SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
·School of Electronics & Communication Engineering
B. Tech. ECE (3rd Sem) (Course Code : ECL DC 203)
B.Tech. ECE Backlog (Course Code : ECL 2040)
Major - Examination (Odd) 2024-25, Date: 19-12-2024

Entry No: | | | | | | | 6 | 8 | Total No. of Pages: [04]

Date: 19-12-2024 Total No. of Questions: [09]

Course Title: Electromagnetic Field Theory

Time Allowed: 3.0 Hours Max Marks: [40]

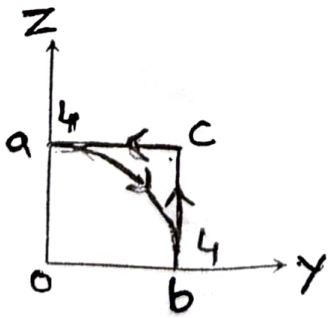
Instructions / NOTE

i. **Attempt ANY FIVE (By selecting at least ONE QUESTION from EACH SECTION and Section-A is COMPULSORY).**
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.
iv. Use of IS Code (Mention Number) is permissible in examination.

Section – A (DO ANY EIGHT)			
Q1.	**(i)**	A lossy dielectric has an intrinsic impedance of 45 $\angle 30^0$ $H = 15e^{-10x}\cos(\omega t - 0.5x)a_y$ A/m, then, electric field E will be _____ kV/m.	**01**
	(ii)	Given a vector field $D = 2r\sin\emptyset a_r - \frac{12}{r}\sin\theta\cos\emptyset a_\theta + r^2 a_\emptyset$. Then the tangential component of D to the spherical surface $r = 10$ at $P = (10, 150^o, 330^o)$ will be _____	**01**
	(iii)	If a non-ideal inductive load is connected to a lossless transmission line, then this load can be located in _____ half of the Y-Smith Chart.	**01**
	(iv)	For a perfectly match TL, Z_L will be located at _____ in the YZ smith chart.	**01**
	(v)	The input admittance of an open-circuited is j 0.25 Ω^{-1} and that of short-circuited is $-j0.04$ Ω^{-1}, respectively. The characteristic impedance of the transmission line would be _____	**01**
	(vi)	If $E = 10\cos(10^6 t + 10z)\,\widehat{a_x} - 10\sin(10^6 t +$	**01**

		$10z)\widehat{a_y}$, Then the EM wave is _____ polarized.	
	(vii)	A transmission line is operated at 2 MHz and has R = 20 Ω /km, L = 80 mH /km, G = 0.64 Ω^{-1} /km, and C = 20 μF/km. The propagation constant (γ) per meter for this line would be _____	01
	(viii)	If 50 Ω transmission has a standing wave ratio of 2.92 dB. The magnitude of maximum input impedance on the transmission line would be_____.	01
	(ix)	If two media are separated by the z=0, where medium-1 has $\mu_r = 5$, $\varepsilon_r = 2$ and medium-2 has $\mu_r = 8$, $\varepsilon_r = 4$, the Brewester angle for parallel polarized wave for this combination of media would be_____.	01
	(x)	The input impedance and standing wave ratio (s) of short circuited transmission line for $l = \lambda/4$ will be____ and____, respectively.	01

Section – B (DO ANY ONE)

Q2.	(a) Calculate the circulation of $A = r^2 cos\theta a_r + rsin\emptyset a_\theta + 5a_\phi$ for the closed loop *abca* shown in figure given below  (b) Given that $D = 2(z^2)\rho cos^2\varphi a_z + \rho^2 a_\emptyset$ C/m2. Calculate the charge density at (1,-135^0,3) and the total charge enclosed by the closed body define by $2 \leq \rho \leq 4$, $-4 \leq z \leq -2$.	4 + 4
Q3.	(a) A plane wave propagating through a medium with $\varepsilon_r = 8$, $\mu_r = 2$ has $E = 2.8e^{-z/6}\sin(10^6 t -$	4 + 4

	$\beta z)\, a_x$ V/m. Determine β, loss tangent, Intrinsic impedance, Wave velocity and H field. (b) The electric field in a certain region is: $E = (z+1)\sin(\emptyset)\, a_\rho + (z+1)\rho\cos(\emptyset)\, a_\emptyset + \rho\sin(\emptyset) a_z$ V/m. Find the work done in moving a charge from A(4,30^0,0) to B(4,30^0,-2)	
	Section – C (DO ANY ONE)	
Q4.	(a) In a certain conducting medium, $H = y^2 z a_x + 2(x+1)yz a_y - (x+1)z^2 a_z$ A/m. Determine the current density at (1,0-3) and the current passing through $y = 1, 0 \le x \le 1, 0 \le z \le 1$ (b) Given the potential $V = \frac{20}{r^3} cos\theta . sin\emptyset$ Find the electric flux density at (2, π/2, 0)	4 + 4
Q5.	(a) Evaluate both sides of the Stokes theorem for the field $F = 3y^2 z a_x + 6x^2 y a_y + 9xz^2 a_z$ and the rectangular path around the edge of the region 0 < x < 2, -2 < y < 1, z = 1. Assume $d\mathbf{S} = dS a_z$. (b)A parallel polarized wave is incident with an angle 30^0 to the normal in medium -1 with $\eta_1 = 2 + j3\ \Omega$ and the transmitted wave makes 45^0 to the normal in medium -2 with $\eta_2 = 4 + j5\ \Omega$. Find the reflection coefficient reflection coefficient (Γ) and the transmission coefficient (τ).	4 + 4
	Section – D (DO ANY ONE)	
Q6.	(a) A 75 Ω lossless transmission line is terminated by a load of $40 - j35\ \Omega$. Determine the reflection coefficient (Γ) and standing wave ratio (s) in dB. In above case, if a quarter wave transformer is inserted just before the load, then find the impedance of the quarter wave transformer used. **(Solve ANALYTICALLY, DO NOT USE SMITH CHART)** **(b)** Define equation of continuity and then derive the relation between conduction current and displacement current density.	4 + 4

Q7.	(a) The input admittance of a 75 Ω lossless transmission line of length 450 m is $0.0056 + j0.01133\ \Omega^{-1}$. The line operated at 30 MHz with wave velocity of 1.5×10^8 m/sec. Find the load impedance ($\mathbf{Z_L}$) connected to this line and also find the reflection coefficient (r), standing wave ratio (s) and 2nd location of V_{max} from the load end. **(Using SMITH CHART ONLY) Do necessary calculations on answer sheet.** (b) For the transmission line considered in Q7 (a), Find the 1st location (d_{stub})of an open-circuited stub inserted from the load in meters, length of the inserted open-circuited stub (l_{stub}) in meters, input impedance (Z_{in_stub}) of the stub inserted and the phase constant β in radians per meter. **(Using SMITH CHART ONLY) Do necessary calculations on answer sheet.**	4 + 4
	Section – E (DO ANY ONE)	
Q8.	(a) Derive the relation for input impedance and standing wave ratio of a lossy transmission line (b) Derive the relation for energy density in electrostatic fields.	4 + 4
Q9.	(a) State and derive the relation of Poynting's theorem. (b) In a nonmagnetic medium $E = 8\sin(2\pi \times 10^7 t - 0.6x)a_z$ V/m. Find ε_r and η for this medium. Find H field and then calculate the total power crossing 100 cm2 of plane $2x + y = 5$	3 + 4

Course Outcomes

After Successful Completion of this Course, students shall be able to;

1) Apply vector calculus to static electric-magnetic fields in different engineering situations.
2) Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
3) Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.
4) Solve Electro Static and Magnetic to Static circuits using Basic relations.

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Electronics & Communication Engineering
B. Tech. Major Examination, 2022-23

Entry No: | 2 | 1 | B | E | C | 1 | 2 | 7 |

Date: 12-05-2023

Total Number of Pages: [01]

Total Number of Sections: [03]

Course Title: Electromagnetic Field Theory

Course Code: ECL 2040

Time Allowed: 03 Hours

Max Marks: [50]

Instructions / NOTE

i. Attempt All Questions. Scientific Calculator and copy of smith chart is allowed.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any appropriate data / information, wherever necessary / missing.

SECTION A

(1X10)

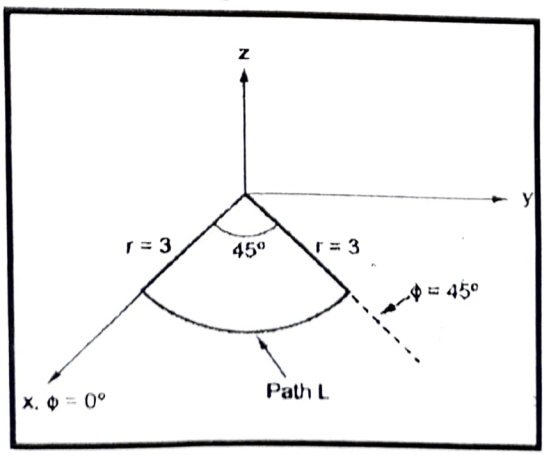
1. A solenoidal field has .....divergence.
2. Gradient of any scalar function is always a.....function.
3. Curl of the gradient of any scalar function is always.....
4. The potential at any point inside a hollow conductor is.....
5. Maxwell's third equation in integral form is.....
6. In magnetic boundary conditions, the tangential component of H is always.....
7. The propagation constant is represented as..... for a conducting medium.
8. The reciprocal of attenuation constant represents.....
9. For free space, the value of intrinsic impedance is.....
10. For a lossless transmission line, the value of attenuation constant is always.....

SECTION B

Q1. If V=x-y+xy+z, find electric field at (1,2,4) and electrostatic energy stored in a cube of side 2m centered at the origin. (04)

Q2. Derive an expression to show conservative nature of magnetic flux density and hence deduce Maxwell's fourth equation. (04)

Q3. Calculate the circulation of vector field, $\vec{F} = r^2 Cos\phi \vec{a_r} + zSin\phi \vec{a_z}$ around the path L defined by $0 \le r \le 3$, $0 \le \Phi \le 45^0$ and z=0 as shown in figure. (04)



Q4. Deduce an expression for input impedance of a transmission line. How input impedance of a shorted line varies with characteristic impedance? (04)

Q5. State and explain Poynting's theorem. Why is it important to study the Poynting theorem? (04)

SECTION C

Q1. Derive suitable equations governing propagation of electromagnetic waves in lossless as well as lossy medium. Define skin depth and hence show values of attenuation coefficient, phase constant and skin depth in a lossy medium. (10)

Q2. A 100 + j150- Ω load is connected to a 75-Ω lossless line. Find:

(a) Reflection coefficient

(b) Standing wave ratio

(c) The load admittance YL

(d) Zin at 0.6λ from the load

(e) The locations of Vmax and Vmin with respect to the load if the line is 0.5λ long

(f) Zin at the generator end.

Use a Smith chart to evaluate the problem and then verify your answers. (10)

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Electronics & Communication Engineering
B. Tech. Mid Term Examination, 2022-23

Entry No: | | | | | | | | |

Date: 21-02-2023

Total Number of Pages: [01]

Total Number of Questions: [05]

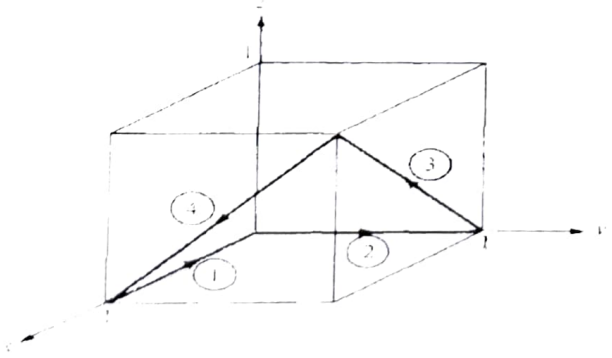
Course Title: Electromagnetic Field Theory
Course Code: ECL 2040

Time Allowed: 1.5 Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions. Scientific Calculator is allowed in this paper.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any appropriate data / information, wherever necessary / missing.
iv. All answers should be brief and to the point.

Q.1	Express vector $B = \frac{10}{r}a_r + r\cos\theta a_\theta + a_\phi$ in Cartesian and cylindrical coordinates. Find B (-3, 4, 0) and B (5, π/2, -2).	[03]
Q.2	Given that $\vec{F} = x^2 a_x - xz a_y - y^2 a_z$, calculate the circulation of F around the closed path shown in fig. Also verify the results using stoke's theorem. 	[05]
Q.3	The temperature in an auditorium is given by $T = x^2 + y^2 - z$. A mosquito located at (1, 1, 2) in the auditorium desires to fly in such a direction that it will get warm as soon as possible. In what direction must it fly?	[03]
Q.4	Determine the flux of $\bar{D} = r^2\cos^2\phi\, a_r + z\sin\phi a_\phi$ over the closed surface of the cylinder $0 \le z \le 1, r = 4$. Verify the results using Divergence theorem	[05]
Q.5	Planes $x = 2$ and $x = -3$ respectively, carry charges 10 nC/m2 and 15 nC/m2. If the line $x = 0, z = 5$ carries charge 10π nC/m, calculate E at (1, 1, -1) due to the three charge distributions.	[04]

Rishav

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Electronics & Communication Engineering
B. Tech. Minor-II Examination, 2022-23

Entry No: | 2 | 1 | B | E | C | 1 | 2 | 7 |

Total Number of Pages: [01]

Date: 27-03-2023

Total Number of Questions: [05]

Course Title: Electromagnetic Field Theory

Course Code: ECL 2040

Time Allowed: 1.5 Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions. Scientific Calculator is allowed in this paper.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any appropriate data / information, wherever necessary / missing.
iv. **All answers should be brief and to the point.**

Q.1.	Derive suitable expression for electric field intensity E due to infinite line charge and hence find electric field at P(6,8,5) due to uniform line charge, infinite in extent with λ=20nc/m and lies along the z-axis.	[05]
Q.2.	A point charge of 6nC is located at origin in free space, find potential of point P if P is located at (0.2,-0.4,0.4) and i) V=0 at infinity ii) V=0 at (1,0,0) iii) V=20v at (-0.5,1,-1)	[03]
Q.3.	a) Discuss the concept of potential difference for a closed path and hence deduce Maxwell's second equation showing conservative nature of electric field. b) Elaborate boundary conditions in electrostatics for conductor-free space interface.	[02] [02]
Q.4.	a)State Ampere's law and deduce associated Maxwell's equations . b) Apply Ampere's law to calculate magnetic field intensity due to an infinite sheet of current.	[02] [02]
Q.5.	Derive expression for energy density in magnetostatics.	[04]