RollNo. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, DEC 2024

Electronics and communication Engneering
III Semester

EC23301 &Electromagnetic Fields
(Regulation2023)

Time:3hrs Max.Marks: 100

CO1	Ability to apply the mathematical concepts to EM laws and theorem
CO2	Ability to apply electromagnetic laws to static fields
CO3	Ability to the understand the basic laws and concepts of static magnetic field.
CO4	Ability to the understand the Maxwells equation and nature of time varying fields
CO5	Ability to the understand the nature of plane waves incident on different media.

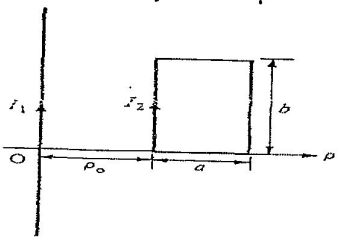
BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	Given that $\mathbf{A} = a_x + \alpha a_y + a_z$ and $\mathbf{B} = \alpha a_x + a_y + a_z$, if A and B are normal to each other, find α	2	1	3
2	Find the Laplacian of the scalar field $U = \rho^2 z \cos 2\varphi$	2	1	3
3	Show that $\mathbf{E} = -\nabla V$	2	2	2
4	A capacitor is designed from 3cm x3 cm ,FR 4 sheet by pasting copper sheet on both sides. The thickness of the sheet is 2 mm. The conductvity of the copper is $\sigma=5.8\times10^7$ S/m. The dielctric constant for the FR4 is 4.4. find the value of the capacitor.	2	2	3
5	A 10 mH solenoid inductor with length 'l' and cross sectional area 'A'. The number of turns used in the indcutor is 10. Find the ratio of cross sectional area of length of the inductor.	2	3	3
16	State Faradays law.	2	3	1
7	Define dielectric constant .	2	4	1
8	Let the region1 z<0 be is charectierized with uniform dielectric material with €r1=3.2, while the region z>0 is charectireized with dielectric material €r2=2. Let $\mathbf{D1}=-30a_x + 50a_y + 70a_z$, find the D2 in the region 2 z>0	2	4	3
9	State Poynting theorem	2	5	1
10	Find the depth of penetration. If $\sigma = 58 \times 10^6$ mhos/m at frequency 10 MHz,10 GHz. Write the inference.	2	5	3

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)	State divergence theorem and verify for the following vector $\mathbf{A} = 2\rho z a_\rho + 3z\sin\varphi a_\varphi - 4\rho\cos\varphi a_z$ and S is the surface of the wedge $0 < \rho < 2$, $0 < 0 < 45°$, $0 < z < 5$.	13	1	3
	OR			
11 (b)	State stokes theorem and verify the thereom for the vector field $\mathbf{H}=6xya_x-3y^2a_y$ A/m and the rectangular path around the region $2\le x\le5$, $-1\le y\le1$, $z=0$. Let the positive direction of dS be along Z	13	1	3
12 (a)	(i)The finite sheet $0 < x < 1$, $0 < y < 1$ on the $z = 0$ plane has a	8+5	2	4

	charge density $\rho_s = xy(x^2 + y^2 + 25)^{3/2}$ nC/m². Find (a) The total charge on the sheet (b) The electric field at (0, 0, 5). (ii) Define electric field intensity and electric flux density. Give its significance			
	OR			
12 (b)	(i) Find the force on a 100μC charge at (0,0,5)m ,if four like charges of 29 μC are located on the x and y axes at ± 5 meters. (ii)Derive the point form of ohms law.	8+5	2	4
13 (a)	(i) Derive the vector magnetic potential from Biot savart law. (ii) A rectangular loop carrying current I2 is placed parrallel to an infintely long filament carrying current I1 as shown in fig. Determine the force between the two elements and also force experenced by the loop. 	5+8	3	4
	OR			
13 (b)	(i) Find the magnetic field intensity for the infinte long conductor using Ampere circuital law. (ii) A circular loop located on x2+ y2=16, z=0 carries a direct current of 10 A ,along $\mathbf{a}_\phi$. Determine **H** at (0,0,2) and (0,0,-2). Apply Biot–Savart'slaw.	5+8	3	4
14 (a)	Derive the electromagnetic boundary condition at the interface, for the region z>0 as good conductor and z<0 is free space.	13	4	2
	OR			
14 (b)	Derive the Maxwells equation from the basic laws and write its significance.	13	4	2
15 (a)	(i)The electric field in free space is given by $\mathbf{E}=50\cos(10^8t+\beta x)\,\mathbf{a}_y$ V/m (a) Find the direction of wave propagation. (b) Calculate β and the time it takes to travel a distance of/2. (c) Sketch the wave at t = 0, T/4, and T/2. (ii) Using maxwells equation derive the electromagnitic wave equation for the time harmonic fields	9+4	5	3
	OR			
15 (b)	(i). A uniform plane wave propagating in a medium has $\mathbf{E} = 2e^{\alpha z}\sin(10^8t - \beta z)\,\mathbf{a}_y$ V/m. If the medium is characterized by €r = 1, μr = 20, and σ= 3 mhos/m, find α,β and H. (ii) Explain the charecteristics of uniform plane wave when incident normally to the conductor interface.	9+4	5	3

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	(i) Define gauss law . Find the electric flux density for the line of charge, sheet of charge and cloud of charge using gauss law. (iii) Discuss the propagtion of wave in the good conductor and lossy dielectric	8+7	1+5	4