

## VESP Vision

To be the centre of excellence in the field of technical education.

Program Code:-Common to all 1st semester

Course Name:-Basic Science(Physics)

Course Code : - 22102

Course coordinator: Mrs. Deepa Gupte

Date: 12/07/2020



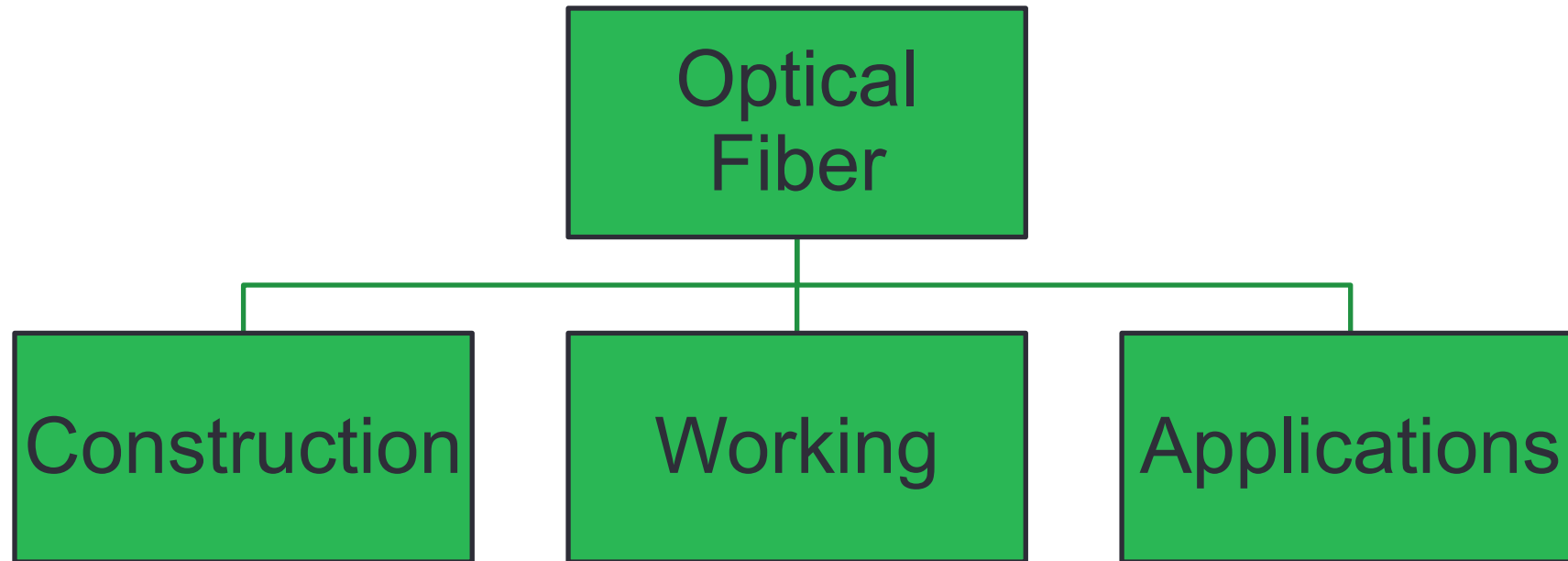
Unit No:3

Unit Name: Heat and Optics

Unit Outcomes (UO3f):Describe light propagation in given types of optical fiber.

Learning Outcome (LO6) : Students will be able to explain construction, working and applications of optical fiber





- ▶ Students will be able to explain structure of optical fiber
- ▶ Students will be able to explain propagation of light through optical fiber
- ▶ Students will be able to state types and applications of optical fiber

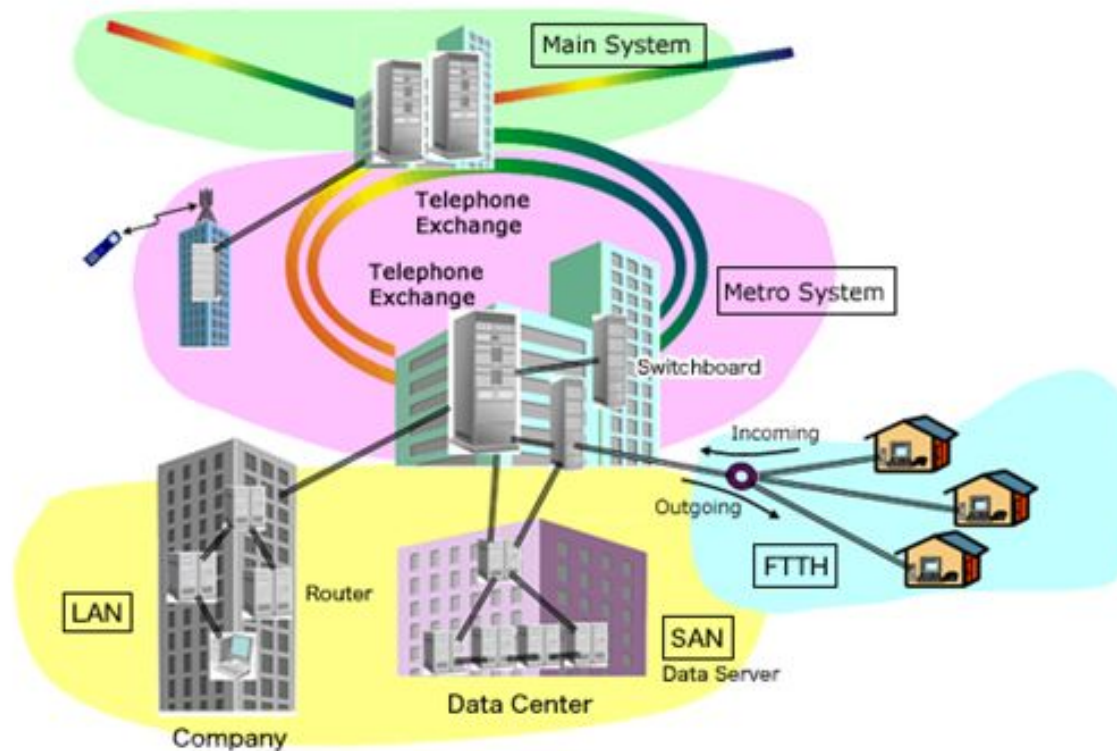


- Now-a-days we find many numbers of separate cables i.e. telephone cables, TV cables etc, thus instead of having number of separate cables, all signals can be carried through a single optical fiber.
- An optical fiber is a cylindrical tube (pipe) which is normally made up of either glass or plastic threads or fibers to transmit signals.
- The light signal is transmitted with the principle of Total Internal Reflection (TIR) in such a way that this can direct the light from one end to another.

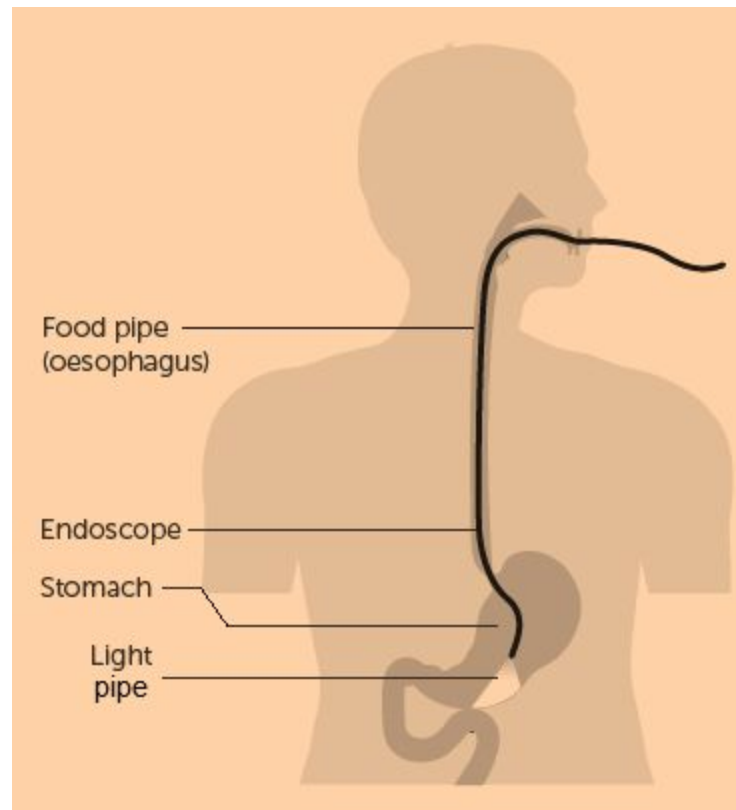


# Applications of Optical fibers

- Optical fibres are widely used in communications for transmitting and receiving electrical signals which are converted to light by suitable transducers.



- They can also be used for medical examination by transmission of optical signals. For example, the 'light pipe' is used to have visual check of internal organs like esophagus, stomach and intestines of human body.



- When a decorative lamp with fine plastic fibres at the free ends in form of fountain like structure is switched on, the light travels from the bottom of each fibre and appears at the tip of its free end as a dot of light. The fibres in such decorative lamps are optical fibres.





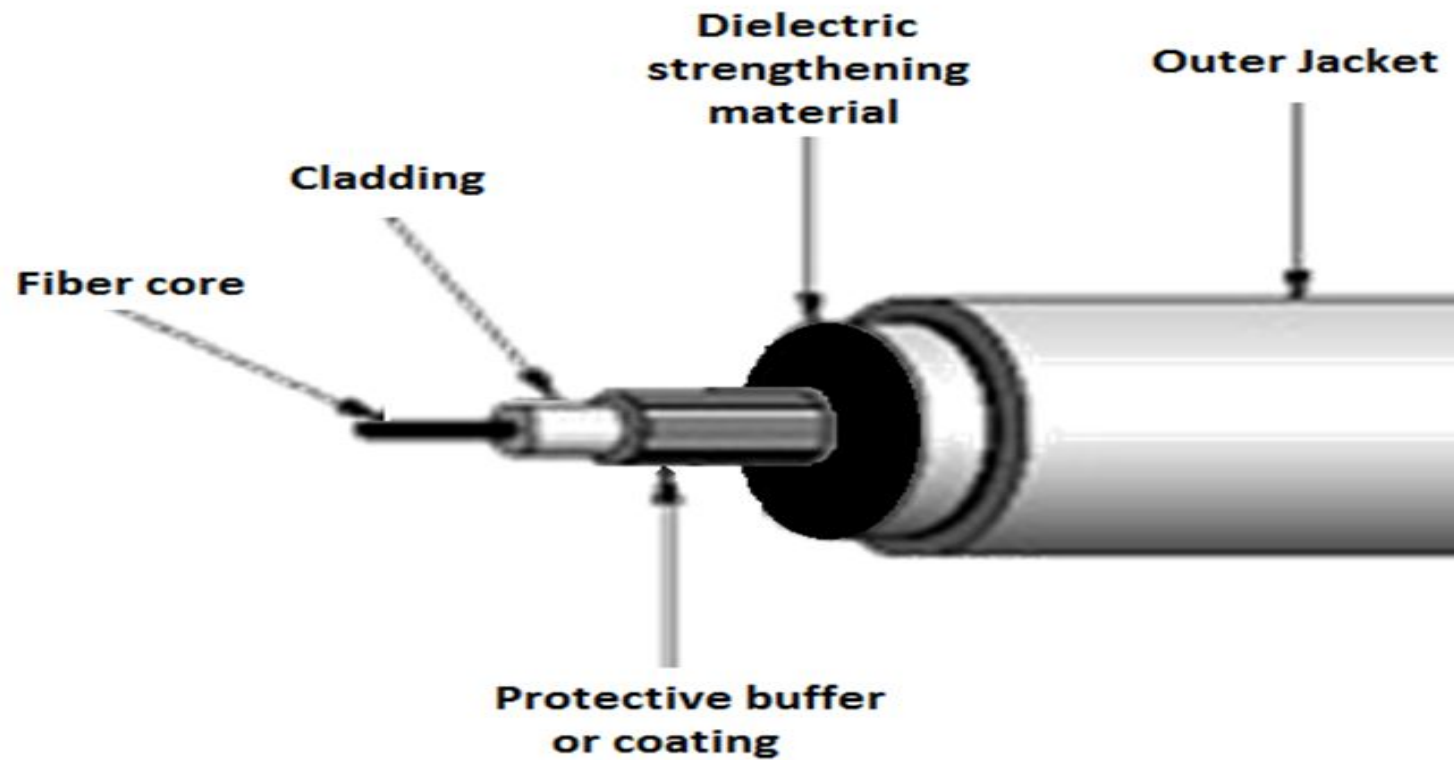
- Optical fiber cable has a core surrounded with cladding coated with plastic buffer (dielectric strength material) and outer jacket (insulator).

The cladding is also made of glass or plastic with refractive index less than that of core and hence acts as reflector, thus cladding keeps the light inside the cable.

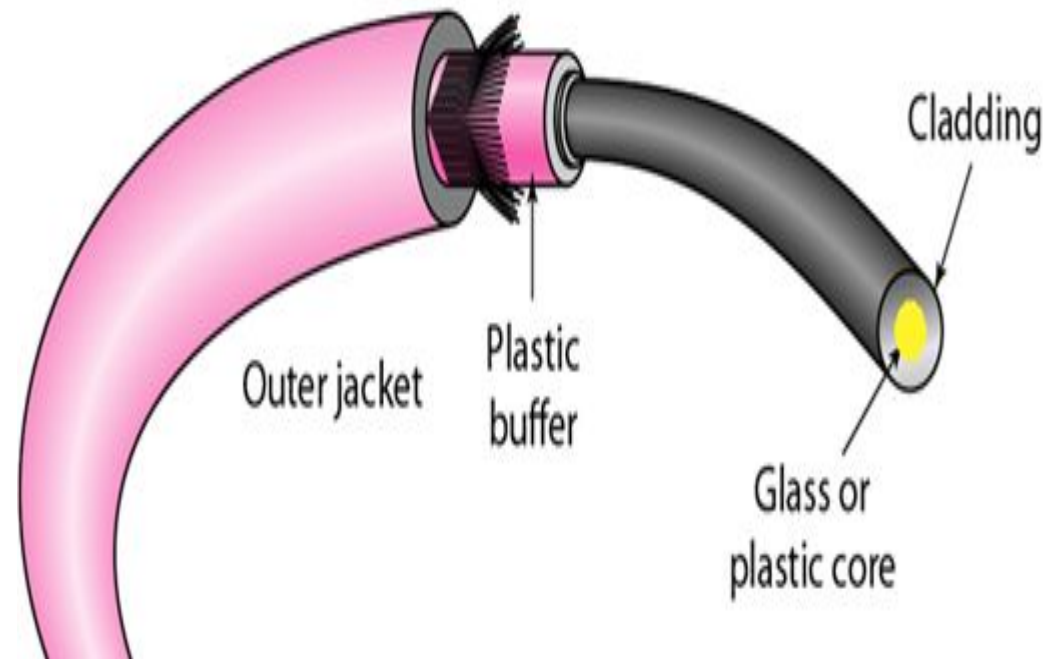
The outer jacket protect the fiber from moisture.

- The core is either made of glass or plastic with refractive index more than that of the cladding.

# Structure of optical Fiber



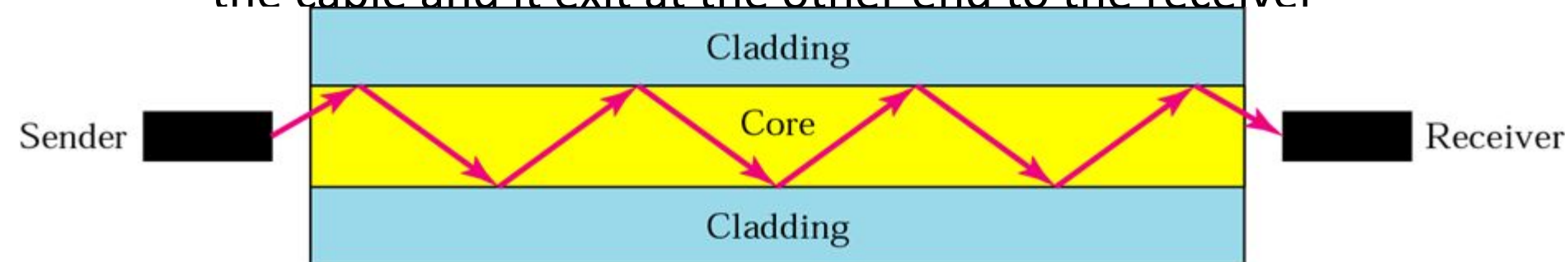
# Structure of optical Fiber



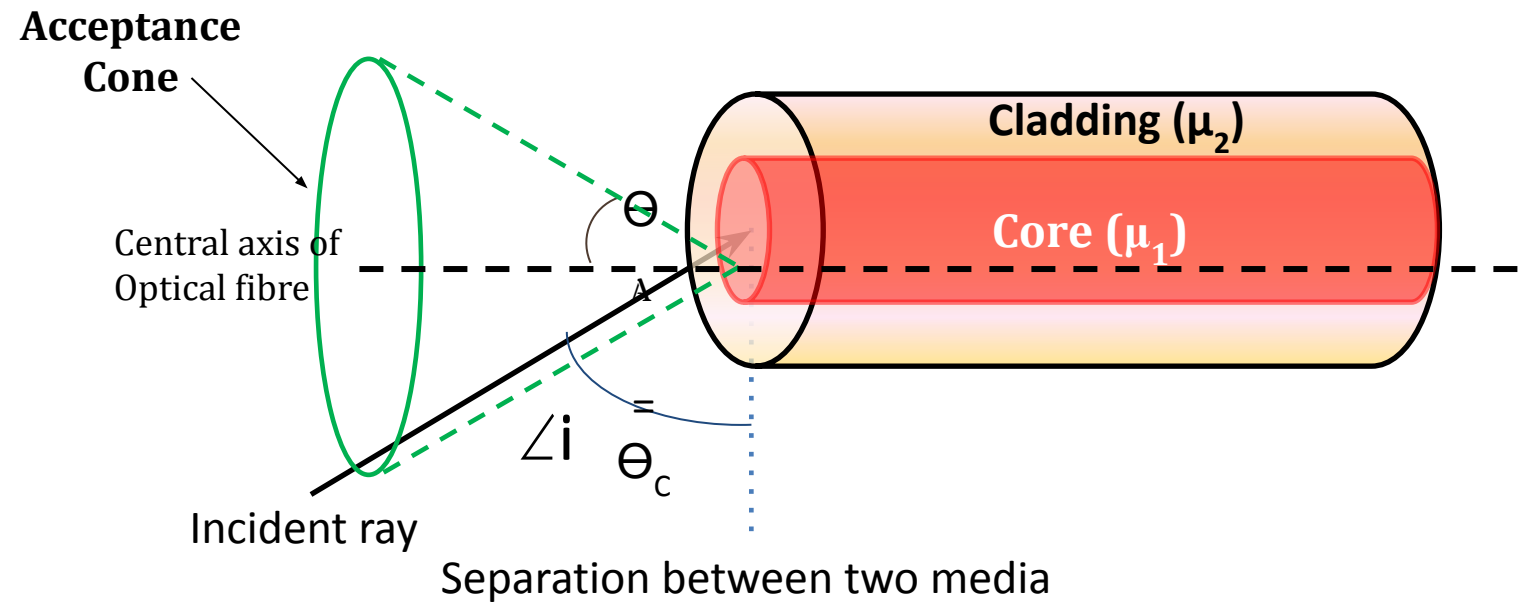


# Propagation in Optical Fiber

- Consider a beam light focused on one end of the optical fiber cable by a sender.
- The angle of incidence of light beam is greater than critical angle, therefore **Total Internal Reflection** takes place and the light beams are reflected through the inner surface of the optical fiber cable.
- When the light beam reflects from the inner the surface of the core, the angle of incidence is equal to angle of reflection.
- Thus the beam reflects back with an multiple angle of  $90^\circ$  and passes through the cable and it exit at the other end to the receiver



# Acceptance Cone & Numerical Aperture



► Critical Angle can be measured from  $\theta_c = \sin^{-1} \left( \frac{\mu_{clad}}{\mu_{core}} \right)$

**Acceptance Angle:** The maximum value of external incident angle for which light will propagate in the optical fiber is called acceptance angle.

Acceptance Angle is measured as  $\theta_A = \sin^{-1}(N_A)$

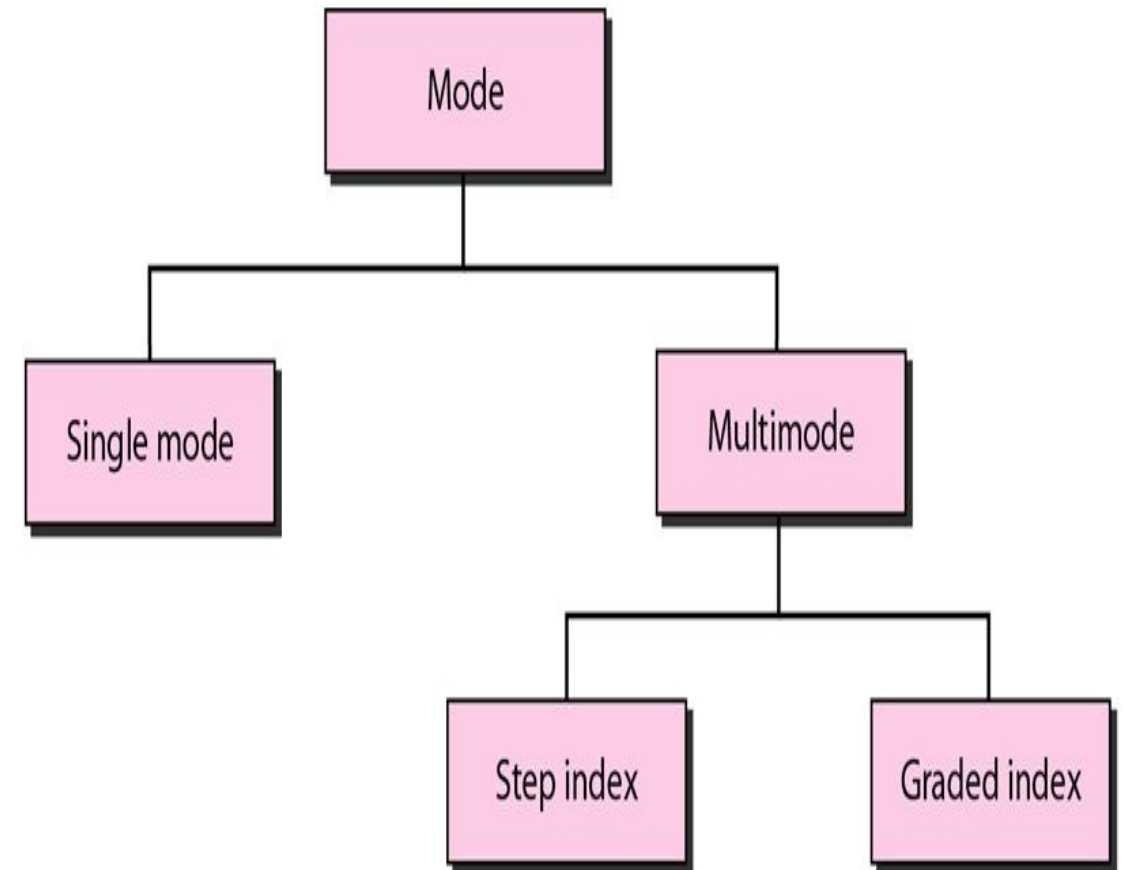
**Acceptance Cone:** It is the cone in which the light incident at acceptance angle or less than the acceptance angle and then the light propagate through the fibre after total internal reflection.

**Numerical Aperture:** It is the sine of acceptance angle. Numerical Aperture measures light gathering power of optical fiber.

Numerical Aperture can be measured by  $N_A = \sqrt{n_{core}^2 \sin^2 \theta_c - n_{clad}^2}$

- Optical Fibers are classified as

1. Single mode step index optical fiber
2. Multimode step index optical fiber
3. Multimode graded index optical fiber





- Fiber optics has several advantages over traditional cable communications lines:
  - Communication is speedy, as optical fiber has light as signal carrier, whereas ordinary cable has electricity as signal carriers.
  - Fiber optic cables have a much greater bandwidth than ordinary cables. This means that they can carry more signals.
  - Fiber optic cables are less susceptible than other cables to interference.
  - Fiber optic cables are much thinner and lighter than other wire cables.
  - Data can be transmitted digitally (the natural form for computer data) rather than analogically.
  - Longer life, easy maintenance and temperature resistance.