SEMESTER S7

NEURAL PROSTHESIS & IMPLANTS

Course Code	PEBMT743	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. To provide an in-depth understanding of the technologies and engineering principles behind neural prostheses, focusing on visual, auditory, and upper limb prosthetics
2. To equip students with the knowledge and skills to design, analyze, and implement neural prosthetic systems, addressing both technical challenges and practical applications

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of Neural Prosthesis, Retinal implant technologies-Epiretinal, Subretinal and Extraocular implants, Visual stimulation in the brain, Optic Nerve Stimulation, Engineering challenges in the development of visual prosthesis, Neural electrical stimulator, DSP-based image processing system for visual prostheses	9
2	Cochlear implants- Architecture and functional block diagram of a modern cochlear implants, External unit, RF link, Internal unit, Electrodes, Safety Considerations, Auditory Prosthesis Using Deep Brain Stimulation: Development and Implementation – Design and implementation, Electrode technologies, Stimulation strategies.	9
3	Brief history of artificial hands - Origin and nature of the myoelectric signal, Anatomy, Contraction Process, Connections to the CNS, Fibre membrane and the action potential, Measurement of the potentials associated with	9

	depolarization, Muscle force mediation, Myoelectric Signal - Acquisition, Processing, Control of prosthetic function, Terminal device electronics	
4	Upper Limb Prosthetics Pre-prosthetic Assessment, Prosthetic Options, Components for the Upper Limb Prosthesis - Hands and Work Hands, and Cosmetic Covers, Electric wrist rotation, Wrist Flexion, Elbow components, control Systems, Interface designs, Indications and contraindications, Training and outcome measurement Mechatronic hands: prosthetic and robotic design Myoelectrically controlled hand - Mechanisms - Materials, actuators, Sensors, Control - finger position, object slip, EMG reference control, Artificial prehension, Brain control and sensing of artificial limbs	**9**

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	Understand the principles and technologies of visual prostheses, including retinal implants and neural electrical stimulators.	**K2**
CO2	Analyze the architecture and functional components of modern cochlear implants and auditory prostheses using deep brain stimulation.	**K4**
CO3	Explain the origin and nature of myoelectric signals and their application in artificial hand prosthetics.	**K2**
CO4	Assess and choose appropriate components and control systems for upper limb prosthetics, considering pre-prosthetic assessment and patient-specific needs.	**K2**
CO5	Design and implement control systems for myoelectrically controlled prosthetic hands, incorporating sensors, actuators, and EMG reference control.	**K3**

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

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CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									2
CO2	3	3	2		2							2
CO3	3	2		2								2
CO4	3		3			2						2
CO5	3	2	3									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	Implantable Neural Prostheses 1 Devices and Applications,	David D. Zhou Elias Greenbaum	Springer	2009
2	Powered Upper Limb Prostheses: Control, Implementation and Clinical Application	L. McLean, R. N. Scott (auth.), Ashok Muzumdar	Springer-Verlag Berlin Heidelberg	2004
3	Mechatronic Hands Prosthetic and Robotic Design, The Institution of Engineering and Technology	Paul H. Chappell	ISBN 978-1-78561-155-1 (PDF)	2016,
4	Upper Limb Prosthetics	Alberto Esquenazi, MD	PM&R	2014
5	Implantable Neural Prostheses 1 Devices and Applications,	David D. Zhou Elias Greenbaum	Springer	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Orthotics and prosthetics in rehabilitation	Kevin Chui, Milagros Jorge, Sheng-Che Yen, Michel M. Lusardi	Elsevier	Fourth edition
2	Active Above-Knee Prosthesis - A Guide to a Smart Prosthetic Leg, ,	Zlata Jelacic, Remzo Dedic, Haris Dindo	Elsevier Inc	2020
3	Mechanics of Biomaterials Fundamental Principles for Implant Design,	Lisa A. Pruitt and Ayyana M. Chakravartula	Cambridge University Press	2011
4	Orthotics and prosthetics in rehabilitation	Kevin Chui, Milagros Jorge, Sheng-Che Yen, Michel M. Lusardi	Elsevier	Fourth edition
5	Active Above-Knee Prosthesis - A Guide to a Smart Prosthetic Leg, ,	Zlata Jelacic, Remzo Dedic, Haris Dindo	Elsevier Inc	2020

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	The Electric Eye: A Visual Prosthesis (youtube.com)
2	How Do Cochlear Implants Work? (youtube.com)
3	Kinder Joy BB HW Top Right Logo 20s (Malayalam) (youtube.com)

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