SEMESTER S8

ARTIFICIAL ORGANS & IMPLANTS

Course Code	PEBMT866	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 understand the design principles and challenges involved in creating functional replacements for various joints and bone fracture-fixation devices
2. To apply knowledge about the design requirements, materials, and techniques for various artificial organs and implants.
3. To implement 3D printing technology to design and develop biomedical applications.

KTU SPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of the artificial organ design process - The Hip joint and Its artificial replacement - The Knee joint and Its artificial replacement- The Ankle Joint and Its Artificial Replacement – The Elbow joint and its artificial replacement - The Wrist Joint and Its Artificial Replacement - The Finger Joint and Its Artificial Replacement - The Design of a Bone Fracture-Fixation Device	9
2	The Eye and its artificial replacement - The Lung and its Artificial Replacement - Dental Implants: Their Design and Manufacture - Dental Implants - Components of Dental Implants - Types of Implants in Use - Biting Force - Implant Shape - Surface Characteristics - Bone Factors - Loading Conditions- The Number, Distribution, Orientation, and Design of Implants - Placement of Implants into Extraction Sites - Clinical and Biomechanical Considerations for Fixed Tooth Replacement. Artificial Pancreas - Intensive Insulin Therapy and Insulin Pump - Bioengineering	9

	Approach to an Artificial Pancreas - Gene Therapy Approach	
3	Design of Total artificial heart - design of heart valves - Kidney and its artificial replacement- Skin and the design of artificial skin - The Liver and its artificial replacement-The medical device market and ethical issues of implants-the manufacturing, testing, and sterilization of implants	**9**
4	Fundamentals of 3D printing and its applications in Biomedical engineering-stages of 3D printing process- 3D modelling- printing-post processing-Types of 3D printing technologies-Biomedical applications of 3D printing technology-applications-maxillofacial surgery- upper limb prosthetics.	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

KTU SPECIAL

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 design principles and challenges involved in creating functional replacements for various joints and bone fracture-fixation devices	**K2**
CO2	Apply knowledge of design requirements and materials to develop functional replacements for organs and joints such as the eye, lung, pancreas, heart, kidney, skin, and liver, while considering clinical and biomechanical factors	**K3**
CO3	Evaluate the market considerations, ethical issues, and processes for manufacturing, testing, and sterilizing medical implants.	**K3**
CO4	Utilize 3D printing technology to design and develop biomedical applications, including prosthetics and scaffolds for tissue engineering, by understanding the stages of the printing process and types of 3D printing technologies.	**K3**

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

KTU SPECIAL

CO-PO Mapping Table:

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

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	Design of artificial human joints & organs	Subrata Pal	Springer	First edition 2014
2	3D Printing in Biomedical Engineering	Singh S, Prakash C, Singh R	Springer	First edition 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Organs	Gerald E. Miller	Morgan & Claypool	First edition 2006
2	Artificial Organ Engineering	Maria Cristina Annesini, Luigi Marrelli, Vincenzo Piemonte, Luca Turchetti	Springers	First edition and 2017

KTU SPECIAL

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.futurelearn.com/courses/medtech-orthopaedic-implants
2	https://nptel.ac.in/courses/102106057
3	https://nptel.ac.in/courses/102106057
4	https://archive.nptel.ac.in/courses/102/106/102106095/