Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2017

EE3CO05 / EX3CO05 Electro-Magnetic Theory

Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated.Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Which one of the following is zero? **1**

(a) Grad div. (b) Div curl. (c) Curl grad. (d) None of these

ii. If the vectors A and B are conservative, then **1**

(a) AxB is solenoidal (b) AxB is conservative

(c) A+B is solenoidal. (d) A-B is solenoidal

iii. Electric potential and electric field intensity inside a spherical shell are: **1**

(a) Zero and constant respectively.

(b) Both inversely proportional to radius.

(c) Constant and zero respectively.

(d) Zero and zero respectively.

iv. Poisson's and Laplace's equations govern the behaviour of electric scalar potential for: **1**

(a) Charge free region.

(b) A region of charge.

(c) Charge free region and a region of charge, respectively

(d) Region of charge and charge free region, respectively

v. Displacement current can flow through: **1**

(a) Capacitor (b) Inductor (c) Resistor (d) None of these

vi. The magnetic field intensity (in ampere/metre) at the centre of a circular coil of diameter 1 metre and carrying a current of 2 ampere is **1**

(a) 8 (b) 4 (c) 3 (d) 2

P.T.O.

vii. Maxwell's equations in differential form from Ampere's law are obtained from **1**
(a) M.M.F area (b) Electric potential area
(c) Magnetic flux volume (d) Electric current area

viii. The laws of electromagnetic induction are summarised in the following: **1**
(a) e=iR (b) e=Ldi/dt (c) e=-dψ/dt (d) None of these

ix. The direction of propogation of electromagnetic waves is given by the direction of **1**
(a) Vector E (b) Vector H
(c) Vector (ExH) (d)None of these

x. Pointing vector has the unit of: **1**
(a) Watt (b) Watt/metre.
(c) Watt/metre^2 (d) None of these

Q.2 i. Give physical significance of divergence and curl. **2**

ii. What are equipotential surfaces? Derive a mathematical equation. **3**

iii. Express vector B in Cartesian and cylindrical coordinate systems. **5**
Given, $\frac{10}{r}\bar{a}_r + rcos\theta\bar{a}_\theta + \bar{a}_\Phi$
Then find B at (-3, 4, 0) and (5, -2 , -2)

OR iv. A point charge of 6nC is located at the origin in free space. Find Vp if point P is located at (0.2, -0.4, 0.4) and **5**
(a) V= 0 at infinity
(b) V= 0 at (1, 0, 0)
(c) V= 20 volts at (-0.5, 1, -1)

Q.3 i. Define perfect conductor **2**

ii. Derive equations for energy density in static electric field **3**

iii. Derive Boundary conditions for static electric field. **5**

OR iv. A parallel plate capacitor as shown in the figure 1 contains three dielectric layer where $E_{r_1} = 1,\ d_1 = 0.2mm,\ E_{r_2} = 2,\ d_2 = 0.3mm,\ E_{r_3} = 3$ and $d_3 = 0.4mm$. Where S= surface area of plane= $20cm^2$. Find the total capacitance. **5**

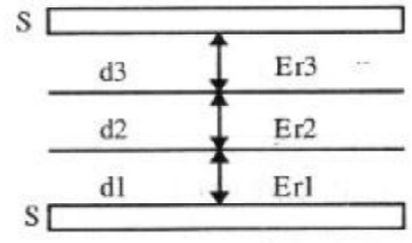

Figure 1

Q.4 i. State Ampere's circuital law as applied to time varying magnetic field. **2**

ii. Derive the expression for force between two current carrying wires. **3**

iii. Derive equation for energy stored and energy density in a magnetic field. **5**

OR iv. Calculate the magnetic flux density produced by a current loop of radius 'R' on the loop axis when the loop is carrying a current 'I' and situated in air. **5**

Q.5 i. Define self and mutual inductance **2**

ii. What is the difference between vector magnetic potential and scalar magnetic potential. **3**

iii. Derive Maxwell's equation in **5**
(a) Differential form
(b) Integral form
(c) Free space

OR iv. Derive for the field at any point P due to long current carrying straight conductor. **5**

Q.6 Attempt any two:

i. State and prove pointings theorem **5**

ii. Derive mathematical equations for reflection at the surface of the conductive medium. **5**

iii. What is meant by polarization of a wave? What is a wave linearly polarized? When is a wave circularly polarized? **5**

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EE3CO05 / EX3CO05 Electro-Magnetic Theory
Marking Scheme

Q.1	i.	(c) Curl grad / (b) Div. Curl	**1**
	ii.	(a) AxB is solenoidal	**1**
	iii.	(c) Constant and zero respectively.	**1**
	iv.	(d) Region of charge and charge free region, respectively	**1**
	v.	(a) Capacitor	**1**
	vi.	(d) 2	**1**
	vii.	(a) M.M.F area.	**1**
	viii.	(c) e=-dΨ/dt	**1**
	ix.	(c) Vector (ExH).	**1**
	x.	(c) Watt/metre^2	**1**
Q.2	i.	Significance of divergence – **1 mark** Significance of curl - **1 mark**	**2**
	ii.	Explanation of equipotential surfaces – **1.5 marks** Mathemaatical Expression – **1.5 marks**	**3**
	iii.	Vector B in Cartesian - **1.5 marks** Vector B in cylindrical coordinate systems. - **1.5 marks** B at (-3, 4, 0) and (5, $\frac{\pi}{2}$, -2) - **2 marks**	**5**
OR	iv.	Vp at (0.2, -0.4, 0.4) - **0.5 marks** Vp if V= 0 at infinity - **1.5 marks** Vp if V= 0 at (1, 0, 0) - **1.5 marks** Vp if V= 20 volts at (-0.5, 1, -1) - **1.5 marks**	**5**
Q.3	i.	Definition of perfect conductor - **2 marks**	**2**
	ii.	Derivation for energy density - 3 **marks**	**3**
	iii.	Derivation of Boundary conditions for static electric field **(each 2.5 marks) * 2 = 5 marks**	**5**
OR	iv.	Formulas / Given - **2 marks** Finding total capacitance - **3 marks**	**5**
Q.4	i.	Statement	**2**
	ii.	Derivation for force between two current carrying wires.	**3**
	iii.	Derivation for energy stored - **2.5 marks** Derivation for energy density in a magnetic field - **2.5 marks**	**5**
OR	iv.	Diagram - **2 marks** Derivation - **3 marks**	**5**
Q.5	i.	Self Inductance - **1 mark** Mutual Inductance - **1 mark**	**2**
	ii.	Difference between magnetic vector potential **1.5 marks** and magnetic scalar potential. **1.5 marks**	**3**
	iii.	Differential form - **1.5 marks** Integral form - **1.5 marks** Free space – **2 marks**	**5**
OR	iv.	Diagram - **2 marks** Derivation - 3 **marks**	**5**
Q.6		Attempt any two:	
	i.	Statement - **1 mark** Derivation - **4 marks**	**1** **4**
	ii.	Derivation (step by step marking)	**5**
	iii.	Explain Polarisation of a wave - **1 mark** Linearly Polarised - **2 marks** Circularly Polarised - **2 marks**	**1** **2** **2**

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