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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; July / August - 2022

Electro Magnetic Field Theory

Time: 3 hrs *Max. Marks: 100*

Course Outcome

The Students will be able to:
*CO1: **Apply** the knowledge of 8-bit processor to understand the 16-bit processor*
*CO2: **Apply** the concepts of 8-bit processor to **analyze** instruction sets and other features in MSP430.*
*CO3: Discuss and **Analyze** the different peripheral components associated with MSP430*
*CO4: To **develop** logical skills to write programs in MSP430 for the given Engineering Problems*
*CO5: To **analyze** the developed code using modern engineering tools.*

***Note**: i) PART-A is compulsory. One question from each unit for maximum of 2 marks.*
*ii) PART-B: Answer any **TWO** sub questions (from a, b, c) from each unit for a Maximum of 18 marks.*

Q. No.	Questions	Marks	BLs	COs
	I : PART - A	**10**		
I a.	What is Gaussian surface? What are the conditions to be satisfied in special Gaussian surface?	2	L2	CO1
b.	What is an equipotential surface?	2	L1	CO2
c.	Give the applications of Stoke's theorem	2	L2	CO3
d.	Define Magneto statics and give an example.	2	L1	CO4
e.	Mention the properties of uniform plane wave.	2	L2	CO5
	II : PART - B	**90**		
	UNIT - I	**18**		
1 a.	Develop an expression for EFI due infinite sheet charge.	9	L3	CO1
b.	Analyze and prove the divergence theorem for a shell region enclosed by spherical surface at r = a and r = b (b>a) and centered at origin, if $\overline{D} = 5r\,\overline{a}_r$ c/m^2 and Evaluate divergence theorem precisely.	9	L4	CO1
c.	A 2 μC point charge is located at A (4, 3, 5) in free space. Evaluate E_ρ, E_φ, and E_z at P (8, 12, 2).	9	L4	CO1
	UNIT - II	**18**		
2 a.	Estimate and analyze the work done in carrying a -2 C charge from P_1 (2, 1, -1) to P_2 (8, 2, -1) in the field $\overline{E} = \overline{a}_x y + \overline{a}_y x$ V/m. i) Analog the parabola $x=2y^2$ ii) Along the straight line joining P_1 and P_2	9	L4	CO2
b.	A uniform surface charge density of 20 n c/m^2 is present on the spherical surface r=0.6 cm in free space.	9	L4	CO2

Contd…2

i) Find the absolute potential at P(r=1 cm, θ=25°, φ=50°,):

ii) Evaluate $V_{AB,}$ given points A(r = 2 cm, θ=30°, ϕ=60°) and B(r = 3 cm, θ=45°, ϕ=90°)

c. State and prove uniqueness theorem. 9 L3 CO2

UNIT - III **18**

3 a. Analyze and develop an expression for boundary conditions between conductor and free space. 9 L3 CO3

b. Let, $J = \frac{25}{\rho}\bar{a}_\rho - \frac{20}{\rho^2 + 0.01}\bar{a}_z$ A/m^2

i) Find the total current crossing the plane Z=0.2 in the a_z direction for ρ<0.4 9 L4 CO3

ii) Calculate $\partial\rho_v/\partial t$

iii) Find the outward current crossing the closed surface defined by ρ = 0.01, ρ = 0.4, Z = 0, and Z = 0.2.

c. Two perfectly-conducting cylindrical surfaces are located at ρ = 3 and ρ = 5 cm. The total current passing radially outward through the medium between the cylinders is 3 A dc. Assume the cylinders are both of length '*l*'.

i) Find the voltage and resistance between the cylinders, and 'E' in the region between the cylinders, if a conducting material having σ = 0.05 S/m is present for 3<ρ<5 cm. 9 L4 CO3

ii) Show that integrating the power dissipated per unit volume cover the volume gives the total dissipated power.

UNIT - IV **18**

4 a. Develop and analyze the magnetic field intensity on the axis of a circular loop conductor using Biot-Savart law. 9 L3 CO4

b. The magnetic field intensity is given in a certain region of space as:

Let $\bar{H} = \frac{x+2y}{z^2}\bar{a}_y + \frac{2}{z}\bar{a}_z$ A/m

i) Find ΔxH ii) Find J 9 L4 CO4

iii) Use J to find the total current passing through the surface z = 4, 1 <x<2, 3<y<5, in the a_z directions. Show that the same result is obtained using the other side of Stoke's theorem.

c. Develop and explain scalar magnetic potential and vector magnetic potential 9 L3 CO4

Contd…3

UNIT - V **18**

5 a.	Analyze and develop expressions for general wave equation.	9	L3	CO5
b.	Develop and analyze the magnetic boundary conditions at the boundary between two permeabities of medium.	9	L3	CO5
c.	State and explain poynting theorem and Let $\mu = 3\times10^{-5}$ H/m, and $\varepsilon = 1.2\times10^{-10}$F/m, and $\sigma = 0$ everywhere. If $H = 2\cos(10^{10}t-\beta x)\, a_z$ A/m, use Maxwell's equations to obtain expressions for 'B', 'D', 'E' and 'β'.	9	L4	CO5

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