Government Engineering College, Nawada

Physics -103201

(Waves and Optics, and Introduction to Quantum Mechanics)

Module 3 (Light and Optics)

Review questions:

1. What is light? Define the characteristics of light.
2. What do the Fresnel equations tell about? Write the four Fresnel equations.
3. Define the terms reflectance and transmittance. Plot reflectance and transmittance versus incident angle for the two cases.
4. What is Brewster's angle? How it is useful in obtaining polarized light. Clearly, write the state of polarized light obtained from this method.
5. What is critical angle and total internal reflection (TIR)? Comment on its applications.
6. Define evanescent waves. Write its expression. How the concept is used in making optical components such as beam splitter?
7. How the concept of TIR is used in optical fiber. What is numerical aperture?
8. What is lens maker's formula?
9. What is paraxial approximation? What are the formulae used for image formulation in lens and mirrors under paraxial approximation.
10. Define the structure of optical fiber with typical values. How optical fiber has changed the concept of data communication.

Problems:

1. How many complete vibrations are contained in the wave train of light of wavelength 520 nm emitted by a laser for a time of 430 ps.
2. The speed of yellow sodium light in a certain liquid is measured to be 1.92×10^8 m/s. Find the index of refraction of the liquid with respect to air, for sodium light.
3. Write Fresnel's equation for incidence angle of 90^0, called as glancing incidence. Show that the energy is conserved between transmitted and reflected light at glancing incidence of light at an interface between two media.
4. We wish to use a plate of glass (n = 1.50) in air as polarizer. Find the polarizing angle (Brewster's angle) and the angle of refraction.

5. A fish is 1.8 m below the surface of a smooth lake. At what angle above the horizontal must it look to see the light from a small camp fire burning at the water's edge 92 m away?
6. A point source of light is 82.0 cm below the surface of a body of water. Find the diameter of the largest circle at the surface through which light can emerge from the water.
7. A concave shaving mirror has a radius of curvature of 35 cm. It is positioned so that the image of a man's face is 2.7 times the size of his face. How far is the mirror from the man's face?
8. Two identical converging lenses of focal lengths $f = f' = +15$ cm are separated by a distance d of 6 cm. A luminous source is placed a distance of $o = 10$ cm from the first lens. Locate the final image.
9. An optical fiber has refractive indices of core (n_1) and cladding (n_2) as 1.46 and 1.44, respectively. Find numerical aperture (NA) and acceptance angle (i_m) for the optical fiber.
10. Light having a vacuum wavelength of 600 nm, travelling in a glass ($n_g = 1.50$) block, is incident at 45^o on a glass-air interface. It is then totally internally reflected. Determine the distance into the air at which the amplitude of the evanescent wave has dropped to a value of 1/e of its maximum value at the interface.