International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B. Sc. Engineering in EEE

Final Exam, Spring 2022

Course Code: **EEE 3621** Course Title: **Engineering Electromagnetism**

Time: 2 hours 30 minutes Full Marks: 50

(i) The figures in the right-hand margin indicate full marks

(ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

Course Outcomes (COs) of the Questions	
CO1	Learn some fundamental laws and theories of electromagnetic fields and waves with applications.
CO2	Understand the interactions of electromagnetic (EM) fields and waves with various materials and media.
CO3	Apply mathematical foundations to solve various electromagnetic fundamental issues.

Bloom's Levels of the Questions						
Letter Symbols	**R**	**U**	**App**	**An**	**E**	**C**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1.	a)	Distinguish between displacement and conduction currents. Obtain Faraday's law of induction in differential form for a stationary medium and show how it can be modified if the medium is moving with velocity.	CO1	R	5
1.	b)	A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage 50sin103t V applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_o$.	CO1	Ap	5
2.	a)	Derive the Expression for intrinsic impedance, propagation constant, and velocity of a plane electromagnetic wave when propagated in a lossy dielectric medium.	CO2	An	5
2.	b)	Determine the depth of penetration in copper at 2MHz, given the conductivity of copper σ=5.8 X10^7 S/m and its permeability = 1.26 uH/m.	CO3	C	5
		Or,			
2.	a)	Explain different media for EM wave propagation. Illustrate the relationship between reflection coefficient and transmission coefficients.	CO2	An	5
2.	b)	Design Maxwell's equations in differential form and integral form for EM propagation theory.	CO3	C	5

Part B

[Answer the questions from the followings]

3.	a)	A beam of yellow light with wavelength of 0.6μm is incident in air upon a glass surface. If the surface is situated in the plane z= 0 and relative permittivity of the glass is 2.55, determine reflection co-efficient and standing wave ratio.	CO3	E	4
3.	b)	Derive the expressions for the reflection and transmission coefficient for a wave traveling in free space, which is normally incident on the surface of a dielectric.	CO2	An	6
4.	a)	From the fundamental voltage & current equations of transmission line, derive the expression for input impedance Z_{in} of the line. Modify the expression for lossy & lossless cases.	CO2	An	6

4.	b)	An air line has characteristic impedance of 70Ω and phase constant of 3 rad/m at 100 MHz. Determine the inductance per meter and the capacitance per meter of the line.	CO3	E	4
5.	a)	Sketch the field lines for TE_{11} mode. Derive the instantaneous expressions for the surface current density of this mode.	CO3	R	5
5.	b)	Consider a rectangular waveguide with dimensions 2.28 cm x 1.01 cm. What TE modes will propagate in this waveguide, if the driving frequency is 1.0×10^{10} Hz?	CO2	C	5
		Or,			
5.	a)	Write down the general instantaneous field expressions for TE and TM modes. Deduce those for TE_{01} and TE_{12} modes.	CO3	R	5
5.	b)	A copper-plated wave guide ($\sigma=5.8 \times 10^7$ S/m) operating at 4.8 GHz is supposed to deliver a minimum power of 1.2 kW to an antenna. If the guide is filled with polystyrene ($\sigma=10^{-17}$ S/m, $\varepsilon = 2.55\varepsilon_o$) and its dimensions are a=4.2 cm, b=2.6 cm, calculate the power dissipated in a length 60 cm of the guide in the TE_{10} mode.	CO2	C	5