**VIT**
Vellore Institute of Technology

# Final Assessment Test – November 2019

Course: ECE1017 - Electromagnetic Field Theory and Transmission Lines

Class NBR(s): 1288 / 1317 Slot: B1+TB1

Time: Three Hours Max. Marks: 100

**KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE**

**General Instructions: Use Smith chart for the Q.11**

Answer <u>ALL</u> Questions

(100 Marks)

1. Derive an expression for electric field intensity due to an infinite sheet of charge in the xy-plane with uniform charge density $\rho_s$ C/m$^2$. [10]

2. a) Determine $\vec{D}$ at (4, 0, 3) if there is a point charge $-5\pi$ mC at (4, 0, 0) and a line charge $3\pi$ mC/m along the y-axis. [10]

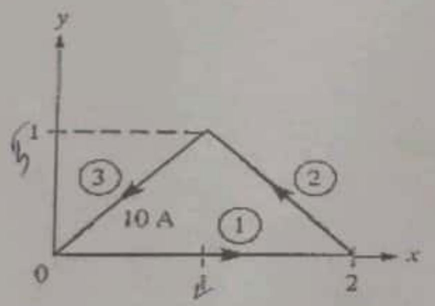
OR

b) A circular ring of radius "a" carries a uniform charge $\rho_L$ C/m and is placed on the xy-plane with axis the same as the z-axis. (i) Find E at (0, 0, h) (ii) If the total charge on the ring is Q, find E as $a \rightarrow 0$. [10]

3. a) Given that $\vec{B} = 4\,\hat{a}_x - 8\,\hat{a}_z$ Wb/m, find the force exerts on a 0.2m conductor on the y-axis with a current 2 A in the $-\hat{a}_y$ direction. [5]

b) An infinitely long filamentary wire carries a current of 2 A in the +z-direction. Calculate (i) B at (-3 , 4 , 7) (ii) The flux through the square loop described by $2 \le \rho \le 6$, $0 \le z \le 4$, $\phi = 90°$. [5]

4.(a) The conducting triangular loop in Figure carries a current of 10 A. Find $\vec{H}$ at (0, 0, 5) due to side 1 and 2 of the loop. [10]

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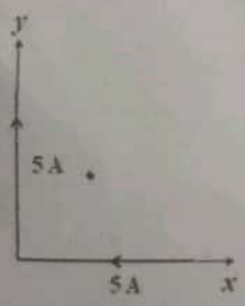
OR

4.(b) An infinitely long conductor is bent into an L shape as shown in Figure. If a direct current of 5 A flows in the conductor, find the magnetic field intensity at (i) (2, 2, 0) (ii) (0, -2 , 0) (iii) (0, 0, 2). [10]




5. a) A 100 MHz signal generator is connected across a parallel plate capacitor with plate area 5 cm$^2$, separation distance 5 mm and 5 V/m electric field exists between the plates. Find the maximum value of displacement current density and displacement current. [5]

b) Derive boundary condition for tangential and normal components of electric field at the interface of two different dielectrics. [5]

6. Given $\vec{H} = 30\cos(2\pi \times 10^8 t - 6x)\hat{a}_y$ mA/m exists in a medium. Find (i) the type of medium (ii) intrinsic impedance (iii) attenuation constant (iv) Poynting vector (v) the time-average power crossing the surface $x = 1, 0 < y < 2, 0 < z < 3$ m. [10]

7. Deduce the loss tangent equation and show how it can used to classify the medium. [5]

8. The electric field component of a plane wave incident normally on a conducting plate is $\vec{E}_i = 40\cos(\omega t - \beta z)\hat{a}_x + 30\sin(\omega t - \beta z)\,\hat{a}_y$ V/m. (i) Find the incident magnetic field component (ii) If the wave encounters a conductor normal to the 'z' axis at 'z=0', find the reflected field components. (iii) Calculate the time average Poynting vector for $z \le 0$ and $z \ge 0$. [10]

9. Calculate the input impedance of a transmission line with half wavelength. List the possible applications of such transmission lines. [5]

10. A transmission line is operating at 500 MHz has $R = 25\,\Omega/m, L = 0.5\mu H/m, G = 100\, mS/m$ and $C = 32\, pF/m$. Calculate (i) propagation constant (ii) attenuation constant (ii) characteristic impedance (iv) phase velocity by which signal would travel [10]

11. A RF transmission line with a characteristic impedance of 50 Ω is connected to a 90+j150 Ω load. Use Smith chart to calculate (i) standing wave ratio (ii) reflection coefficient (iii) lengths and locations of a short circuited shunt stub to match the load to the transmission line. [10]

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