	Seat No.:	Enrolment No
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Subject Code: 151002

Subject Name: Engineering Electromagnetics

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V EXAMINATION - WINTER 2015

Date: 08/12/2015

	me: 1 tructio	.0:30am to 1:00pm Total Marks: 70	
		Attempt all questions. Make suitable assumptions wherever necessary.	
Q.1	(a) (b)	Write a detailed note on the divergence & its physical interpretation. State & explain Biot-Savart law. Derive an expression of magnetic field intensity for an infinitely long straight filament carrying a direct current I on the z axis from $-\infty < z < \infty$.	07 07
Q.2	(a)	Calculate the total charge within each of the indicated volumes: (a) $0 \le \rho \le 0.1$,	07
	(b)	$0 \le \emptyset \le \pi$, $2 \le z \le 4$: $\rho_v = \rho^2 z^2 \sin 0.6\emptyset$; (b) universe: $\rho_v = e^{-2r}/r^2$. Determine an expression for the volume charge density associated with each D field following: (a) $\mathbf{D} = 4xy/z \mathbf{a}_x + 2x^2/z \mathbf{a}_y - 2x^2y/z^2 \mathbf{a}_z$; (b) $\mathbf{D} = z \sin \varphi \mathbf{a}_{\varphi} + z \cos \varphi \mathbf{a}_{\varphi} + \rho \sin \varphi \mathbf{a}_z$; (c) $\mathbf{D} = \sin \varphi \sin \varphi \mathbf{a}_r + \cos \varphi \sin \varphi \mathbf{a}_{\varphi} + \cos \varphi \mathbf{a}_{\varphi}$.	07
	(b)	With the help of proper mathematical treatise prove that, "The divergence of the curl of any vector $\mathbf{A} = A_x \mathbf{a}_x + A_y \mathbf{a}_y + A_z \mathbf{a}_z$ is zero".	07
Q.3	(a)	What is an electric dipole? Derive the expression for the potential and electric field intensity due to a dipole at distances very large from the origin compared to the spacing between the charges of the dipole.	07
	(b)	Derive the expression for the electric field $\vec{\mathbf{E}}$ due to infinitely long line charge distribution.	07
Q.3	(a)	OR What are the characteristics of a good conductor? Determine boundary conditions	07
Q.C	(b)	at a boundary between a conductor and free space. Given the potential field in cylindrical coordinates, $V = (100/z^2 + 1) \rho \cos \varphi$ Volt, and point P at $\rho = 3$ m, $\varphi = 60^\circ$, $z = 2$ m, find values at P for: (a) V ; (b) \mathbf{E} ; (c) E ; (d) dV/dN ; (e) \mathbf{a}_N in free space.	07
Q.4	(a)	Derive the expression for following capacitors: (a) Coaxial capacitor, (b) Spherical capacitor, (c) Isolated spherical capacitor, (d) Parallel-plate capacitor	07
	(b)	having two dielectrics parallel to the plates. Find the magnitude of current density in a sample of silver for which $\sigma = 6.17 \times 10^7$ S/m and $\mu_e = 0.0056$ m ² /V·s if: (a) the drift velocity is 1.5 μ m/s; (b) the electric field intensity is 1 mV/m; (c) the sample is a cube 2.5 mm on a side having a voltage of 0.4 mV between opposite faces; (d) the sample is a cube 2.5 mm on a side carrying a total current of 0.5 A.	07
Q.4	(a)	Explain Hall voltage & Hall effect and mention its uses. Also derive the equation for the force on a differential current element.	07
	(b)	A slab of dielectric material has a relative dielectric constant of 3.8 and contains a uniform electric flux density of 8 nC/m ² . If the material is lossless, find: (a) E ; (b) P ; (c) the average number of dipoles per cubic meter if the average dipole moment is 10^{-29} C·m.	07

Q.5	(a)	Using Faraday's law and the concept of displacement current density,	07
		Ampere's circuital law, divergence theorem, obtain all Maxwell's equations for	
		time varying fields in point and integral forms.	
	(b)	(a) Evaluate the closed line integral of H about the rectangular path $P_1(2,3,4)$ to	07
		$P_2(4,3,4)$ to $P_3(4,3,1)$ to $P_4(2,3,1)$ to P_1 , given $\mathbf{H} = 3z\mathbf{a}_x - 2x^3\mathbf{a}_z$ A/m. (b)	
		Determine the quotient of the closed line integral and the area enclosed by the	
		path as an approximation to $(\nabla \times \mathbf{H})_y$.	

OR

Q.5

07

07

(a) Write a short note on propagation in good conductors.
(b) Find the magnetization in a magnetic material where: (a) μ = 1.8 × 10⁻⁵ H/m and H = 120 A/m; (b) μ_r = 22, there are 8.3 × 10²⁸ atoms/m³, and each atom has a dipole moment of 4.5 × 10⁻²⁷ A·m²; (c) B = 300 μT and χ_m = 15.
