



ROHINI

COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE and affiliated to Anna University, (An ISO Certified Institution)

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DEPARTMENT OF BIOMEDICAL ENGINEERING

III Semester

BM3301 SENSORS AND MEASUREMENTS

UNIT – 3

3.1 Phototube

A phototube, also known as a photoelectric tube, is a light-sensitive electronic device. It is designed to emit an electric current when exposed to light or another form of electromagnetic radiation.

A phototube consists of a photoemissive cathode and an anode in an evacuated tube along with a quartz window as shown in Figure 3.1.1. These two electrodes are subjected to high voltage (about 100 V) difference. While a photon enters the tube and strikes the cathode, an electron is ejected and is attracted to the anode resulting in a flow of current that could be amplified and measured. The response of the photoemissive material is wavelength dependent and dissimilar phototubes are available for various regions of the spectrum.

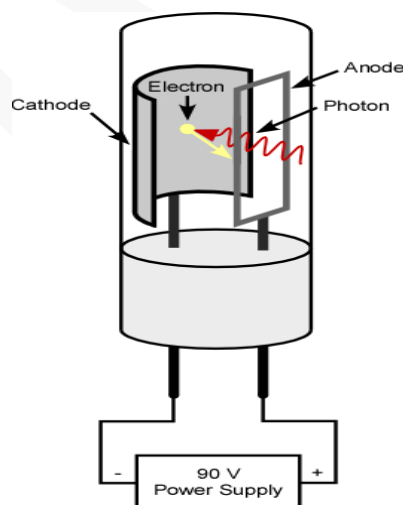


Figure. 3.1.1 Phototube

- The most important photocathode now used in photocells is the cesium antimony surface, which is characterized by high sensitivity in the visible spectrum.
- The type of glass employed in the glass envelope determines mainly the sensitivity of the device at other wave lengths.
- Usually the glass cuts off the transmitted radiations in the ultraviolet region.
- The photocathode emits electrons when stimulated by incident radiant energy and electrons thus emitted are collected by the plate or anode.
- The voltage-current characteristics are shown in Fig. 3.1.2

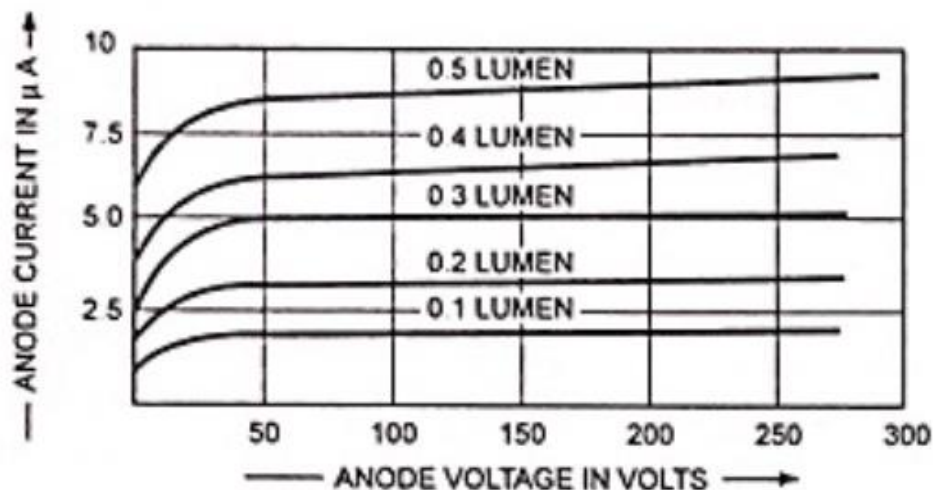


Figure 3.1.2 V-I Characteristics of Phototube

- The current through the Photoemissive cells depends upon (i) intensity of light (ii) colour or wavelength of light and (iii) the voltage applied between cathode and plate.
- From the voltage-ampere characteristics shown in Fig. 3.1.2, it is obvious that when sufficient voltage is applied between the photocathode and the anode, the plate current entirely depends upon the amount of incident light.
- The main advantage of such tubes is that these are stable and do not change their characteristics over long periods of time provided these are operated at low voltage and are protected against excessive current. The main drawback of such Photoemissive cells is low sensitivity.

- These tubes are used to best advantage in applications requiring the observation of light pulses of short duration, or light modulated at relatively high frequencies.

Applications of Phototubes:

- i. Phototubes are used in **spectrometers** to detect and measure the intensity of emitted or transmitted light.
- ii. Phototubes are employed in conjunction with scintillators in **medical imaging** devices like gamma cameras.
- iii. In **environmental research**, phototubes are used in lidar (light detection and ranging) systems to measure distances and map atmospheric conditions using laser-induced pulses of light.
- iv. In the study of **fluorescence**, where substances emit light after absorbing photons, phototubes are used to measure the emitted light and analyze the sample.
