19P108A (Pages: 2) Name: …….……

Reg. No…….……...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(Supplementary/Improvement)

(CUCSS-PG)

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

(Physics)

(2015 to 2018 Admissions)

Time: Three Hours Maximum: 36 Weightage

Part A

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

1. Show that Lorentz condition for potentials is consistent with the equation of continuity.
2. Obtain the homogenous vector Helmholtz's equations for a simple non-conducting source free medium.
3. Define propagation constant, attenuation constant and phase constant.
4. Define intrinsic impedance of a medium. Mention the value of the intrinsic impedance of the free space.
5. What is meant by cut off frequency of a waveguide? Can a waveguide have more than one cut off frequency?
6. What is the essential difference between transmission lines and ordinary electric networks?
7. Give the nonzero field components for the TE_{10} mode in a rectangular waveguide?
8. Define quality factor of a cavity resonator. What is its significance?
9. Show that $E^2 - c^2B^2$ is relativistically invariant.
10. Write down the Lorentz transformation matrix.
11. On the basis of fluid theory, briefly explain the origin of plasma oscillations.
12. Distinguish between Alfven waves and magnetosonic waves.

(12 x 1 = 12 Weightage)

Part B

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

13. Discuss the reflection and transmission of e.m. wave for normal incidence at a plane dielectric boundary.
14. Derive the expressions for (i) inductance per unit length; (ii) capacitance per unit length for a transverse electromagnetic wave along a parallel plane transmission line. Hence arrive at the equations for the instantaneous current and voltage along the line.

15. Write down the complete set of transformation rules for **E** and **B** and hence obtain the components of field tensor $F^{\mu\nu}$ and dual tensor $G^{\mu\nu}$
16. Discuss the motion of charged particles in uniform electric and magnetic fields and obtain the expression for drift velocity. Hence establish that current cannot flow in neutral plasma subjected to uniform electric and magnetic fields.

(2 x 6 = 12 Weightage)

Part C

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

17. A sinusoidal electric intensity of amplitude 250 (V/m) and frequency 1.5(GHz) exists in a lossy dielectric medium that has a relative permittivity of 2.45 and a loss tangent of 0.001. Find the average power dissipated in the medium per cubic meter.
18. Prove that the magnetic field lags behind the electric field by 45^0, when uniform plane waves propagate in a good conductor.
19. The following characteristics have been measured on a lossy transmission line at 150 MHz: Z0 = 60 + j0 (Ω); $\alpha = 0.015$ (dB/m) ; and $\beta = 0.85\ \pi$ (rad/m). Determine R, L, G, and C for the line.
20. Prove that the following wavelength relation holds for a uniform waveguide:

$$\frac{1}{\lambda_g{}^2} = \frac{1}{\lambda^2} - \frac{1}{\lambda_c{}^2}$$

where λ_g= guide wavelength, λ = wavelength in unbounded dielectric medium, and λ_c = cutoff wavelength.

21. Prove that the symmetry (or antisymmetry) of a tensor is preserved by Lorentz transformation.
22. Compute Debye length and number of particles in Debye sphere for $n = 10^{16}\ m^3$

(4 x 3 = 12 Weightage)

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