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Reg. No. : .....

Name : .....

**Second Semester M.Sc. Degree Examination, September 2022**

**Physics**

**PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY**

**(2020 Admission Onwards)**

Time : 3 Hours

Max. Marks : 75

**PART – A**

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

1. Distinguish between Fresnel and Fraunhofer diffraction.
2. Give an account of third harmonic generation of non-linear optics.
3. Explain the propagation of EM waves through linear media.
4. What are vector and scalar potentials?
5. Obtain the expression for power radiated by an arbitrary charge.
6. Discuss the significance of Smith chart.
7. Write a short note on rectangular waveguides.
8. What are antenna arrays?

**(5 × 3 = 15 Marks)**

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PART – B

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

9. (a) Demonstrate the first experiment to show the existence of second harmonic generation.

(b) Elaborate the concept of phase matching.

OR

10. (a) Write a note on Raman Nath diffraction and Bragg diffraction.

(b) How will you demonstrate the occurrence of interference with multibeam?

11. Explain the electric dipole radiation. Obtain the expressions for the fields due to oscillating electric dipole and deduce the power radiation.

OR

12. Discuss the propagation of electromagnetic waves in conductors and derive an expression for skin depth.

13. (a) List the advantages of waveguides over transmission lines.

(b) Explain the propagation of waves through waveguides.

OR

14. (a) Explain the radiation from Hertzian dipole.

(b) Explain EIRP and Friis equations of antenna.

**(3 × 15 = 45 Marks)**



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PART - C

Answer any three questions. Each carries 5 marks.

15. A distortion less line has  $Z_0 = 60\Omega$ ,  $\alpha = 20\text{mNp/m}$ ,  $u = 0.6c$ , where  $c$  is the speed of light in vacuum. Find  $R$  and  $L$  at 100 MHz.
16. An electric field of strength  $10\mu\text{V/m}$  is to be measured at an observation point  $\theta = \pi/2$ , 500 km from a half-wave (resonant) dipole antenna operating in air at 50MHz. find the average power radiated by the antenna.
17. In a rectangular waveguide for which  $a = 1.5\text{cm}$ ,  $b = 0.8\text{cm}$ ,  $\sigma = 0$ ,  $\mu = \mu_0$  and  $\epsilon = 4\epsilon_0$ ,  $H_x = 2\sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)\sin(\pi \times 10^{11}t - \beta z)\text{A/m}$ . Determine
  - (a) The mode of operation
  - (b) The cut off frequency
  - (c) The phase constant  $\beta$
18. Obtain gauge transformation conditions.
19. A beam of X-rays of wavelength 0.071 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.
20. Obtain the expression for energy and momentum in electromagnetic waves.

(3 × 5 = 15 Marks)

