BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING EXAMINATION, 2018

(3rd Year, 1st Semester)

FIELD THEORY

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-I

Answer ***any three*** questions

Two marks are reserved for neat and well organized answer script

1. Derive the expression for electric field intensity due to a uniformly charged ring, at a point lying on the axis of the ring. Also find the expression for electric field intensity due to a uniformly charged disc, at a point lying on the axis of the disc. 8+8

2. a) The potential field at any point in space containing a dielectric medium of $\varepsilon_r = 5$ is given by $\phi = 5x^3 - 3y^3 - 4z^3$ V, where x, y and z are in meters. Calculate the electric flux density at the point (1,3,5) m. 8

   b) A point charge $Q_1 = +0.5\ \mu C$ is located at the origin of a reference axes. Another point charge $Q_2 = -1.0\ \mu C$ is located at (4,0,1)m. Calculate the y-component of electric field intensity at (2,2,1)m. Medium is air. 8

3. For a single-core cable having one dielectric medium, find out the minimum and maximum field intensity within the dielectric. 16

4. a) Discuss the boundary conditions for electric field in two different dielectric media. 10

   b) With respect to Fig. 1, calculate the unknown node voltages using FDM. Consider air as the medium. 6

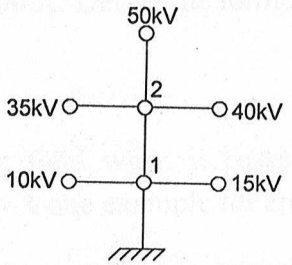

Fig. 1

P.T.O.

5. a) Derive the expressions for the electric field intensity components at any point due to an electric dipole. 8

b) Explain how the field due to co-axial cylindrical system can be converted to the field due to a parallel-plate capacitor system with the help of conformal transformation. 8

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PART-II

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 **T** using **definition of curl**, written as $\nabla \times \mathbf{T}$ where ∇ is the vector differential operator in Cartesian co-ordinates. What is the **physical significance** of the curl of a vector field?

b) Establish the **Stoke's Theorem**. Show that an irrotational field is also known as a conservative field. **8+8=16**

2. a) What is significance of $\nabla.\mathbf{J} = 0$ in static field.

b) Show that $\nabla.\mathbf{B} = 0$ and draw the field.

c) Establish $\nabla \times \mathbf{H} = \mathbf{J}$ and draw the fields. **5+5+6=16**

3. a) Explain Vector Magnetic Potential. Using Vector Magnetic Potential deduce " Biot-Savart Law" and draw the fields.

b) Establish $\nabla \times \mathbf{E} = -\partial \mathbf{B}/\partial t$ and show the pictorial view of this relation. **10+6=16**

4. a) Using Maxwell's equation derive electromagnetic wave equations.

Using E.M. wave equation in free space, obtain an analytical solution of the wave equation of Electric Field (E) considering it as a plane wave and also draw the wave propagation. Find E.M. wave velocity in free space.

b) Using Biot-Savart Law find **H** on the axis at a distance **10 cm** from the plane of a circular current loop of radius **10 cm** carrying current of **1000 A**. Derive the formula if used any. **10+6=16**

8+8=16

5. Write short notes on any two:

a) Boundary relation for magnetic field when it passes through two different magnetic media having permeabilities μ_1 and μ_2 respectively & one example for application of this relation.

b) Expression for self-inductance for a two wire transmission line having solid conductor assuming th necessary parameters for the system concern.

c) E.M. Wave polarization.