Model Question Paper-1 with effect from 2019-20(CBCS Scheme)

USN

Fourth Semester B.E. Degree Examination

Electromagnetic Field Theory

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Assume missing data

		Module-1	L	CO	PO	Marks
Q.01	(a)	Explain different coordinate systems with diagram.				
			2	1	2	8
	(b)	Explain dot and cross products.				
			2	1	2	6
	(c)	Find the dot product and cross product between the two given vectors. $\mathbf{A} = (2\,\mathbf{a_x} + 3\,\mathbf{a_y} + 4\,\mathbf{a_z})$ and $\mathbf{B} = (5\,\mathbf{a_x} - 3\,\mathbf{a_y} - 2\,\mathbf{a_z})$				
			3	1	2	6
		OR				
Q.02	(a)	Explain the Coulomb's Law in vector form.				
			2	1	2	7
	(b)	State and explain divergence theorem.				
			2	1	2	6
	(c)	Given that $\mathbf{D} = (4\,y^2\,\mathbf{a_x} + 3\,x^2\,y\,\mathbf{a_y} + 15\,\mathbf{a_z})$ C/ m^2. Verify both the sides of the divergence theorem and evaluate charge enclosed within $0 < x, y, z < 2$.				
			4	1	3	7
		Module-2				
Q.03	(a)	Derive the expression for a potential at a point due to a point charge.				
			2	2	2	7
	(b)	Show that electric field intensity is a negative potential gradient.				
			2	2	2	6
	(c)	Determine work done in carrying the charge of 2 Couloumbs from B (1, 0, 1) to A (0.8, 0.6, 1) in an electric field along the short arc of the circle $x^2 + y^2 = 1$, $z = 1$ given that $\boldsymbol{E} = y\,\boldsymbol{a_x} + x\,\boldsymbol{a_y} + 2\,\boldsymbol{a_z}$				
			3	2	3	7

OR						
Q.04	(a)	Derive the equation of continuity.				
			2	2	2	6
	(b)	Explain the boundary conditions for two different dielectric mediums				
			2	2	2	7
	(c)	The capacitance of the condenser formed by two parallel metal sheets each of 100 cm^2 in area, are separated by a dielectric of 2 mm thick is $2x10^{-4}$ µF. A potential of 20 kV is applied to it. Find i) Electric flux ii) Potential gradient iii) The relative permittivity of the material.				
			3	2	3	7
Module-3						
Q.05	(a)	State and explain uniqueness theorem.				
			2	3	2	6
	(b)	Derive the expression of capacitance for a parallel plate capacitor using the Laplace's equation.				
			2	3	2	7
	(c)	Verify whether the following potential field satisfy the Laplace equation or not i) $V = x^2 - y^2 + z^2$ ii) $V = r \cos \phi + z$ iii) $V = r \cos \theta + \phi$.				
			3	3	3	7
OR						
Q.06	(a)	State and explain Biot Savart's Law.				
			2	3	2	6
	(b)	Derive an expression for magnetic field intensity at a point due to an infinite long straight conductor carrying a current of I amps along the z - axis.				
			2	3	2	7
	(c)	Given that, $\mathbf{H} = 20\ r^2\ \mathbf{a}_\phi$ A/ m. Determine the current density **J,** also determine the total current that crosses the surface $r = 1m, 0 < \varphi < 2\pi$ and $z = 0$ in cylindrical coordinate.				
			3	3	3	7
Module-4						
Q.07	(a)	Deduce the expression for force between the two differential current elements.				
			2	4	3	6
	(b)	Derive the expression for Force and Torque on a closed circuit.				
			2	4	3	7
	(c)	A point charge Q = 18 nC has a velocity of 5×10^6 m/s in the direction $\mathbf{a} = 0.6\ \mathbf{a}_x + 0.75\ \mathbf{a}_y + 0.3\ \mathbf{a}_z$. Calculate the magnitude of force exerted on the charge by the field i) $\mathbf{E} = (-3\ \mathbf{a}_x + 4\ \mathbf{a}_y + 6\ \mathbf{a}_z)$ k V/m, ii) $\mathbf{B} = (-3\ \mathbf{a}_x + 4\ \mathbf{a}_y + 6\ \mathbf{a}_z)$ m T				

		iii) **B** and **E** acting together.				
			3	4	3	7
OR						
Q.08	(a)	Derive the expression for Lorentz Force.				
			2	4	2	6
	(b)	Explain the boundary conditions between two magnetic materials.				
			2	4	2	7
	(c)	Calculate the inductance of a solenoid of 200 turns wound tightly on a cylindrical tube of length 60 cm and diameter 6 cm. Derive the expression used.				
			3	4	3	7
Module-5						
Q.09	(a)	Obtain Faraday's law of electromagnetic induction in integral form and hence arrive at the differential form of Faraday's law.				
			2	5	2	6
	(b)	State Maxwell's equation in point and integral form for time varying fields from Faraday's law.				
			2	5	2	8
	(c)	The circular loop conductor at z = 0 plane has a radius of 0.1 m and a resistance of 5Ω. **B** = 0.5 sin (103t $\mathbf{a_z}$) T. Find the current in the loop.				
			3	5	3	6
OR						
Q.10	(a)	Using Maxwell's equations derive an expression for uniform plane wave in free space.				
			2	5	2	6
	(b)	State and explain poynting theorem.				
			2	5	2	6
	(c)	A 300 MHz uniform plane wave propagates through fresh water for which $\sigma = 0$, $\mu_r = 1$ and $\varepsilon_r = 78$. Calculate i) attenuation constant ii) phase constant iii) wavelength iv) intrinsic impedance.				
			3	5	3	8

CO's :

1. Use different coordinate systems, Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
2. Calculate the energy and potential due to a system of charges & Explain the behaviour of electric field across a boundary conditions.
3. Explain the Poisson's, Laplace equations and behaviour of steady magnetic fields.
4. Explain the behaviour of magnetic fields and magnetic materials.

5. Explain time varying fields and propagation of waves in different media

PO's:

PO 1	:	**Engineering Knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of the complex engineering problems
PO 2	:	**Problem Analysis :** Identify formulate, Review research literature and analyze complex engineering problems.
PO 3	:	**Design Development of Solutions :** Design the solutions for complex engineering problem and design system components or processes that meet the specified needs with appropriate considerations for the public health and safety and cultural and societal and environmental considerations.
PO 4	:	**Conduct Investigations of Complex Problem :** Use research based knowledge and research method including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**
PO 5	:	**Modern Tool Usage :** Create, Select and Apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex engineering activities with understanding of the limitations**.**
PO 6	:	**Engineer and Society :** Apply reasoning informed by contextual knowledge, to assess societal health, safety, legal and cultural issues and consequent responsibility relevant to professional engineering practices.
PO 7	:	**Environment and Sustainability :** Understand the impact of professional engineering solution in societal and environmental context and demonstrate the knowledge of and need for sustainable development.
PO 8	:	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.
PO 9	:	**Individual and Team Work :** Function effectively as an individual and as a member or leader in diversity and multi-disciplinary settings.
PO 10	:	**Communications :** Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentations, make effective presentations and view and receive clear instructions.
PO 11	:	**Project Management and Finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team to manage project and in multi-disciplinary environments.
PO 12	:	**Life Long Learning :** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.