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Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, September 2024

Physics/Physics with Specialization in space Physics/Physics with specialization in Nano Science

PHSP 521/PHNS 521/PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. Explain Raman-Nath diffraction.
2. Write about propagation of light in crystals.
3. Elaborate optical mixing.
4. Write electromagnetic wave equations and its modification.
5. Define Coulomb gauge.
6. Differentiate lossless line and distortion less line.
7. Explain TM and TE modes in wave guides.
8. Explain the significance of Frii's equation in telecommunication.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer any **three** questions. Each question carries **15** marks.

9. (a) Explain and Derive Kirchoff's integral theorem and formula. **7**

   (b) Briefly explain about Fabry-perot interference and the expression for resolving power of Fabry – Perot interferometer. **8**

OR

10. (a) Explain Harmonic generation in Non-Linear optics, elaborate second and third harmonic generation. **9**

    (b) Give an account on multi-quantum photoelectric effect. **6**

11. (a) Explain the basics of propagation of electromagnetic waves in conducting and non-conducting media. **9**

    (b) Discuss the energy and momentum in electromagnetic waves. **6**

OR

12. (a) What is a gauge transformation? Differentiate coulomb gauge and Lorentz gauge. **8**

    (b) Explain Electric field of a uniformly moving point charge. **7**

13. (a) Comment on point charges and briefly explain the power radiated from a point charge. **8**

    (b) What is dipole radiation and elaborate on its types. **7**

OR

14. (a) What are transmission line parameters and provide the equations. **6**

    (b) Explain in detail the propagation of TM and TE waves in a rectangular wave guide. **9**

($3 \times 15 = 45$ Marks)

PART – C

Answer any **three** questions. Each question carries **5** marks.

15. Explain in detail the parametric generation of light.

16. In a rectangular waveguide with dimensions a = 2.5 cm, b = 1.2 cm and the operating frequency f = 15 GHz. Determine the mode of operation, cut off frequency for the dominant mode and the phase constant at the operating frequency.

17. A magnetic field strength of 2 $\mu A/m$ is required at a point on $\theta = \pi/2$, 2 km from an antenna in air. Neglecting ohmic loss, how much power must the antenna transmit if it is a half-wave dipole?

18. A beam of X-rays of wavelength 0.07 1 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second-order diffraction.

19. A pulse of light of duration 10–6 s is absorbed completely by a small object initially at rest. If the power of the pulse is 60 $\times$ 10–3 W, calculate the final momentum of the object.

20. Prove that the secondary maxima of a single slit Fraunhofer diffraction pattern occur at the points for which $\beta = \tan\beta$. Also show that the first three roots are given by $\beta = 1.43\pi, 2.46\pi$, and 3.47π approximately.

(3 $\times$ 5 = 15 Marks)

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