National Institute of Technology Hamirpur (H.P.)

Examination: B. Tech. End Semester Examination, December-2021

Branch :   Electrical Engineering   Semester : IIIrd
Course :   Electromagnetic Field Theory   Code   : EE-212

Time: 02:00 Hours   **Maximum Marks: 50**

Instruction: Attempt all the questions.

Q.1. (a) A circle of radius 4 is centered at the origin of the xyz axes and rests in yz plane. If $A = 6y^2 a_x + 4z\, a_y + 12y\, a_z$, find $\oint A.\, dl$ where the contour is the circumference of the circle. Verify this by using Stokes's Theorem. **[05]**

(b) State and explain the Laplace's and Poison's equations in details and describe its applications. **[05]**

[Total = 10 Marks]

Q.2. (a) Given that $H_1 = -3a_x + 10a_y + 5a_z\ A/m$ in region $y - x - 4 \leq 0$, where $\mu_1 = 7\mu_0$, calculate
(i) M_1 and B_1
(ii) M_2 and B_2 in region $y - x - 4 \geq 0$, where $\mu_2 = 4\mu_0$ **[05]**

(b) A uniform plane wave propagating in a medium has
$$E = 4e^{-\alpha z} \sin(10^7 t - \beta z)\, a_y\ V/m$$
If medium is characterized by $\varepsilon_r = 1,\ \mu_r = 10,\ \&\ \sigma = 5\ S/m$, find $\alpha, \beta, \& H$. **[05]**

[Total = 10 Marks]

Q.3. (a) Given a uniform plane wave in air as
$$E_i = 20 \cos(\omega t - \beta z)\, a_x + 10 \sin(\omega t - \beta z) a_y\ V/m$$
(i) Find H_i
(ii) If the wave encounters a perfectly conducting plate normal to the z axis at $z = 0$, find the reflected wave E_r and H_r
(iii) What are the total E and H fields for $z \leq 0$? **[05]**

(b) In a nonmagnetic material,
$$E = 8 \sin(2\pi \times 10^6 t - 0.6x)\, a_z\ V/m$$
Find:
(i) ε_r, and the intrinsic impedance η
(ii) The time-average power carried by the wave
(iii) Total power crossing 200 cm^2 of plane 3x + y = 7 **[05]**

[Total = 10 Marks]

Q.4. (a) A distortionless line has $Z_0 = 50\,\Omega$, $\alpha = 10\,\frac{mNp}{m}$, $u = 0.4c$, where c is the speed of light in a vacuum. Find R, L, G, C, and λ at 200 MHz. **[04]**

(b) A load of $100 + j150\ \Omega$ is connected to a 75 Ω lossless line. Calculate:
(i) Reflection coefficient Γ (ii) Standing wave ratio s (iii) The load admittance Y_L
(iv) Z_{in} at 0.4 λ from the load (v) The location of V_{max} and V_{min} with respect to the load if the line is 0.6 λ long (vi) Z_{in} at the generator. **[06]**

[Total = 10 Marks]

Q.5. (a) In a rectangular waveguide for which $a = 2.5$ cm, $b = 0.4$ cm, $\sigma = 0$, $\mu = \mu_0$ and $\varepsilon = 5\varepsilon_0$,

$$H_x = 6\sin(\pi x/a)\cos(2\pi y/b)\sin(\pi \times 10^{12}t - \beta z)\ A/m$$

Find:
(i) The mode of operation
(ii) The cutoff frequency
(iii) The phase constant β
(iv) The propagation constant γ
(v) The intrinsic wave impedance η **[05]**

(b) An air-filled resonant cavity with dimensions $a = 10$ cm, $b = 7$ cm, and $c = 15$ cm is made of copper ($\sigma_c = 5.8 \times 10^7 S/m$). Find the five lowest-order modes. **[05]**

[Total = 10 Marks]

~~ All The Best ~~