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

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

Sub_Code: REE4D001/REL4D001

4th Semester Back Examination: 2024-25
SUBJECT: Electro Magnetic Theory
BRANCH(S): EEE,ELECTRICAL
Time: 3 Hours
Max Marks: 100
Q.Code: S590

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

a) Given point X (6.32, 71.56º, 3) in Cylindrical system, evaluate X in Cartesian system.
b) Point charges 2 mC and –2 mC are located at (1, 1, –2) and (–2, –1, 1), respectively. Calculate the electric force on 10 nC charge located at (0, 3, 1).
c) What is the Faraday's law and Lenz's Law.
d) Define the transmission line parameters.
e) What is function of a RF waveguide?
f) State and prove divergence theorem.
g) State Ampere circuit law. Using stoke theorem derive maxwell's third equation.
h) What are the boundary conditions that H or B must satisfy at the interface between two different media.
i) Define standing wave ratio. What happens to the amplitudes of its travelling waves.
j) D = (x + z) ay. Transform the vector to cylindrical and spherical coordinates.

Part-II

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

a) Briefly describe the stokes theorem and divergence theorem using necessary equations.
b) Express the given Cartesian coordinate points in Cylindrical and spherical coordinates: (I) P (–1, 6, 2) (b) Q (1, 3, 5)
c) With suitable examples discuss the physical significance of gradient and curl of a given function.
d) Given the magnetic vector potential A = $p^2 / 4a_z$ Wb/m. Calculate the total magnetic flux crossing the surface $\phi = \pi / 2$, $1 \le p \le 2$m, $0 \le z \le 5$.
e) Show that, in a perfect conductor, the static electric field and all time varying fields are zero.
f) Write notes on Poisson's and Laplace's Equations.
g) State and explain Poynting theorem.
h) Explain the reflection of a plane wave at the Interface of Two Dielectric Regions.

i) Define reflection coefficient and transmission coefficient. Two non-magnetic perfect dielectric regions have a plane common boundary surface. A uniform plane wave of parallel polarization is incident at an angle θ_i with the normal to the interface. The relative permittivity of the regions are 3.5 and 4.8 respectively. If the incident wave is from the region of the lower permittivity and angle of refraction is 25°, find the transmission and reflection coefficients for the electric field.

j) The plane wave E = 30 cos (wt – z)a_x V/m in air normally hits a lossless medium having, $\mu = \mu_0$, $\varepsilon = 4\varepsilon_0$ at z = 0. Find Γ, τ and S.

k) Determine the gain, beam width, and capture area for a parabolic reflector antenna with 10 m diameter dish and dipole feed at 10 GHz.

l) Write, which mode is the dominant mode in a rectangular waveguide. The inside dimensions of a hollow rectangular waveguide, with air as dielectric, are a = 2.5 cm and b = 1.6 cm in the x and y direction respectively. It transmits electromagnetic energy at a source frequency equal to 1.5 times the cut-off frequency in the dominant TE mode. The amplitude of electric field intensity in y direction is 7500 V/m. Calculate the average power transmitted.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 Calculate the field intensities due to cylindrical and spherical charge distributions using Gauss's law. A uniformly charge distributed plane surface S = 3x + 5y + 6z = 30 m is located in air. The surface charge density is 1.5 nC/m^2. Find the field intensity. **(16)**

Q4 Derive the continuity equation. Write the displacement current you know about it. Considering 1 GHz frequency of field intensity that varies harmonically with time, Calculate the ratio of conduction current density to displacement current density in **(16)**

(a) A good conductor for which the conductivity is 3.8×10^7 S/m and the relative permittivity is 1.0.

(b) A good dielectric for which the conductivity is 1.2×10^{-9} S/m and the relative permittivity is 5.0.

Q5 What are linear, circular, and elliptical polarization of uniform plane waves? The conductivity, relative permittivity, and relative permeability of a medium are1.6×10^{-3} S/m, 11.8, and 1.0 respectively. Find the propagation constant, attenuation constant, phase constant, and intrinsic impedance of the medium at a frequency of 160 MHz. **(16)**

Q6 What is a half-wave dipole antenna? Derive the radiation properties such as power radiated, radiation resistance, radiation intensity, and directive gain discussing the radiation pattern of a half-wave dipole in free space. A vertically oriented Hertzian dipole has a uniformly distributed current of 25 A amplitude at 60 MHz. it is located in free space with its mid-point at the origin of spherical coordinates. The length of the dipole is 3 cm. Find the radiation electric and magnetic field intensities at (150 m, 90°, 0°), total radiated power, and maximum and average values of radiation intensity. If the radius and conductivity of the antenna wire will be 1.5 mm and 57 MS/m respectively, what will be the radiation Efficiency of the antenna. **(16)**