SEMESTER S5

BIOMEDICAL OPTICS & BIOPHOTONICS

Course Code	PEBMT 522	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 know the different applications of lasers in medical field.
2. To understand the working principles of different lasers used in medicine.
3. To learn the optical properties of tissue and the opto-thermal interaction of the tissue.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Basic optics: polarized waves-linear, circular and elliptical, propagation of a light wave through a quarter wave plate, reflection at a plane interface, two beam interference, concept of coherence. Basic characteristics of optical fibres: numerical aperture, coherent bundle, attenuation in optical fibres, pulse dispersion in step index optical fibres, loss mechanisms: absorptive losses, radiative losses.	9
2	Introduction to Lasers: principle, construction and classification of Lasers - Nd-YAG. Fibre optics and Medical Applications - Endoscopic imaging: formation, resolution, signal to noise ratio – Optical coherence tomography. Minimally Invasive cardio-vascular technologies- Angioplasty, Stents, Aneurysm treatment, Embolic filters, Cardiac ablation catheters.	9

3	Optical Micromanipulation tools: Laser tweezer and Laser scissor: principle of working. Applications- Manipulation of single DNA molecules, molecular motors, protein-protein interaction. Biosensor- an introduction, Fiber - Optic biosensors, Planar waveguide biosensors, Evanescent wave biosensors, Interferometric biosensors, Surface plasmon resonance biosensors. Photobiology: Interaction of light with tissues–Optical biopsy- Tissue Engineering and light activation: Laser tissue contouring and restructuring, Laser tissue welding, and regeneration.	**9**
4	Thermal therapy- mechanism, Image guided thermal therapy: device placement, thermometry, assessment of thermal damage. Photodynamic therapy - basic principle, mechanism of photodynamic action, applications. Light irradiation for photodynamic therapy: laser source, laser dosimetry, light delivery. Interface of nanotechnology and photonics, Biomaterials for Photonics – an introduction.	**9**

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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**

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	Get an exposure to the basics of optics and characteristics of optical fibre.	**K1**
CO2	Understand the importance of fibre optics in medical applications.	**K2**
CO3	Acquire the knowledge on micromanipulation tools and biosensor.	**K3**
CO4	Evaluate the interaction of light with tissues and mechanism of thermal therapy.	**K5**
CO5	Introduce the therapeutic applications of laser in medical field.	**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	3	2	2							2		2
CO2	3	2	2							2		2
CO3	3	2	2							2		2
CO4	3	2	2							2		2
CO5	3	2	2							2		2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fiber Optics	Ghattak & Thyagarajan	Cambridge University Press	1989
2	Introduction to Biomedical Photonics	Paras N Prasad	John Wiley	2003
3	BIOMEDICAL TECHNOLOGY and DEVICES HANDBOOK	James Moore and George Zouridakis	CRC Press	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Biomechatronics in Medicine and Health Care	Raymond K. Y. Tong	Pan Stanford Publishing Pvt. Ltd.	
2	Biomedical Photonics Handbook	Taun Vo-Dinh	CRC Press	
3	Biomedical Engineering and Design Handbook	Myer Kutz	McGraw Hill	Vol 2
4	Advances in Biomedical Engineering	Pascal Verdonck	Elsevier	
5	Biomedical Applications of Light Scattering	Adam Wax and VadimBackman	McGraw Hill	

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108106135
2	https://nptel.ac.in/courses/108106135
3	https://nptel.ac.in/courses/112103312