2.2 TYPES OF FIBER OPTICS SENSOR

- Intrinsic sensor
- Extrinsic sensor

Optical fibers can be used as sensors to measure

- Strain,
- Temperature
- Pressure

Intrinsic sensor -Temperature/Pressure sensor Principle:

It is based on the principle of Interference between the beams emerging out from the reference fiber and the fiber kept in the measuring environment.

Working:

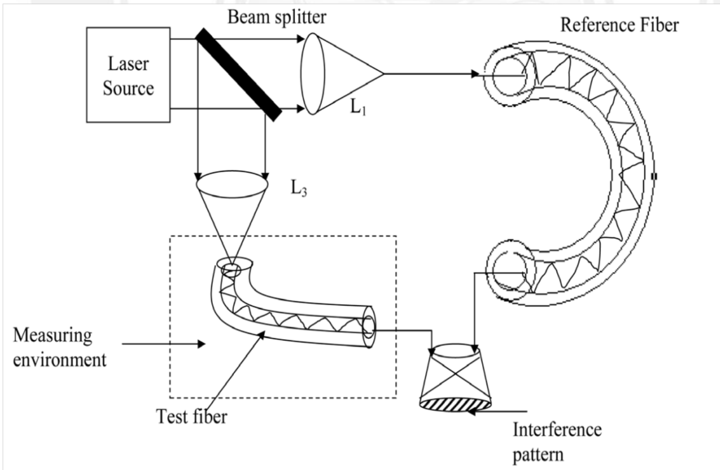

Figure 2.2.1 Fibre Optics Sensor

[Source: "Optical Fibre Communications" by J.M.Senior, Page:231]

- A monochromatic source of light is emitted from the laser source.
- It consists of a Laser source to emit light. A beam splitter, made of glass plate is inclined at an angle of 45° used to split the single beam into two beams.
- The main beam passes through the lens L1 and is focused onto the reference fiber which is isolated from the environment to be sensed.
- The beam after passing through the reference fiber then falls on the lens L2.

- The spitted beam passes through the lens L3 and is focused onto the test fiber kept inthe environment to be sensed.
- The splitted beam after passing through the test fiber is made to fall on the lens L2.
- The two beams after passing through the fibers, produces a path difference due to thechange in parameters such as pressure, temperature etc., in the environment.
- Therefore a path difference is produced between the two beams, causing the interference pattern.
- Thus the change in pressure (or) temperature can be accurately measured with the help of the interference pattern obtained.

And other quantities by modifying a fiber so that the quantity to be measured modulates the intensity, phase, polarization, wavelength or transit time of light in the fiber. Sensors that vary the intensity of light are the simplest, since only a simple source and detector are required. A particularly useful feature of intrinsic fiber optic sensors is that they can, if required, provide distributed sensing over very large distances.

Temperature can be measured by using a fiber that has evanescent loss that varies with temperature, or by analyzing the Raman scattering of the optical fiber. Electrical voltage can be sensed by nonlinear optical effects in specially-doped fiber, which alter the polarization of light as a function of voltage or electric field. Angle measurement sensors can be based on the Sagnac effect.

Special fibers like long-period fiber grating (LPG) optical fibers can be used for direction recognition. Photonics Research Group of Aston University in UK has some publications on vectorial bend sensor applications.

Optical fibers are used as hydrophones for seismic and sonar applications. Hydrophone systems with more than one hundred sensors per fiber cable have been developed. Hydrophone sensor systems are used by the oil industry as well as a few countries' navies.

Both bottom-mounted hydrophone arrays and towed streamer systems are in use. The German company Sennheiser developed a laser microphone for use with optical fibers.

A fiber optic microphone and fiber-optic based headphone are useful in areas with strong electrical or magnetic fields, such as communication amongst the team of people working ona patient inside a magnetic resonance imaging (MRI) machine during MRI-guided surgery.

Optical fiber sensors for temperature and pressure have been developed for down hole measurement in oil wells. The fiber optic sensor is well suited for this environment as it functions at temperatures too high for semiconductor sensors (distributed temperature sensing).

Optical fibers can be made into Interferometric sensors such as fiber optic gyroscopes, which are used in the Boeing 767 and in some car models (for navigation purposes). Theyare also used to make hydrogen sensors.

Fiber-optic sensors have been developed to measure co-located temperature and strain simultaneously with very high accuracy using fiber Bragg gratings. This is particularly useful when acquiring information from small complex structures. Brillouin scattering effects can be used to detect strain and temperature over larger distances (20–30 kilometers).