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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication Engineering
Semester End Examination; July / August - 2022
Electromagnetic Field Theory

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the knowledge of physics and Vector calculus to understand EM fields and waves.

CO2: Analyse Electric and magnetic fields and waves and its effect in various charge distribution of medium

CO3: Compute the electric and magnetic field potentials due to different charge distributions and boundary conditions

CO4: Analyze time-varying electromagnetic fields and waves as governed by Maxwell's equations

CO5: Examine the effects and losses of medium on wave and various parameters influencing wave propagation

***Note**: **I) PART - A** is compulsory. **Two** marks for each question.*

***II) PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I:PART - A	**10**			
I a.	What are the sources of electric field and magnetic field?	2	L1	CO1	PO1
b.	Define potential difference.	2	L1	CO3	PO2
c.	State Biot-savarts law.	2	L1	CO2	PO1
d.	Define dielectric strength.	2	L1	CO1	PO1
e.	What is critical frequency?	2	L1	CO5	PO1
	II:PART - B	**90**			
	UNIT - I	**18**			
1 a.	Explain the concept of electric field intensity at a point in an electric field produced by a point charge. Show that the electric field intensity at any point due to an infinite sheet of charge is independent of the distance to the point from the sheet.	9	L2	CO2	PO2
b.	State and explain Gauss's law and verify it for a point charge. Find the electric flux density $\vec{D}$ at $(1,\ 3,\ \text{-}4)$m for a point charge Q = 30 nC located at the origin in Cartesian coordinates.	9	L2	CO2	PO2
c.	State and explain Gauss divergence theorem. If, $\vec{D} = xy^2z^2\overrightarrow{ax} + s^2yz^2\overrightarrow{ay} + x^2y^2z\overrightarrow{az}\ c/m^2$ find; i) An expression for ρ_V ii) The total charge within the cube defined by $0 \le x \le 2,\ 0 \le y \le 2,\ 0 \le z \le 2$	9	L2	CO2	PO2
	UNIT - II	**18**			
2 a.	Find an expression establishing the relationship between electric field intensity and gradient of potential. Find the electric field strength $\vec{E}$ at the point (1, 2, -1) given the potential $V = 3x^2y + 2yz^2 + 3xyz$	9	L2	CO2	PO2

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b.	What is dipole moment? Find V at P (2, 3, 4) for a dipole having moment $\vec{p} = 3\vec{ax} - 5\vec{ay} + 10\vec{az}\ nCm$ located at $Q(1,2,-4)$ in free space.	9	L2 CO3 PO3
c.	Starting with Gauss law in point from obtain the Poisson's equation in Cartesian co-ordinates. Deduce Laplace's equation from it. Verify that the potential field, $V = 2x^2 - 3y^2 + z^2$, satisfies the Laplace's equation.	9	L3 CO3 PO3
	UNIT - III	**18**	
3 a.	State and prove Ampere's circuital law and apply it to a straight infinitely long conductor to calculate the magnetic field intensity.	9	
b.	Discuss the concept of vector magnetic potential and arrive at an expression for it. Given the vector magnetic potential $\vec{A} = x^2\vec{ax} + 2yz\vec{ay} + (-x^2)\vec{az}$ find the magnetic flux density.	9	
c.	Discuss the magnetic boundary conditions for $\vec{B}$ and $\vec{H}$ at the interface between two different magnetic materials.	9	
	UNIT - IV	**18**	
4 a.	Derive Maxwell's equation from Faraday's law. Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2\times10^{-4}$ mho/m and $\epsilon_r = 81$.	9	
b.	Explain the different types of polarization of the sinusoidal wave. The electric field of a uniform plane wave is given by, $\vec{E} = 10\sin(3\pi x10^8 t - \pi z)\vec{ax} + 10\cos(3\pi\times10^8 t - \pi z)\vec{ay}\ V/m$ Find the polarization of the wave.	9	
c.	State and prove Poynting's theorem.	9	
	UNIT - V	**18**	
5 a.	Explain the occurrence of surface wave propagation and discuss the dependence of ground attenuation factor with numerical distance.	9	
b.	Derive the expression for the field strength due to space wave in terms of height of receiving and transmitting antenna and distance between them.	9	
c.	Derive the equation for skip distance in terms of maximum usable frequency. An high frequency radio communication is to be established between two points on the earth's surface. The points are at a distance of 2000 km. The height of the ionosphere layer is 200 km and critical frequency is 6 MHz. Find maximum usable frequencies.	9	

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