SEMESTER S6

MEDICAL ROBOTICS

Course Code	**PEBMT 632**	**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**	PE

Course Objectives:

1. This course aims to make students able to understand the engineering aspects of Robots, analyse and design robotic structures and their applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Components of robotic system**: History of medical robots, Classification of medical robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.	9
2	**Drive systems and Sensors Drive system:** Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison. **Sensors in robots** – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.	9
3	**Robot kinematics and robot programming:** Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor	9

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	Commands, End Effector commands and simple Programs.	
4	**Robots in healthcare**: Teleoperated Robot-Assisted Minimally Invasive Surgery, Robot design concepts Robot assisted Image-Guided Interventions: CT, MR, Ultrasound, Other applications: Robotic catheters for heart electrophysiology, Humanoids, Micro/nano robots for biomedicine - Delivery, surgery, sensing and detoxification	**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**

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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	Introduce the fundamentals of robotics and its components	**K2**
CO2	Understand sensors and drive mechanisms in robotics	**K2**
CO3	Familiarize the Kinematics and robotic programming	**K3**
CO4	Analyse applications of robots in healthcare	**K3**

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

CO-PO Mapping Table:

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

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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	"Robot Modelling and Control"	Mark W. Spong, Seth Hutchinson, and M. Vidyasagar	John Wiley & Sons	2nd e,2020
2	"Medical robotics- Minimally Invasive surgery"	Paula Gomes	Woodhead	2012
3	Industrial Robotics – Technology, Programming and Applications	Mikell and Groover	McGraw Hill	2/e, 2012
4	Introduction to Robotics. Analysis and control, applications	Saeed B. Niku	Wiley	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Introduction to Robotics Mechanics and Control"	Craig J.J.	Pearson Education	2008
2	"Robotics Technology and Flexible Automation"	Deb S.R.	Tata McGraw Hill Book Co.	1994
3	"Medical Robotics"	Achim Schweikard, Floris Ernst	Springer	2015
4	"Medical Robots"	Daniel Faust	Rosen Publishers	2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_me88/preview

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