(MPM-202)
Optoelectronics and Optical Communication System

UNIT-II (Optical Sources and Detectors)

Lecture-5

by

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SYLLABUS

MPC-202 OPTOELECTRONICS AND OPTICAL COMMUNICATION SYSTEM   Credits 4 (3-1-0)

UNIT I: Optical process in semiconductors

Optoelectronic properties of semiconductor: effect of temperature and pressure on bandgap, carrier scattering phenomena, conductance processes in semiconductor, bulk and surface recombination phenomena, optical properties of semiconductor, EHP formation and recombination, absorption in semiconductors, effect of electric field on absorption.

UNIT II: Optical sources and detectors

An overview of optical sources (Semiconductor Laser and LEDs), Optical Detectors: Type of photo detectors, characteristics of photo detectors, noise in photo detectors, photo transistors and photo conductors.

UNIT III: Optical fiber

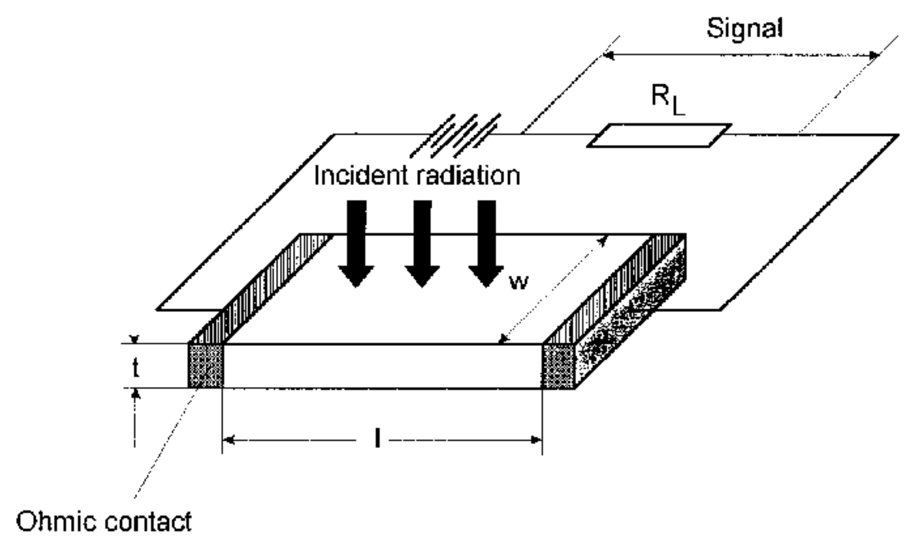
Structure of optical wave guide, light propagation in optical fiber, ray and wave theory, modes of optical fiber, step and graded index fibers, transmission characteristics of optical fibers, signal degradation in optical fibers; attenuation, dispersion and pulse broadening in different types of optical fibres.

UNIT IV: Fiber components and optoelectronic modulation

Fiber components: Fibre alignments and joint loss, fiber splices, fiber connectors, optical fiber communication, components of an optical fiber communication system, modulation formats, digital and analog optical communication systems, analysis and performance of optical receivers, optoelectronic modulation.

Photoconductors

- The photoconductor are the photodetector which is also called **'Photoresistors or light dependent resistor (LDR)'.**
- **Based on change in conductivity of a semiconductor due to incident photon flux Φ.**
- **Mostly used in configuration shown in the figure-**



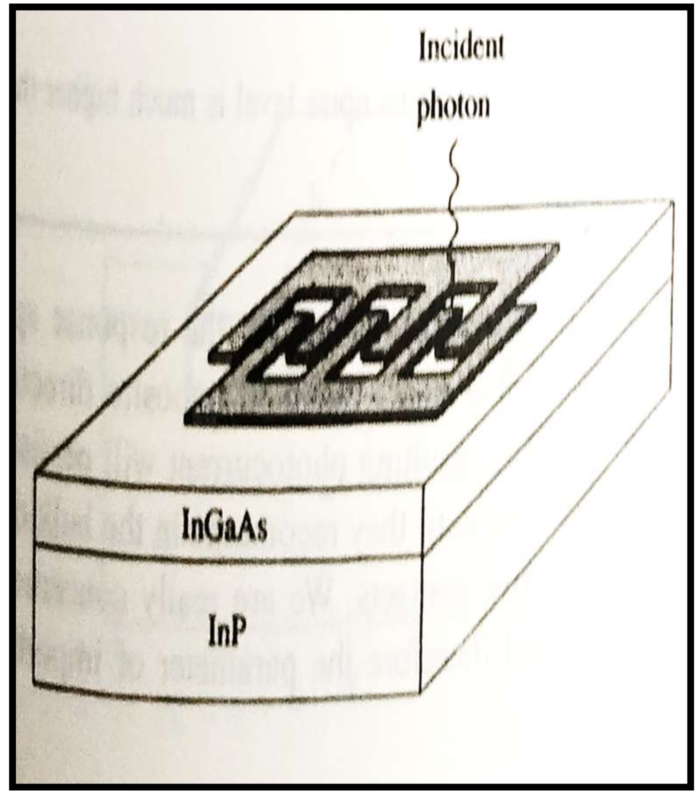
Photoconductors

- The photoconductor is perhaps the simplest optical detector that exhibits an internal gain mechanism and clearly demonstrates the gain-bandwidth limitation.
- Its operation is based on increase in conductivity of a specific region with photoexcitation.
- The photogenerated electrons and holes are collected by opposite contacts and result in a photocurrent.

Photoconductors

- The schematic of a photoconductor in its simplest form, with two top contacts, is shown in figure.

- The active layer is formed epitaxially, or sometimes by ion implantation, on a high resistivity substrate, and suitable contacts are delineated on top by evaporation of metals and subsequent alloying.



Photoconductors

- The thickness of active layer should be large enough so that it can absorb a significant fraction of incident light but at the same time small enough so as to minimize the noise current resulting from a low resistance of the semiconductor layer
- The separation between the contact pads, either in linear or interdigitated form, is also an important parameter in the operation of the device.
- A suitable bias is applied across the contacts to collect the photogenerated carriers.

Photoconductors

- In InGaAs photoconductors, $\eta_{ext} \sim 80\% - 90\%$
- To increase the quantum efficiency, an antireflective coating, or wider bandgap window layer needs to be formed on the surface of the absorbing region.
- Another important consideration in the performance of the device is noise generation.
- The noise is principally generated by the large dark current of the device and it is known as ***Johnson or thermal noise,*** that has its origin in the random motion of the carriers that contribute to the current.


THANK YOU