(MPM-202)
Optoelectronics and Optical Communication System

UNIT-II (Optical Sources and Detectors)

Lecture-7

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.

Phototransistor

- A phototransistor is an ordinary N-P-N transistor except that no base terminal is provided.
- This is used in common emitter configuration i.e. the bias voltage is applied between emitter-collector circuit with the base left open.
- Instead of base current, the input to the transistor is in the form of light.
- The device is housed in a case having a little hole made on the surface near the collector-base junction.
- A small lens is fixed on the hole to allow a focused light beam to incident on collector base junction

Phototransistor

- In modern method of fabrication, highly light effective materials are used instead of making a hole and lens is fixed on it.

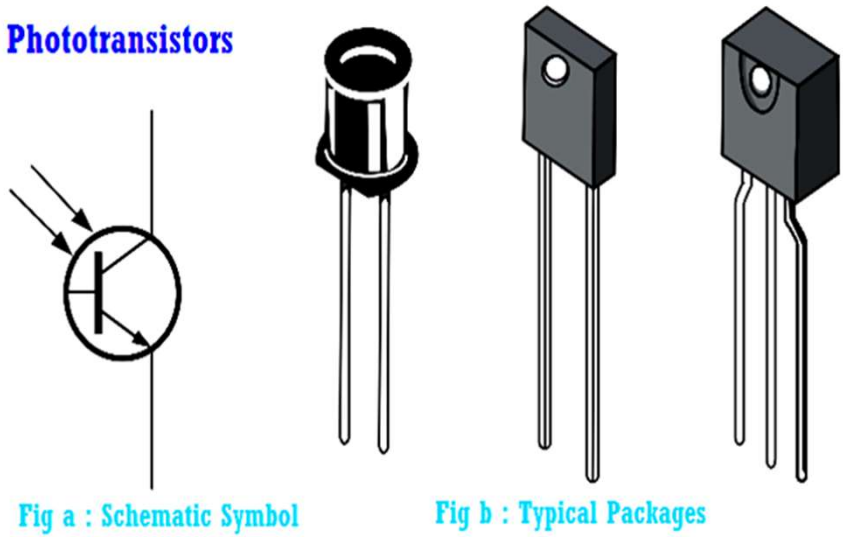
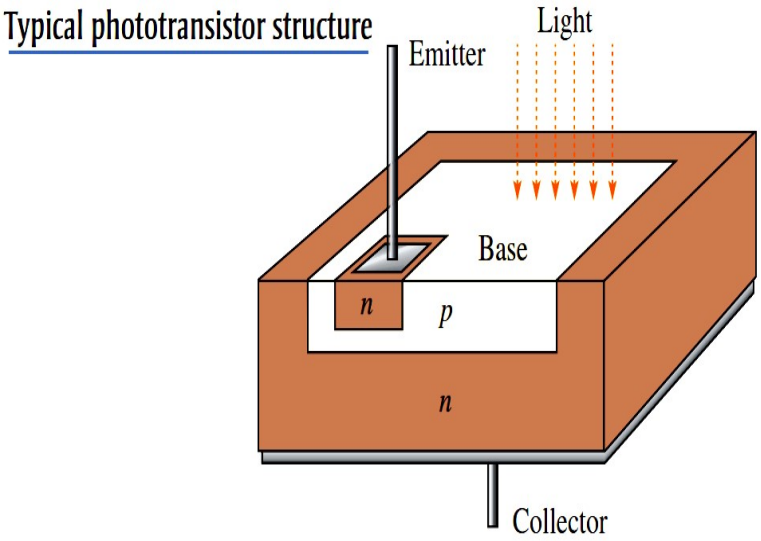


Fig a : Schematic Symbol

Fig b : Typical Packages



Working of Phototransistor

- **In absence of light-signal,** there is no base current, i.e. $\boldsymbol{I_b = 0}$.
- As the emitter base junction is forward biased and collector base junction is reverse biased , there will be few minority carriers (thermally generated)which will cause the flow of reverse saturation collector current.
- The current is called the dark current as is of the order of few **nanoampere**.
- **When light is allowed to incident** on collector base junction, electron hole pairs are produced and this produces the base current.
- The base current is directly proportional to the light intensity.
- Now the collector current $\boldsymbol{I_c}$ is β times the base current.

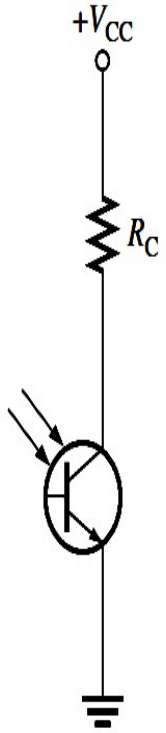
Working of Phototransistor

- **Therefore, as soon as the light is allowed to incident, the transistor starts conducting and amplified current starts flowing through the reverse bias junction.**
- By transistor action, the current due to luminous flux will increase a lot.

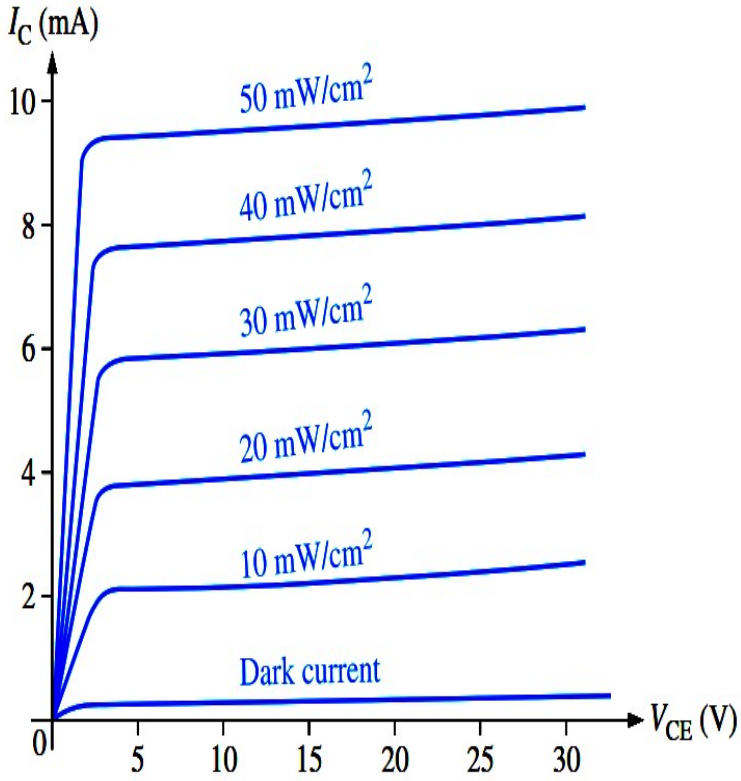
Characteristics of Phototransistors

- The circuit arrangement for drawing the characteristics of phototransistor is shown is figure.
- The characteristics curve of phototransistor i.e. curves drawn between $V_{CE}(in\ volts)$ and $I_c(in\ mA)$ as a function of illumination level (in mW/cm^2).

Phototransistor circuit



Phototransistor collector characteristic curves



Characteristics of Phototransistors

- It is obvious that as the intensity of incident light increases, the collector current also increases.
- For a given illumination, the collector current is almost constant.

- The main difference between a photodiode and a phototransistor is the current gain. The phototransistor produces β_{dc} times more current than photodiode if same amount of light is incident on both devices.
- Photodiodes are more faster than phototransistors
- A phototransistor can be converted into photodiode by using only its base and collector terminals and ignoring emitter terminal.


THANK YOU