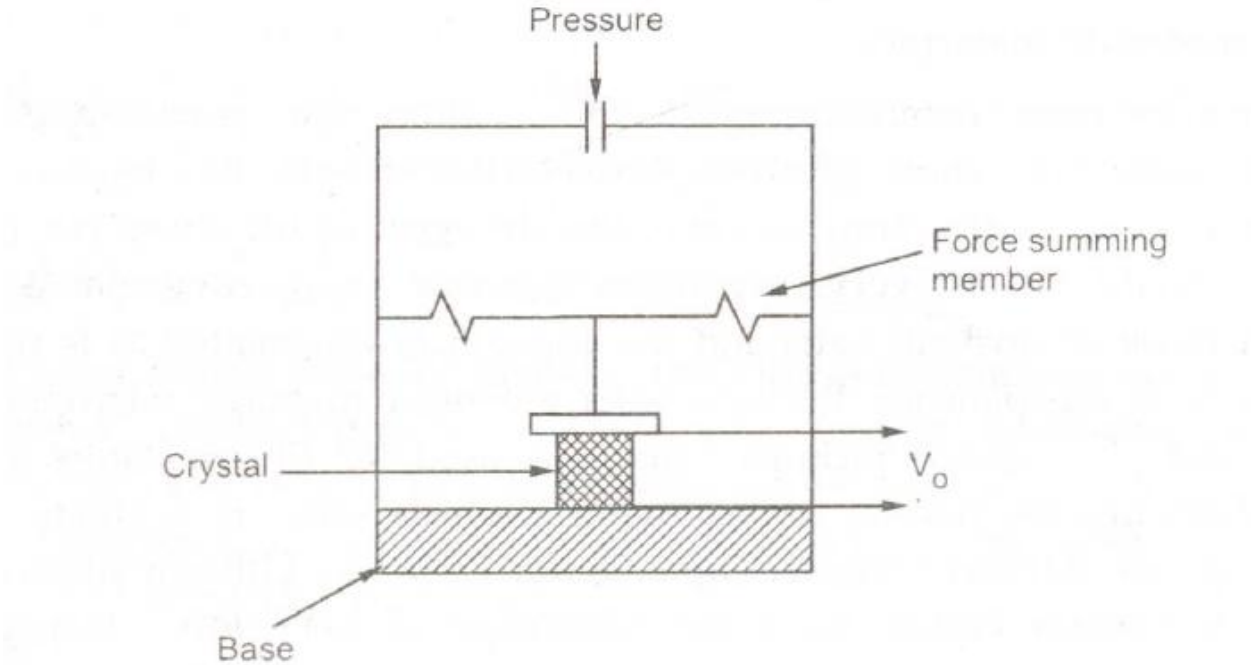
PIEZOELECTRIC TRANSDUCER, PHOTOVOLTAIC CELL AND PHOTOTRANSISTOR

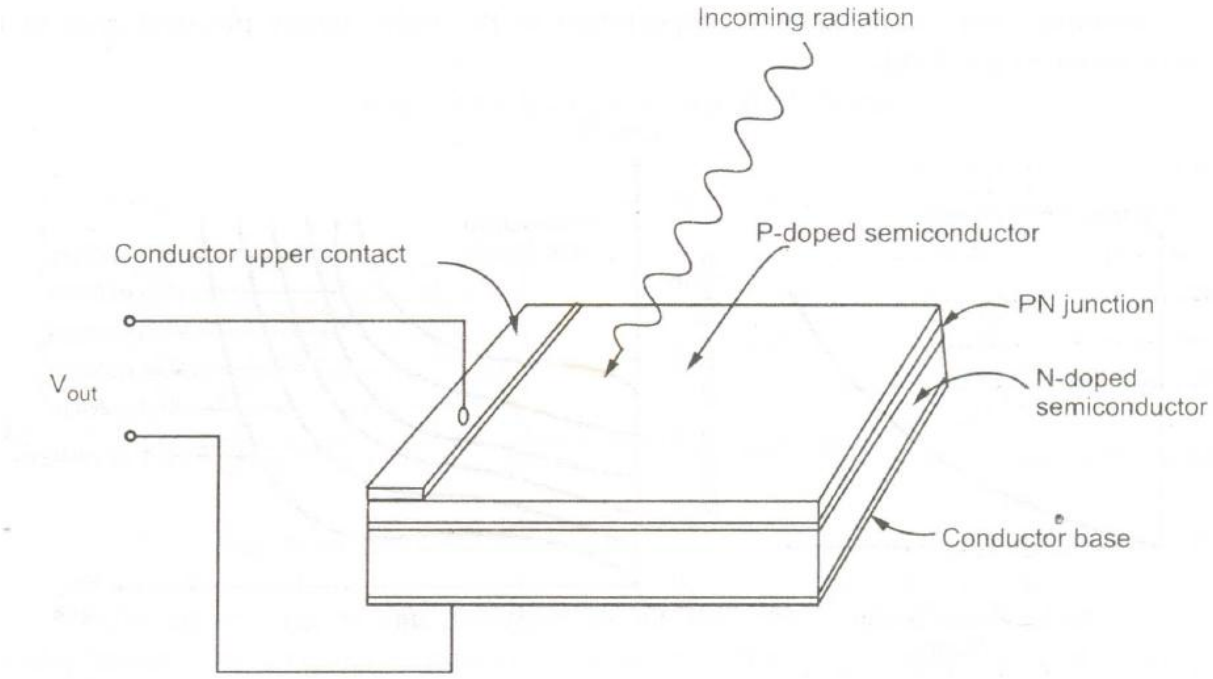


Piezoelectric transducer

A piezoelectric quartz crystal is hexagonal prism shaped crystal, which has pyramids Jt both ends. This is shown in the Fig. (a). The marking of co-ordinate axes are fixed for such crystals. The axis passing through the end points of pyramids is called optic axis or z axis. The axis passing through corners is called electrical axis or x axis while the aXIs passing through midpoints of opposite sides is called mechanical axis or y axis. The axes are shown in the

Photovoltaic cell:

Fig shows structure of photovoltaic cell. It shows that cell is actually a PN-junction diode with appropriately doped semiconductors. When photons strike on the thin p-doped upper layer, they are absorbed by the electrons in the n-layer; which causes formation of conduction electrons and holes. These conduction electrons and holes are separated by depletion region potential of the pn junction. When il load is connected across the cell, the depletion region potential causes the photocurrent to flow through the load N



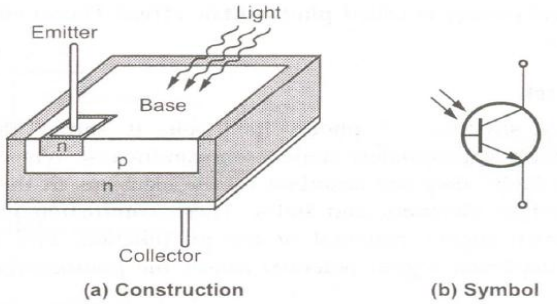
Phototransistor:

The photo transistor has a light sensitive collector to base junction. A lens is used in a transistor package to expose base to an incident light. When no light is incident, a small leakage current flows from collector to emitter called IeEO, due to small thermal generation. This is very small current, of the order of nA. This is called a **dark current.**

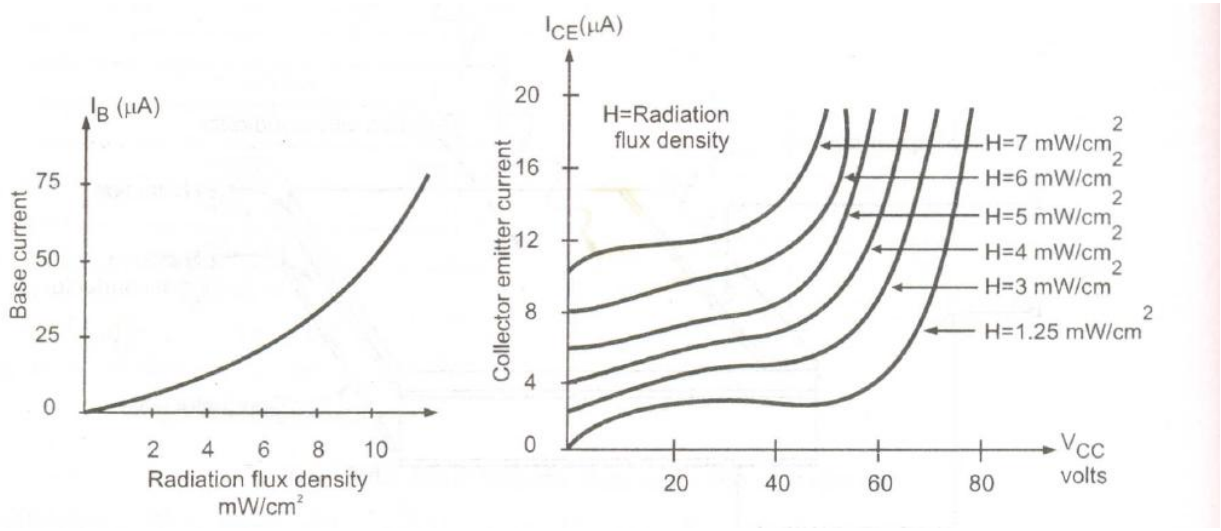
When the base is exposed to the light, the base current is produced which is proportional to the light intensity. Such photoinduced base current is denoted as I)...The resulting collector current is given by,

$$I_C \approx h_{fe} I_\lambda$$

The structure of a phototransistor is shown in the Fig. 9.15 (a) while the symbol is shown in the Fig.



To generate more base current proportional to the light, larger physical area of the base is exposed to the light.

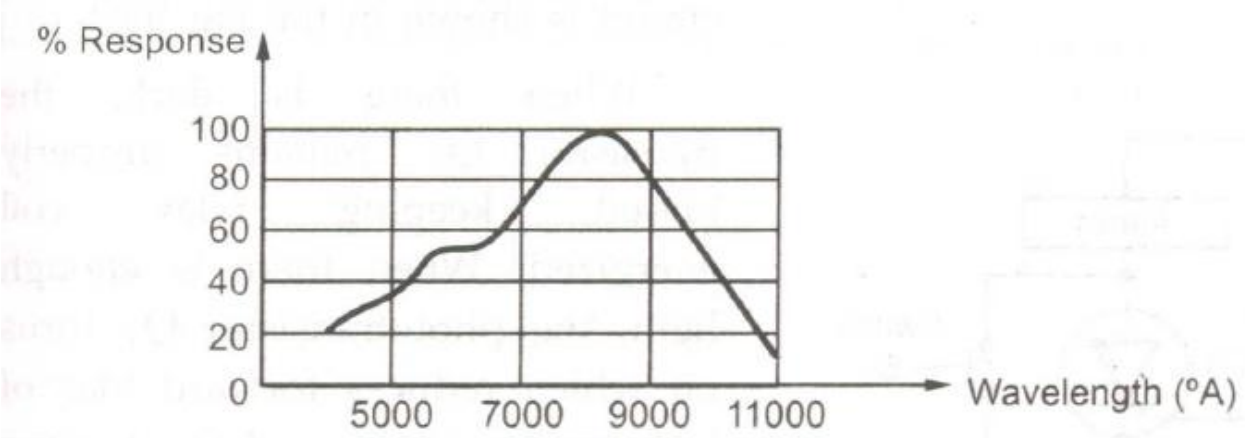


The fig .shows the graph of base current against· the radiation flux density measured in mW/ cm2. The Fig. (b) shows the collector characteristics of a phototransistor. As light intensity increases, the base current increases exponentially.

Similarly the collector current also increases corresponding to the increase in the light intensity.

A phototransistor can be either a two lead or a three lead device. In a three lead device, the base lead is brought out so that it can be used as a conventional BJT with or without the light sensitivity feature.

In a two lead device, the base is not electrically available and the device use is totally light dependent. The use of phototransistor as a two lead device is shown in the Fig. (a) while the Fig. (b) shows the typical collector characteristic curves.



Spectral response

Each curve on the characteristic graph is related to specific light intensity. The collector current level increases corresponding to increase in the light intensity. In most of the applications the phototransistor is used as a two lead device.

The phototransistor is not sensitive to all the light but sensitive to light within a certain range. The graph of response against wavelength is called **spectral** response. A typical spectral response is shown in the Fig

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