DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC602 – Microwave and Optical Engineering

III YEAR / VI SEMESTER

Unit IV – OPTICAL COMMUNICATION

Topic Optical fiber and devices

INTRODUCTION

•An **optical fiber**, is a flexible glass or plastic fiber that can transmit light[a] from one end to the other.

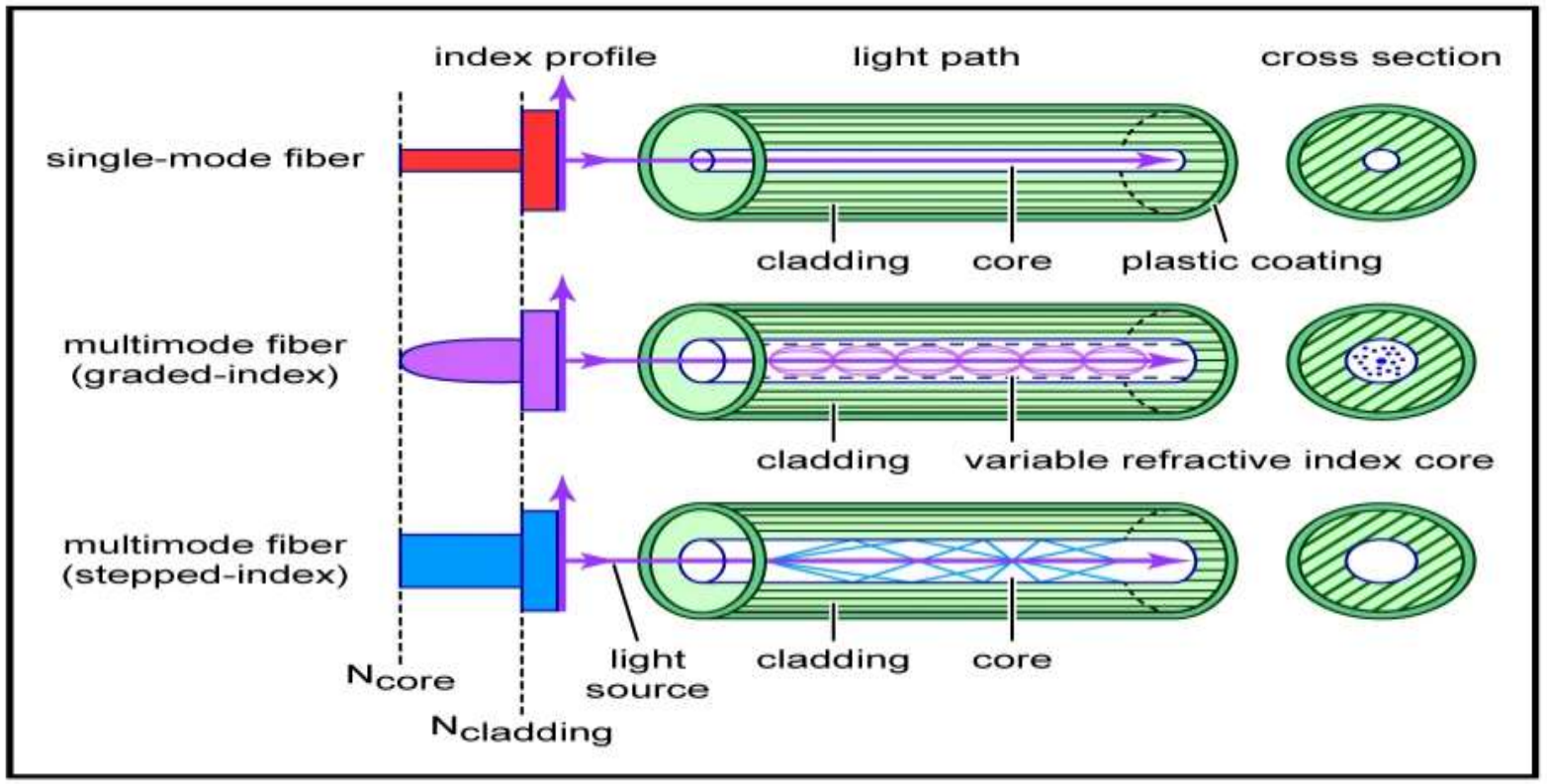
•Such fibers find wide usage in fiber-optic communications, where they permit transmission over longer distances and at higher bandwidths (data transfer rates) than electrical cables.

•Fibers are used instead of metal wires because signals travel along them with less loss and are immune to electromagnetic interference.[

PRINCIPLE OF OPERATION

- An optical fiber is a cylindrical dielectric waveguide (nonconducting waveguide) that transmits light along its axis through the process of total internal reflection.
- The fiber consists of a *core* surrounded by a cladding layer, both of which are made of dielectric materials.[61]
- To confine the optical signal in the core, the refractive index of the core must be greater than that of the cladding. The boundary between the core and cladding may either be abrupt, in *step-index fiber*, or gradual, in *graded-index fiber*.
- Light can be fed into optical fibers using lasers or LEDs.

BLOCK DIAGRAM



REFRACTIVE INDEX :

The refractive index is a way of measuring the speed of light in a material. Light travels fastest in a vacuum, such as in outer space. The speed of light in vacuum is about 300,000 kilometers (186,000 miles) per second. The refractive index of a medium is calculated by dividing the speed of light in vacuum by the speed of light in that medium.

TOTAL INTERNAL REFLECTION :

When light traveling in an optically dense medium hits a boundary at a steep angle of incidence (larger than the critical angle for the boundary), the light is completely reflected. This is called total internal reflection. This effect is used in optical fibers to confine light in the core.

MULTI MODE FIBER :

Optical fibers with a large core diameter (greater than 10 micrometers) may be analyzed by geometrical optics. Such fibers are called multi-mode fibers, from the electromagnetic analysis (see below). In a step-index multi-mode fiber, rays of light are guided along the fiber core by total internal reflection.

- **Step index fiber**
- **Graded index fiber**

WORKING

STEP INDEX FIBER :

In a step-index multi-mode fiber, rays of light are guided along the fiber core by total internal reflection. Rays that meet the core-cladding boundary at an angle (measured relative to a line normal to the boundary) greater than the critical angle for this boundary, are completely reflected. The critical angle is determined by the difference in the index of refraction between the core and cladding materials.

GRADED INDEX FIBER :

In graded-index fiber, the index of refraction in the core decreases continuously between the axis and the cladding. This causes light rays to bend smoothly as they approach the cladding, rather than reflecting abruptly from the core-cladding boundary.

SINGLE MODE FIBER :

Fibers with a core diameter less than about ten times the wavelength of the propagating light cannot be modeled using geometric optics. Instead, they must be analyzed as an electromagnetic waveguide structure, according to Maxwell's equations as reduced to the electromagnetic wave equation.

APPLICATIONS

- Optical fibre is a hair-like flexible and transparent fibre which is used for the transmission of data signals over large distances with a higher speed.
- Hence optical fibre is used to provide the service of internet, telephone and television etc.
- Optical fibre works on the principle of total internal reflection.

Any Query????

Thank you……