

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN

--	--	--	--	--	--	--	--	--	--

Course Code

2	2	E	C	4	2
---	---	---	---	---	---

Fourth Semester B.E. Degree Examinations, July 2026

ENGINEERING ELECTROMAGNETICS

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
<u>Module-1</u>			
1	a. Calculate the net force acting on a point charge of 30 μC located at (0,0,1) m, when four-point charges each of 10 μC are placed in free space at the coordinates (1,0,0), (-1,0,0), (0,1,0), and (0,-1,0) m. Illustrate the configuration using a neat vector diagram in the Cartesian coordinate system and evaluate the resultant force using Coulomb's law.	10	(3 :1: 1.4.1)
	b. Derive the expression for electric field intensity due to infinite sheet of charge applying Coulomb's law with necessary illustrations.	10	(3 :1: 1.3.1)
(OR)			
2.	a. State and prove integral form of Gauss's law, also explain the significance of point form of Gauss's law.	10	(2 :1: 1.3.1)
	b. Given that, $\vec{D} = \frac{5r^2}{4} \vec{a}_r \text{ C/m}^2$, evaluate both sides of the divergence theorem for the volume enclosed by $r = 2 \text{ m}$ and $\theta = \pi/4 \text{ rad}$ and take $0 < \phi < 2\pi$ (Use spherical coordinates).	10	(3 :1: 1.4.1)
<u>Module-2</u>			
3.	a. Find an expression establishing the relationship between electric field intensity and potential gradient.	10	(2 :2: 1.3.1)
	b. A point charge of 4 nC is located at the origin in free space, write a MATLAB code to find the absolute potential at point P (2, 3, -4) if $V_r = 0$ volts at (12, 2, 0) and support your answer with numerical computations.	10	(1 :2: 5.1.2)
(OR)			
4.	a. Start from Gauss's law, derive Poisson's and Laplace's equations, and check the potential field $V = r^2 + z^2$ satisfies Laplace's equation or not.	10	(3 :3: 1.3.1)
	b. Find the expression for the capacitance of two concentric cylinders of infinite length (co-axial cable) by applying Laplace's equation.	10	(3 :3: 1.4.1)
<u>Module-3</u>			
5.	a. State Ampere's circuital law and derive the expression for magnetic field intensity at a point P due to an infinite current-carrying conductor applying Ampere's circuital law.	10	(3 :4: 1.3.1)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

- c. Write a MATLAB code to find the CURL of magnetic field intensity (current density) at a point P (2, 3, 4) given $\vec{H} = 6xy\vec{a}_x - 3y^2\vec{a}_y$ A/m and support your answer with numerical computations.

(OR)

6. a. Derive the expressions for magnetic boundary conditions between the two different magnetic media with necessary illustrations (Both Normal Tangential Components). 10 (2 :4: 1.3.1)
- b. State and prove Stoke's theorem. 10 (3 :4: 1.4.1)

Module-4

7. a. State and explain integral and differential form of Faraday's law of electromagnetic induction. 10 (2 :5: 1.3.1)
- b. A parallel plate capacitor with plate area of 5 cm² and plate separation of 3 mm has a voltage of 50 sin 10³t volts applied to its plates. Calculate the displacement current assuming $\epsilon = 2\epsilon_0$. 10 (3 :5: 1.4.1)

(OR)

8. a. A circular conducting loop of radius 40 cm lies in the x-y plane and has a resistance of 20 Ω . If the magnetic flux density in the region is given by, $\vec{B} = 0.2\cos 500t\vec{a}_x + 0.75\sin 400t\vec{a}_y + 1.2\cos 314t\vec{a}_z$ T, determine the effective value of induced current in the loop using Faraday's law. 10 (3 :5: 1.4.1)
- b. Tabulate the Maxwell's equations for (i) Steady fields (ii) Time varying fields in both integral and differential form. 10 (2:5:1.3.1)

Module-5

9. a. A 10 GHz plane wave travelling in a free space has an amplitude of E field of 10 V/m. Find β , η , v , λ and amplitude, direction of $\vec{H}$. 10 (3:5:1.4.1)
- b. Define Electromagnetic Compatibility (EMC). Briefly explain the goals, importance of EMC and also point out the applications of EMC. 10 (2:5:1.3.1)

(OR)

10. a. Derive the general wave equations in electric and magnetic fields, starting from differential form of Maxwell's equations. 10 (3:5:1.3.1)
- b. Explain the wave propagation in good conductors using the skin depth with necessary illustrations and graphs. 10 (3:5:1.3.1)

** ** *