18PYB101J MODULE-5 LECTURE 15

- FIBRE OPTIC COMMUNICATION SYSTEM
- FIBRE OPTIC SENSORS

Fiber optic communication system

Introduction

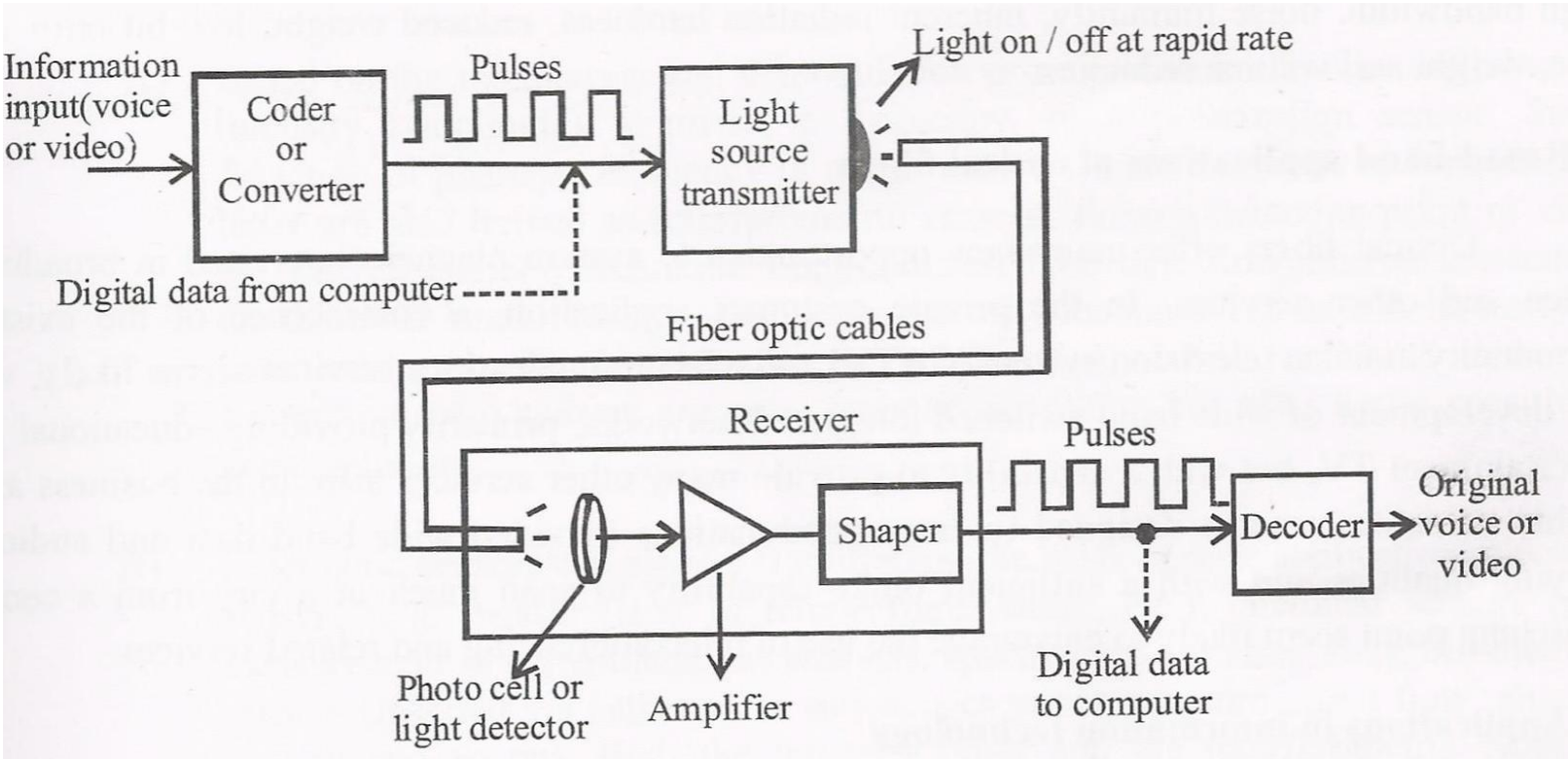
- In the early stages of development, fiber communication promised extremely high data rates, which would allow large masses of data to be transmitted quickly.
- It also had the potential for transmission over long distances without the need to amplify and retransmit along the way.
- Recent developments have exceeded the hope of those involved in the technology.

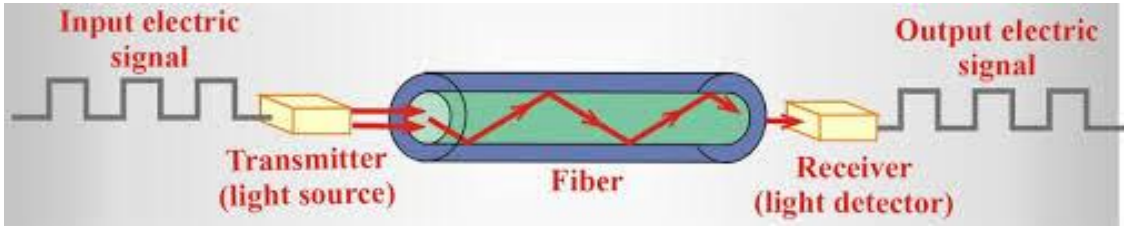
Basic model

- The bandwidth of the fiber optic communication system, which determines the maximum data rate, depends on the major components of the system.
- Fig. shows the block diagram of fiber optic communication system.
- The information signal to be transmitted may be voice, video or computer data.
- The first step is to convert the information into a form compatible with the communications medium.
- This is usually done by converting continuous analog signals such as voice and video (TV) signals into a series of digital pulses.
- An Analog – to – Digital (A/D) converter is used for this purpose. Computer data is already in the digital form.

- These digital pulses are then used to flash a powerful light source (i.e.) off and on very rapidly.
- In a simple low – cost system that transmits over short distances, the light source is usually a light emitting diode (LED).
- This is a semiconductor device that puts out a low – intensity red light beam. Other colours are also used.
- Infrared beams like those used in TV remote controls are also used in transmission.
- Another commonly used light source is the solid state laser.
- This is also a semiconductor device that generates an extremely intense single frequency light beam.

Fiber optic communication system





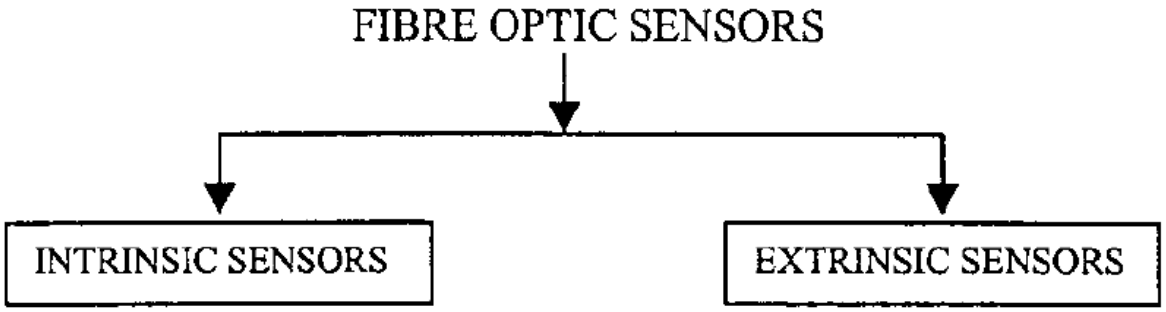
- The light beam pulses are then fed into a fiber – optic cable where they are transmitted over long distances.
- At the receiving end, a light sensitive device known as a photocell or light detector is used to detect the light pulses.
- This photocell or photo detector converts the light pulses into an electrical signal.
- The electrical pulses are amplified and reshaped back into digital form.
- They are fed to a decoder, such as a Digital – to – Analog converter (D/A), where the original voice or video is recovered.

- Both the light sources at the sending end and the light detectors on the receiving end must be capable of operating at the same data rate.
- The circuitry that drives the light source and the circuitry that amplifies and processes the detected light must both have suitable high-frequency response.
- The fiber itself must not distort the high-speed light pulses used in the data transmission.

- In very long transmission systems, repeater units must be used along the way.
- Since the light is greatly attenuated when it travels over long distances, at some point it may be too weak to be received reliably.
- To overcome this problem, special relay stations are used to pick up light beam, convert it back into electrical pulses that are amplified and then retransmit the pulses on another beam.
- Several stages of repeaters may be needed over very long distances.
- But despite the attenuation problem, the loss is less than the loss that occurs with the electric cables.

FIBRE OPTIC SENSORS

- **Sensor** is a transducer which is used to convert one physical variable into another
- Fibre optic sensors are fibre based devices for sensing some quantity, typically temperature mechanical strain, but sometimes also displacements, vibrations, pressure, acceleration or concentrations of chemical species.

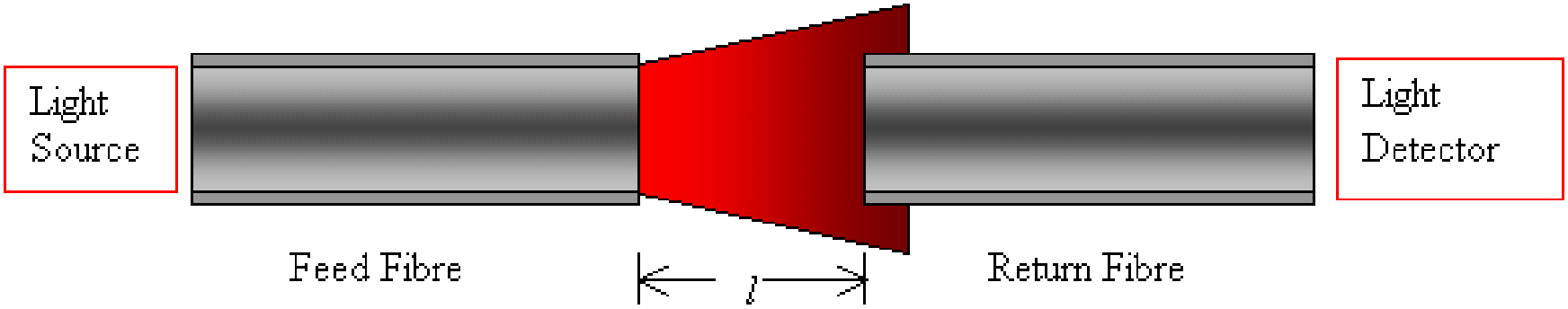


Introduction

- Fiber Optic Sensor Classifications
  - Sensing region: Intrinsic vs. Extrinsic
    - Intrinsic fiber optic sensor has a sensing region within the fiber and light never goes out of the fiber.
    - In extrinsic sensors, light has to leave the fiber and reach the sensing region outside and then comes back to the fiber.
  - Optical modulation mechanism
    - Intensity modulated
    - Phase modulated
    - Wavelength modulated
    - Polarization modulated

CLASSIFICATION

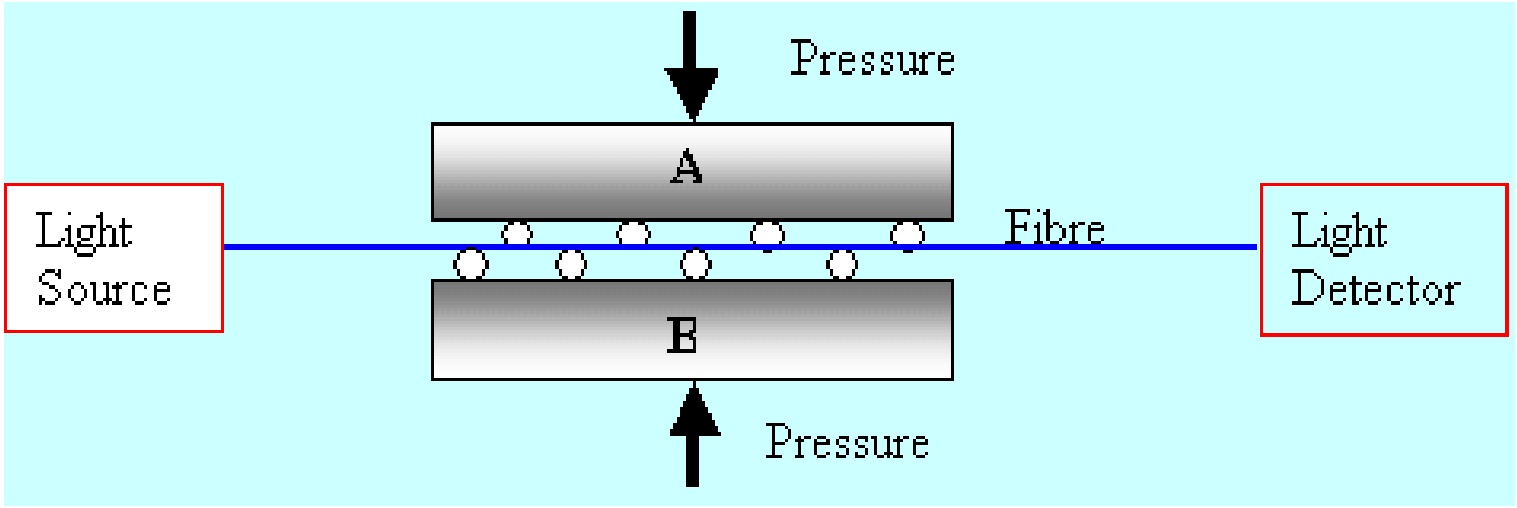
- EXTRINSIC SENSORS



WHERE THE LIGHT LEAVES THE FEED OR TRANSMITTING FIBER TO BE CHANGED BEFORE IT CONTINUES TO THE DETECTOR BY MEANS OF THE RETURN OR RECEIVING FIBER

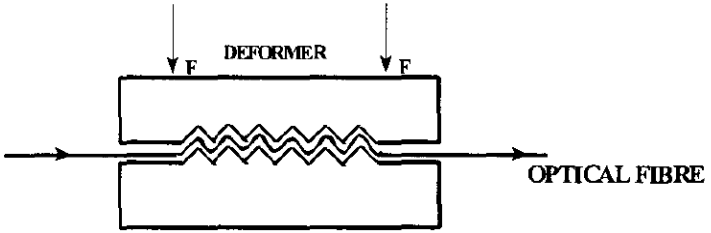
CLASSIFICATION

- INTRINSIC SENSORS

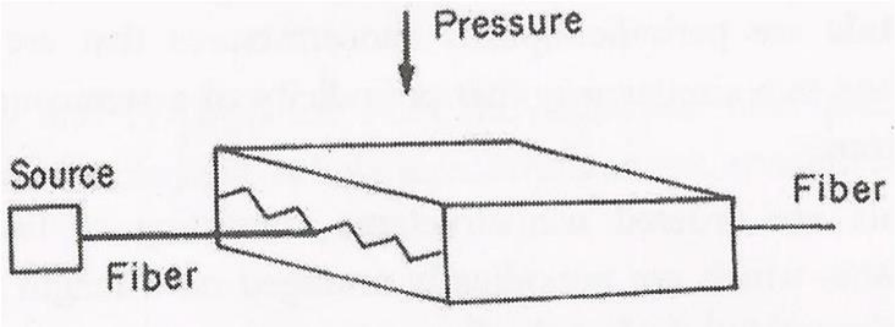


INTRINSIC SENSORS ARE DIFFERENT IN THAT THE LIGHT BEAM DOES NOT LEAVE THE OPTICAL FIBER BUT IS CHANGED WHILST STILL CONTAINED WITHIN IT.

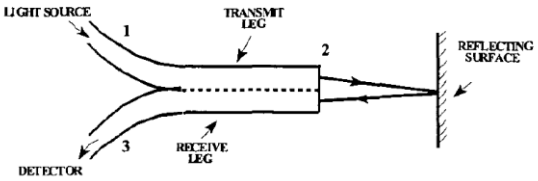
DISPLACEMENT SENSOR (Intrinsic)



- Optical fiber placed between a pair of ridged plates which impart a periodic perturbation to the fiber.
- The quantity to be measured acts directly on the fiber to modify the radiation passing through it.
- The plates induce micro bend losses due to displacement
- The intensity of the light output varies
- By measuring the change in intensity, displacement is measured.



POSITION SENSOR (Extrinsic)



- It consists of two fibers, one to transmit light from source to object and other to collect light from the object.
- The quantity to be measured acts indirectly on the fiber to modify the radiation.
- Change in the position of the object will result in changes in the amount of light collected by the detector.
- By recording the change in intensity, the position is estimated.