Registration no: | | | | | | | | | | |

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B.TECH
PCEE4302

6th Semester Regular / Back Examination 2016-17
ELECTRO MAGNETIC THEORY
BRANCH: ELECTRICAL
Time: 3 Hours
Max Marks: 70
Q. Code: Z178

Answer Question No.1 which is compulsory and any Five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Express the field $\vec{E} = A\overrightarrow{a_r}/r^2$ in (a) Rectangular Components, (b) Cylindrical Components.

b) An infinite line charge charged uniformly with a line charge density of 20 nC/m is located along z - axis. Find $\vec{E}$ at (6, 8, 3) m.

c) What is the difference between magnetic vector potential and magnetic scalar potential?

d) In an electric field two equipotential surfaces cannot intersect. Explain why?

e) State Poynting theorem.

f) Distinguish between transformer emf and motional emf.

g) Find the velocity of a plane wave in a lossless medium having a relative permittivity of 5 and relative permeability of unity.

h) A solenoid 3 cm in length carries a current of 200 mA. If solenoid is to produce a magnetic flux density of 4.6 mWb/m^2, how many turns of wire are needed?

i) Calculate the capacitance of a parallel plate capacitor having an electrode area of 100cm^2. The distance between the electrodes is 4mm and the dielectric used has a permittivity of 3.5. The applied potential is 100 Volts.

j) State the Uniqueness Theorem.

Q2 **a)** Show that the vector field $\vec{E} = yz\overrightarrow{a_x} + xz\overrightarrow{a_y} + xy\overrightarrow{a_z}$ is both continuous (solenoidal) and conservative (irrotational). **(4)**

b) Verify stokes theorem over a hemispherical surface at r = 2 and $0 \leq \theta \leq \pi/2$ for a function $\vec{F} = 100\cos\theta\,\overrightarrow{a_r}$. **(6)**

Q3 **a)** State and explain Biot-Savart Law. **(4)**

b) In a one dimensional device the charge density is given by $\rho_v = \frac{\rho_0 x}{a}$, if $\vec{E} = 0\ at x = 0, \& V = 0\ at x = a$, Find V and $\vec{E}$. **(6)**

Q4 **(a)** A current sheet with density $\vec{K}$= 12.5$\overrightarrow{a_x}$A/m is located on z=0 plane and another current sheet with density $\vec{K}$= -12.5$\overrightarrow{a_x}$A/m is located on z=5m plane. Determine magnetic field intensity in all the regions. **(5)**

(b) In a conducting medium, **(5)**

$\vec{H} = y^2z\overrightarrow{a_x} + 2(x+1)yz\overrightarrow{a_y} - (x+1)z^2\overrightarrow{a_z}$A/m

Find (i) Current Density $\vec{J}$ at (1,0,-3)

(ii) The current passing through y=1, 0 ≤ x ≤ 1, 0≤z≤ 1

Q5 **a)** A point charge of 20 nC is located at the origin while plane y = 3 carries charge 20 nC/m^2. Find $\vec{D}$at (0,4,3). **(5)**

b) Two dipoles with dipole moments -5$\overrightarrow{a_z}$nC.m and 9$\overrightarrow{a_z}$nC.m are located at points (0,0,-2) and (0,0,3) respectively. Find the potential at the origin. **(5)**

Q6 **a)** Derive an expression for attenuation constant and phase constant in a lossless dielectric medium. **(5)**

b) The electric field in free space is given by **(5)**

$$\vec{E} = 55\,Cos\,(10^8t + \beta z)\,\overrightarrow{a_y}V/m$$

(i) Find the direction of wave propagation.

(ii)Calculate β and the time it takes to travel a distance of λ/2

(iii) Find λ, f, $\vec{H}$.

Q7 **a)** A spherical capacitor has inner radius a and outer radius b, filled with an inhomogeneous dielectric with $\varepsilon = \varepsilon_0 k/r^2$. Show that the capacitance of the capacitor is $C = \frac{4\pi\varepsilon_0 k}{b-a}$. **(5)**

b) The plane z=0 marks the boundary between free space and a dielectric with a dielectric constant 8. If the electric field intensity in the free space is $\vec{E}$ = 5$\overrightarrow{a_x}$ + 7$\overrightarrow{a_y}$ + 4$\overrightarrow{a_z}$ V/m, then determine $\vec{E}$ in the dielectric medium. **(5)**

Q8 **Write short notes on anytwo:** **(5x2)**

a) Boundary Conditions in a Magnetic Field.

b) Method of images

c) Maxwell's equations in differential forms

d) Polarization of EM wave.