DEPARTMENT OF PRODUCTION TECHNOLOGY

MADRAS INSTITUTE OF TECHNOLOGY CAMPUS

ANNA UNIVERSITY : CHENNAI – 600 044.

COURSE PLAN

COURSE DETAILS:

Degree	B.E.		
Programme Name	Production engineering		
Course Code & Title	**PR5073: ROBOTIC TECHNOLOGY**		
Credits	3	**Session**	Jan – May 2024
Course Type	Elective	**Section**	A
Name of the Faculty	**Mr. P.Mani** Teaching Fellow, Department of Production Technology, MIT, Anna University, Chennai.		

COURSE CONTENT:

Syllabus: (Approved Syllabus as per Regulation 2019)

Unit I   FUNDAMENTALS OF ROBOT   9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

Unit II   ROBOT KINEMATICS   9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg transformation.

Unit III   ROBOT DRIVE SYSTEMS AND END EFFECTORS   9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

Unit IV   SENSORS IN ROBOTICS   9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

Text Books:

1. Ganesh.S.Hedge ,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.

McGraw Hill 2th edition 2012.

2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications",

References:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision andIntelligence", McGraw Hill book co. 2007.

2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.

3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.

4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.

5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

COURSE LEARNING OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To study the kinematics, drive systems and programming of robots.

2. To study the basics of robot laws and transmission systems.

3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.

4. To familiarize students with the various Programming and Machine Vison application in robots.

5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

COURSE OUTCOME (CO)

Upon completion of this course, the students will be able to:

1. Interpret the features of robots and technology involved in the control.

2. Apply the basic engineering knowledge and laws for the design of robotics.

3. Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots

4. Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.

5. Demonstrate the image processing and image analysis techniques by machine vision system.

COURSE ARTICULATION MATRIX

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	2	-	1	-	-		-	1	2	-	-
2	3	-	-	-	2	-	1	-	-		-	1	2	-	-
3	3	-	-	-	2	-	1	-	-		-	1	2	-	-
4	3	-	-	-	2	-	1	-	-		-	1	2	-	-
5	3	-	-	-	2	-	1	-	-		-	1	2	-	-

The correlation levels: 1: Low; 2: Medium; 3: High.

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

PO	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design a system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct selves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

PSO	Graduates demonstrate
1	Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
2	Apply the knowledge acquired to investigate research oriented problems in mechanical engineering with due consideration for environmental and social impacts.
3	Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

COURSE TENTATIVE SCHEDULE / PLAN

Week	Day	Date	Hrs	Unit	Topics	Text / Ref.
1	1	23/01/2024	2	1	Robot – Definition – Robot Anatomy – Co-ordinate systems	T2
	2	24/01/2024	1	1	Work Envelope, types and classification – specifications	T2
2	3	30/01/2024	2	1	Pitch, yaw, Roll, Joint Notations	T2
	4	31/01/2024	1	1	Speed of Motion, Pay Load	T2
3	5	06/02/2024	2	1	Robot Parts and their functions	T2
	6	07/02/2024	1	1	Need for Robots	T2
4	7	06/02/2024	2	2	Forward kinematics, inverse kinematics and the difference	T2
	8	07/02/2024	1	2	Forward kinematics and inverse Kinematics of Manipulators with two degrees of freedom (in 2 dimensional)	T2
5	9	06/02/2024	2	2	Forward kinematics and inverse Kinematics of Manipulators with three degrees of freedom (in 2 dimensional)	T2
	10	07/02/2024	1	2	Forward kinematics and inverse Kinematics of Manipulators with four degrees of freedom (in 3 dimensional)	T2
6	11	13/02/2024	2	2	Derivations and problems	T2
	12	14/02/2024	1	2	Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg transformation.	T2
7	13	20/02/2024	2	3	Pneumatic Drives – Hydraulic Drives – Mechanical Drives	T2
	14	21/02/2024	1	3	D.C. Servo Motors, Stepper Motor, A.C. Servo Motors— Salient Features, Applications and Comparison of All These Drives.	T2
8	15	27/02/2024	2	3	Electrical Drives, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers	T2
	16	28/02/2024	1	3	Two fingered and three fingered grippers, internal grippers and external grippers	T2
9	17	05/03/2024	2	3	Selection and design considerations of a gripper	T2
	18	06/03/2024	1	3	Gripper force calculation and analysis	T2
10	19	12/03/2024	2	4	Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, ,– data reduction, segmentation, feature extraction, object recognition, other algorithms, applications –	T2
	20	13/03/2024	1	4	Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion	T2
11	21	19/03/2024	2	4	Image storage, lighting techniques, image processing and analysis	T2

	22	20/03/2024	1	4	Data reduction, segmentation, feature extraction	T2
12	23	26/03/2024	2	4	Object recognition, other algorithms, applications	T2
	24	27/03/2024	1	4	Inspection, identification, visual serving and navigation.	T2
13	25	02/04/2024	2	5	Teach pendant programming, lead through programming, , -, ,.	T2
	26	03/04/2024	1		Robot programming languages – VAL programming – Motion Commands, Sensors commands	T2
14	27	09/04/2024	2		End-Effector Commands, and simple programs	T2
	28	10/04/2024	1	5	Role of robots in inspection	T2
15	29	16/04/2024	2	5	Assembly, material handling, underwater	T2
	30	17/04/2024	1	5	Space and medical fields	T2

COURSE DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ Chalk & Talk	✓ Stud. Assignments	✓ Web Resources
✓ LCD/Smart boards	✓ Stud. Seminars	☐ Add-On Courses

COURSE ASSESSMENT METHODOLOGIES-DIRECT

✓ University (End Semester) Examination		✓ Internal Assessment Tests	
✓ Assignments	☐ Laboratory Practices	☐ Mini/Major Projects	✓ Stud. Seminars
☐ Viva Voce	☐ Certifications	☐ Add-On Courses	☐ Others

COURSE ASSESSMENT METHODS

S.N.	Mode of Assessment	Date	Duration	% Weight
1	Internal Assessment Tests 1		1½ hr	25 %
2	Internal Assessment Tests 2		1½ hr	25 %
3.	University Examination		3 hr	50 %
	Additional marks may be given for Assignments / Group / Team Seminar Presentation)			

COURSE ASSESSMENT METHODOLOGIES-INDIRECT

✓ Assessment of CO (By Feedback, Once)	✓ Student Feedback On Faculty (Once)
☐ Assessment of Mini/Major projects by Ext. Experts	☐ Others

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.

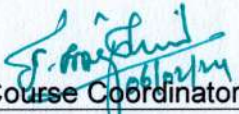| Rating:	1: Slight (Low)	2: Moderate (Medium)	3: Substantial (High)
CO1:			
CO2:			
CO3:			
CO4:			
CO5:			

COURSE POLICY (Compensation Assessment)
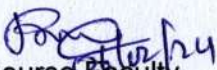
1. Attending all the assessment is mandatory for every student
2. Course policy will be followed as per the academic course regulation

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   Course Coordinator   HOD (Mech)