SEMESTER S8

ROBOTICS

Course Code	PEEVT 866	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 Type	Theory

Course Objectives:

1. Impart knowledge about the engineering aspects of Robots.
2. Discuss the various sensors and actuators used in robotic manipulator.
3. Practice forward and inverse kinematic calculations of known robotic manipulators.
4. Teach the method of Trajectory planning calculation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Definition and origin of robotics, Robot Anatomy, Robot specifications, **Robot characteristics:** accuracy, precision, and repeatability, Areas of application, classification of robots. **Robotic arm:** Components and structure, Types of joints and workspace, Common kinematic arrangements, Wrists, End effectors.	9
2	**Sensors:** Types and applications of sensors in Robotics, position and displacement sensors, Strain gauge based force torque sensors, Tachometers. **Robotic vision systems:** Imaging, Sensing and Digitization, Image processing techniques, Areas of application in robotics. **Robotic drive systems and actuators:** Hydraulic, Pneumatic and Electric drives. Specification, principle of operation and areas of application of: Stepper motor, Servo motor and brushless DC motor. Microprocessor control of electric motors, speed control using PWM and direction control	9

	using H- Bridge.	
3	**Introduction to kinematics:** Position and orientation of objects, Rotation, Euler angles, Rigid motion representation using Homogenous Transformation matrix. **Forward kinematics:** Link coordinates, Denavit-Hartenberg Representation, Application of DH convention to different serial kinematic arrangements fitted with spherical wrist. **Inverse kinematics**: General properties of solutions, Kinematic Decoupling, Inverse kinematic solutions for all basic types of three-link robotic arms fitted with a spherical wrist.	**9**
4	**Velocity kinematics:** Derivation of the Jacobian, Application of velocity kinematics for serial manipulators, importance of Singularities. **Manipulator Dynamics:** Introduction to Legrangian mechanics and Dynamic equation for 2 DOF robots, Introduction to position control and force control of robotic manipulators. **Trajectory Planning:** Joint space Vs Cartesian space, Joint space trajectory planning	**9**

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	Identify the anatomy of robotic manipulators used in industry.	**Understand**
CO2	Identify the sensors and actuators required for robotic manipulators.	**Understand**
CO3	Determine the forward and inverse kinematics of robotic manipulators.	**Apply**
CO4	Determine the dynamics and path planning of robotic manipulators.	**Apply**

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	3	2	-	-	-	-	-	-	-	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2
CO4	2	3	2	-	-	-	-	-	-	-	-	2
CO5	2	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. Analysis, control, applications	Saeed B. Niku	Wiley student edition	2nd Edition, 2010
2	Industrial Robotics – Technology, Programming and Applications	Mikell and Groover	McGraw Hill	2nd Edition, 2012

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	2006 Edition
2	Robot Dynamics and Control	Spong and Vidyasagar	Wiley Student Edition	2008 Edition
3	Fundamentals of Robotics: Analysis & Control	Robert J. Schilling	Pearson Education	2000 Edition

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/j8vYClEnyk0 https://youtu.be/o0NLi-wJS1I https://youtu.be/MH26PuRNMXM https://youtu.be/Ra-R0ZCdkPc https://youtu.be/8lCTkf-qjA0 https://youtu.be/KMqWSypAuEg https://youtu.be/nLRoK6Hyj0w https://youtu.be/uMxmBVX1pAQ https://youtu.be/xKzAqwpT06A
2	https://youtu.be/sCTgZv33tuA https://youtu.be/T6kGQrnUYD8 https://youtu.be/NcK9vlcdvZs https://youtu.be/rYaTu3Y2DMY https://youtu.be/HITCMaNCFQ8 https://youtu.be/HQgU76ZOP0o
3	https://youtu.be/wcy0Y3Jgf14 https://youtu.be/9Xyy24mbLQ0 https://youtu.be/kw64yS6vH14 https://youtu.be/6Wb0rmIvIlI https://youtu.be/AbRhzpReb2Q https://youtu.be/h4_2xAPj3y0 https://youtu.be/Zh55IM043rY https://youtu.be/iENLo_dxCZI https://youtu.be/NibHkkg2CQU https://youtu.be/93xncDTKqT4
4	https://youtu.be/B67ug1yx13E https://youtu.be/mXxEp5Q6dA8 https://youtu.be/thGicrIgtv0 https://youtu.be/irfHrA4fSDw https://youtu.be/O6ZbUDSFg_o https://youtu.be/kpiF_f_AntI https://youtu.be/zSvCAW-mowg https://youtu.be/OVGH_e0kjSE