

**ACADEMIC AFFAIRS OFFICE  
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

No. Acd./ 1928 /IAPC-70

Dated: April 16, 2019

**Head, Department of Electrical Engineering**  
(through e-mail)

The IAPC in its 70<sup>th</sup> meeting held on 02.04.2019 vide **Item No. 70.2.2** considered the syllabi of new Program Elective Course (PEC) **EEN-614: Bio-Medical Robotics**, duly recommended by DFC of the Department of Electrical Engineering as per **Appendix-B**.

The IAPC accepted the proposal with minor modifications. Duly modified and approved syllabus is placed as **Appendix-B1**.

Further action may kindly be taken accordingly.

  
**Asstt. Registrar (Curriculum)**

**Encl:** as above

**Copy to (through e mail):-**

1. All faculty
2. All Head of Departments/Centres
3. Dean of Academic Affairs
4. Associate Dean of Academic Affairs (Curriculum)
5. Channel I/ Academic webpage of iitr.ac.in

**Institute Elective**  
**PG/UG**

**INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EEN-614** Course Title: **Bio-Medical Robotics**

2. Contact Hours: **L: 3 T: 1 P: 2**

3. Examination Duration (Hrs.): **Theory: 3 Practical: 1**

4. Relative Weight: **CWS: 10-25 PRS: 25 MTE: 15-25 ETE: 30-40 PRE: 0**

5. Credits: **4** 6. Semester: **Spring/Autumn** 7. Subject Area: **PEC**

8. Pre-requisite: **Bio-Medical Instrumentation, Introduction to Robotics, Control Systems Basics**

9. Objective:

To develop competence in designing, developing and controlling bio-medical robots and image guided techniques.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	<b>Introduction to Bio-Medical Robotics</b> Introduction to application and paradigms of Bio-Medical Robots. Basic kinematics concepts – forward, inverse, spatial transformations, joints, degrees of freedom of biological systems. Tendon driven systems.	8
2.	<b>Minimally Invasive Surgery</b> Video images in MIS. Teleoperation. Augmented and Virtual Reality.	8
3.	<b>Image-Guided Interventions</b> Medical Imaging Modalities – CT, US, MRI. Needling System – Passive and Active Needles – Unicycle, Bicycle Modeling, Design concepts, Actuation involving smart actuator such as Shape Memory Alloy actuators, Image-Guided Feedback Control.	10
4.	<b>Rehabilitation Robotics</b> Exoskeletons-Design, Development and Control.	8

	Human Hand Biomechanics – Manipulability analysis, Redundancy resolution. EMG, EEG signal recording and processing using LabView.	
5.	<b>Current Topics in Bio-Medical Robotics</b> Haptic Augmentation in Exoskeletons. Robotic Catheters for percutaneous interventions. Unsupervised learning for mapping in Bio-Robots.	8
	<b>Total</b>	<b>42</b>

#### 11. Laboratory Components:

S. No.	Experiments	Contact Hours
1.	Introduction to Laboratory Equipments – Exoskeletons, Ultrasound Imaging Modality and Electromagnetic Tracking System	2
2.	Simulation Study on Robot Dynamics	2
3.	Simulation Study on Robot Kinematics and Control	2
4.	Position Control of a Hand Exoskeleton using Subject's Intention.	2
5.	Force Control of a Hand Exoskeleton in Real-Time LabView Platform.	2
6.	Needle Maneuverability in Tissue Phantom through Image Guidance.	2
7.	Human Hand Biomechanics Study.	2
	<b>Total</b>	<b>14</b>

#### 12. Suggested Books:

S. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Paula Gomes, "Medical robotics: minimally invasive surgery", Woodhead Publishing.	2012
2.	Shane Xie, "Advanced Robotics for Medical Rehabilitation: Current state of the art and recent advances", Springer.	2016
3.	John J. Craig, "Introduction to Robotics Mechanics and Control", 3 <sup>rd</sup> Ed., Pearson Prentice Education.	2005
4.	Mark W. Spong and M. Vidyasaagar, "Robotics Dynamics and Control", 2 <sup>nd</sup> Ed., Wiley Education.	1989
5.	William R. Sherman and Alan B. Craig, "Understanding Virtual Reality, 1 <sup>st</sup> Ed., Interface, Application and Design", Morgan Kaufmann Publication.	2003
6.	Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley and Sons Publication.	2000

Approved & forwarded -  
 Sra.  
 3/4/2019  
 (DAPE Chairman)