[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 2038 **Your Roll No.....**

Unique Paper Code: 2512042403

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Name of the Paper: Optical Instrumentation (Core)
Name of the Department: Instrumentation
Semester: IV
Name of the Course: B.Sc. Instrumentation (NEP UGCF Mode)
Duration: 3 hours
Max. Marks:90

Instructions for candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt five questions in all. Question 1 is compulsory
3. Use of non-programmable scientific calculator is allowed.

Q.1 (a) Define Interference. What are the conditions required to obtain an Interference pattern? (3)

(b) Explain Magneto-optic effect with example. (3)

(c) Can Gallium Nitride (GaN) be used to design an LED? If band gap (E_g) of GaN is 3.4eV, calculate the wavelength of light emitted by it. (h= 4.135×10^{-15} eV.s) (3)

(d) Draw the diagram of a three level LASER and expalin its working in brief. (3)

(e) What is the basic working principle of Rayleigh's Interferometer? What are its applications? (3)

(f) What is numerical aperture of an optical fibre cable with a clad index of 1.365 and a core index of 1.574? (3)

Q.2 (a) Derive the expression of path difference obtained in Young's double slit experiment to obtain interference patterns. Also mention the conditions obtained for bright and dark fringe. (7)

(b) What is meant by polarization of light? Differentiate between a polarized and unpolarized light. What is an elliptically polarized light and circularly polarized light? (7)

(c) Differentiate between Fresnel and Fraunhoffer diffraction. (4)

Q.3 (a) Derive the expressions for Einstein coefficients and Einstein relations used in lasing action. (7)

(b) Explain the working of Solar cell. Draw its IV characteristics. Mention its applications in day-to-day life. (7)

(c) What is a Photo-diode? How is it different from a Solar cell? (4)

Q.4 (a) Explain the basic principle, construction and working of Fabry-Perot Interferometer. (7)

(b) Explain the fundamental principle of Holography. Describe in detail the steps involved in producing a three-dimensional image. (7)

(c) By how much distance the movable mirror of a Michelson Interferometer be moved to obtain consecutive positions of maximum distinctness for sodium D-lines λ_1=5890Å and λ_2=5898Å. (4)

Q.5 (a) What is an Optical fibre? Explain the basic principle by which light travels through the optical fibre. Differentiate between (i) Single mode step index fibre (ii) Multimode step index fiber (iii) Graded index fibre. (7)

(b) Define Attenuation in an optical fibre. Derive the expression for the attenuation obtained in dB/km. (7)

(c) In an optical fibre, the core material has refractive index 1.5 and refractive index of clad material is 1.2. What is the value of critical angle? Also find the value of acceptance angle. (4)

Q.6 (a) What is a Semiconductor LASER? How is the state of population inversion achieved in this type of LASER? Explain its working. (7)

(b) What is a photo-conductor? What is its basic working principle? What are different materials that are used to construct a photo-conductor? (7)

(c) What is basic working principle of Abbe refractometer? (4)

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Q.7 (a) Describe the working principle and construction of a Fiber-optic Refractive Index sensor. (7)

(b) What is a LED? How is light generated in a LED? What type of band gap materials-direct or indirect are used in construction of LED? (7)

(c) In a Fraunhoffer diffraction due to narrow slit a screen is placed 3m away from the lens to obtain a pattern. If the slit width is 0.4mm and first minima lie 6mm on either side of the central maxima, find the wavelength of light. (4)