1E3102

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1E3102

B.Tech. I Sem. (Main) Examination, April / May - 2022
1FY2-02 Engineering Physics

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

Attempt all ten questions From Part A, five Questions out of seven questions from Part B and three questions out of five questions from Part C .

Schematic diagram must be shown wherever necessary. Any data you feel missing suitably be assumed and states clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

PART - A

(Answers should be given up to 25 words only)

All questions are compulsory. **(10×2=20)**

1. What will be the effect on Newton's rings if a plane mirror is placed instead of the glass plate below the plano convex lens?
2. What is the role of compensatory plate in Michelson interferometer?
3. Define optical fiber. What is the working principle of optical fiber?
4. Define coherence length and coherence time.
5. What are the essential requirements for producing laser action?
6. What are intrinsic and extrinsic semiconductors?
7. What is zero point energy for a particle trapped in one dimensional box?
8. Define divergence of electrostatic field and its physical significance.
9. Why visible light cannot be used in diffraction by a crystal?
10. What are the necessary conditions of physically acceptable wave function?

PART - B

(Analytical/Problem solving questions)

Attempt any five questions: **(5×4=20)**

1. Light containing two wavelengths λ_1 and λ_2 falls normally on a plano-convex lens radius of Curvature R, resting on a glass plate. If the nth dark ring due to λ_1 coincides with the (n+1)th dark ring due to λ_2. Prove that the radius of the nth dark ring of λ_1 is $\sqrt{\frac{(\lambda_1\lambda_2 R)}{(\lambda_1-\lambda_2)}}$.

2. LASER action occurs by stimulated emission from an excited state to a state of energy 30.5eV. If the wavelength of LASER light emitted is 690 nm, what is the energy of the excited one?

3. For intrinsic silicon, at room temperature the electrical conductivity is $4\times10^{-4}\Omega^{-1}m^{-1}$. The electron and hole mobilities are $0.14 m^2V^{-1}s^{-1}$ and $0.040\, m^2V^{-1}s^{-1}$ respectively. Compute the intrinsic charge carrier density at room temperature.

4. A diffraction grating has total ruled width 5 cm for normal incidence. It is found that a line of wavelength $6000\,\overset{0}{\mathrm{A}}$ in a certain order superimposed on another line of wavelength $4500\,\overset{0}{\mathrm{A}}$ of the next highest order. If the angle of diffraction is 30°, how many lines are there in the grating?

5. Define numerical aperture of an optical fiber. Prove that the numerical aperture of a step index optical fiber is given by-

   $N.A. = \mu_{core}\sqrt{2\Delta}$, where symbols have their usual meanings.

6. Find the probability that a particle in a box of width a can be found between $x=0$ and $x=a/n$ when it is in the nth state.

7. Derive an expression for resolving power of a grating.

PART - C

(Descriptive/Analytical/Problem solving/Design Questions)

Attempt any three questions. **(3×10=30)**

1. Derive an expression for the intensity of diffracted light in the Fraunhofer's diffraction due to a single slit and show that the relative intensities of successive maxima are in the ratio:

   $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}:\frac{4}{49\pi^2}$ **(5+5)**

2. Solve the schrodinger's equation for a free electron in 3-Dimensional box and find the energy eigen value and eigen functions of free electron. Find the lowest energy of the following states:

   i) Non-degenerate

   ii) Triply degenerate for 3-Dimensional cubical box. **(6+2+2)**

3. With the help of suitable diagram, explain the principle, construction and working of He Ne laser. **(2+4+4)**

4. a) What is Hall effect? Show that for a n-type semiconductor the Hall coefficient is $R_H = \frac{-1}{ne}$. **(5)**

   b) Classify conductor, semiconductor, and Insulator based on energy band theory. **(5)**

5. a) Define poynting vector and derive poynting theorem. **(5)**

   b) State Ampere's circuital law and using Maxwell's correction, derive fourth Maxwell's equation. **(5)**
