SEMESTER S5

MEDICAL ROBOTICS

Course Code	PCBRT501	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCBRT404	Course Type	Theory

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, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.; **Drive systems-** Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives, D.C.Servo Motors, Stepper Motors, A.C.Servo Motors-Salient Features and Applications	11
2	**Sensors in robots-** Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors. **Robot kinematics:** 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.	11

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3	**Robot programming Languages**-VAL Programming-Motion Commands, Sensor Commands, End Effect or commands and simple Programs **Robots in health care**: Tele operated 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	**11**
4	**Case Studies**: Cardiac, abdominal, and urologic procedures with tele-operated robots (3 procedures each), Neurosurgery and Orthopedic surgery with robots. Other types of healthcare robots: Physically assistive robots, socially assistive robots, Rehabilitation robotics, Design methodologies-Technological choices - Security. Professional and medical ethics; Robo ethics- social and ethical implications	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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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	Explain the fundamentals of robotics and its components and also understand drive mechanisms in robotics	**K2**
CO2	Understand sensors in robotic sand also Illustrate the Kinematics and Dynamics of robotics	**K2**
CO3	Analyse applications of robots in healthcare	**K3**
CO4	Develop programs for controlling robots.	**K6**

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

CO-PO Mapping Table:

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	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**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Robot Modeling and Control"	Mark W. Spong, Seth Hutchinson, and M. Vidyasagar	Wiley Publishers	2006.
2	"Medical robotics -Minimally Invasive surgery",	Paul a Gomes	Wood head	2012
3	Industrial Robotics– Technology, Programming and Applications,	Mikell and Groover	McGraw Hill,2/e	2012
5	Introduction to Robotics. Analysis and control, applications-	Saeed B. Niku	Wiley student edition	2010

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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://youtu.be/a6_fgnuuYfE?si=lXClvqDUReU_xMmQ
2	https://youtu.be/L_de-Xlh3Sg?si=8eBFtVJrRH9AmwD5
3	https://youtu.be/ZBMIGbKLi30?si=ZLCXWIpQTXinlpmT
4	https://youtu.be/topzzV2oKRw?si=nHfB34FYaGFgnbbh

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