18P108 (Pages: 2) Name: …….

Reg. No……...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(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 down the time – harmonic Maxwell's equations in terms of vector field phasors and source phasors for a linear, isotropic and homogenous medium.
2. Outline the advantages of using phasors in electromagnetics.
3. Explain the AM broadcasting, TV broadcasting and FM broadcasting in terms of polarization.
4. Define group velocity. Explain the cases in which the group velocity is different from the phase velocity.
5. Explain the case in which the finite transmission line is matched.
6. Obtain an expression for quality factor of a parallel resonant circuit with well insulated line.
7. Single conductor waveguides cannot support TEM waves. Why?
8. Write a short note on cavity resonators.
9. Show that $E^2 - c^2B^2$ is relativistically invariant.
10. Write down the electromagnetic field tensor $F^{\mu\nu}$ and the dual tensor $G^{\mu\nu}$.
11. It is not useful to consider plasma as a magnetic medium. Justify.
12. Write short note on plasma oscillations.

(12 x 1 = 12 Weightage)

Part B

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

13. Discuss in detail, the reflection and transmission of an e.m. wave (parallel polarization) incident obliquely at a plane dielectric boundary. Mention the important theoretical observations.

14. Discuss the propagation of TM waves in a rectangular waveguide and obtain an expression for the cut-off frequency and phase velocity.
15. Formulate Maxwell's equations and Lorentz force law in relativistic notations.
16. Describe the Debye shielding in plasma. Derive an expression for Debye length and explain plasma in terms of Debye length.

(2 x 6 = 12 Weightage)

Part C

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

17. A plane wave of angular frequency ω and wave vector $|\mathbf{k}|$ propagates in a neutral, homogenous, anisotropic, non conducting medium with $\mu = 1$. Show that **H** is orthogonal to **E** and **k**, and also that **E** and **H** are transverse.
18. Prove that the magnetic field lags behind the electric field by 45^0, when uniform plane waves propagate in a good conductor.
19. A signal generator of internal resistance 1ohm with an open circuit voltage of $0.3\cos(2\pi 10^8 t)$ V is connected to a 50 ohm lossless transmission line of 4m long. The wave propagates on the line with a velocity of 2.5×10^8m/s. Find the instantaneous expressions for the voltage and current at an arbitrary location on the line, for a matched load.
20. Find the maximum amount of 10 GHz average power that can be transmitted through an air filled rectangular waveguide a = 2.25cm, b = 1cm at the TE_{10} mode without a breakdown.
21. Describe magnetism as a relativistic phenomenon by considering the force between current carrying wire and a moving charge.
22. For a low density plasma, the dispersion relation is given by $\omega^2 = \omega_0^2 + c^2k^2$, where k is the wave vector and ω_0 the plasma frequency. Derive a relation between the phase velocity and group velocity of the plasma.

(4 x 3 = 12 Weightage)

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