Ref.No. Ex/ EE/5/T/213/2019(Old)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION,2019(Old)

(SECOND YEAR FIRST SEMESTER)

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) What is the fundamental definition of curl of a vector field?
   Also derive the expression for curl of a vector field **C**, written as $\nabla \times \mathbf{C}$ where, ∇ is the vector differential operator in Cartesian coordinates. What is the physical significance of the curl of a vector field?

   b) Establish the Stoke's Theorem.

   10+6=16

2. a) Show that $\nabla \times \mathbf{H} = \mathbf{J}$.
   b) Using Biot- Savart Law derive B (wb/m^2) at the centre of a square current loop of 2 m side having current 200A in clockwise direction and derive the formulae used if any.

   6+10 =16

3. a) Establish $\nabla \times \mathbf{H} = \mathbf{J} + \partial \mathbf{D}/\partial t$ and explain the displacement current?
   b) Derive an expression for Self-Inductance per unit length for a Coaxial Cable of solid inner conductor assuming the cable inner conductor radius 'R_1' and hollow outer conductor radius 'R_2'.

   8+8=16

4. a) Derive electromagnetic (E.M.) wave equation for Electric Field (**E**). 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.
   b) What is "Poynting Vector"?

   12+4=16

5. Write short notes on any two: 8+8=16
   a) $\nabla . \mathbf{J} = 0$ and $\nabla . \mathbf{B} = 0$.
   b) $\nabla \times \mathbf{E} = -\partial \mathbf{B}/\partial t$ showing the pictorial view of this relation.
   c) Boundary relation for magnetic field when it passes through two different magnetic media having permeabilities μ_1 and μ_2.

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Ref No.: Ex/EE/5/T/213/2019 (Old)

BACHELOR OF ENGINEERING
IN ELECTRICAL ENGINEERING (EVENING) EXAMINATION (Old), 2019
(2nd Year, 1st Semester)

SUBJECT: FIELD THEORY

Time: Three Hours | Full Marks: 100
(50 Marks for each part)

Use a separate Answer-Script for each part
Two marks for neat and well-organized answers

Question No.		Part-II	Marks

Answer any three questions

1. (a) State and prove the integral form of Gauss's Law. 2+6
   (b) Find the electric field intensity at P(0,0,5)m in air due to the point charges Q1 = 0.45μC at A(0,4,0)m and Q2 = - 0.35μC at B(3,0,0)m. 8

2. (a) Find an expression for the electric field intensity at a point located on the axis of a ring charge at the height "h" from the plane of the ring. The uniform charge density of the ring is ρ_l C/m and the permittivity of the medium is ε_r. 8
   (b) The potential field at any point in a space containing a dielectric medium of $\varepsilon_r = 4$ is given by 8
   $\phi = 7xy^2 - 3yz^2 - 4zx^2$ V, where x, y and z are in meters.
   Calculate the absolute value of electric field intensity at the point (4,3,2) m.

3. (a) Derive an expression for the field intensity at any radius 'r' ($r_1<r<r_2$) in the case of two coaxial cylinders having three different dielectrics in between the inner charged cylinder of radius r_1 and the outer grounded cylinder of radius r_2. 8
   (b) A metallic cylinder of 10cm diameter is charged with 0.5 μC/m spread uniformly over the surface and is surrounded by air. Find the electric field intensity exactly on the cylinder surface. Derive the formulae used. 3+5

4. (a) For the two-dimensional system with equal nodal distances shown in Fig.1, write the FDM equations for the unknown node potentials. Derive the formulae used. 8

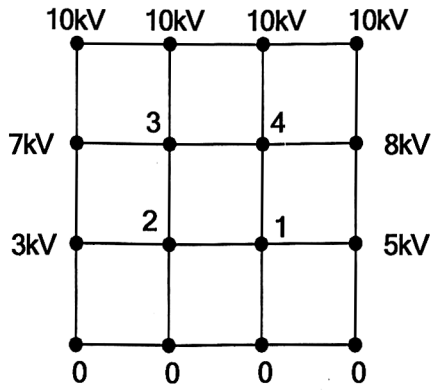

Fig.1

(b) Explain how the field due to co-axial cylindrical system can be analyzed with the help of conformal transformation. 8

(a) State and prove Uniqueness Theorem. 2+6

(b) Derive an expression for the volume density of energy stored in an electric field. 8