Course Name: Electromagnetic Field Theory (BEET504)

Course Outcomes:

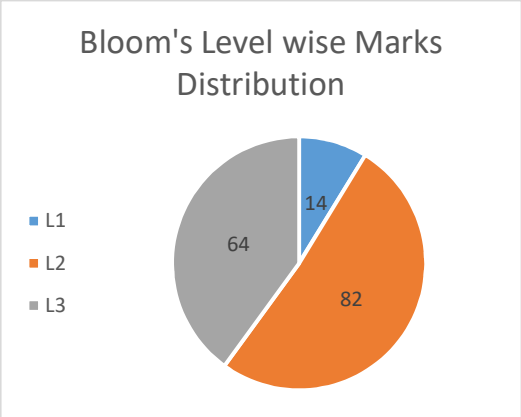
At the end of the course the student should be able to:

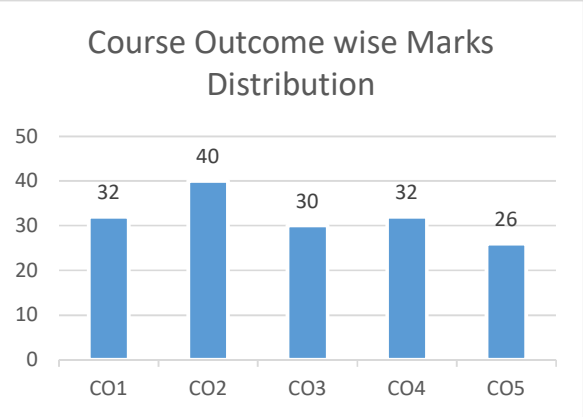
CO1 To understand the various operations of vector calculus.
CO2 To understand the basic laws of electromagnetism.
CO3 To obtain the electric and magnetic fields for simple configurations under static conditions.
CO4 To analyse time varying electric and magnetic fields.
CO5 To understant Maxwell's equation in different forms and different media.

Model Question Paper

Q.No.	Questions	Marks	CO	BL	PI
1a	Given a vector field $\mathbf{H}=\rho z\cos\varphi\,\mathbf{a}_\rho+e^{-2}\sin\varphi/2\,\mathbf{a}_\varphi+2\,\mathbf{a}_z$. At point $(1,\pi/2,0)$, find (a) $\mathbf{H}\cdot\mathbf{a}_x$, (b) $\mathbf{H}\times\mathbf{a}_\theta$.	6	CO1	L3	1.1.1
1b	i. A current filament carrying 15 A in the $\mathbf{a}_z$ direction lies along the entire z-axis. Find **H** in rectangular co-ordinate system at P(2,-4,4). ii. Plane y=1 carries current K=50$\mathbf{a}_z$ mA/m. Find **H** at origin.	8	CO3	L3	1.2.1
1c	Define Poynting vector and derive the expression for it using Maxwell's equation. How it follows the principal of energy conservation ?	6	CO5	L2	2.1.2
2a	Using Gauss's Law find the expression for flux density at a distance r due to point charge of Q C, infinite line charge of charge density ρ_L C/m and infinite surface charge ρ_S C/m^2.	10	CO3	L2	2.3.1
2b	Define the following terms:- i. Relaxation time ii. Convection current iii. Displacement current iv. Skin depth (or penetration depth)	10	CO5	L1	4.1.1
3a	Determine the divergence and curl of the following vectors: i. $\mathbf{P}=x^2yz\mathbf{a_x}+xz\mathbf{a_z}$ ii. $\mathbf{Q}=\rho\sin\varphi\,\mathbf{a_\rho}+\rho^2z\mathbf{a_\varphi}+z\cos\varphi\,\mathbf{a_z}$	8	CO1	L3	2.4.1
3b	State and prove the divergence theorem with the help of relevant diagram.	6	CO2	L2	2.1.2
3c	Derive the expression for Ohm's Law in point form.	6	CO3	L2	1.1.1
4a	A plane wave in a non-magnetic medium has $\mathbf{E}=50\sin(10^8t+2z)\mathbf{a_y}$V/m. Find the direction of wave propagation, wavelength (λ), frequency (f)and magnetic field intensity (**H**).	10	CO4	L3	2.4.1
4b	i. For a scalar field V, show that $\nabla\times\nabla V=0$. ii. For a vector field **A**, show that $\nabla\cdot\nabla\times\mathbf{A}=0$.	10	CO1	L2	1.1.1
5a	Find the gradient and Laplacian of the following scalar fields:- i. $V=\rho^2z\cos2\varphi$ ii. $U=10r\sin^2\theta\cos\varphi$	8	CO1	L3	2.4.1
5b	State and prove the Stoke's theorem with the help of relevant diagram.	6	CO2	L2	1.1.1
5c	Given $\mathbf{D}=z\rho\cos^2\varphi\mathbf{a_z}$ C/m^2, calculate the charge density at $(1,\pi/4,3)$ and the total charge enclosed by the cylinder of radius 1 m with $-2\le z\le 2$ m.	6	CO3	L3	2.4.1

6a	Given potential $V = \frac{10}{r^2}\sin\theta\cos\varphi$, i. Find the electric flux density D at (2, π/2,0). ii. Calculate the work done in moving a 10μC charge from point A(1, 30º, 120º) to B(4, 90º, 60º).	10	CO2	L3	2.4.1
6b	Show that the electrostatic energy density in an electric field **E** in free space is given by $w = \frac{1}{2}\varepsilon_o E^2$ J/m^3.	10	CO3	L2	1.1.1
7a	A tramsmission line operating at 500 MHz, has characteristic impedance Z_o=80 Ω, attenuation constant α = 0.04 Np/m, β = 1.5 rad/m. Find the line parameters *R, L, G, C*.	10	CO5	L2	1.2.1
7b	Write a brief note on the classification of magnetic materials.	4	CO4	L1	4.1.1
7c	Derive the expression for self-inductance per unit length of an infinitely long solenoid with μ permeability of the core, having cross sectional area of solenoid A, and *n* number of turns per unit length.	6	CO4	L2	1.2.1
8a	State and explain the following:- i. Ampere's circuital Law, ii. Biot-Savart's Law. iii. Uniqueness Theorem.	12	CO2	L2	1.2.1
8b	A charged particle of mass 2 kg and 1 C starts from origin with velocity 3$\mathbf{a}_y$ m/s and travels in the region of uniform magnetic field **B**=10$\mathbf{a}_z$ Wb/m^2. At t = 4 s, calculate the velocity, acceleration and kinetic energy of the particle.	8	CO4	L3	1.3.1





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

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code