15P108 **Name:………………………………**

Reg. No……………………………..

FIRST SEMESTER M.Sc. DEGREE EXTERNAL EXAMINATION FEBRUARY 2016

(2015 Admission)

CC15P PHY1C03 – Electrodynamics and Plasma Physics

(Physics)

Time: 3 hours **Total weightage: 36**

Part A

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

1. What do you mean by retarded potentials? Write down the expressions for retarded vector potential and scalar potential.
2. Discuss the advantages of using phasors in electromagnetics.
3. What is the skin depth of a conductor? How is it related to the attenuation constant, conductivity and frequency?
4. Write short notes on perpendicular polarization and parallel polarization of an incident wave.
5. Explain why waves along a lossy transmission line cannot be purely TEM.
6. What is the input impedance of a short circuited lossless transmission line if the length of the line is (a) $\lambda/4$ and if (b) $\lambda/2$
7. State the boundary conditions to be satisfied by H_z for TE waves in a rectangular waveguide.
8. What do you mean by degenerate and dominant modes of a rectangular cavity resonator?
9. Show that the current density 4-vector is divergenceless.
10. Obtain Lorentz force law in relativistic notation.
11. What happens physically in an Alfven wave?
12. Write a short note on Debye shielding. Obtain an expression for Debye shielding length.

(12 × 1 = 12 Weightage)

Part B

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

13. Work out the normal incidence of an electromagnetic wave at a plane dielectric boundary.
14. Discuss the wave characteristics on finite transmission lines.

15. Derive the transformation equations for electromagnetic field vectors. Express them in terms of the field tensor.

16. Obtain Boltzmann and Vlasov equations and derive their first and second moments.

(2 × 6 = 12 Weightage)

Part C

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

17. Obtain the momentum of the electromagnetic waves in terms of the Poynting vector. The intensity of sunlight falling on the earth is about $1300 Wm^{-2}$. Assuming the earth to be a perfect absorber, what pressure does sunlight exert?

18. A uniform sinusoidal plane wave in air with the following phasor expression for electric intensity $E_i(x,z) = \boldsymbol{a}_y 10 e^{-j(6x+8z)}\, V/m$ 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. The following characteristic has been measured on a lossy transmission line at 100MHz.

    $Z_0 = 50 + j0\ (\Omega)$, $\alpha = 0.01$ (dBm) and $\beta = 0.8\pi$ (rad/m).

    Determine R. L, G, and C for the line.

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

    (a) **E . B** is relativistically invariant.

    (b) $E^2 - c^2B^2$ is relativistically invariant.

22. Show that the plasma angular frequency can be expressed by the relation $\omega_p{}^2 = \frac{4\pi n e^2}{m}$

(4 × 3 = 12 Weightage)

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