VESP Vision

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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 (UO3d):Determine the relation between specific heats for the given materials.
Learning Outcome (LO4) : Students will be able to determine the relation between specific heats for the given materials.

Learning Objective/ Key learning

- Students will be explain ,why gases have two specific heats.
- Students will be able to explain Mayer's relation

Specific Heat Of Gas

- **Specific heat of a gas:-It is the amount heat required to increase the temperature of 1 Kg of a gas by one degree kelvin.**
- **unit:- SI-J/Kg K**
- **MKS-Kcal/Kg0c**
- **CGS-cal/gm0c**

Cp and Cv

- **Practically & theoretically it is noted that if a gas is heated at constant pressure its volume changes and vice-versa, hence there are two specific heats of a gas.**
- **They are specific heat of a gas at constant volume (Cv) and specific heat of a gas at constant pressure (Cp)**
- **Specific heat at constant volume (cv): The quantity of heat required to increase the temperature of unit mass of gas by 1°K or 1°C, at constant volume is called specific heat of gas at constant volume (Cv).**
- **Specific heat at constant pressure (Cp): The quantity of heat required to increase the temperature of unit mass of gas by 1°K or 1°C, at constant pressure is called specific heat of gas at constant pressure (Cp).**

- Specific heat at constant pressure and specific heat at constant volume is also expressed in term of one mole of gas, instead of unit mass of gas. They are called molar specific heat of a gas at constant volume (C_v) and molar specific heat of a gas at constant pressure (C_p)

- Molar specific heat at constant volume (C_v): The quantity of heat required to increase the temperature of one mole of gas by 1°K or 1° C, at constant volume is called molar specific heat of gas at constant volume (C_v)

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- Molar Specific heat at constant pressure (C_p): The quantity of heat required to increase the temperature of one mole of gas by 1°K or 1° C, at constant pressure is called molar specific heat of gas at constant pressure (C_p).

Relation between Cp & Cv(Mayor's relation)

- **Consider 1 kg of gas is heated at constant volume**
- **as volume constant,heat supplied is used to**
- **1)Increase the temperature only**
- **Consider 1 kg of gas is heated at constant pressure**
- **as pressure constant but volume increases,heat supplied is used to**
- **1)Increase the temperature**
- **2)Increase the volume**
- **Thus in case of Cp, additional heat required**
- **$C_p = C_v + H$**

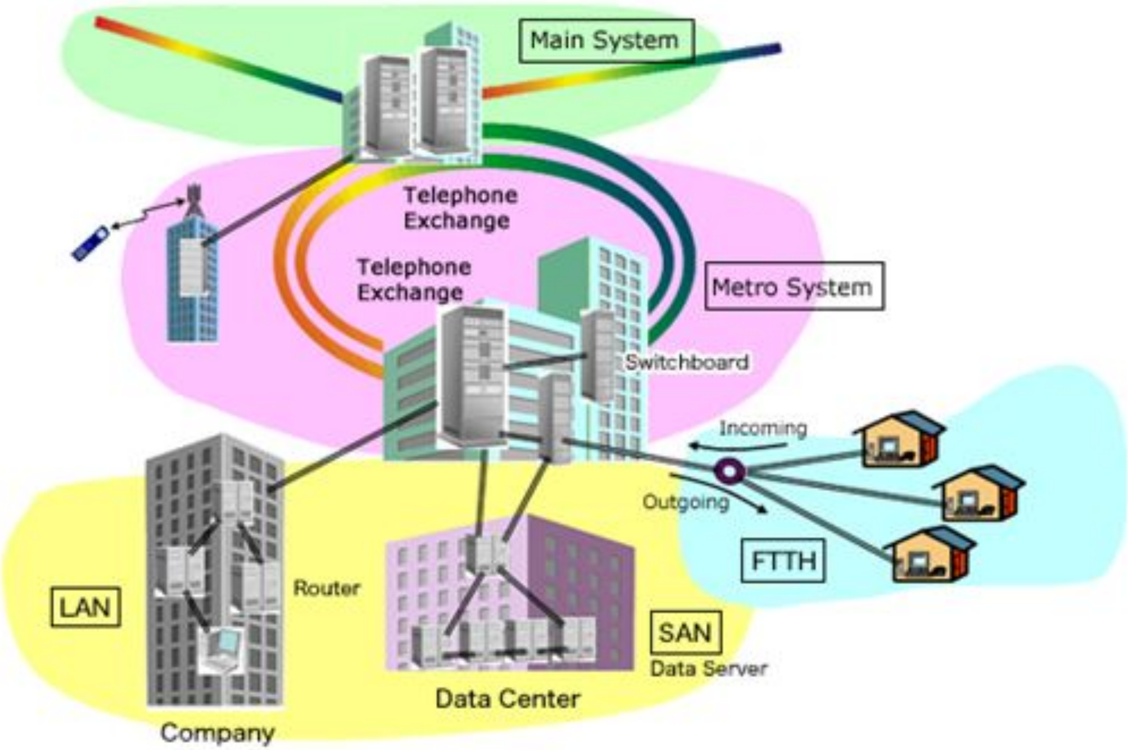
Mayor's Relation

- $Cp=Cv+W/J$
- $\quad =Cv+P(V2-V1)/J$
- $\quad =Cv+R(T2-T1)/J$
- But $T2-T1=1$
- So
- $Cp=Cv+R/J$
- If 1Kg Mole Of Gas Is Taken Then
- $R'=R/M$ Where M=Molecular weight
- $Cp=Cv+R'/J$

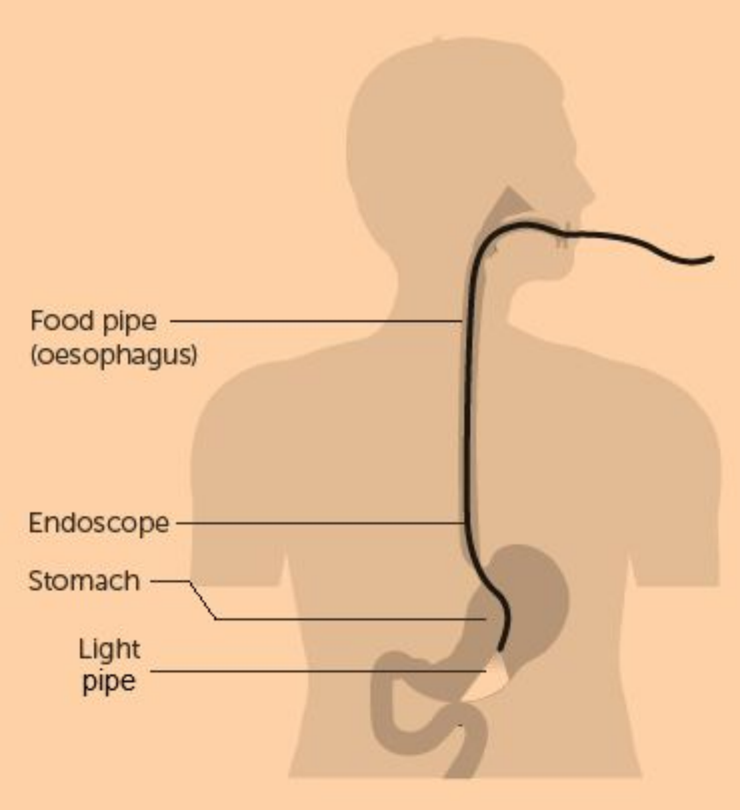
Ratio of specific heats

- **Ratio of specific heat:-**
- **Cp and Cv are always constant and Cp greater than Cv**
- $\frac{Cp}{Cv}=\gamma$
- $\frac{Cp}{Cv}$ **>1, because Cp>Cv**
- **Value of γ =1.66 for monoatomic gases**
- γ **=1.41 for diatomic gases**
- γ **=1.31 for triatomic gas**

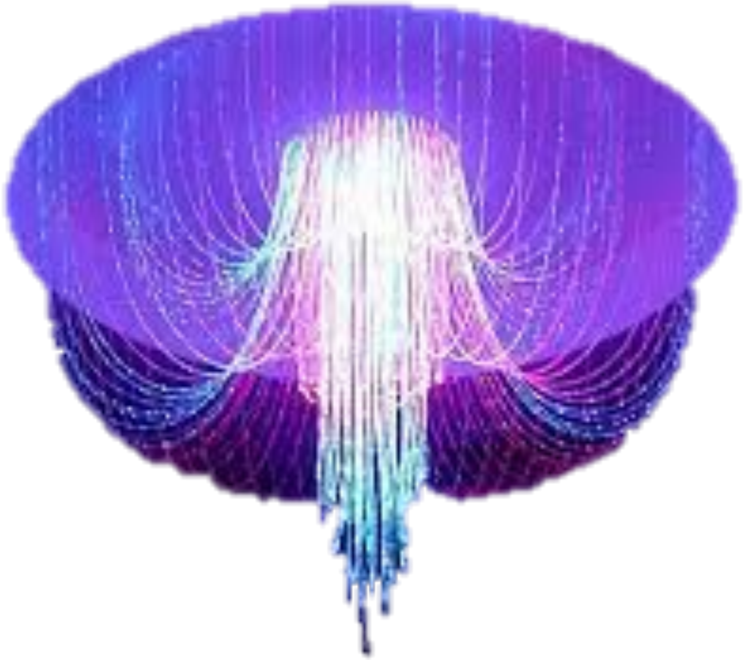
- Optical fibres are widely used in communications for transmitting and receiving electrical signals which are converted to light by suitable transducers.



- 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.



Structure of optical fiber

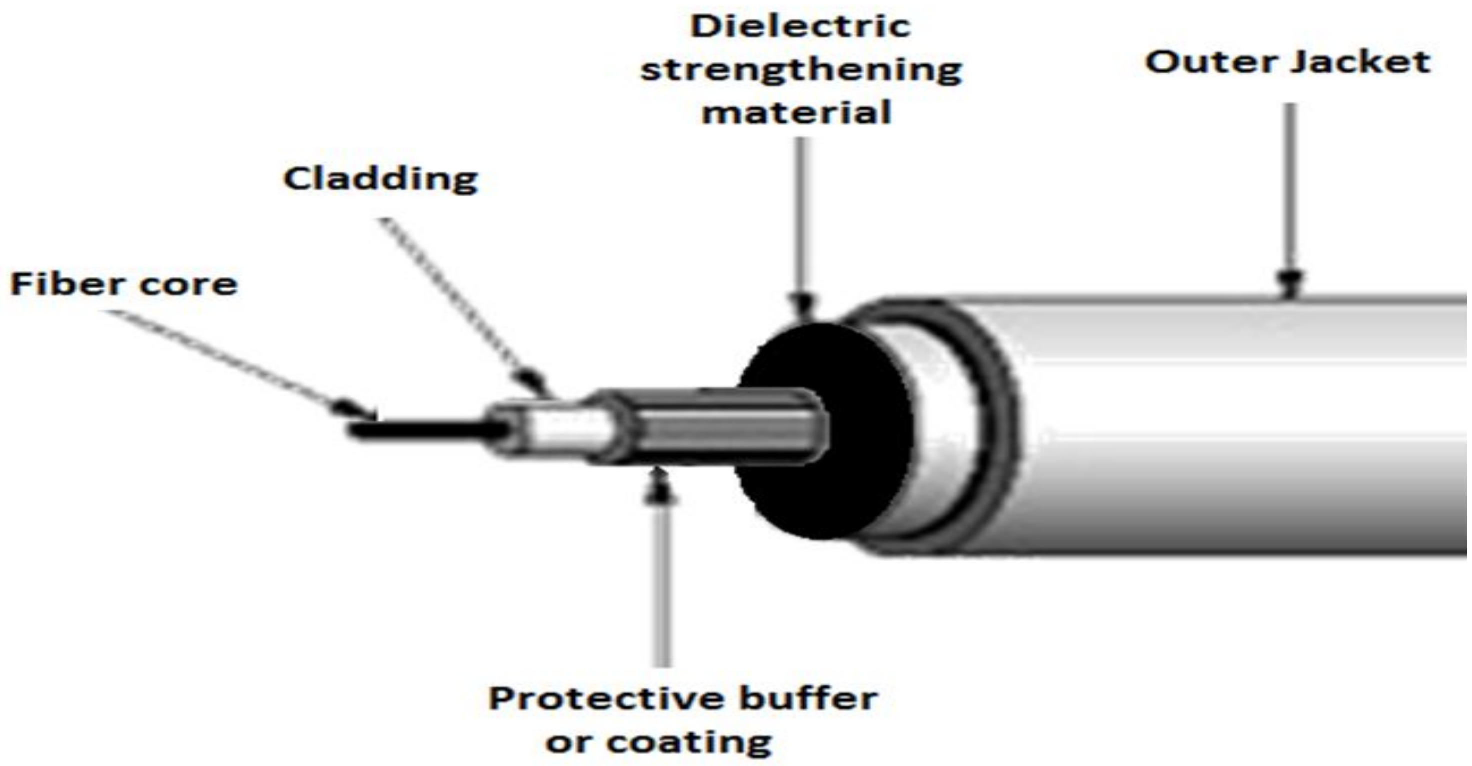
- Optical fiber cable has a core surrounded with cladding coated with plastic buffer (dielectric strength material) and outer jacket (insulator).

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.

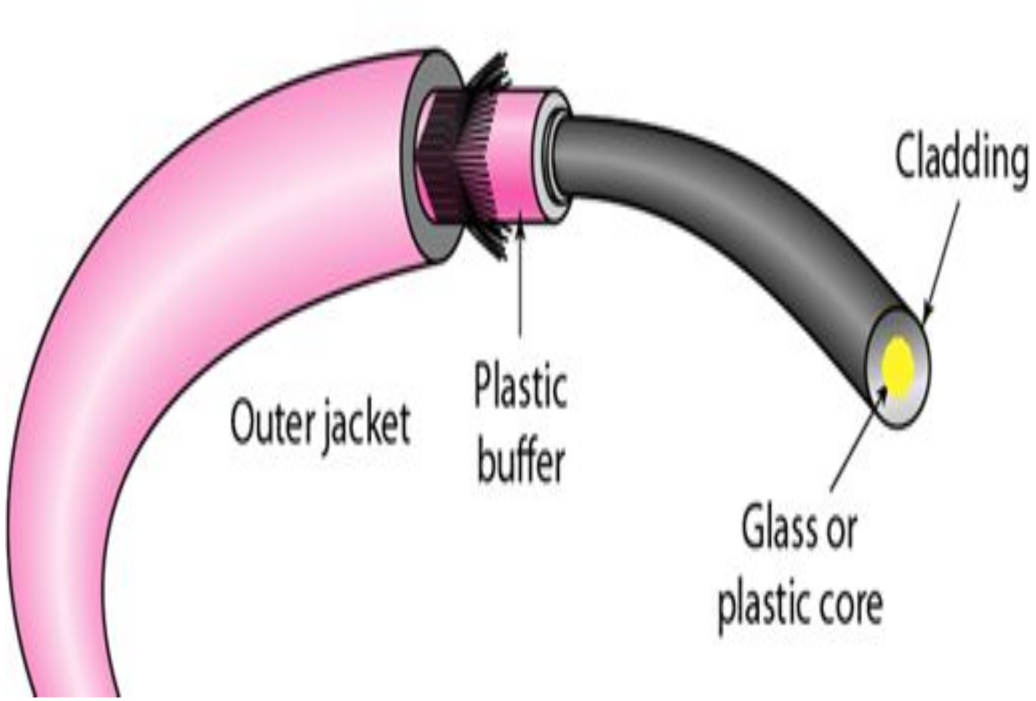
The outer jacket protect the fiber from moisture.

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

Structure of optical Fiber

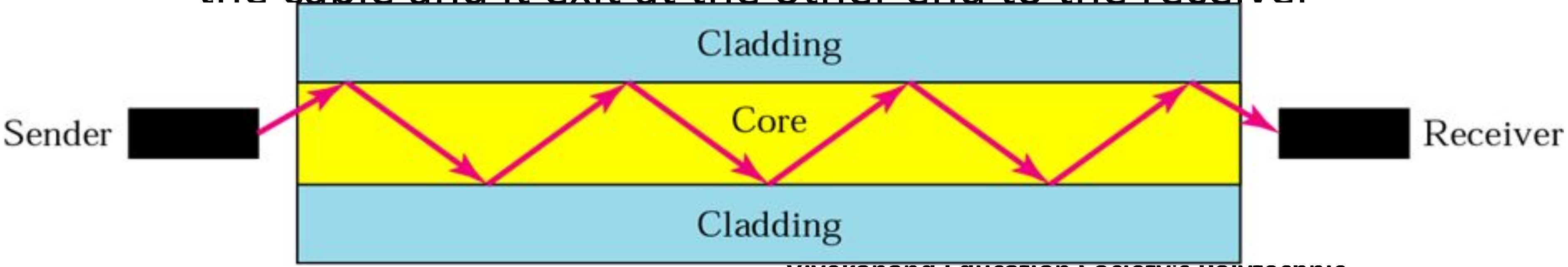


Structure of optical Fiber



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 90^0 and passes through the cable and it exit at the other end to the receiver



Acceptance Cone & Numerical Aperture

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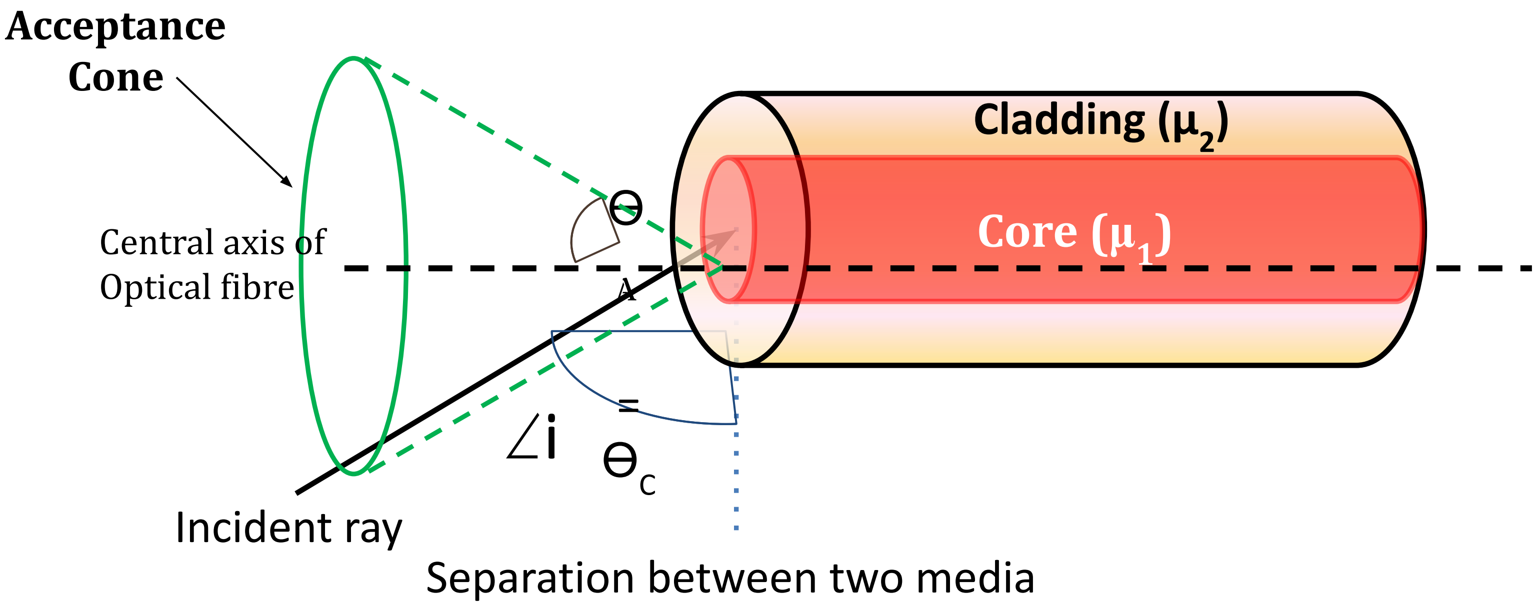


Definations

- 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.

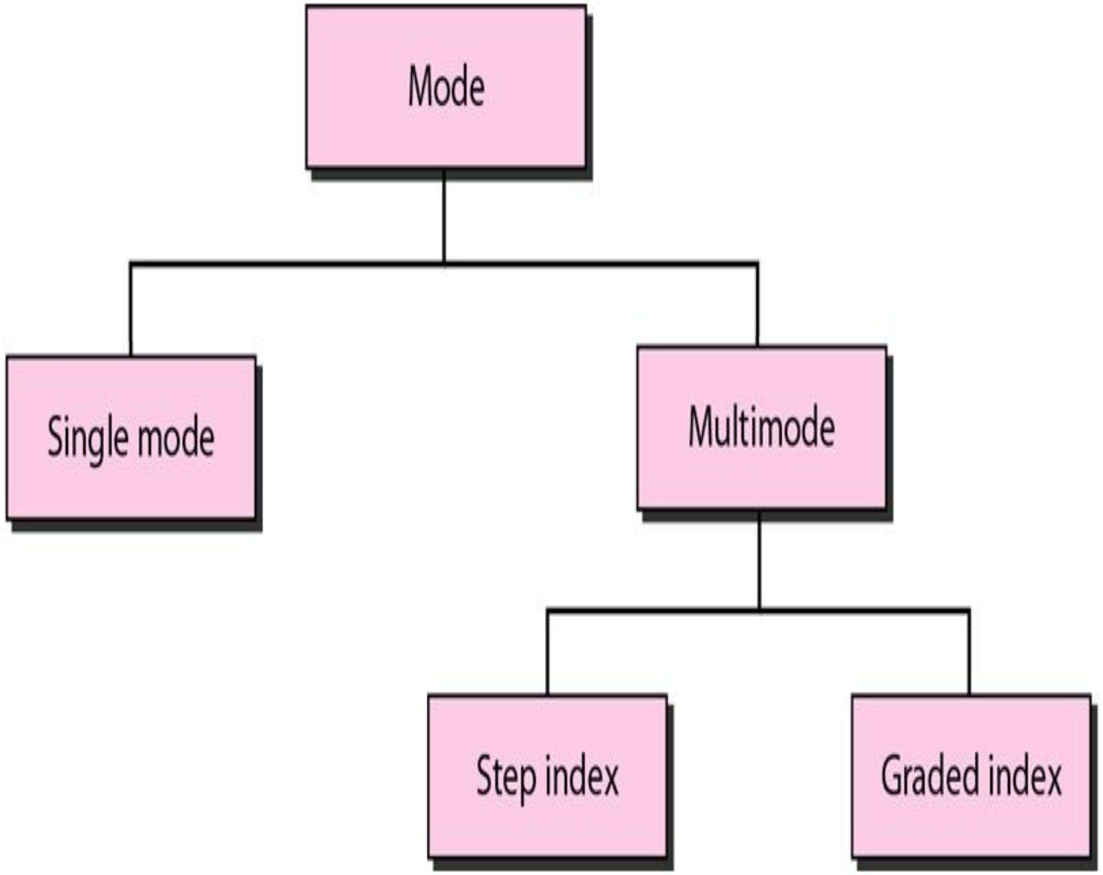
Acceptance Angle is measured as $\theta_A = \sin^{-1}(N_A)$

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 $N = \sqrt{(\mu\quad)^2 - (\mu\quad)^2}$

- Optical Fibers are classified as
    1. Single mode step index optical fiber
    2. Multimode step index optical fiber
    3. Multimode graded index optical fiber



Advantages of Fiber Optics

- 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.