

17P110

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Name:

Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2017

(Regular/Supplementary/Improvement)

(CUCSS-PG)

CC15P PHY1 C03/ CC17P PHY1 C03 – ELECTRODYNAMICS AND PLASMA PHYSICS

(Physics)

(2015 Admission Onwards)

Time: Three Hours

Maximum:36 Weightage

PART - A

Answer **all** questions. Each question carries 1 weightage.

1. Write Maxwell's equations in differential form and give their physical meaning.
2. Write the relations connecting electromagnetic potentials and field.
3. For a TEM wave, show that there is no component of E (or H) in the direction of propagation.
4. Show that the magnetic field inside a conductor is lagging behind the electric field.
5. Define reflection and transmission coefficient. What is the relationship between them?
6. What do mean by a distortion-less transmission line? How can it be achieved in a practical line?
7. What is the cut off wavelength for the dominant mode in a rectangular waveguide?
8. Explain electromagnetic field tensor.
9. Represent propagation equations for potentials in terms of field tensor.
10. Explain the characteristics of plasma.
11. What is Debye shielding?
12. Obtain the equation of continuity for plasma fluid.

(12 x 1 = 12 Weightage)

PART -B

Answer any **two** questions. Each question carries 6 weightage.

13. Analyze the propagation of electromagnetic waves in conducting medium and obtain an expression for the skin depth.
14. Discuss the propagation of TM waves in a rectangular waveguide and write the instantaneous field expressions for TM_{11} mode.
15. Obtain the transformation equations for electromagnetic field vectors and represent them in terms of the field tensor.
16. Explain the characteristics of plasma. Discuss plasma oscillations and obtain an expression for plasma frequency.

(2 x 6 = 12 Weightage)

PART -C

Answer any **four** questions. Each question carries 3 weightage.

17. A sinusoidal electric field of amplitude 50 V/m and frequency 1 GHz exists in a lossy dielectric medium that has a permittivity of 0.2×10^{-10} F/m and a loss tangent of 0.001. Find the conductivity of the medium and the average power dissipated per cubic meter.
18. A uniform plane wave with $\mathbf{E} = a_x E_x$ propagates in a lossless medium ($\epsilon_r = 4, \mu_r = 1, \sigma = 0$) in the $+z$ direction. Assume that E_x is sinusoidal with a frequency 100 MHz and has a maximum value of $+10^{-4}$ V/m at $t = 0$ and $z = 1/8$ m. Write instantaneous expressions for E and H for any t and z .
19. A distortion-less line has $Z_0 = 60 \Omega$, $\alpha = 20$ mNp/m, $u = 0.6c$, where c is the speed of light in vacuum. Find R, L, G, C and λ at 100 MHz.
20. Prove that the resonant frequency of a rectangular cavity resonator is

$$f_{r(mnp)} = \frac{u}{2} \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2 + \left(\frac{p}{d}\right)^2}$$

21. A point charge q is at rest at the origin of a coordinate system S_0 . What is the electric field of this charge in a system S moving along the positive x axis with a speed v_0 relative to S_0 ?
22. A non-relativistic particle of mass m and charge q is initially moving with velocity $\mathbf{v} = v\hat{i}$ in a uniform magnetic field $\mathbf{B} = B\hat{k}$. At subsequent times the particle (neglecting radiation) moves in a circle of Larmor radius R_L . Find an expression for R_L in terms of m, v, q and B .

(4 x 3 = 12 Weightage)

PART -B

Answer any two questions. Each question carries 6 weightage.

13. Analyze the propagation of electromagnetic waves in conducting medium and obtain an expression for the skin depth.
14. Discuss the propagation of TM waves in a rectangular waveguide and write the instantaneous field expressions for TM_{11} mode.
15. Obtain the transformation equations for electromagnetic field vectors and represent them in terms of the field tensor.
16. Explain the characteristics of plasma. Discuss plasma oscillations and obtain an expression for plasma frequency.

(2 x 6 = 12 Weightage)