18ECPE602	PHYSICS OF OPTOELECTRONICS	L	T	P	C
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Course Objectives:To gain knowledge on,

1.	Basic concepts of semiconductors and light semiconductor interaction.
2.	Principle, working, materials and characteristics of LEDs and LCDs.
3.	Structure, materials and device characteristics of semiconductor laser, photo detectors, opto electronics modulators and solar cell.

Unit I	REVIEW OF SEMICONDUCTOR PHYSICS	9	+	0

E-k diagram - Density of states - Occupation probability - Fermi level and quasi - Fermi level (variation by carrier concentration and temperature) - P-N junction - Metal-semiconductor junction (Ohmic and Schottky) - Carrier transport – generation and recombination - Semiconductor materials of interest for optoelectronic devices – Band gap modification - Hetero structures - Light semiconductor interaction: Rates of optical transitions - Joint density of states and condition for optical amplification.

Unit II	SEMICONDUCTOR OPTICAL DIODES (LEDS AND LCDS)	9	+	0

Rate equations for carrier density - Radiative and non-radiative recombination mechanisms in semiconductors - LED: Device structure - Materials – Characteristics and figures of merit – LCD - Principle and working – Optical switches – Self Electro optic Effect Devices (SEED).

Unit III	SEMICONDUCTOR LASERS	9	+	0

Review of laser physics - Rate equations for carrier and photon density - Steady state Solutions - Laser dynamics - Relaxation oscillations - Input-output characteristics of lasers - Semiconductor laser: Structure - Materials - Device characteristics - Figures of merit – DFB - DBR - Vertical_cavity surface_Emitting lasers (VECSEL) - Tunable semiconductor lasers.

Unit IV	PHOTO DETECTORS	9	+	0

Types of semiconductor photo detectors - PN junction, PIN, Avalanche: Structure, materials, working principle, and characteristics. Noise limits on performance; Photovoltaic effect - Solar cells - construction, working and applications.

Unit V	OPTOELECTRONIC MODULATOR	9	+	0

Introduction - Analog and Digital Modulation - Electro-optic modulators - Magneto-Optic devices - Franz-Keldysh and Stark effect electro absorption modulators - Acousto optic devices - Optical, Switching and Logic Devices.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the physics bebind the semiconductors devices.
CO2	:	Gain knowledge on principle of working of optical semiconductor devices.
CO3	:	Gain knowledge on principle of working photo detectors.
CO4	:	Understand and design opto electronic modulators and other optical devices.

Text Books:

1.	Pallab Bhattacharya, “Semiconductor optoelectronic devices”, Pearson Education publications, New delhi, 2002.
2.	S.M.Sze, “emiconductor Devices:Physics and Technology”,wiley,2008.

Reference Books:

1.	David A.Bell, “Electronic Devices and Circuits”, Oxford University press publications, New Delhi, 2008.
2.	Arumugam M, “Semiconductor Physics and Optoelectronics”, Anuradha publications, kumbakonam, 2006.
3.	Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
4.	Online course: “Optoelectronic Materials and Devices” by Monica Katiyar and Deepak Gupta on NPTEL.

E-References:

1.	https://ocw.mit.edu/courses
2.	https://electrical-engineering-and-computer-science
3.	https://semiconductor-optoelectronics-theory-and-design-fall-2002/