PES University, Bengaluru

(Established under Karnataka Act 16 of 2013)

END SEMESTER ASSESSMENT (ESA) - DEC 2023

UE20EC303 - Electromagnetic Field Theory

Total Marks : 100.0

1.a. Derive an expression for electric field intensity due to an infinite sheet of charge with charge density $\rho_s\, C/m^2$. Assume suitable assumptions

(8.0 Marks)

1.b. State Guass's law and hence derive the First Maxwell's equation.

(6.0 Marks)

1.c. Given the potential $V = \frac{10\sin\theta\cos\phi}{r^2}$. Determine (i) **E -** Electric Field Intensity (ii) ***D –*** *Electric Flux Density at* $(2, \frac{\pi}{2}, 0)$

(6.0 Marks)

2.a. State Biot Savart's law and hence give the mathematical expression for Biot Savart's law in Vector form. (5.0 Marks)

2.b. Derive an expression for Magnetic field Intensity **H** due to an infinite sheet of charge. Assume suitable assumptions (7.0 Marks)

2.c. State Maxwell's equations for Static Electric and Magnetic fields both in differential form and Integral form (4.0 Marks)

2.d. A charged particle moves with a uniform velocity of $4a_x\ m/s$ in a region where $E = 20a_y\ V/m$. Determine B_0 such that the velocity of the particle remains constant. (4.0 Marks)

3.a. Derive an expression for the V_{emf} generated
(i) By having a stationary loop in a Time-Varying **B** -field
(ii) By having a moving loop in a static **B** - field
(iii) By having a moving loop in a time-varying **B**-field (6.0 Marks)

3.b. Starting from $\nabla \times H = J$ derive an expression for displacement current density. (8.0 Marks)

3.c. The electric and magnetic fields in free space are given by $\boldsymbol{E} = \frac{50}{\rho}\cos(10^6 t + \beta z)\, a_{\varnothing}\, V/m$ *and* $\boldsymbol{H} = \frac{H_0}{\rho}\cos(10^6 t + \beta z) a_{\rho}$. Express these in Phasor form (6.0 Marks)

4.a. For an L-type equivalent circuit model of a two-conductor transmission line of length Δz derive an expression $\frac{d^2 V_s}{dz^2} - \gamma^2 V_s = 0$ *where* $\gamma^2 = (R + j\omega L)(G + j\omega C)$ (8.0 Marks)

4.b. A loss line has a characteristic impedance of 70 ohms and a phase constant of 3 rad/m at 100 MHz. Calculate the inductance per meter and capacitance per meter. (6.0 Marks)

4.c. Define the following with relevant mathematical expressions
(i) Reflection coefficient (ii) Standing wave ratio (iii) Input Impedance
(6.0 Marks)

5.a. A lossless line has a characteristic impedance of 300 ohms. The line is terminated with a load impedance of 300 + j 300 ohms. Calculate the reflection coefficient and Standing wave ratio from the Smith Chart
(8.0 Marks)

5.b. Write Short notes on Quarter wave Transformer with relevant mathematical expressions. (5.0 Marks)

5.c. Write the procedure for single stub matching using Smith chart
(7.0 Marks)