Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PEI3I001

3rd Semester Back Examination 2019-20
ELECTROMAGNETIC FIELD THEORY
BRANCH : AEIE, EIE, IEE
Max Marks : 100
Time : 3 Hours
Q.CODE : HB822

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define curl of a vector field A.
b) How are the small increments in length represented in cylindrical coordinates and spherical coordinates?
c) For the scalar field $u = \frac{x^2}{2} + \frac{y^3}{3}$, find the magnitude of the gradient at the point (1,3).
d) Two-point charges -1nC and 4nC are located at (0,0,0) and (0,0,1). Find the energy in the system.
e) State the boundary condition that is valid at the boundary between two dielectrics 1 and 2.
f) Give the relationship between potential gradient and electric field.
g) What do you mean by vector magnetic potential?
h) Write down the generalized Ampere's law and explain each term in the equation.
i) Write the plane wave equation for dielectric medium.
j) What is Brewester angle?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Given points A (x=2, y=3, z= -1) and B (ρ=4, ø= -50^0, z=2). Find the distance from (i) A to origin (ii) B to origin (iii) A to B.
b) Define Gradient, Divergence and Curl. Explain their significances.
c) Express the field E=2xyz $\hat{a}_x$ -5(x+y+z) $\hat{a}_z$ in cylindrical coordinates. Hence find |E| at the point P(ρ=2,ø=60^0,z=3).
d) Infinite plane sheets of charge lie in z= -2, z=0 and z=2 planes with uniform surface charge densities of ρ_{s1}, ρ_{s2} and ρ_{s3} C/m^2, respectively. Given that the resulting electric field intensities at the points (5,3,-1), (6,-2,1) and (4,-7,10) are 0, -2a_z and a_z V/m respectively. Find (i) ρ_{s1}, ρ_{s2} and ρ_{s3} (ii) E at the point (-8,9,-20).
e) State and explain Gauss's law in differential form and explain what do you mean by $\nabla . D$
f) Write and explain Laplace's equations and Uniqueness theorem.
g) A current distribution gives rise to the vector magnetic potential A= $x^2y\, a_x + y^2x\, a_y - 4xyz\, a_z$ Wb/m^2. Calculate the flux through the surface defined by z=1, 0≤ x ≤1 and -1 ≤ y ≤ 4.
h) Explain BiotSavart law in vector form.
i) Derive theexpression forself-inductance of co-axial cable of inner radius 'a' and outer radius radius 'b'.
j) Write and explain the Maxwell's equations in integral form and differential form with its physical significance.

k) A 300 MHz plane EM wave is propagating in free space. The wave is incident normally on an infinite copper slab. For the transmitted wave in the copper slab, calculate the following: (a) attenuation constant (b) phase constant (c) skin depth (d) phase velocity (d) group velocity

l) A uniform plane electromagnetic wave travelling in free space enters into a loseless medium at normal incidence. In the medium its velocity reduces by 50% and in free space sets up a standing wave having a relection coefficient of 0.125. calculate the permeability and permittivity of the medium.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Describe in detail the various coordinate systems used in Electromagnetics. **(10)**

b) What is Laplacian of a scalar? Express Laplacian operator in Cartesian, cylindrical & spherical coordinate system. **(6)**

Q4 **a)** State Gauss's law and using Gauss's law find out electric flux density for (i)Infinite line charge (ii) uniformly charged sphere. **(10)**

b) Explain the method of electrical images and discuss its applications in the study of electromagnetic problems. **(6)**

Q5 **a)** State and explain the differential and integral forms of Ampere's circuital law. Verify that within a conductor carrying a current *I*, the magnetic field strength at a distance *r* from the centre of the wire is given by $H = \frac{Ir}{2\pi R^2}$, where *R* is the radius of the wire. The current density is constant across the cross section of the conductor. **(10)**

b) State and explain Lenz's law. What is curl of the induced electric field? **(6)**

Q6 **a)** State and derive poynting theorem. What is poynting vector? Obtain expression for the average energy densities for time harmonic fields. **(10)**

b) Derive the relation between E and H in uniform plane wave propagation. **(6)**