20P108 (Pages: 2) Name: ……

Reg. No……...……...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CBCSS-PG)

(Regular/Supplementary/Improvement)

CC19P PHY1 C03 – ELECTRODYNAMICS AND PLASMA PHYSICS

(Physics)

(2019 Admission onwards)

Time: Three Hours Maximum: 30 Weightage

Part A

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

1. Give the electromagnetic boundary conditions at the interface between two lossless linear media.
2. Bring out the physical significance of the complex permittivity.
3. How are ordinary electric networks different from transmission lines?
4. How is group velocity related to phase velocity for normal and anomalous dispersion?
5. What are cavity resonators? How can you excite a particular mode in a cavity resonator?
6. Show that space-time interval is invariant under four-vector transformation.
7. Express the relation between fields and potentials in relativistic notation?
8. Write down the Boltzmann and Vlasov equations and their significance.

(8 x 1 = 8 Weightage)

Part B

Answer any **two** questions. Each question carries 5 weightage.

9. Obtain the non-homogeneous wave equation for magnetic vector and electric scalar potentials. Discuss about the solutions to these non-homogenous wave equations for potentials.
10. Discuss the reflection and transmission of a perpendicularly polarized electromagnetic wave obliquely incident at a plane dielectric boundary.
11. Obtain matching condition for the propagation of electromagnetic waves on transmission lines from general transmission line equations. What is the necessity of transmission line impedance matching?
12. Obtain the transformation equations for the components of electric and magnetic fields when we move from one inertial frame to another moving with a uniform relative velocity.

(2 x 5 = 10 Weightage)

Part C

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

13. The instantaneous expression for magnetic field intensity of a uniform plane wave propagating in the +y direction in air is given by $\mathbf{H} = \mathbf{a_z}\ 4 \times 10^{-6} \cos [10^7 \pi t - k_o y + (\pi/4)]$ (A/m). (a) Determine k_o and the location where $\mathbf{H_z}$ vanishes at t = 3 ms, (b) Write the instantaneous expression for **E**.
14. Show that the electric field of a pure dipole falls off as r^{-n}, where r is the distance 'r' from the dipole. Also, find the value of 'n'.
15. Determine and compare the attentuation constant and skin depth of copper [σ_{Cu}= 5.80 x 10^7 (S/m)] at the following frequencies: (a) 60 Hz, (b) 1 GHz.
16. The attenuation on a 50 **Ω** distortionless transmission line is 0.01dB/m. The line has a capacitance of 0.1 nF/m. Find the resistance, inductance and conductance per meter of the line.
17. Determine the wave impedance and guide wavelength at a frequency equal to twice the cut-off frequency in a waveguide for TM and TE modes. Compare the values to that of a TEM mode.
18. Compute the tensor invariant $F^{\mu\nu}G_{\mu\nu}$ in terms of **E** and **B**.
19. Compute Debye length and number of particles in a Debye sphere for n = 10^{18} per m^3 and $k_B T_e$ = 0.1 eV.

(4 x 3 = 12 Weightage)

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