

Unit-4

Lecture -4

Characteristics, Reponse Time

Characteristics of Photodetectors

- **Internal Quantum Efficiency**

$$\eta_i = \frac{\text{Number of Collected electrons}}{\text{Number of Photons *Entering* detector}} = \left[1 - e^{-\alpha W} \right]$$

- **External Quantum efficiency**

$$\eta_e = \frac{\text{Number of Collected electrons}}{\text{Number of Photons *Incident* on detector}} = \frac{i_{ph} / q}{P_o / h\nu} = (1 - R_p) [1 - e^{-\alpha W}]$$

- **Responsivity**

$$R = \frac{\text{Photo Current (Amps)}}{\text{Incident Optical Power (Watts)}} = \frac{i_{ph}}{P_o} = \frac{q}{h\nu} (1 - R_p) [1 - e^{-\alpha W}]$$

- **Photocurrent**

Diagram illustrating the relationship between incident photon flux, fraction transmitted into the detector, and the resulting photocurrent i_{ph} .

The equation shown is:

$$i_{ph} = q \left[\frac{P}{h\nu} \right] (1 - R_p) \left[1 - e^{-\alpha W} \right] = R P_o$$

Annotations:

- Fraction Transmitted into Detector:** Indicated by a downward arrow pointing to the term $(1 - R_p)$.
- Fraction absorbed in:** Indicated by an upward arrow pointing to the term $\left[1 - e^{-\alpha W} \right]$.
- Incident Photon Flux:** Indicated by an upward arrow pointing to the term $\left[\frac{P}{h\nu} \right]$.

Responsivity

Output current per unit incident light power;
typically 0.5 A/W

$$R = \frac{\eta e}{h\nu} M$$

Photodiode Responsivity

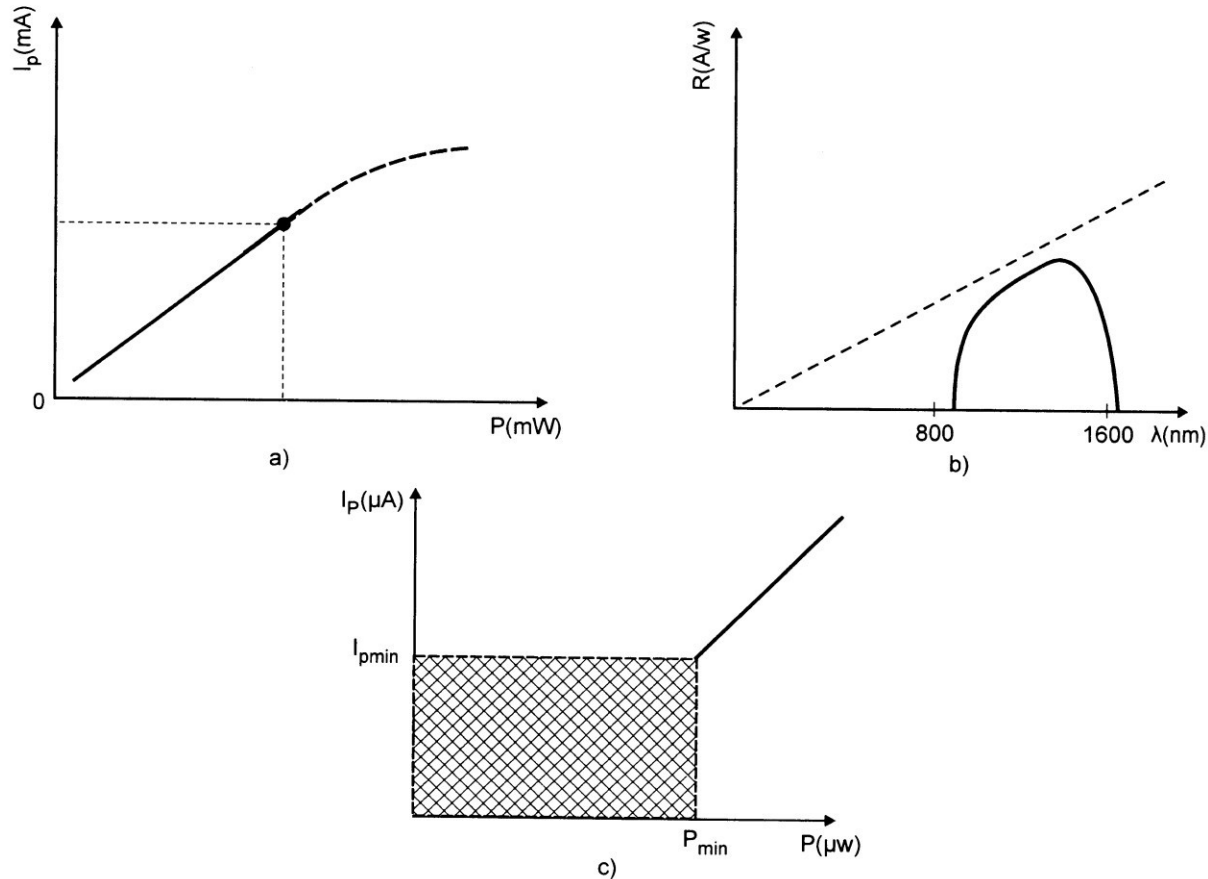


Figure 11.2 Responsivity of a photodiode: (a) Input-output characteristic; (b) responsivity vs. wavelength; (c) dark-current sensitivity.