Ref.No. Ex/ EE/5/T/213/2019

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION,2019

(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 **F**, written as $\nabla \times \mathbf{F}$ 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 4m side having current 100A in clockwise direction and derive the formulae used if any.

   6+10 =16

3. a) Establish $\nabla \times \mathbf{E} = -\partial \mathbf{B}/\partial t$ and show the pictorial view of this relation.
   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) $\nabla \times \mathbf{H} = \mathbf{J} + \partial \mathbf{D}/\partial t$ and the displacement current?
   c) Electromagnetic (E.M.) wave propagations for **E** & **H** field in free space.

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Ref No.: Ex/EE/5/T/213/2019

BACHELOR OF ENGINEERING
IN ELECTRICAL ENGINEERING (EVENING) EXAMINATION, 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) Derive the differential form of Gauss's Law. Hence, show how it leads to Divergence Theorem. 6+2

   (b) The potential field in a medium having relative permittivity of *3.8* is given by $\phi = 3x^3y^2 + 2y^3z^2 - 4x^2z^3$ volts. Find the electric flux density in vector form at the point (1,4,2)m. 8

2. (a) Derive the expression for the electric field intensity at a particular point located at a height "*h*" on the axis of a ring charge of radius "*r*" having uniform charge density. 8

   (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 air. 8

3. (a) For a single core cable, find the conductor radius 'r' for minimum electric field intensity on the inner conductor surface for a fixed outer sheath radius 'R'. Derive the formulae used. 8

   (b) Prove that the electric field intensity just off the conductor surface is twice the electric field intensity on the conductor surface. 8

4. (a) Derive the FDM equations for the unknown node potentials in 2-D system with equal nodal distances in homogeneous medium. 8

   (b) State and prove Uniqueness Theorem. 8

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

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