1E3102

Total No. of Questions : 22 Total No. of Pages : 04

Roll No. : ..

1E3102

B.Tech. I-Sem. (Main/Back) Exam. - 2024

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

Use of following supporting material is permitted during examination.

(Mentioned in Form No. 205)

1. ..... 2. .....

PART-A **[10×2=20]**

(Answer should be given upto 25 words only)

All questions are compulsory

Q.1. Give the physical significance of divergence and curl of a field.

Q.2. Write all four Maxwell's equations in integral form for free space.

Q.3. What do you mean by eigenfunctions and eigen values?

Q.4. When the movable mirror of Michelson's interferometer is shifted by 0.030 mm, the shift of 100 fringes is observed. Calculate the wavelength of light in $\mathring{A}$ and state its colour.

Q.5. State Rayleigh's criterion of resolution.

Q.6. Find the lowest energy of an electron confirmed to move in one dimensional potential box of length 1 $\mathring{A}$.

Q.7. Calculate the numerical aperture and acceptance angle of an optical fiber. Given refractive index of fiber core=1.62 and refractive index of cladding=1.52.

Q.8. Define spatial and temporal coherence.

Q.9. What do you mean by stimulated emission and spontaneous emission?

Q.10. The carrier concentration in n-type semiconductor 10^{19} per m^3. What is the value of Hall coefficient?

PART-B **[5×4=20]**

(Analytical/Problem solving questions)

Attempt any five questions

Q.1. Give the construction and theory of plane transmission grating and explain the formation of spectra by it.

Q.2. Prove that in high frequency region laser action is not possible.

Q.3. For intrinsic semiconductor with a band gap E_g=0.7 eV, calculate the density of electrons and holes at 300K.

Q.4. A ray of light entres from air into fiber. The refractive index of air is one. The fiber has a core of refractive index 1.5 and cladding of refractive index 1.48. Find the critical angle, the fractional refractive index, acceptance angle and numerical aperture.

Q.5. A plane transmission grating of length 6 cm has 5000 lines/cm. Find the resolving power of grating and the smallest wavelength difference that can be resolved for light of wavelength 5000 $\mathring{A}$.

Q.6. If a potential function is given by the expression , $\phi = xyz$, determine the potential gradient and also prove that the vector is irrotational.

Q.7. Calculate the angles at which the first dark band and the next bright band are formed in the Fraunhofer diffraction pattern of a slit 0.3 mm wide ($\lambda = 5890$ $\mathring{A}$).

PART-C **[3×10=30]**

(Descriptive/Analytical/Problem Solving/Design Question)
Attempt any three questions

Q.1. In a Newton's ring arrangement with air film observed with light of wavelength 6×10^{-5} cm, the difference of squares of diameters of successive rings is 0.125 cm^2. What will happen to this quantity if :

(i) Wavelength of light is changed to 4.5×10^{-5} cm.

(ii) A liquid of refractive index 1.33 is introduced between the lens and the plate

(iii) The radius of curvature of the convex surface of the Plano-convex lens is doubled?

Q.2. Explain the terms : Population inversion and optical pumping. Discuss with suitable diagrams the principle, construction and working of Helium-Neon Laser.

Q.3. The Hall voltage for the sodium metal is 0.001 mV, measured at I=100 mA, B=2 Tesla, the width of the specimen=0.05 mm and $\sigma = 2.09 \times 10^7 \Omega^{-1} m^{-1}$,

(a) calculate the number of carriers per cubic meter in sodium.

(b) calculate the mobility of electrons in sodium.

Q.4. State and prove Poynting theorem for the rate of flow of energy in electromagnetic field. What is Poynting vector?

Q.5. Give physical significance of wave function. Derive time dependent and time independent Schrödinger wave equation.

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