

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

[$10 \times 2 = 20$]

(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 \AA and state its colour.
- Q.5. State Rayleigh's criterion of resolution.
- Q.6. Find the lowest energy of an electron confined to move in one dimensional potential box of length 1 \AA .
- 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

[$5 \times 4 = 20$]

(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 $E_g = 0.7 \text{ eV}$, calculate the density of electrons and holes at 300K.

- Q.4. A ray of light enters 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 \AA .
- 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 ($\lambda = 5890 \text{ \AA}$).

PART-C

[$3 \times 10 = 30$]

(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 $6 \times 10^{-5} \text{ cm}$, the difference of squares of diameters of successive rings is 0.125 cm^2 . What will happen to this quantity if: <https://www.rtuonline.com>
- (i) Wavelength of light is changed to $4.5 \times 10^{-5} \text{ cm}$.
 - (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 $\sigma = 2.09 \times 10^7 \Omega^{-1} \text{m}^{-1}$,
- calculate the number of carriers per cubic meter in sodium.
 - 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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