SCHEME OF COURSE WORK

Course Details:

Course Title	**:Robot Analysis and Design**		
Course Code	**: 13ME2209**	**L T P C**	**: 4 0 0 3**
Program:	**: M.Tech.**		
Specialization:	**: CAAD**		
Semester	**:SECOND**		
Prerequisites	**: ROBOTICS, ENGINEERING MECHANICS**		
Courses to which it is a prerequisite	**:AUTOMATION IN MANUFACTURING**		

Course Outcomes (COs):

At the end of the course, the student will be able to

1. demonstrate critical awareness and evaluation of current research in order to apply analytical techniques for solving the kinematics of a robot manipulator
2. demonstrate a comprehensive understanding and critical evaluation of the application of PID control for automation
3. identify various types of sensors and grippers required for specific applications
4. develop programming language for programming and control of robot system that performs a specific task.
5. select an appropriate robotic system for a given application and discuss the limitations of such a system.

Program Outcomes (POs):

At the end of the program, the students in CAAD will be able to

PO 1	acquire knowledge in latest computer-aided design and analysis tools
PO 2	create 3D models of real-time components using latest CAD software
PO 3	acquire technical skills to formulate and solve engineering and industrial problems
PO 4	carry out analysis for the design of new products
PO 5	have proficiency to solve problems using modern engineering design tools
PO 6	have capability to work in multidisciplinary streams
PO 7	apply project and finance management skills to organise engineering projects
PO 8	prepare technical reports and present them effectively
PO 9	engage in lifelong learning
PO 10	realize professional and ethical responsibilities
PO 11	conduct surveys, analyse data, plan, design and implement new ideas into action

Course Outcomeversus**Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1	M	M	S		S			M	M		M
CO-2	M	M	S	M	S	M		M	M		M
CO-3	M	M	S	S	S	M		M			M
CO-4	M	M	S	M	S	S	M	S	M		M
CO-5	M	M	S	M	S	S		S	S		

S - Strongly correlated, *M* - *Moderately* correlated, *Blank* - *No correlation*

AssessmentMethods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Types of robots, overview of robot subsystems	CO1	Explain the basic types of Robots in view of automation	▫ Lecture ▫ Demo class	
2	Resolution, repeatability and accuracy, degrees of freedom of robots	CO1	Write in brief about various degree of freedom involved in robot	▫ Lecture ▫ Discussion	
3	Robot configurations and concept of workspace, mechanisms and transmission	CO1 & CO5	Explain the concept of various configurations in robot function	▫ Lecture ▫ Discussion	
4	Pneumatic, hydraulic and electrical actuators, specifications of different industrial robots.	CO4 & CO5	Explain different types of actuators in robotic concern with neat sketch	▫ Lecture ▫ Discussion	
5	Euler angle and RPY representation, homogeneous transformation matrices, Denavit-Hartenberg notation	CO2 & CO3	Write in brief about Denavit-Hartenberg notation	▫ Lecture ▫ Discussion ▫ Problem solving	
6	Direct kinematics, inverse kinematics, Jacobian of RR and RP type planar robots and use of Lagrangian and Newton-Euler formulations.	CO2 & CO3	Explain about the direct kinematics and inverse kinematics in robot	▫ Lecture ▫ Discussion ▫ Problem solving	
7	PD and PID feedback, actuator models, force feedback, hybrid control.	CO2	Write a short note on feedback control and hybrid control in robot	▫ Lecture ▫ Discussion	**Case study - 1 (Week 5 - 7)**
8	Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors	CO2	Explain various sensors used in functioning of robot with neat sketch	▫ Lecture ▫ Discussion	**Seminar - 1 (Week 8)**
9	**Mid-Test 1**				**Mid-Test 1 (Week 9)**
10	Grippers - types, operation, mechanism, force analysis, tools as end effectors, considerations	CO2	What are the considerations to be taken while selecting and designing a gripper	▫ Lecture ▫ Discussion ▫ Problem	

	in gripper selection and design.			solving	
11	Robot vision: image processing fundamentals for robotic applications	CO2	Explain the brief architecture of robot vision system with a neat sketch	▫ Lecture ▫ Discussion	
12	Robot programming and languages: Lead through programming, robot programming as a path in space, motion interpolation	CO2 & CO4	Write about lead through programming method involved in robot programming	▫ Lecture ▫ Discussion	
13	WAIT, SIGNAL and DELAY commands, textual robot languages, generations, robot language structures	CO2 & CO4	Explain about the robot language structure with elements	▫ Lecture ▫ Discussion	
14	Robot cell layouts and considerations in work cell design	CO4	Discuss different types of robot cell layouts with neat sketch	▫ Lecture ▫ Discussion	
15	Robot work cell control, interlocks, error detection, work cell controller.	CO4	Discuss about the importance of robot work cell control in a brief manner	▫ Lecture ▫ Discussion	
16	Robot applications: Material transfer, machine loading/unloading.	CO4 & CO5	Explain any two robot applications in view of material transfer function	▫ Lecture ▫ Discussion	**Case study - 2 (Week 14- 16)**
17	Robot applications: processing operations, assembly and inspections.	CO4 & CO5	Explain any two robot applications in view of assembly and inspection function	▫ Lecture ▫ Discussion	**Seminar - 2 (Week 17)**
18	**Mid-Test 2**				**Mid-Test 2 (Week 18)**
19/20	**END EXAM**				**END EXAM**