



PHYSICS

SEMICONDUCTORS OPTOELECTRONICS



PROF. M.R. SHENOY

Department of Physics
IIT Delhi

TYPE OF COURSE : Rerun | Elective/Core | UG/PG

COURSE DURATION : 12 weeks (20 Jul'20 - 9 Oct'20)

INTENDED AUDIENCE : IIIrd, IVth year B.Tech /

EXAM DATE : 17 October 2020

M.Sc (Physics/ Electronics/ Electronic Sciences) students, M.Tech 1st Sem students

PREREQUISITES : Basic undergraduate-level knowledge of Semiconductors, Optics, Electronics and Quantum Mechanics would be required.

INDUSTRIES APPLICABLE TO : Companies and R&D Laboratories working on Laser Applications, Optoelectronic and Optical Communication are expected to value this course.

COURSE OUTLINE :

This course introduces the students to the field of Semiconductor Optoelectronics, which deals with the physics and technology of semiconductor optoelectronic devices such as light emitting diodes, laser diodes and photodiodes, which are becoming important components in consumer optoelectronics, IT and communication devices, and in industrial instrumentation. Assuming a general science/engineering undergraduate level background, the course begins with a recap of essential (to this course) semiconductor physics, followed by the study of interaction of photons with electrons and holes in a semiconductor, leading to the realization of semiconductor photon amplifiers, sources, modulators, and detectors. A variety of designs and configurations of these devices have been emerging with application-specific characteristics. The course is 'applied' in nature, and could be offered at the level of B.E/B.Tech IIIrd/ IVth Year, M.Sc IIInd/ M.Tech. I Year.

ABOUT INSTRUCTOR :

M. R. Shenoy received the M. Sc. in Physics in 1979 from Mysore University and the PhD in the field of Fiber and Integrated Optics from IIT Delhi in 1987. He joined the faculty of IIT Delhi in 1988, where he is currently Professor in the Department of Physics. Dr. Shenoy was a Visiting Scientist with the Department of Electrical and Electronic Engineering, University of Glasgow, Glasgow, U.K., in 1990 for 10 months, and on short- duration visits at the University of Nice – Sophia Antipolis, Nice, France, in 1992, 1997, 2006 and 2008 for collaborative research on Integrated Optical Devices. He has authored/co- authored a number of research papers and book chapters, and has supervised a large number of student projects at the B.Tech, M.Sc. M.Tech and Ph.D. levels. He is a co-editor of the book Fiber Optics Through Experiments (Viva Publications, New Delhi, 1994, 2008).

COURSE PLAN :

Week 01 : Introduction, Energy bands in solids, Density of states

Week 02 : Occupation probability and Carrier concentration, Quasi Fermi levels

Week 03 : Semiconductor optoelectronic materials and Heterostructures

Week 04 : Heterostructure p-n junctions, Schottky junctions, Ohmic contacts

Week 05 : Interaction of photons with electrons and holes in a semiconductor

Week 06 : Amplification by stimulated emission, The semiconductor laser amplifier

Week 07 : Absorption in semiconductors and quantum wells, Electro-absorption modulator

Week 08 : Injection electroluminescence, Light emitting diode and their characteristics

Week 09 : Semiconductor laser: Device structure and characteristics

Week 10 : Single frequency lasers, VCSEL and Quantum well lasers

Week 11 : Semiconductor photodetectors, General characteristics

Week 12 : Photodiodes: PIN diode and APD. Photonic Integrated Circuits