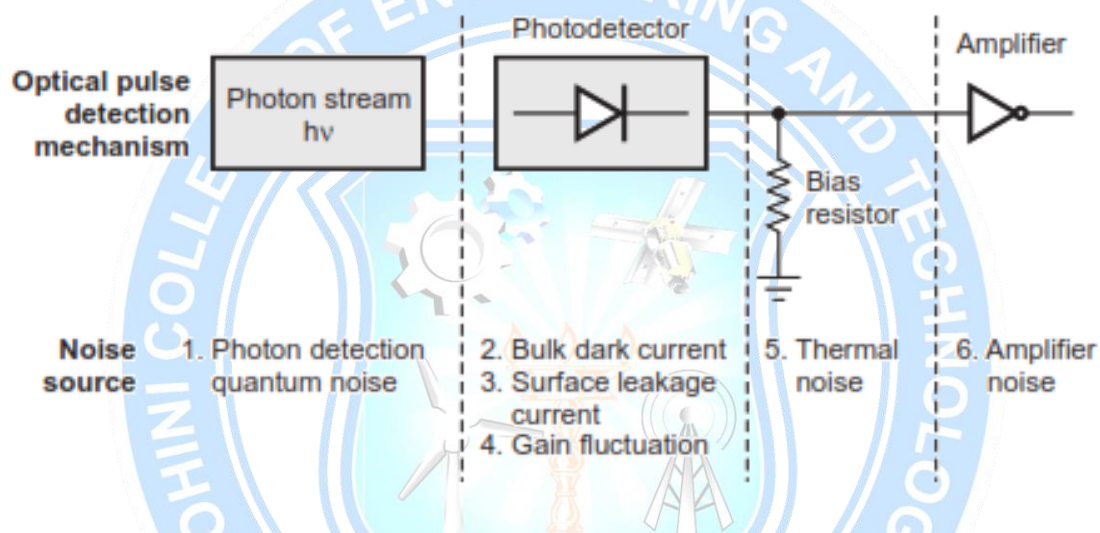


4.3 Error Sources

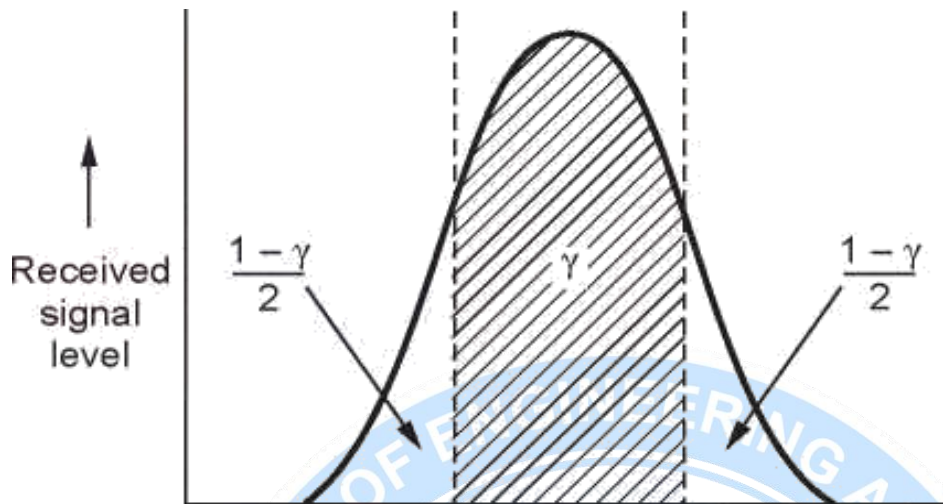
- In a receiver system errors arise because of noises and disturbances in the signal detection system. Noise is an unwanted electric signal in signal processing. The noise sources can be internal or external to the system. Only the internal sources of noise are considered here.
- In an optical pulse detection mechanism various noise sources exist as shown in Figure



- The noise is generated by spontaneous fluctuations of current and voltage (e.g. shot noise, thermal noise). When photons incident on the photodetector are random in nature, quantum noise (shot noise) is generated. This noise is significant for both PIN and APD receivers.
- Other sources of photodetector noise are from dark current and leakage current. These noise can be reduced considerably by choosing proper components. Thermal noise is generated from detector load resistances

Intersymbol Interference (ISI)

- Intersymbol interference (ISI) also contributes to error which is caused from pulse spreading.
- Because of pulse spreading energy of a pulse spreads into neighbouring time slots, results in an interfering signal. Figure shows ISI.



Noise Mechanisms

- The output of equalizer can be written as,

$$v_{out}(t) = \langle v_{out}(t) \rangle + v_N(t)$$

where,

$v_N(t)$ is noise voltage.

$\langle v_{out}(t) \rangle$ is mean output voltage.

- The noise voltage can be expressed as -

$$v_N^2(t) = v_{shot}^2(t) + v_R^2(t) + v_I^2(t) + v_E^2(t)$$

where,

$v_{shot}(t)$ is quantum or shot noise.

$v_R(t)$ is thermal or Johnson noise.

$v_I(t)$ is resulted by amplifier input noise current source $i_a(t)$.

$v_E(t)$ is resulted by amplifier input voltage noise source $e_a(t)$.

- The mean square noise voltage is expressed as

$$\langle v_N^2 \rangle = \langle v_{shot}^2(t) \rangle + \langle v_R^2(t) \rangle + \langle v_I^2(t) \rangle + \langle v_E^2(t) \rangle$$