VIT

Final Assessment Test – November/December 2023

Course: BECE2054 – Engineering Electromagnetics

Class NBR(s): 2264 / 2266 / 2268 / 2271 / 2274

Slot: D2+TD2

Time: Three Hours

Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN "OFF" POSITION, IS TREATED AS EXAM MALPRACTICE

General Instruction: Smith Chart will be provided.

Answer ALL Questions

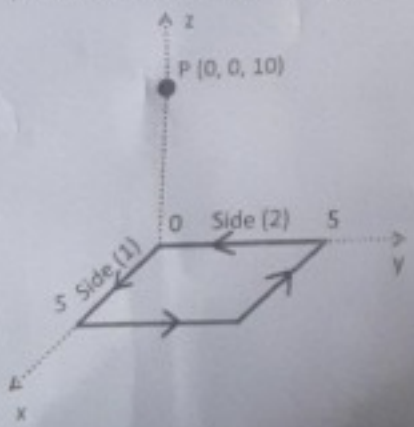
(10 X 10 = 100 Marks)

1. Given vectors $\mathbf{A} = 2\,\mathbf{a}_x + 4\,\mathbf{a}_y + 10\,\mathbf{a}_z$ and $\mathbf{B} = -5\,\mathbf{a}_\rho + \mathbf{a}_\phi - 3\,\mathbf{a}_z$, find
   a) $\mathbf{A} + \mathbf{B}$ at P (0, 2, -5)
   b) The angle between A and B at P

2. The electric flux density $\mathbf{D} = 7\rho \sin\phi\, \mathbf{a}_\rho + 5\rho \cos\phi\, \mathbf{a}_\phi$ C/m^2.
   a) Find the volume charge density at P (2.6, 38°, -6.1)
   b) How much charge is located inside the region defined by
   $0 < \rho < 2.8,\ 20° < \phi < 80°,\ 3.4 < z < 4.1$

3. In a slab of dielectric material for which $\varepsilon = 3.8\varepsilon_0$ and $V = 320\,z^2$ (volt), Determine:
   a) Electric field intensity
   b) Electric flux density
   c) Volume charge density
   d) Electric susceptibility
   e) Polarization field.

4. A square loop, as shown in Fig., is carrying 5 mA. Find the total magnetic field at (0, 0, 10) due to side (1) and (2). Draw the vectors of resulting magnetic field.



5. Let $\mu_{r1} = 3.3$ in region 1 where $x < 0$, while $\mu_{r2} = 5.5$ in region 2 where $x > 0$. Assume there is no surface current density at $x = 0$. In region 1, the field is $\mathbf{B} = 2.4\mathbf{a}_x - 3\mathbf{a}_y + \mathbf{a}_z$ mT. Find the value of magnetic flux density in region 2 and the angle B_2 makes with the normal to the surface.

6. A plane wave in a nonmagnetic medium has $E = 50 \sin(10^8 t + 2z)\mathbf{a}_x$ V/m. Find
   a) The direction of wave propagation
   b) relative permittivity of a dielectric material ε_r
   c) Wave impedance
   d) Magnetic field **H**

7. The characteristic impedance of a line is $710\angle -16^\circ\ \Omega$. At 1 KHz, the attenuation constant is 0.01 Neper/km and the phase constant is 0.035 rad/km, calculate the primary parameters R, L, G, C per km and velocity of propagation.

8. A load impedance 40-j20 Ω is connected to 50 Ω lossless line of length 0.18λ, determine
   a) Standing wave ratio
   b) Voltage reflection co-efficient
   c) Input impedance
   d) Input admittance
   e) Return loss

9. Design an LC-section matching network to match a series RC load with an impedance $Z_L = (200\text{-}j60)\ \Omega$ to a 100 Ω line at a frequency of 2 GHz using Smith Chart (any one solution).

10. A hollow rectangular waveguide has dimensions a = 6 cm and b = 4 cm, which is operating at 10 GHz in the TE_{10} mode. Compute,
    a) Cut-off frequency
    b) guide wavelength
    c) phase constant
    d) phase velocity
    e) wave impedance Z for the case when the waveguide is filled with an air

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