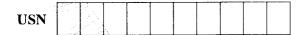
Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages



## Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018 Field Theory

Time: 3 hrs. Marks:100

Note: 1. Answer any FIVE full questions, selecting atleast TWO questions from each part.

2. Missing data, if any, may be suitably assumed.

## PART - A

- 1 a. State and explain Coulomb's law for electrostatic force between two point charges.

  Represent force in vector form. (05 Marks)
  - b. Find electric flux density in Cartesian co-ordinate system at a point (6, 8, -10) due to:
    - i) A point charge of 60mc at the origin
    - ii) A uniform surface charge of density  $\rho_S = 100 \,\mu\text{c/mt}^2$  on the plane x = 12mt. (08 Marks)
  - c. Given the electric flux density  $\overrightarrow{D} = 5\sin\theta \, \widehat{a}_{\theta} + 5\sin\phi \, \widehat{a}_{\phi}$ , find the charge density of (0.7m,  $\pi/2$ ,  $2\pi$ ) (spherical coordinates). (07 Marks)
- 2 a. Obtain the boundary conditions between two perfect dielectrics. (07 Marks)
  - b. An electrostatic field is given by  $\dot{E} = -12xy\,\hat{a}_x 6x^2\,\hat{a}_y + \hat{a}_z$  V/m. The charge of 6c is to be moved from B(1, 8, 5) to A(2, 18, 6). Find the work done in each of the following cases:
    - i) The path selected is  $y = 3x^2 + z$ ; z = x + 4
    - ii) The straight line from B to A

Show that the work done remains same and is independent of the path selected. (08 Marks)

- c. Find the work done in assembling four equal point charges of 2 μc each on x and y axis at ±3m and ±4m respectively. (05 Marks)
- a. Obtain Poisson's and Laplace's equations form Maxwell's first equation. (06 Marks)
  - b. State and prove uniqueness theorem.

(08 Marks)

- c. Determine whether or not the following potential fields satisfy the Laplace's equation:
  - i)  $V = x^2 y^2 + z^2$
  - ii)  $V = r \cos \phi + t$
  - iii)  $V = r \cos \theta + \phi$ .

(06 Marks)

- 4 a. Obtain on expression for magnetic field intensity of a point due to infinite conductor using
  Biot Savart's law.. (08 Marks)
  - b. State and prove Ampere's circuital law as applied to magnetic field. (05 Marks)
  - c. Evaluate both sides of the Stoke's theorem for the field.  $\overrightarrow{H} = 6xy \, \hat{a}_x 3y^2 \, \hat{a}_y$  A/m and the rectangular path around the region,  $2 \le x \le 5$ ;  $-1 \le y \le 1$ ; z = 0. Let the positive direction of

 $\overrightarrow{ds}$  be  $\widehat{a}_z$ . (07 Marks)

## PART - B

- 5 a. Discuss the magnetic boundary conditions to apply B and H at the interface between two different magnetic materials. (06 Marks
  - b. Define self inductance. Derive an expression for self inductance of a co-axial cable.

(06 Marks

- A rectangular loop in z = 0 plane has corners at (0, 0, 0), (1, 0, 0), (1, 2, 0) and (0, 2, 0). The loop carries a current of 5A in  $\hat{a}_x$  direction. Find the total force produced by the magnetic field,  $\hat{B} = 2\hat{a}_x + 2\hat{a}_y 4\hat{a}_z$  Wh/mt<sup>2</sup>.
- 6 a. Explain the interpretation of Faraday's law applicable to time varying magnetic field and derive an expressions for 'transformer e.m.f' and motional e.m.f. (06 Marks
  - b. Derive the equation giving relation between A and V (Lorent'z condition for potentials fron retarded potentials)

    (07 Marks)
  - c. A parallel plate capacitor with plate area of  $5 \text{cm}^2$  and plate separation of 3 mm has a voltage of  $50 \text{ sin } (10^3 \text{t})$  volts applied to its plates. Calculate the displacement current assuming  $\epsilon = 2 \epsilon_0$ .
- 7 a. Obtain the solution of wave equations for uniform plane wave propagating in free space.
  (10 Marks
  - b. Wet marshy soil is characterized by  $\sigma = 10^{-2}$  s/m,  $\epsilon_r = 15$  and  $\mu_r = 1$ . At frequencies 60Hz 1mHz, 100mHz and 10 GHz. Indicate whether soil be considered as a conductor or a dielectric.
- 8 a. With necessary expression, explain (SWR) standing wave ratio. (10 Marks)
  - b. Derive the expressions for transmission co-efficient and reflection co-efficient. (10 Marks)

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