Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fifth Semester - Regular) Examinations, November 2025

23BECPC35004- Electromagnetic Waves

(ECE)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions

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

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. Define Skin depth and find Skin depth (δ) at a frequency 1.6 MHz in Aluminium. Where $\mu_r = 1$, $\sigma = 38.2$ MS/m.	CO5	K2
b. In a material for which $\sigma = 5.0$ S/m and $\varepsilon_r = 1$ the electric field intensity is 250 Sin 10^{10}t (V/m). Find the conduction and displacement current density.	CO4	K1
c. Test the function $F = b\,(a\text{-}r^2)$ can represent electrostatic potential in the charge free region. If not find the charge density for this region.	CO1	K2
d. Find the inductance per unit length of a coaxial conductor with an inner radius a = 2mm and an outer conductor at b = 9mm. Assume $\mu_r = 1$.	CO3	K2
e. Prove that Scalar Magnetic potential obeys Laplace equation.	CO2	K3

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a. Prove that Gauss law is an alternative statement of Coulomb's law and that Coulomb's law is implicit in Maxwell equation.	7	CO1	K2
b. Show that the potential $V = \frac{1}{r}$, satisfies the Laplace equation where r is position vector.	3	CO1	K2
(OR)			
c. Given potential V = $\frac{10}{r^2}$ $\sin\theta \cos\emptyset$. Find the electric flux density D at (2, $\frac{\pi}{2}$, 0). Also define Solenoidal, Conservative and harmonic fields.	7	CO1	K1
d. Derive One dimensional solution of Laplace equation in Spherical coordinate.	3	CO1	K2
3.a. Derive the boundary conditions for electric field vector E and the displacement vector D at the dielectric-dielectric interface.	8	CO2	K2
b. State Biot- Savart Law.	2	CO2	K3
(OR)			
c. Two homogeneous dielectrics meet on plane Z =0 for z > 0 $\varepsilon_{r1} = 4$ for Z < 0, $\varepsilon_{r2} = 3$. A uniform electric field $E_1 = 5a_x\text{-}2a_y\text{+}3a_z$ *kV/m* exists for Z $\geq$ 0. Find E_2 for Z $\leq$ 0.	4	CO2	K2
d. Explain Polarisation and its type in a dielectric material.	6	CO2	K2
4.a. Define magnetic susceptibility and intensity of magnetization. The B value in a material is 1.4 w/m^2. H = 1750 A/m. Calculate μ_r, X_m, M.	5	CO3	K2
b. Classify Dia, Para and Ferro magnetic material with Examples.	5	CO3	K2
(OR)			

c.	State and explain Faraday's Law of electromagnetic Induction. Write its differential and integral form.	6	CO3	K2
d.	Write the continuity equation and explain the need of displacement current. Also write Maxwell Ampere's Law.	4	CO3	K2
5.a.	State and Explain Poynting Theorem.	7	CO4	K2
b.	Define Poynting vector with Physical significance. and write its unit and dimension.	3	CO4	K2
	(OR)			
c.	Write Maxwells equations in integral form for free space with physical interpretation of each equation.	7	CO4	K2
d.	Calculate the magnitude of Poynting vector at the surface of Sun. Given that Power radiated by Sun = 3.8×10^{26} Watt and radius of Sun is 7×10^{8} m.	3	CO4	K2
6.a.	Compare qualitative and quantitatively the propagation of EM waves in good conductor and free space medium.	6	CO5	K2
b.	Calculate the intrinsic impedance, propagation constant, Skin depth and wave velocity for a conducting medium in which $\sigma = 58$ MS/m, $\mu_r = 1$, for frequency 100 MHz.	4	CO5	K1
	(OR)			
c.	Derive EM wave equation for a free space medium defining its physical parameters.	7	CO5	K2
d.	A plane electromagnetic wave travelling in positive Z- direction in a loss less dielectric medium with relative permeability $\mu_r = 1$, $\varepsilon_r = 3$, has a peak electric field intensity is 6 V/m. Find Speed of wave and intrinsic impedance of medium, peak value of magnetic field.	3	CO5	K1

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