VIT®

Vellore Institute of Technology

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Reg. No. : 23BEC1396

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	**B.Tech.**	Semester	**Fall Semester 2024-25**
Course Code	**BECE205L**	Faculty Name	**Prof. Anith Nelleri**
Course Title	**Engineering Electromagnetics**	Slot	**C1+TC1**
		Class Nbr	**CH2024250100226**
Time	**3 hours**	Max. Marks	**100**

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

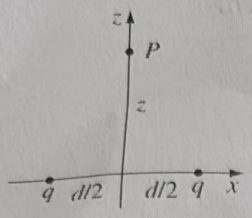
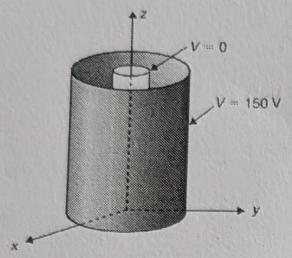
Course Outcomes

1. Evaluate and analyse Electric Fields & Electric Potential due to different Charge distributions.
2. Compute and analyze magnetic fields in different materials and media.
3. Analyze the EM wave propagation in conducting as well as in dielectric materials through time varying Maxwell's equations.
4. Illustrate the wave mechanism in different transmission lines at high frequencies using transmission line parameters.
5. Design Impedance matching circuits using Smith chart.
6. Analyze the field components of different waveguides based on various modes of E and H field.

Section - I

Answer all Questions (6 × 15 Marks) *M - Marks

Q.No	Question	*M	CO	BL
01.	(a) A thin hollow cylindrical conductor of radius, r = 5 cm, infinite in length, carries a current I = 2 A. Determine the magnetic field inside and outside the cylinder as a function of radial distance from the axis of the cylinder. [8 Marks] (b) A charged particle with a uniform velocity $4\hat{a}_x$ (m/s) is in a region where the electric field is $E = 20\hat{a}_y$ V/m and magnetic field is $B = B_0\hat{a}_z$ T. Determine the magnetic field such that the velocity of the particle is constant. [7 Marks]	15	2	3
02.	(a) What is the inconsistency in the Ampere's circuital law? Explain how it was rectified by Maxwell. Derive the expression for displacement current. [8 Marks] (b) A parallel-plate capacitor with plate area 5 mm^2 and plate separation 3 mm has a voltage $V(t) = 50\sin 10^3 t$ V applied to its plates. Calculate the displacement current assuming that the medium between the plates is air. [7 Marks]	15	3	4

03.	(a) Find the electric field at a distance 'z' above the midpoint between two equal charges 'q', a distance 'd' apart as shown in the Fig.1. [7 Marks]  Fig. 1 (b) Find the potential function and the electric field intensity for the region between two concentric right circular cylinders, where the inner cylinder with radius r = 1 mm is at voltage V = 0 V and the outer cylinder with r = 20 mm is at V = 150 V as shown in the Fig. 2. [8 Marks]  Fig. 2	15	1	3
04.	(a) The electric field in an electromagnetic wave in free space is given by $\mathbf{E} = 50\cos(10^8 t + k\bar{x})$ V/m (i) Find the direction of propagation and the magnetic field of the wave. (ii) Calculate the wave number and the time it takes to travel a distance $\frac{\lambda}{2}$. [7 Marks] (b) The parameters for the parrel-wire transmission line are as given below L = 2.0 μH/m, C = 5.56 pF/m, R = 2.59×10^{-3} Ω/m, G = 0 S/m. Calculate the characteristic impedance, propagation constant, velocity of propagation and wavelength for operation at 5 kHz. [8 Marks]	15	4	4
05.	Use the Smith chart to find the input impedance of a section of a 50Ω lossless transmission line that is 0.1 wavelength long and is terminated in a short-circuit.	15	5	3
06.	A TE_{10} wave at 10 GHz propagates in a rectangular waveguide with inner dimensions a = 1.5 cm and b = 0.6 cm, which is filled with polyethylene. The relative permitivity of polyethylene is 2.25. Determine (i) the phase constant, (ii) the cut-off frequency, (iii) the guide wavelength, (iv) the phase velocity, and (v) the wave impedance.	15	6	4

Section - II

Answer all Questions (1 × 10 Marks) *M - Marks

Q.No	Question	*M	CO	BL
07.	(a) Transform the vector $\mathbf{B} = y\hat{\mathbf{a}}_x + x\hat{\mathbf{a}}_y + z\hat{\mathbf{a}}_z$ into cylindrical coordinates. [5 Marks] (b) Calculate the line integral of the function $\mathbf{B} = y^2\hat{\mathbf{a}}_x + 2x(y+1)\hat{\mathbf{a}}_y$ along the straight-line path from point a = (1,1,0) to point b = (2,2,0). [5 Marks]	10	1	3

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)