Khulna University of Engineering & Technology
B. Sc. Engineering Special Backlog Examination 2018
Department of Electrical and Electronic Engineering
EE 2211
Electromagnetic Fields

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.

(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) State and explain Coulomb's law. (05)

(b) Write Gauss's law. Using the law, find fields between concentric spherical electrodes with two dielectrics and fields of a spherical region of uniform charge density. (11)

(c) Define electrostatic potential. Deduce the equation for potential at any point in a system of charges. Find potentials around a line charge and between co-axial cylinders. (11)

(d) Two point charges of 120nC are located at A(0,0,1) and B(0,0,-1). (i) Find E at P(0.5,0,0) and (ii) what single charge at the origin would provide the identical field strength? (08)

Q2. (a) What is electric dipole? Define dipole moment and show that the dipole potential decreases with $1/r^2$ rate with increasing distance. (09)

(b) Derive Laplace and Poisson's equation. (14)

(c) A current carrying filament carrying 15A in the $\overline{a_z}$ direction lies along the entire z-axis. Find $\bar{H}$ in rectangular co-ordinates at (i) P_A ($\sqrt{20}$, 0, 4) (ii) P_B (2, -4, 4). (12)

Q3. (a) Show that the energy stored in an electrostatic field is $W_E = \frac{1}{2}\int_{vol} \varepsilon_o E^2 dv$; where the symbols have their usual meanings. (13)

(b) State and explain Biot-Savart law. (07)

(c) What is retarded potential? Deduce the equations for vector potential and magnetic field of a parallel wire transmission line. (15)

Q4. (a) State Stoke's theorem and demonstrate it. (12)

(b) Write Ampere's circuital law for magnetic field. Using Ampere's circuital law, determine the magnetic field intensity $\bar{H}$ at different cross-section positions of a coaxial cable. (12)

(c) Prove that $\nabla \times \bar{H} = \bar{J}$; where the symbols have their usual meanings. (11)

Section B

Q5. (a) State Faraday's law. Compose the conditions for having a non-zero $d\varphi/dt$. Within a cylindrical region $\rho < b$, the magnetic field is given by $\bar{B} = B_0 e^{kt} \bar{a}_z$. Find electric field intensity at any point due to this magnetic field. (15)

(b) State and explain displacement current. (08)

(c) Determine the displacement current in between two parallel plates of a capacitor energized by an alternating current source. (12)

Q6. (a) Derive the velocity of a plane wave in free space using Maxwell's equation. (12)

(b) State and explain KVL for electromagnetic circuit. (11)

(c) A material has $\mu_r = 1$, $\varepsilon_r' = 2.5$ and loss tangent = 0.12 in the frequency range 0.5 MHz to 100 MHz, calculate: (i) σ (ii) λ and (iii) V_p at 1MHz and 75MHz. (12)

Q7. (a) What is linear and circular polarization? Prove that a linear polarized wave can be represented by two circular polarized waves. (12)

(b) Derive the condition for complete reflection and zero reflection for three mediums having different intrinsic impedances. How there conditions can help to design the coating on a camera lens. (11)

(c) Prove that maximum amplitude of magnetic field intensity occurs one-eighth of a cycle later than the maximum amplitude of electric field intensity for a UPM travelling through a good conductor. (12)

Q8. (a) Write short notes on (i) MUF (ii) Ground wave propagation and (iii) Rain and cloud effects on line of sight communication. (10)

(b) Determine the input impedance at the interface of two medium having impedances η_1 and η_2. The second medium has another interface with the third medium having an impedance of η_3. (13)

(c) Write down the prominent modes of radio wave propagation. Prove that the receiving electromagnetic field changes due to earth curvature in space wave propagation. (12)