BACHELOR OF ELECTRICAL ENGINEERING (Evening) EXAMINATION, 2018

(2nd Year, 1st Semester Supplementary)

FIELD THEORY

Time:3 hours Full Marks:100

(50 marks for each part)

Use separate Answer-script for each part

PART-I

Answer any three questions. Two marks for neatness. All symbols have their usual significance

1. a) Derive the expression for curl of a vector field **B**, written as $\nabla \times \mathbf{B}$ where ∇ is the vector differential operator in Cartesian coordinate.

b) What is the physical significance of the curl of a vector field?

c) Establish the Stoke's Theorem. **8+3+5+=16**

2. a) Establish Boundary relation for magnetic field when it passes through two different magnetic media having permeabilities μ_1 and μ_2.

b) Derive an expression for self-inductance per unit length of a Co-axial Cable having solid inner conductor of radius R_1 and outer conductor of radius R_2 with negligible thickness.

8+8=16

3. a) Establish that $\nabla \times \mathbf{H} = \mathbf{J}$

b) Show that $\nabla . \mathbf{B} = 0$

c) Show that $\nabla . \mathbf{J} = 0$ **6+5+5=16**

4. a) Establish $\nabla \times \mathbf{E} = - \partial \mathbf{B}/\partial t$.

b) Establish $\nabla \times \mathbf{H} = \mathbf{J} + \partial \mathbf{D}/\partial t$. **8+8=16**

5. a) What is plane electromagnetic wave ? Using E.M. wave equation in free space, explain its propagation by obtaining an analytical solution of the wave equation. Draw E.M. wave propagation in free space.

b) Establish "Poynting Theorem" . **10+6=16**

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Ex/EE/5/T/213/2018(S)

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PART-II

Answer ***any three*** questions

Two marks are reserved for neatness and well organized answer script

1. a) Deduce an expression for electric field intensity at a point on the axis of a uniformly charged ring. 8

   b) Show that electric field lines are always normal to the equipotential surfaces. Give proper illustration in support of your answer. 8

2. a) From the three basic equations of electrostatics derive (i) Poisson's and (ii) Laplace's equations. 6

   b) A point charge $Q_1 = 0.8\ \mu C$ is located at (2,1,4) m and another point charge $Q_2 = 0.6\ \mu C$ is located at (0,3,1) m. Calculate the electric field intensity at (1,4,1) m in vector form. Medium is oil ($\varepsilon_r = 2.1$). 10

3. a) State and prove Gauss's Law in integral form. 8

   b) The potential field at any point in a space containing a dielectric medium of $\varepsilon_r = 4$ is given by $\phi = 7xy^2 - 3yz^2 - 4zx^2$ V, where x, y and z are in meters. Calculate the absolute value of electric field intensity at the point (4,3,2) m. 8

4. a) Explain the boundary conditions for dielectric-dielectric boundary of different permittivities. 8

   b) Derive the FDM equations for node potentials in 2-D system with equal nodal distances. 8

5. a) Prove "Uniqueness Theorem". 8

   b) The flux lines of an electric field pass from air into glass, making an angle 30° with the normal to the plane surface separating air and glass at the air-side of the surface. The relative permittivity of glass is 5.0. The field intensity in air is 200 V/m. Calculate the flux density in glass and also the angle, which the flux lines make with the normal on the glass side. 8

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