**Question Bank for Polarization, Fibre Optics and LASER**

**Polarization**

1. What is Polarized light? Distinguish between Polarized and unpolarised light.
2. How is the transverse nature of light waves established by the polarization of light?
3. What are the types of polarized light? Explain each of them (Plane polarized, circularly polarized and elliptically polarized)
4. Describe the production of plane polarized light by reflection.
5. Explain the phenomenon of double refraction.
6. State and explain the law of Malus’.
7. State and Explain Brewster’s law.
8. Explain Optical Activity and define Specific rotation.

**Numerical**

* + - 1. A ray of light is incident on a surface of a water of refractive index 1.33. If the reflected light is completely plane polarized, calculate the angle of polarization and hence angle of incidence and refraction.
      2. Two polarizing sheets have polarizing directions parallel so that the intensity of the transmitted light is maximum. Through what angle must either sheet be turned if the intensity is to drop by half?
      3. A polarizer and an analyser are parallel so that the maximum light is transmitted. When the analyser is rotated through 30 0, 40 0, 600 and 90 0 to what percentage of its maximum value is the intensity of transmitted light reduced?
      4. It is desired to use a plate of glass to obtain polarized light. If the R.I of glass is 1.5, what is polarizing angle?

**Formula:** µ = tan 𝜭 [Ans: 𝜭 = 56.31 degree].

6. The critical angle of incidence for total reflection in case of water is 480. What is

the polarization angle? What is the angle of refraction corresponding to the polarization angle?

**Formula:** µ = 1/sin𝜭 and µ = tan 𝜭

**[Ans: 𝜭 = 53.4 degree, Angle of refraction r = 36039`]**

7. Unpolarized light falls on two polarizing sheets placed one on top of the other. What must be the angle between the characteristic directions of the sheets if the intensity of the transmitted light is one-third intensity of the incident beam?

**[Ans: 𝜭=35.3 degree]**

8.Light of intensity I0 is incident on a polarizer. What is the intensity of the resultant beam?

if 1) Incident light is unpolarised? 2) Incident light is PPL with it’s electric field making an angle of 300 with the axis of polarizer?

**Formula:** Use Malus law  **[Ans: 1) I0 / 2 2) I = ¾ I0 ]**

**IV: Fiber Optics**

1. What is an optical fiber? What is the main principle involved in its working?
2. With a neat diagram explain the structure of an optical fiber.
3. Explain the following terms related to optical fiber: a) critical angle, b) acceptance cone, c) numerical aperture and d) V-number.
4. Describe the propagation of light in an optical fiber and obtain expressions for critical angle, acceptance angle and numerical aperture in terms of its core and cladding refractive indices.
5. Classify the fibers on the basis of refractive index profile, on the basis of modes and on the basis of materials.
6. Differentiate between the step-index and graded-index (GRIN) fiber.
7. What are the advantages of optical fiber over conventional cables?
8. Explain the important applications of optical fiber.

**Numericals**

1. Calculate the numerical aperture and acceptance angle of an optical fibre.

Given n1 =1.55, n2 = 1.50

1. A fibre cable has an acceptance angle of 300 and a core index of refraction of 1.4. Calculate the refractive index of the cladding.
2. Calculate the refractive indices of the core and cladding material of a fibre from following data. Numerical aperture = 0.22 and fractional difference of indices = 0.122.
3. In an optical fiber, the core material has R.I 1.43 and R.I of clad material is 1.4. Find the propagation angle.

**Formula:** cos 𝜭 = n2 / n1 [Ans: 𝜭 = 11.80 ]

1. In an optical fiber, the core material has R.I 1.6 and R.I. of clad material is 1.3. What is the value of critical angle? Also calculate the value of angle of acceptance cone.

Formula: 1. Sin Φ = n2 / n1  Critical angle Φ = 54.30

2. Acceptance angle = 𝜭 =

3. Angle of acceptance cone = 2𝜭=1210

1. Calculate the numerical power aperture and acceptance angle of an optical fiber from following data.

R. I. of core = 1.55, R.I. of clad = 1.50

**Formula:** NA =

Acceptance angle = 𝜭 =

1. A fiber cable has an acceptance angle of 300 and a core index of refraction of 1.4. Calculate the R.I. of cladding.

**Formula** sin𝜭 = **[Ans: n2 = 1.308]**

1. Calculate the angle of acceptance of a given optical fiber, if the R.I. of the core and the cladding are 1.563 and 1.498 respectively.

**Formula:** sin𝜭 =

1. A step index fibre is made with a core of R.I 1.52, a diameter of 29 micrometer and a fractional difference index of 0.0007. It is operated at a wavelength of 1.3 micrometer. Find the V-number.

**Formula:**

**V: LASER**

1. What is LASER? Discuss its different characteristics.
2. Explain absorption, spontaneous emission and stimulated emission with suitable diagrams.
3. Write short note on stimulated emission explaining its importance for laser production.
4. State Boltzmann’s distribution law and hence show that in normal conditions ground state will remain most populated.
5. Explain Einstein’s A and B coefficients in relation with the theory of lasing.
6. What is meant by metastable state? What is its significance?
7. Explain population inversion, active system and pumping?
8. What is meant by pumping? Why it is necessary for laser production? Discuss different types of pumping mechanisms.
9. Explain why simple heating cannot achieve population inversion.
10. Why lasing cannot be obtained using only two energy levels?
11. Distinguish between 3-level and 4-level lasers.
12. What is an optical resonator? Explain in detail how it plays a key role in laser production.
13. Explain the construction and working of a carbon-dioxide laser with energy level diagram. What are the roles of Helium and Nitrogen gases?
14. Explain the construction and working of a Ruby laser with energy level diagram.
15. Explain the construction and working of a Nd:Yag laser with energy level diagram
16. List the applications of laser in different fields.
17. Write a short note on holography.