Ref.No. EE/T/315/2017(S)

BACHELOR OF ELECTRICAL ENGINEERING EXAMINATION,2017

(3-RD YEAR 1-ST SEMESTER SUPPLE)

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 F using **definition of curl**, written as $\nabla \times F$ where ∇ is the vector differential operator in Cartesian coordinates.

b) Establish the **Stoke's Theorem**. What is the **physical significance** of the curl of a vector field? **8+8=16**

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

Find the curl H at the origin, where $\mathbf{H} = (2y)\mathbf{i} - (x^2+z^2)\mathbf{j} + (3y)\mathbf{k}$ A/m .

b) Show that $\nabla . \mathbf{B} = 0$ **and** $\nabla . \mathbf{J} = 0$ in static field. **8+8=16**

3. a) Establish $\nabla \times \mathbf{H} = \mathbf{J} + \partial \mathbf{D}/\partial t$ and show the pictorial view of this relation.

b) Find **H** on the axis at a distance **1m** from the plane of a circular current loop of radius **10 cm** carrying current of **1000 A**. Derive the formula if used any using Biot-Savart Law. **8+8=16**

4. a) What do you mean by electromagnetic(E.M.) wave? Derive electromagnetic wave equations.

Using E.M. wave equation in free space, obtain an analytical solution of the wave equation of Magnetic Field considering it as a **plane wave** and also draw the wave propagation.

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

5. Write short notes on any two: **8+8=16**

a) Wave Guide and Skin effect .

b) Expression for self-inductance for a co-axial cable having solid inner conductor.

c) Maxwell equation $\nabla \times \mathbf{E} = -\partial \mathbf{B}/\partial t$ and its **physical significance** .

BACHELOR OF ENGINEERING IN

ELECTRICAL ENGINEERING EXAMINATION, 2017

(3rd Year, 1st Semester, Supplementary)

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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 disc. 12

   b) What is "Equipotential Surface"? Explain with example. 4

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

   b) A point charge Q1 = +1.0μC is located at (3,1,1) m in air. Find the magnitude and polarity of the point charge located at (1,2,2) m for which the z-component of electric field intensity will be zero at the origin. 8

3. a) How mechanical pressure is produced at charged conductor surface? Derive its expression. 8

   b) Find the electric field intensity of a hollow copper sphere (i) just off the sphere, (ii) on the sphere and (iii) inside the sphere. Assume that the sphere is surrounded by air. 8

4. a) A circular disc of charge of radius 1m having a uniform charge density $\rho_s = +1nC/m^2$ lies in the z=0 plane, with center at the origin. Find the uniform charge density of a circular ring of charge of radius 2m lying in the z=0 plane, with center at the origin, which would produce the same electric field intensity at the point (0,0,5) m as that due to the disc charge. Medium is air. 10

   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. 6

5. a) Prove "Uniqueness Theorem". 8

   b) Explain how the field within a single-core, single-dielectric co-axial cable can be analyzed by means of conformal transformation. 8

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