3rd Semester Regular/Back Examination 2017-18
ELECTROMAGNETIC FIELD THEORY
BRANCH: AEIE, EIE, IEE
Time: 3 Hours
Max Marks: 100
Q.CODE : B1114

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

Q1   Answer the following questions: *multiple type or dash fill up type*   **(2 x 10)**

a) A positive charge Q C is located at point A (0,0,3) and a negative charge of magnitude Q C is located at point B (0,0,-3). The electric field intensity at point C (4,0,0) is in the
     a) –ve X-direction   c) -ve Z direction
     b) +ve X-direction   d) +ve Z direction

b) Gauss law relates the electric field intensity E with the volume charge density ρ at a point as:
     a) $\nabla \times E = \epsilon_0 \rho$ c) $\nabla . E = \epsilon_0 \rho$
     b) $\nabla \times E = \rho / \epsilon_0$ d) $\nabla . E = \rho / \epsilon_0$

c) Voltage applied across a glass dielectric produces an electric field 10 times of that of air. The dielectric constant for glass is _____ .

d) The sum of two oppositely rotating circularly polarized waves of equal amplitude will be
     a) A circularly polarized wave
     b) A linearly polarized wave.
     c) An elliptically polarized wave.
     d) An un-polarized wave.

e) The _____ is the rate of change of potential measured in the direction of electric field.

f) The relation between electric intensity E, voltage applied V and distance d between the plates of a parallel plate capacitor is _____.

g) When a plane wave travelling in free space is incident normally on a medium having $\epsilon_r = 4.0$, then fraction of power transmitted into the medium is given by
     a) 8/9   b) 1/2   c) 1/3   d) 5/6

h) If $H = 0.1 \sin(10^8 \pi t + \beta y) a_x$ A/ m for a plane wave propagating in free space, then the time average Poynting vector is _____ .

i) When the phase velocity of an electromagnetic wave depends on frequency in any medium, the phenomenon is called _____ .

j) For sea water with $\sigma = 5 \frac{mho}{m}$ and $\epsilon_r = 80$, what is the distance for which radio signal can be transmitted with 90% attenuation at 25KHz?
     a) 0.322m   b) 3.22m   c) 32.2m   322m

Q2   Answer the following questions: *Short answer type*   **(2 x 10)**

a) Two small diameter 5g dielectric balls can slide freely on a vertical non conducting thread. Each ball carries a negative charge of 2µC. If the lower ball is restrained from moving then what is the separation between two balls?

b) If the curl of a vector field is zero, what is the vector field called?

c) The plane Z = 0, marks the boundary between free space and a dielectric with a dielectric constant 4. The E in free space is $E = 5a_x + 12a_y + 3a_z$ V/m. Determine the E in dielectric medium?

d) What is displacement current? Does it exist in free space or not?

e) In a field of charge Q at the origin, potential at A(2,0,0) and B(1/2,0,0) are V_A = 15V and V_B = 30V respectively. What will be the potential at C(1,0,0)?

f) What is a Poynting vector and what is its physical interpretation?

g) What is the capacitance of a solid infinitely conducting solid sphere of radius 'R' in free space?

h) Write down the generalized Ampere's law and explain each term in the equation.

i) Find the polarization $cos (wt +30) a_x + 3 sin (wt-45) a_y$?

j) What is difference between polarization and charging of a neutral object?

Q3 a) Write down the statements of Divergence theorem and Stoke' theorem. **(10)** Also Prove that the divergence of the Curl of a vector A is ZERO.
Find the divergence of $V(x,y,z) = -(x \cos xy+y)i + (\sin z^2+x^2+y^2)k$

b) Given $J = 5x\, a_x + (y-3)a_y + (2+z)a_z\ A/m^2$. Find the charge crossing **(5)** per unit time out of the surface S of the rectangular box bounded by the planes   x=0, x=2, y=0, y=2, z=0, z=2.

Q4 a) What is the limitation of Ampere's circuital law? Explain the correction done **(10)** by Maxwell to Ampere's law by explaining continuity equation.

b) A uniform plane electromagnetic wave propagating in air is given as $E = $ **(5)** $i_x \cos[\omega t - (2\pi/\lambda)y]$. Derive by Maxwell's equation the expression for the vector magnetic field.

Q5 a) Derive the boundary conditions for electric field intensity E, electric flux **(10)** density D, magnetic field intensity H and magnetic flux density B for an interface between two perfect dielectric media.

b) For a current distribution in free space $A = (2x^2y + yz)a_x + (xy^2 - xz^3)a_y - (6xyz - 2x^2y^2)a_z Wb/m$. calculate magnetic flux density. **(5)**

Q6 a) Derive the expression for Energy and Energy density in static electric field. **(10)**

b) Write and explain the Maxwell's equations in integral form and differential **(5)** form with its physical significance.

Q7 a) Explain about magnetization vector and derive the expression for relative **(10)** permeability.

b) If two parallel plates of area 4 m^2 are separated by a distance 6mm, find the **(5)** capacitance between these two plates. If a rubber sheet of 2 mm thick with £r=2.4 is introduced in between the plates leaving a gap of 1mm on both sides, determine the capacitance.

Q8 a) State and explain the Poynting theorem and derive the expression for **(10)** poynting vector.

b) Write short notes on : **(5)**
a)Skin depth
b)Vector Potential

Q9 a) Derive the relation between E and H in uniform plane wave propagation. **(10)** Define intrinsic impedance and give its physical significance.

b) Find the input impedance of the distortion-less transmission line at radio **(5)** frequencies in both open circuited and shorted cases.