16P108 (Pages:2) Name: ……

Reg. No……...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2016

(Regular/Supplementary/Improvement)

(CUCSS-PG)

CC15P PHY1 C03 – ELECTRODYNAMICS AND PLASMA PHYSICS

(Physics)

(2015 Admission Onwards)

Time: Three Hours Maximum: 36 Weightage

Part A

(*Answer **all** questions. Each question has weightage **1***)**

1. Obtain the time harmonic Maxwell's equations in phasor notation.
2. What is meant by the loss tangent of a medium? Define good conductor and a lossy dielectric in a time varying situation.
3. Define standing wave ratio. What is its relationship with reflection coeffiecient?
4. Obtain a general relationship between the group and phase velocities in a dispersive medium. Compare them if it is a medium of
   (a) no dispersion (b) normal dispersion (c) Anomalous dispersion.
5. What is meant by 'distortionless line'? What relation must the distributed parameters of a line satisfy in order for the line to be distortionless?
6. Why is a high standing wave ratio on a transmission line undesirable?
7. Why is the TE_{10} mode in a rectangular waveguide is of particular practical importance?
8. State the boundary conditions to be satisfied by H_z for TE waves in a rectangular waveguide?
9. Show that **E.B** is relativistically invariant.
10. How does relativity combine the electric and magnetic fields into a single entity $F^{\mu\nu}$?
11. Plasmas are diamagnetic. Justify
12. Briefly explain the criteria for plasmas. **(12 × 1 = 12 Weightage)**

Part B

(*Answer any **two** questions. Each question has weightage **6***)**

13. Discuss the propagation of electromagnetic waves in a conducting media and bring out the idea of skin effect. Hence explain how frequency affects conductivity.
14. Discuss the propagation of TE waves in a rectangular waveguide and obtain an expression for the field components, cut-off frequency and phase velocity.

15. With the help of the potential formalism of Relativistic Electrodynamics, rewrite Maxwell's electromagnetic equations using 4 vector potentials.

16. Discuss in detail, about the plasma oscillations. **(2 × 6 = 12 Weightage)**

Part C

(*Answer any **four** questions. Each question has weightage **3***)**

17. Deduce the laws of reflection and the Snell's law by considering the incidence of electro magnetic waves on a plane dielectric boundary.

18. A uniform sinusoidal plane wave in air with the following phasor expression for electric intensity $E_i(x,z) = \boldsymbol{a}_y 10e^{-j(6x+8z)}\, V/m$ is incident on a perfectly conducting plane at z = 0.

    (a) Find the frequency and wavelength of the wave.

    (b) Find $\mathbf{E}_1$(x,z) and $\mathbf{H}_1$(x,z) of the total field .

19. Find the input impedance of a low-loss quarter-wavelength line (a) terminated in a short circuit and (b) terminated in an open circuit.

20. Show that the lowest cut-off frequency in TM mode is $\left(1 + \frac{a^2}{b^2}\right)^{1/2}$ times the cut-off frequency in TE mode for a rectangular waveguide, where a and b are the lengths of the sides. (Assume a > b.)

21. Show that $\frac{\partial G^{\mu\nu}}{\partial x^{\nu}} = 0$ can be expressed in terms of field tensor $F^{\mu\nu}$ as

$$\frac{\partial F_{\mu\nu}}{\partial x^{\lambda}} + \frac{\partial F_{\nu\lambda}}{\partial x^{\mu}} + \frac{\partial F_{\lambda\mu}}{\partial x^{\nu}} = 0$$

22. Briefly explain about the interaction of a moving charged particle with a constant magnetic field. find an expression for the Larmor radius R_L in terms of the mass 'm', velocity 'v', charge 'q', and magnetic field intensity 'B'.

(4 × 3 = 12 Weightage)

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