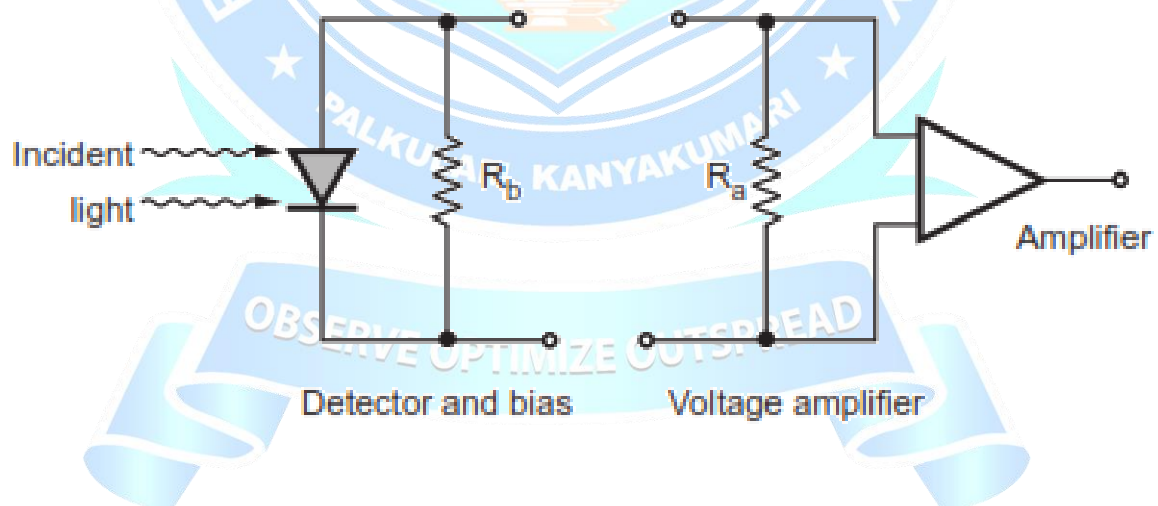


4.2 Preamplifier

- The preamplifiers are front end amplifiers.
- The bandwidth, BER, noise and sensitivity of optical receiver are determined by preamplifier stage.
- Preamplifier circuit must be designed with the aim of optimizing these characteristics.
- Commonly used preamplifier in optical communication receiver are -
 1. Low - impedance preamplifier (LZ)
 2. High - impedance preamplifier (HZ)
 3. Transimpedance preamplifier (TZ).

Low - impedance preamplifier (LZ)

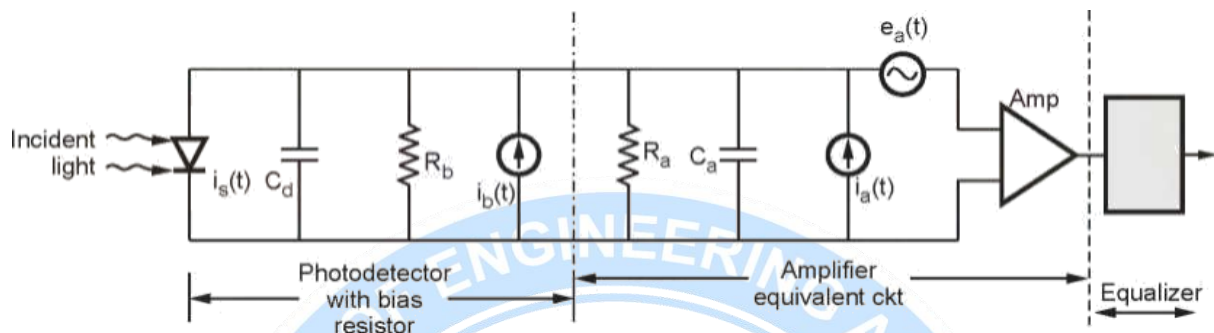
- In low-impedance preamplifier, the photodiode is configured as low - impedance amplifier. The bias resistor R_b is used to match the amplifier impedance. R_b along with the input capacitance of amplifier decides the bandwidth of amplifier.
- Figure shows low impedance preamplifier configuration.
- Low - impedance preamplifier can operate over a wide bandwidth but they have poor receiver sensitivity. Therefore the low - impedance amplifier are used where sensitivity is of not prime concern.



High Impedance Preamplifier (HZ)

- In high - impedance preamplifier the objective is to minimize the noise from all sources. This can be achieved by -
 1. Reducing input capacitance by selecting proper devices.
 2. Selecting detectors with low dark currents.
 3. Minimizing thermal noise of biasing resistors.
 4. Using high impedance amplifier with large R_b .

- The high impedance amplifier uses FET or a BJT. As the high impedance circuit has large RC time constant, the bandwidth is reduced. Figure shows equivalent circuit of high input impedance pre-amplifier.



- High-input impedance preamplifier are most sensitive and finds applications in long - wavelength, long haul routes. The high sensitivity is due to the use of a high input resistance (typically $> 1 \text{ M}\Omega$), which results in exceptionally low thermal noise.
- The combination of high resistance and receiver input capacitance, results in very low BW, typically $< 30 \text{ kHz}$, and this causes integration of the received signal. A differentiating, equalizing or compensating network at the receiver output corrects for this integration.

Transimpedance Preamplifier (TZ)

- The drawbacks of high input impedance are eliminated in transimpedance preamplifier. A negative feedback is introduced by a feedback resistor R_f to increase the bandwidth of open loop preamplifier with an equivalent thermal noise current $i_f(t)$ shunting the input.

