SEMESTER S6

FUNDAMENTALS OF ROBOTICS

Course Code	**OERUT611**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. Understand and discuss the Robotic systems on the basis of various parameters
2. Provide insight into the types of sensors and actuators used in robotics
3. Explain the various types of end effectors.
4. Educate on the principles of kinematics and motion planning.

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definitions- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-links, joints, actuators, sensors, controller; open kinematic vs closed kinematic chain; degrees of freedom; Robot considerations for an application- number of axes, work volume, capacity & speed, stroke &reach, Repeatability, Precision and Accuracy, Operating environment, point to point control or continuous path control. Robot Applications- medical, mining, space, defense, security, domestic, entertainment, Industrial Applications-Material handling, welding, Spray painting, Machining.	9
2	Sensors and Actuators Sensor classification- touch, force, proximity, vision sensors. Internal sensors-Position sensors, velocity sensors, acceleration sensors, Force sensors; External sensors-contact type, noncontact type; Vision - Elements of vision sensor, image acquisition, image processing; Selection of sensors.	9

	Actuators for robots- classification-Electric, Hydraulic, Pneumatic actuators; their advantages and disadvantages; Electric actuators- Stepper motors, DC motors, DC servo motors and their drivers, AC motors, Linear actuators, selection of motors; Hydraulic actuators- Components and typical circuit, advantages and disadvantages; Pneumatic Actuators- Components and typical circuit, advantages and disadvantages.	
3	Robotic configurations and end effectors Robot configurations-PPP, RPP, RRP, RRR; features of SCARA, PUMA Robots; Classification of robots based on motion control methods and drive technologies; 3R concurrent wrist; Classification of End effectors - mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot.	**9**
4	Kinematics and Motion Planning Robot Coordinate Systems- Fundamental and composite rotations, homogeneous co-ordinates and transformations, Kinematic parameters, D-H representation, Direct Kinematics. The Arm equation forward Kinematic analysis of a typical robots up to 3 DOF. Motion Planning- joint space trajectory planning-cubic polynomial, linear trajectory with parabolic blends; Cartesian space planning, Point to point vs continuous path planning.	**9**

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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Familiarise with anatomy, specifications and applications of Robots	**K2**
CO2	Choose the appropriate sensors and actuators for robots	**K3**
CO3	Choose appropriate Robotic configuration and gripper for a particular application	**K3**
CO4	Obtain kinematic model of robotic manipulators	**K4**
CO5	Plan trajectories in joint space and Cartesian space	**K4**

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Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	2	1										
CO3	2	1										
CO4	3	2	2									
CO5	3	2	2									

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Robotics	S K Saha,	Mc Graw Hill Eduaction	
2	Fundamentals of robotics – Analysis and control	Robert. J. Schilling	Prentice Hall of India	1996.
3	Robotics and Control	R K Mittal and I J Nagrath	Tata McGraw Hill	2003.
4	Introduction to Robotics (Mechanics and control)	John. J. Craig	Pearson Education Asia	2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Robotics-Fundamental concepts and analysis	Ashitava Ghosal	Oxford University press.	
2	Robotics Technology and Flexible Automation	S. R. Deb	Mc Graw Hill Eduaction	Second Edition

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