

Pr. S2 Sum
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Reg. No. :

Name :

Second Semester M.Sc. Degree Examination, August 2025

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

SECTION - A

Answer any five questions. Each question carries 3 marks.

1. Compare Fraunhofer and Fresnel diffraction
2. Discuss the role of multilayer films in reducing reflections and improving optical transmission.
3. Explain the multi-quantum photoelectric effect
4. What is skin depth, and why is it important for electromagnetic waves in conducting media?
5. What are scalar and vector potentials?
6. How does a point charge emit radiation?
7. What are rectangular waveguides, and how do they differ from transmission lines.
8. Describe the basic radiation pattern of a Hertzian dipole.

(5 × 3 = 15 Marks)

SECTION - B

Answer all questions. Each question carries 15 marks.

9. Explain multiple-beam interference and derive an expression for the intensity distribution of an interference pattern. 15

OR

10. Explain the principle of phase matching. Derive the phase matching condition and discuss its role in second harmonic generation. 15

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11. (a) Explain the behavior of electromagnetic waves at oblique incidence on a boundary. 8
 (b) Derive Snell's law and explain Fresnel's equations. 7

OR

12. (a) Explain the electromagnetic field tensor and derive its components. 8
 (b) Derive any two of Maxwell's equations in tensor notation. 7
 13. (a) Explain the propagation of electromagnetic waves in a rectangular waveguide. 5
 (b) Derive expressions for cut-off frequency for TE Mode and TM Mode. 5
 (c) Discuss the applications of rectangular waveguides in communication systems. 5

OR

14. Discuss the design and characteristics of
 (a) Half-wave dipole antenna. 8
 (b) Quarter-wave monopole antenna. 7

(3 × 15 = 45 Marks)

SECTION – C

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

15. What is holography? Explain how it enables wave front reconstruction.
 16. Distinguish between two-photon and three-photon absorption processes.
 17. A point charge q is at rest at the origin in the system S_0 . What is the electric field of this same charge in the system S , which moves to the right at speed V_0 relative to S_0 .
 18. Define the wave equation for electromagnetic waves and its significance
 19. An airline has a characteristic impedance of 70Ω and the phase constant of 3 rad/m at 100 MHz. Calculate the impedance per meter and capacitance per meter of the line.
 20. Explain the use of the Smith Chart in analyzing transmission lines.

(3 × 5 = 15 Marks)