GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Biomedical Engineering (03)
SUBJECT NAME: MEDICAL OPTICS
SUBJECT CODE: 2170312
B.E. 7th SEMESTER

Type of course: Department Elective

Prerequisite: Basic Physics, Principle of LASER and its types, Anatomy and physiology.

Rationale: to impart in students detailed knowledge about Principle and working of LASER fiber optics. To give brief knowledge about integration of LASER & fiber optic techniques for therapeutic, diagnosis and imaging modalities.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Optical Fiber and light- a brilliant combination:** Light guiding, communication, Refraction, Units, Snell's Law, Critical Angle, Total internal reflection, Electromagnetic waves-Spectrum **Propagation of light along the fiber:** Transmission of light through straight transparent slab and bend slab, Cone of acceptance, numerical aperture, the use of decibels in fiber optic circuits **Losses and dispersion in fiber optics:** Absorption, Rayleigh scatter, Fresnel Reflection, Bending losses, dispersion Graded Index fiber, Single mode fiber, cables for fiber optics, Problems occurring in connecting optical fibers, Cleaving Process, Connectors and couplers	15	30
2	**Medical Laser:** Introduction, Laser physics, medical lasers, Laser safety fundamentals	4	10
3	**Application of Lasers in therapy and diagnosis:** Introduction, laser assisted diagnosis and therapy fundamentals, Interaction of Laser beams and materials-principles, Laser interaction with tissue, application of Lasers in Diagnosis and Imaging, Laser surgery and therapy, thermal interaction between laser and Tissue. Integrated laser-fiber systems and their applications, Complications in the use of Laser fiberoptic system	6	25
4	**Endoscopy:** Endoscopic imaging system fundamentals, Angioscope, Videoscopy, Fluorescence endoscopy, Endoscopic therapy, Endoscopic ultrasound imaging-principles	5	10

5	**Fiber Optic Medical Diagnosis:** introduction, fundamentals, fiberoptic biomedical sensor-principles, Direct-indirect Sensor principles	4	10
6	**Clinical applications of fiber optic Laser systems:** Fiber optic Laser system in cardiovascular disease, Fiber optic Laser system in Gastroenterology, Fiber optic Laser system in general and thoracic surgery, Fiber optic Laser system in Neurosurgery, Fiber optic Laser system in Oncology, Fiber optic Laser system in Opthalmology, Fiber optic Laser system in Orthopedics, Fiber optic Laser system in Otolaryngology, Fiber optic Laser system in Urology, Flow chart diagrams for clinical applications of laser –fiber systems.	6	15
Total		45	

Reference Books:

1. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic press Inc.
2. John Crisp," Introduction to fiber optics", 2nd Edition, 2001, Newnes

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	**U Level**	**A Level**	**N Level**	**E Level**
25%	**30%**	**25%**	**10%**	**10%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:

1. Understand the LASER physics, Light and its working principle with different modes of operation.
2. Learn the construction, working principle of fibers and Light propagation through fibers.
3. Learn biomedical sensor integration with optical fiber and thus its emerging various therapeutic, diagnostic as well as imaging application, its advantages and safety aspects.
4. Understand the various applications for curing different diseases accurately by fiber optic laser system in an easy, fast and safe method of operation.

List of Experiments: (Outlines)

1. To study electromagnetic spectrum.
2. To study the structure of optical fiber and its working principle.
3. To study the propagation of light through straight and bend fiber.
4. To study the terminology related to fiber optic communication.
5. To study losses and dispersion in fiber optics.
6. To study the working principle of LASER.
7. To study various types of LASER used in biomedical engineering.
8. To study the application of LASER in Neurosurgery
9. To study the application of LASER in Gastroenterology

10. To study the application of LASER in Opthalmology
11. To study the application of LASER in Oncology
12. To study the application of LASER in Urology
13. To study the application of LASER in Orthopedics
14. To study the principle and construction of Endoscopy.
15. To study fiber optic biomedical sensors and its coupling with fibers.

Active Learning Assignments: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Medical Optics. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.