GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS ENGINEERING
OPTOELECTRONICS
SUBJECT CODE: 2161008
B.E. 6th SEMESTER

Type of course: Regular

Prerequisite: Fundamental knowledge of Electromagnetics, Electronics devices and Analytical and mathematical knowledge**.**

Rationale: BE students of EL Engineering need to have good understanding of the fundamentals of Photo-luminous-semiconductors, Optoelectronics devices, Optical modulator, Optical detectors and understand the technology behind latest Display devices like LCD, Plasma**.**

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Light:** Nature of light, Wave nature of light, Light sources – blackbody radiation, units of light.	03	8
2	**Review of Semiconductor Device Physics:** Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells.	08	16
3	**Interaction of photons with electrons and holes in a semiconductor:** Rates of emission and absorption, Condition for amplification by stimulated emission, the laser amplifier.	05	13
4	**Semiconductor Photon Sources: Display Devices** Electroluminescence. The LED: Device structure, materials and characteristics, LED drive circuitry, Plasma displays, liquid crystals: properties,LCD, Numeric displays.	05	13
5	**Semiconductor Photon Sources: LASER** The Semiconductor Laser: Basic structure, theory and device characteristics; direct current modulation. Quantum-well lasers; DFB-, DBR- and vertical-cavity surface-emitting lasers (VCSEL); Laser diode arrays.	07	16

	Device packages and handling..		
6	**Semiconductor Optical Amplifiers & Modulators:** Semiconductor optical amplifiers (SOA), SOA characteristics and some applications, Quantumconfined Stark Effect and Electro-Absorption Modulators.	**08**	**16**
7	**Semiconductor Photodetectors:** Types of photodetectors, Photoconductors, Single junction under illumination: photon and carrie r-loss mechanisms, Noise in photodetection; Photodiodes, PIN diodes and APDs: structure, materials, characteristics, and device performance. Photo-transistors, solar cells, and CCDs. Optoelectronic integrated circuits – OEICs	**10**	**18**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**30**	**20**	**10**	**8**	**2**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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.

Reference Books:

1. J.Wilson and J.Hawkes,"Optoelectronics-An Introduction",PHI
2. P. Bhattacharya, Semiconductor Optoelectronic Devices; Prentice Hall of India. ,
3. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley &Sons, Inc., 2nd Ed.,
4. G. Keiser, Optical Fiber Communications, McGraw-Hill Inc., 3rd Ed.
5. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press,
6. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc.
7. J. M. Senior, Optical Fiber Communication: Principles and Practice, Prentice Hall of India, 2nd Ed.

Course Outcome:

After completing this course students shall able to:

1. Ability to solve problems on basic semiconductor optoelectronic devices and light.
2. Ability to gain fundamental knowledge of basic semiconductor optoelectronic devices like LED, Laser and drive circuits.
3. Ability to understand the Basics of light, interaction of photons with electrons and holes in a semiconductors.
4. Ability to understand the working of optical detectors/modulators and various optical devices like amplifiers.
5. Ability to relate impacts of semiconductor material properties into the fabrications of semiconductor optoelectronic devices.

List of Experiments:

This shall consist of about 10 Practical's based on the above syllabus.

Design based Problems (DP)/Open Ended Problem:

Students learn advanced topics in modern physics, semiconductor physics, and optics relevant to Engineering Science. The design content is relatively low apart from open-ended problems and term projects but prepare mini projects based on optics principles.

List of Open Source Software/learning website: www.nptel.ac.in

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. 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.