146926

D 13159

(Pages : 2)

Name.....

Reg. No.....

FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2021

(CBCSS)

Physics

PHY 1C 03—ELECTRODYNAMICS AND PLASMA PHYSICS

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend* **all** *questions in each section.*
2. *The minimum number of questions to be attended from the Section / Part shall remain the same.*
3. *The instruction if any, to attend a minimum number of questions from each sub section / sub part / sub division may be ignored.*
4. *There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.*

Section A

(8 Short questions answerable within 7.5 minutes)

Answer **all** *questions.*

Each carry weightage 1.

1. Explain the loss tangent of a medium. How do we define a good conductor in a time varying field ?
2. Define reflection coefficient and transmission coefficient. Obtain the relation between them.
3. Explain the term skin depth. How does it vary with wavelength ?
4. State the boundary conditions to be satisfied by H_z for TE waves in a rectangular waveguide.
5. Define the quality factor of a cavity resonator.
6. Express the field tensor in terms of four-vector potential.
7. What is meant by plasma frequency ? Give the expression.
8. Explain the krook collision term.

(8 × 1 = 8 weightage)

Turn over

Section B

(4 essay questions answerable within 30 minutes)
Answer any **two** *questions.*
Each carry weightage 5.

9. Derive the homogeneous electromagnetic wave equations in a source free region ?

10. Obtain the general transmission-line equations for arbitrary time dependence and for time-harmonic time dependence ?

11. Derive the general transformation rules for electromagnetic field.

12. Derive the fluid equation of motion in isotropic case.

(2 × 5 = 10 weightage)

Section C

(7 problems answerable within 15 minutes)
Answer any **four** *questions.*
Each carry weightage 3.

13. Obtain the boundary conditions between a lossless dielectric and a perfect conductor.

14. Prove that a uniform plane wave propagating in an arbitrary direction $\hat{a}$, is a TEM wave with E perpendicular to H and that both E and H are normal to $\hat{a}$.

15. A narrow-band signal propagates in a lossy dielectric medium which has a loss tangent 0.12 at 3 kHz, the carrier frequency of the signal. The dielectric constant of the medium is 2. Calculate the phase and group velocity ?

16. A signal generator having an internal resistance 1 Ω and an open circuit voltage $v(t) = 0.03\cos(2\pi(10^6)t)$ is connected to a 48 Ω lossless transmission line. If the velocity of wave propagation on the line is 10^8 (m/s), find the instantaneous expressions for the voltage and current at an arbitrary location on the line. Find the average power transmitted to the load ?

17. Derive the continuity equation in tensor form.

18. Compute the Larmor radius for a solar proton streaming with velocity 240 km/s in a magnetic field of (5×10^{-5}) Tesla ? What does its value for a 1.1keV He^+ ion in the same field ?

19. Compute λ_D and N_D in a fusion reactor with capacity of ion concentration from $10^{13}/m^3$ to 10^{9} and at kT_e 0.01eV.

(4 × 3 = 12 weightage)