International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination Spring-2019
Course Code: EEE-3621
Time: 2 hours 30 minutes

Program: B.Sc. Engg. (EEE)
Course Title: Engineering Electromagnetism
Full Marks: 50

Part A

[Answer any ***two*** questions from the followings; figures in the right margin indicate full marks.]

1(a). State the Biot-savarts law. **2**

1(b). Prove that, "Magnetostatic field is not conservative". **4**

1(c). Consider the loop of Fig.1(c); if B=0.5a_z Wb/m^2, R=20Ω, l=10cm, and the rod is moving with a constant velocity of 8a_x m/s, find: **4**

i. Induced EMF in the rod
ii. The current through the resistor
iii. The motional force on the rod
iv. Power dissipated by the resistor.

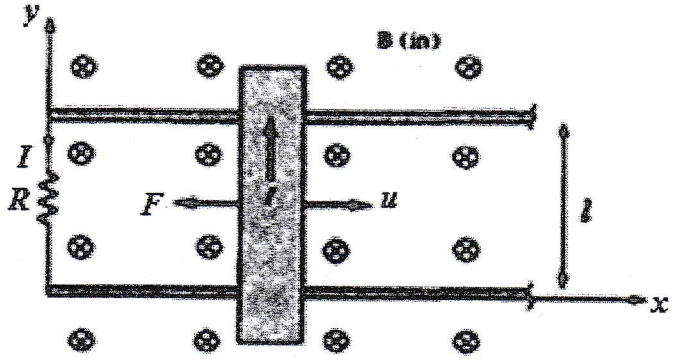

Fig. 1(c)

2(a). What is lossy dielectric? Derive the Helmholtz equation for a linear, isotropic, homogeneous and lossy dielectric medium. **4**

2(b). Electric field intensity of a linearly polarized uniform plain wave propagating in the +z direction in the sea water is, E=a_x100 cos ($10^7\pi$t) V/m at z=0. The constitutive parameters of sea water are, ϵ_r=80, μ_r=1 and σ=4 S/m. Determine the attenuation constant, phase constant, intrinsic impedance, phase velocity wavelength and skin depth. Find, the distance at which amplitude of E is 1% of its value at z=0. **5**

2(c). What is skin depth? **1**

3(a). Write Maxwell's four equation both in differential and integral form for static electromagnetic fields. **2**

3(b). State Faraday's law. Show that, $\nabla \times E = -\frac{\partial B}{\partial t}$; where symbols have their usual meanings. **4**

3(c). A sinusoidal electric intensity, having amplitude of 50V/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. **4**

Part B

[Answer any ***three*** questions from the followings; figures in the right margin indicate full marks.]

4(a). Define standing wave and critical angle. **2**

4(b). Show that, $E_t = \tau E_i$, where symbols have their usual meaning. **4**

4(c). Medium-1 and Medium-2 are lossless non-ferromagnetic dielectric where, $\mu 1=\mu 2=\mu 0$. Wave entering to conductor. Permittivity for Medium-1 is $\epsilon 1$ and permittivity for Medium-2 is $\epsilon 2$. Find, E_r and E_t; where symbols have their usual meaning. **4**

5(a). Define: Distortion less line, Voltage reflection coefficient, VSWR. **3**

5(b). Derive the general time harmonic transmission line equations. **3**

5(c). It is found that attenuation on a 50Ω distortion less transmission line is 0.01 (dB/m). The line has a capacitance of 0.1 (nF/m). Determine resistance, inductance and conductance per meter of the line. Also find the velocity of the wave propagation. **4**

6(a). Write the difference between transmission line and waveguide? What is the importance and applications of waveguide? **3**

6(b). Define TEM wave. Why TEM mode not exists in waveguide? **3**

6(c). A waveguide with dimensions a = 1cm and b = 0.7cm, is to be used at 20GHz. Determine the wave impedance for the dominant mode when, (a) the guide is empty, and (b) the guide is filled with polyethylene (whose $\varepsilon_r = 2.25$). **4**

7(a). Show that, for a lossless transmission line, $Z_0=\sqrt{\frac{L}{C}}$. **2**

7(b). Explain the features of Smith chart. **3**

7(c). A 90 + j120-Ω load is connected to a 30-Ω lossless line. Find using Smith chart: **5**

i. Γ,
ii. s,
iii. The load admittance Y_L,
iv. Z_{in} at 0.4λ from the load,
v. Z_{in} at $0.6\ \lambda$ from the generator;

where symbols have their usual meaning.