

International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination Spring-2018

Program: B.Sc. Engg. (EEE)

Course Code: EEE-3621

Course Title: Engineering Electromagnetism

Time: 2 hours 30 minutes

Full Marks: 50

[Figures in the right margin indicate full marks. Use separate script for each part]

PART-A

[Answer any two questions from the followings]

- 1(a). Is it possible to isolate Magnetic field? Explain with proper diagram. 2
- 1(b). State the Ampere's circuital law. Prove that, $\nabla \times H = J$, where symbols have their usual meaning. 4
- 1(c). Consider a loop of Fig.1(c), If $B=0.5a_z \text{ Wb/m}^2$, $R=20\Omega$, $l=10\text{cm}$, and the rod is moving with a constant velocity of $8a_x \text{ m/s}$. Find, 4
- a) Induced EMF in the rod,
 - b) The current through the resistor,
 - c) The motional force on the rod,
 - d) Power dissipated by the resistor.

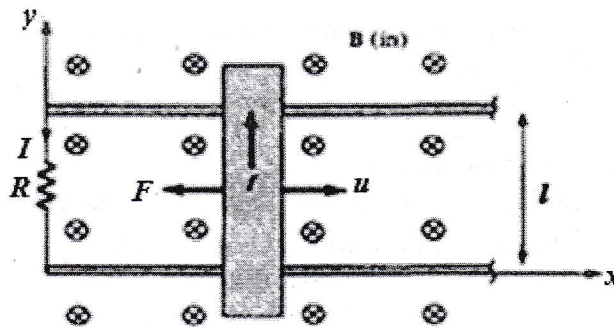


Fig. 1(c)

- 2(a). What is meant by lossy dielectric? Prove that, for a linear, isotropic, homogeneous, lossy dielectric medium, $\nabla^2 E_s - \gamma^2 E_s = 0$ (symbols have their usual meaning) 3
- 2(b). Define skin depth. If we have plane wave in free space where, $\sigma = 0, \epsilon = \epsilon_0, \mu = \mu_0$ what will be the value of intrinsic impedance (η)? 3.5
- 2(c). A sinusoidal electric intensity of amplitude of 50 V/m and frequency 1 GHz exists in a lossy dielectric medium that has a relative permittivity of 2.5 and loss tangent of 0.001. Find the average power dissipated in the medium per cubic meter. 3.5
- 3(a). Derive the Maxwell's equation for time varying magnetic field. 3
- 3(b). Electric field intensity of a linearly polarized uniform plain wave propagating in the +z direction in the sea water is, $E=a_x 100 \cos(10^7 \pi t)$ V/m at $z=0$. The constitutive parameters of sea water are, $\epsilon_r=80, \mu_r=1$ and $\sigma=4 \text{ s/m}$. Determine the attenuation constant, intrinsic impedance, phase velocity wavelength and skin depth. 3

- 3(c). In a nonmagnetic medium, 4

$$\mathbf{E} = 4 \sin \left(2\pi \times 10^7 t - \frac{1}{2} x \right) \mathbf{a}_z \text{ V/m}$$

Find,

- i. ϵ_r, η
- ii. The time-average power carried by the wave
- iii. The total power crossing 8 m^2 of plane $2x + y = 5$.

PART-B

[Answer any **three** questions from the followings]

- 4(a). Define Brewster's angle and critical angle. 2
- 4(b). Show that, $E_r = \Gamma E_i$, where symbols have their usual meaning. 4
- 4(c). Suppose, wave entering from medium 1 air (η_0) to medium 2 conductor (η_c) and $\eta_0 \gg \eta_c$. Find E_t, E_r, H_t, H_r ; where symbols have their usual meaning. 4
- 5(a). Differentiate between transmission line and waveguide? Briefly discuss the importance of waveguide. 3.5
- 5(b). Discuss the different mode categories that may exist in a waveguide. 3.5
- 5(c). A hollow rectangular waveguide is to be used to transmit signals at a carrier frequency of 6 GHz. Choose its dimensions so that the cutoff frequency of the dominant TE mode is lower than the carrier by 25% and that of the next mode is at least 25% higher than the carrier. 3
- 6(a). Define: Distortion less line and VSWR. 2
- 6(b). A transmission line operating at 500 MHz has $Z_o = 80 \Omega$, $\alpha = 0.04 \text{ Np/m}$, $\beta = 1.5 \text{ rad/m}$. Find the line parameters R, L, G , and C . 4
- 6(c). A lossless transmission line of length 0.434λ and characteristic impedance 100Ω is terminated in an impedance $260 + j180 \Omega$. Using **smith chart** find (a) the voltage reflection co-efficient (b) the standing wave ratio (c) the input impedance and (d) the location of voltage maximum on the line. 4
- 7(a). Why TEM mode not exists in waveguide? Also, define phase velocity and group velocity. 3
- 7(b). Define Voltage reflection coefficient for a transmission line. What will be the value of Characteristic Impedance (Z_0) if we have a lossless transmission line and why? 3
- 7(c). A certain transmission line operating at $\omega = 10^6 \text{ rad/s}$ has $\alpha = 8 \text{ dB/m}$, $\beta = 1 \text{ rad/m}$ and $Z_o = 50 + j40 \Omega$, and is 3 m long. If the line is connected to a source of $10 \angle 0^\circ \text{ V}$, $Z_g = 40 \Omega$ and terminated by a load of $20 + j40 \Omega$, determine: 4
- i. The input impedance
 - ii. The sending-end current
 - iii. The current at the middle of the line