
38					Material Handling, Assembly, Inspection. Surgical robot	
39					Haptics technology	
40					Space vehicle and unmanned aerial vehicle	
41					Underwater- ROV, AUV	
42					Robot in Nuclear industry	
43					Humanoid Robots	
44					special type of robots	
45					**CONTINUOUS ASSESSMENT -1**	
46					**CONTINUOUS ASSESSMENT - 2**	
47					**Assignments/ Case Studies/ project work**	

COURSE DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ Chalk & Talk	✓ Web Resources	✓ Recorded videos
✓ LCD/~~Smart boards~~	✓ hands on software simulation	

ASSESSMENT METHODOLOGIES-DIRECT

✓ University (End Semester) Examination		**✓ Internal Assessment Tests**	
✓ Descriptive type Written test		**✓ Descriptive type Written test**	**✓ Descriptive type Written test**
		✓ Assignments/ Case Studies/ project work	

COURSE ASSESSMENT METHODS, R2023, 3 CREDIT, THEORY

S.N.	Mode of Assessment	Date	Duration, marks, factor	% Weight
1	Continuous Assessment Test -1		1½ hr (50 marks) (mark *0.32)	16 %
3	Continuous Assessment Test - 2		1½ hr 50 marks (mark *0.32)	16 %
4	Individual assignment/Case study/ seminar/ project work		10 Marks (mark*0.8)	8%
			Internal total	**40%**
5.	University Examination		3 hr (mark *0.6)	60 %
			End sem	**60%**

COURSE ASSESSMENT METHODOLOGIES-INDIRECT

✓ Student Feedback on Learning Outcomes	

COURSE (EXTRA) ESSENTIAL READINGS:

COURSE EXIT SURVEY (will be collected at end of the course)

The purpose of this survey is to find out from students about their learning experiences and their thoughts about the course.

COURSE POLICY (Compensation Assessment)

1. Attending all the assessment is mandatory for every student
2. Course policy will be followed as per the academic course regulation

COURSE ACADEMIC DISHONESTY AND PLAGIARISM

1. All rules and regulation prescribed by the ACOE, University Departments, are applicable in the Internal Assessment Tests and University (End Semester) Examinations. **(https://acoe.annauniv.edu/download_forms/student_forms/Guidelines.pdf)**
2. In general, possessing a mobile phone, carrying bits of paper with materials, talking to other students, copying from other students during Internal Assessment Tests and University (End Semester) Examinations will be treated as Malpractice and punishable as per the rules and regulations. The misuse of Assignment / Project / Seminar works from others is considered as academic dishonesty and will be treated with the rules and regulations of the University.

COURSE ADDITIONAL INFORMATION

Queries / clarifications / discussion (if required) may be e-mailed to / contact the course instructors during their Office Hours.

FOR APPROVAL

Course Faculty | Professor I/C | HOD (PT)