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15MAT31

Third Semester B.E. Degree Examination, July/August 2022
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Find the Fourier series expansion of $f(x) = 2x - x^2$ in (0, 3). **(08 Marks)**

b. The turning moment T is given for a series of values of the Crank angle $\theta^\circ = 75^\circ$

θ°	0	30	60	90	120	150	180
T	0	5224	8097	7850	5499	2626	0

Obtain the first four terms in a series of sires to represent T. Also calculate T for $\theta = 75^\circ$. **(08 Marks)**

OR

2 a. Obtain Fourier series for the function f(x) given by

$$f(x) = \begin{cases} \pi + x & -\pi < x < 0 \\ \pi - x & 0 \le x < \pi \end{cases}. \text{ Hence deduce } \frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}.$$ **(08 Marks)**

b. i) Define Half range Fourier sine series of f(x) **(02 Marks)**

ii) Find the half range Cosine series of $f(x) = x^2$ in the range $0 \le x \le \pi$. **(06 Marks)**

Module-2

3 a. Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{for} |x| < 1 \\ 0 & \text{for} |x| > 1 \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{\sin x}{x}\right) dx$. **(06 Marks)**

b. Find the inverse sine transform of $F_s(\alpha) = \begin{cases} 1 & 0 \le \alpha < 1 \\ 2 & 1 \le \alpha < 2 \\ 0 & \alpha \ge 2 \end{cases}$ **(05 Marks)**

c. Find the inverse Z- transform of $\frac{2z^2 + 3z}{(z+2)(z-4)}$. **(05 Marks)**

OR

4 a. Find the Fourier Sine transform of $f(x) = e^{-|x|}$ and hence show that

$$\int_0^\infty \frac{x \sin mx}{1 + x^2} dx = \frac{\pi}{2} e^{-m}, m > 0.$$ **(06 Marks)**

b. Find the Z-transform of i) $\cosh n\theta$ ii) $\sinh n\theta$. **(05 Marks)**

c. Using the Z- transform, solve $u_{n+2} + u_n = 0$ given $u_0 = 1$, $u_1 = 2$. **(05 Marks)**

Module-3

5 a. Find the correlation coefficient between x and y

x	2	4	6	8	10
y	5	7	9	8	11

(06 Marks)

b. Fit the curve of the form $y = a + bx + cx^2$ to the following data :

x	0	1	2	3	4
y	-4	-1	4	11	20

(05 Marks)

c. Find the root of the equation $2x - \log_e x = 7$ using Regula-Falsi method. Carry out 3 iteration. **(05 Marks)**

OR

6 a. If θ is the angle between the two regression lines, show that $\tan\theta = \left(\frac{1-r^2}{r}\right)\left[\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}\right]$.

Explain the significance when r = 0 and r = ±1. **(06 Marks)**

b. Use the method of least squares fit a curve of the form $y = a\,e^{bx}$ for the following data :

x	0	2	4	6	8
y	150	63	28	12	5.6

(05 Marks)

c. Find the real root of the equation $x^4 - x = 10$ by using Newton –Raphson method, carryout 3 iteration. **(05 Marks)**

Module-4

7 a. Find f(x), using Newton's interpolation formula

x	0	1	2	3	4
f(x)	-5	-10	-9	4	35

(06 Marks)

b. Find f(g) : Using Newton's divided difference formula

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

(05 Marks)

c. Evaluate, using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule for $\int_0^{\pi/2}\sqrt{\sin x}\,dx$ by taking 6 intervals. **(05 Marks)**

OR

8 a. A curve passing through the points (0, 18) (1, 10) (3, -18) and (6, 90). Find f(x), using Lagrange's interpolation formula. **(05 Marks)**

b. Evaluate, using Weddle's rule $\int_0^6 \frac{e^x}{1+x}dx$ by taking 7 ordinates. **(05 Marks)**

c. The area 'A' of a circle of diameter 'd' is given for the following values

d	80	85	90	95	100
A	5026	5674	6362	7088	7854

Calculate the area of a circle of diameter 105. **(06 Marks)**

Module-5

9 a. By using Green's theorem, evaluate $\int_C [(y - \sin x)dx + \cos x\, dy]$ where C is the plane triangle enclosed by the lines $y = 0$; $x = \frac{\pi}{2}$ and : $y = \frac{2}{\pi}x$. **(06 Marks)**

b. Apply Stoke's theorem evaluate

$\int_C (x + y)dx + (2x - z)dy + (y + z)dz$ where C is the boundary of the triangle with vertices (2, 0, 0) (0, 3, 0) and (0, 0,6). **(05 Marks)**

c. Find the curve on which the functional $\int_0^1 (y')^2 + 12xy\, dx$ with y(0) = 0 and y(1) = 1 can be extremized. **(05 Marks)**

OR

10 a. Derive the Euler's equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(06 Marks)**

b. Show that the geodesics on a plane are straight lines. **(05 Marks)**

c. Evaluate $\iint_S \vec{F} \cdot \hat{n}\, ds$ where $\vec{F} = 4xz\,\hat{i} + y^2\,\hat{j} + yz\,\hat{k}$ and S in the surface of the cube bounded by the planes x = 0, x = 1, y = 0, y = 1, z = 0, z = 1. **(05 Marks)**

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CBCS SCHEME

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15MATDIP31

Third Semester B.E. Degree Examination, July/August 2022
Additional Mathematics - I

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Express $\frac{(2-3i)(2+i)^2}{1+i}$ in the form of x + iy. **(06 Marks)**

b. If $x+\frac{1}{x}=2\cos\alpha$ then prove that $x^n+\frac{1}{x^n}=2\cos n\alpha$. **(05 Marks)**

c. Find the cosine of the angle between the vectors $\vec{a}=5\hat{i}-\hat{j}+\hat{k}$ and $\vec{b}=2\hat{i}-3\hat{j}+6\hat{k}$. **(05 Marks)**

OR

2 a. Find the Fourth roots of $1-i\sqrt{3}$ and represent them on an Argand plane. **(06 Marks)**

b. Show that the vectors $\vec{a}=\hat{i}-2\hat{j}+3\hat{k}$, $\vec{b}=2\hat{i}+\hat{j}+\hat{k}$ and $\vec{c}=3\hat{i}+4\hat{j}-\hat{k}$ are co-planar. **(05 Marks)**

c. Prove that $[\vec{a}+\vec{b},\ \vec{b}+\vec{c},\ \vec{c}+\vec{a}]=2[\vec{a},\vec{b},\vec{c}]$. **(05 Marks)**

Module-2

3 a. Obtain the n^{th} derivative of $e^{ax}\cos(bx+c)$. **(06 Marks)**

b. Show that the curves $r=a(1+\cos\theta)$ and $r=a(1-\cos\theta)$ are orthogonal. **(05 Marks)**

c. If $u=x(1-y)$, $v=xy$ find the Jacobians $J=\frac{\partial(u,v)}{\partial(x,y)}$ and $J'=\frac{\partial(x,y)}{\partial(u,v)}$. **(05 Marks)**

OR

4 a. If $y=a\cos(\log x)+b\sin(\log x)$, prove that $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$. **(06 Marks)**

b. If $u=\sin^{-1}\left(\frac{x^3-y^3}{x-y}\right)$, show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=2\,\mathrm{Tan}\,u$. **(05 Marks)**

c. If $z=xy^2+x^2y$, where $x=at^2$, $y=2at$. Find $\frac{dz}{dt}$. **(05 Marks)**

Module-3

5 a. Evaluate $\int_0^\pi x\sin^6 x\,dx$. **(06 Marks)**

b. Evaluate $\int_0^1\int_0^1 \frac{dxdy}{\sqrt{(1-x^2)(1-y^2)}}$. **(05 Marks)**

c. Evaluate $\int_0^1\int_0^1\int_0^1 (x+y+z)dx\,dy\,dz$. **(05 Marks)**

OR

6 a. Evaluate $\int_0^1 x^5(1-x^2)^{\frac{5}{2}}\, x.dx$. **(06 Marks)**

b. Evaluate $\int_0^{2a}\int_0^{\frac{x^2}{4a}} xy\ dy\,dx$. **(05 Marks)**

c. Evaluate $\int_0^1\int_0^1\int_0^y xyz\ dx\,dy\,dz$. **(05 Marks)**

Module-4

7 a. A particle moves along the curve $\vec{r} = 2t^2\,\hat{i} + (t^2 - 4t)\hat{j} + (3t-5)\hat{k}$. Find the components of velocity and acceleration at t = 2. **(06 Marks)**

b. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $\vec{a} = 2\hat{i} - \hat{j} - 2\hat{k}$. **(05 Marks)**

c. Find $\text{div}\,\vec{f}$ for $\vec{f} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. **(05 Marks)**

OR

8 a. Find the unit tangent vector to the curve $\vec{r} = t^2\,\hat{i} + 2t\,\hat{j} - t^3\,\hat{k}$ at $t = \pm 1$. **(06 Marks)**

b. Find the unit normal vector to the surface xy + yz + zx = c at the point (-1, 2, 3). **(05 Marks)**

c. Show that $\vec{f} = (z + \sin y)\,\hat{i} + (x\cos y - z)\,\hat{j} + (x-y)\,\hat{k}$ is irrotational. **(05 Marks)**

Module-5

9 a. Solve $\frac{dy}{dx} = \frac{y}{x} + \text{Sin}\left(\frac{y}{x}\right)$. **(06 Marks)**

b. Solve $\frac{dy}{dx} + y\cot x = \text{Sin}\,x$. **(05 Marks)**

c. Solve $(x^2 + y)\,dx + (y^3 + x)\,dy = 0$. **(05 Marks)**

OR

10 a. Solve $\frac{dy}{dx} = (4x + y + 1)^2$. **(06 Marks)**

b. Solve $\frac{dy}{dx} + \frac{2}{x}y = \frac{3x^2+1}{x^2}$. **(05 Marks)**

c. Solve $[y(1+\frac{1}{x}) + \text{Cos}\,y]\,dx + (x + \log x - x\,\text{Sin}\,y)\,dy = 0$. **(05 Marks)**

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CBCS SCHEME

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Third Semester B.E. Degree Examination, July/August 2022
Network Analysis

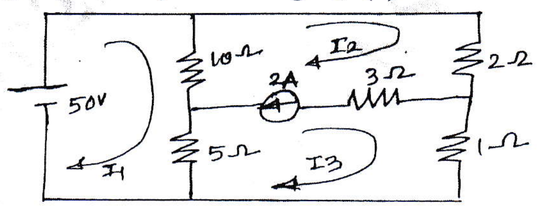
Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

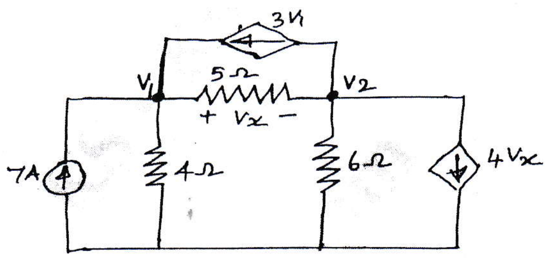
1 a. Find the current 'I' in 5Ω using Mesh analysis for Fig. Q1(a). **(08 Marks)**

Fig. Q1(a)



b. Find the voltage V_x using Node Analysis for Fig. Q1(b). **(08 Marks)**

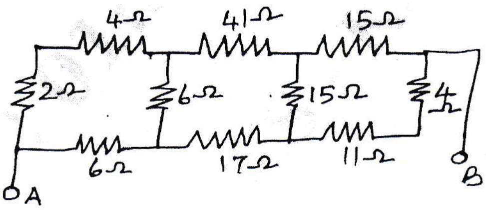
Fig. Q1(b)



OR

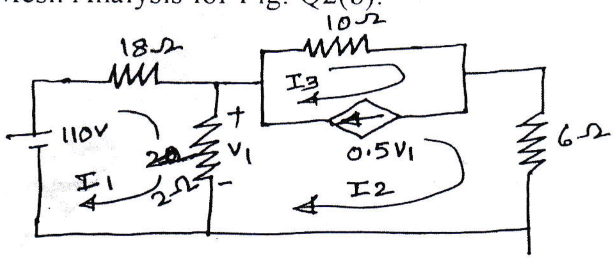
2 a. Determine the resistance between A and B using Δ to Y conversion for Fig. Q2(a). **(04 Marks)**

Fig. Q2(a)



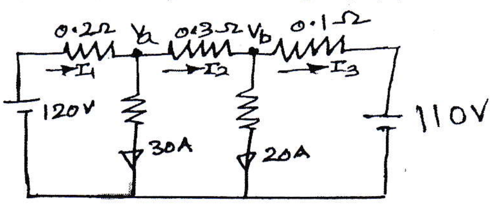
b. Find the current I_1 , I_2 using Mesh Analysis for Fig. Q2(b). **(06 Marks)**

Fig. Q2(b)



c. Calculate I_1 , I_2 , I_3 , V_a , V_b using Node analysis for Fig. Q2(c). **(06 Marks)**

Fig. Q2(c)

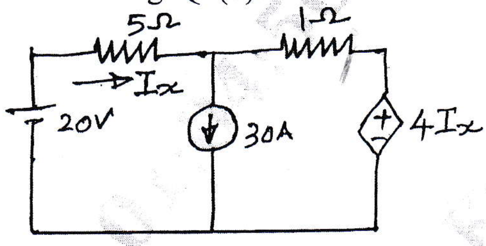


Module-2

3 a. State and prove Thevenin's theorem. **(05 Marks)**

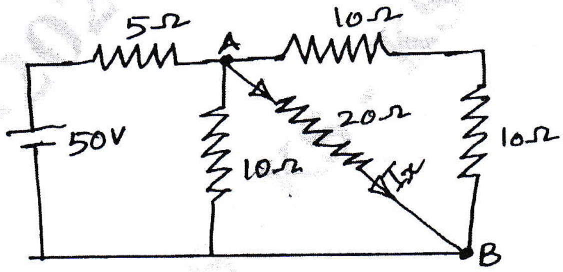
b. Find I_x using Super position theorem for Fig. Q3(b). **(05 Marks)**

Fig. Q3 (b)



c. Verify the Reciprocity theorem for the circuit in Fig. Q3(c). **(06 Marks)**

Fig. Q3 (c)

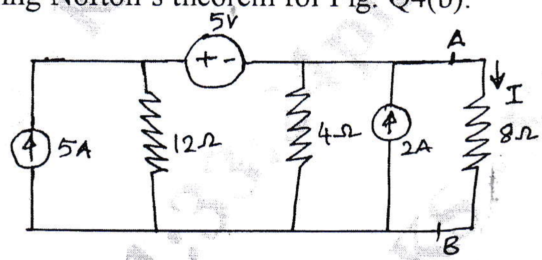


OR

4 a. State and prove Milliman's theorem. **(05 Marks)**

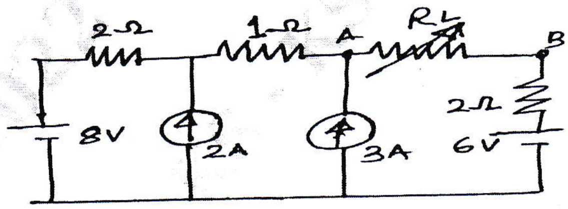
b. Determine I through 8Ω using Norton's theorem for Fig. Q4(b). **(05 Marks)**

Fig. Q4 (b)



c. Find the value of R_L and Maxi Power delivered to R_L using Maxi Power theorem for Fig. Q4(c). **(06 Marks)**

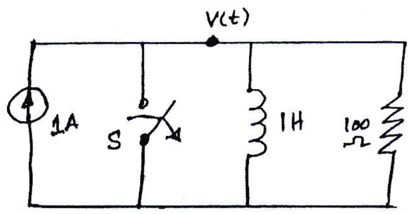
Fig. Q4 (c)



Module-3

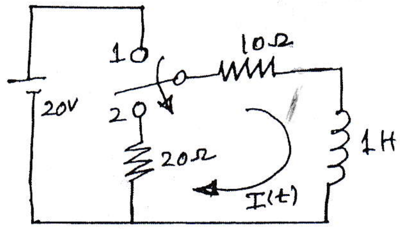
5 a. S – opened at t = 0 for the circuit Fig. Q5(a). Calculate $V(0^+)$ $\frac{dv(0^+)}{dt}$, $\frac{d^2v(0^+)}{dt^2}$. **(05 Marks)**

Fig. Q5(a)



b. S – is moved from 1 to 2 at t = 0 find $I(0^+)$, $\dfrac{dI(0^+)}{dt}$, $\dfrac{d^2I(0^+)}{dt^2}$ for the circuit in Fig. Q5(b).

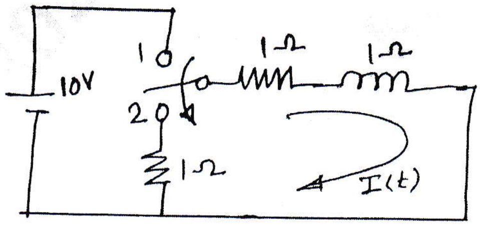
Fig. Q5 (b)



(05 Marks)

c. S – is moved from 1 to 2 at t = 0. Determine I(t) using Laplace Transformation for t > 0 in the circuit Fig. Q5(c). (06 Marks)

Fig. Q5 (c)

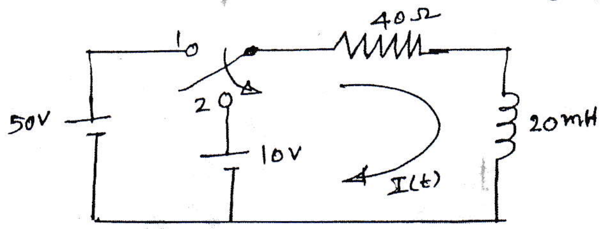


OR

6 a. Find Inverse Laplace Transform of $\dfrac{1}{s(s+1)}$. (04 Marks)

b. S – is changed from 1 to 2 at t = 0, find I(t) for t > 0 in the circuit Fig. Q6(b). (06 Marks)

Fig. Q6 (b)



c. A series R, L circuit with initial current I_O in inductor is connected to a D.C voltage V at t = 0. Derive an expression for I(t) through the inductor for t > 0. (06 Marks)

Module-4

7 a. Show the resonance frequency $f_0 = \sqrt{f_1 \; f_2}$ for series resonance circuit. (05 Marks)

b. Derive an expression for resonance frequency f_o in case of parallel resonance circuit when inductor L resistance R_L is considered. (05 Marks)

c. A series resonance circuit C = 1μF and its inductor L resistance is 16Ω. If the Bandwidth is 500rad/sec. Determine f_o, Q, L. (06 Marks)

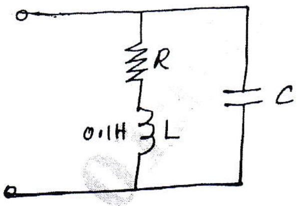
OR

8 a. Define Q – factor, Bandwidth , selectivity of series resonance circuit. (06 Marks)

b. Determine the frequency w_c, when the voltage across the capacitor is maximum incase of series resonance circuit. (05 Marks)

c. The inductor value L = 0.1H for the circuit Fig. Q8(c) and its Q value is 5. The resonance frequency of the circuit is 500rad/sec. Determine the values of capacitance C and R. **(05 Marks)**

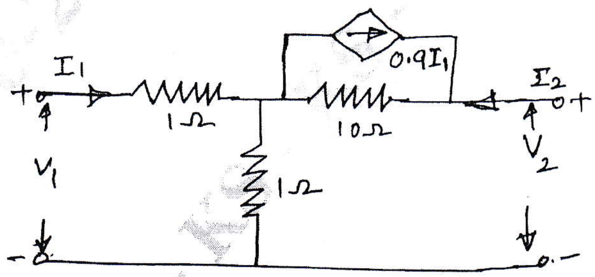
Fig. Q8 (c)



Module-5

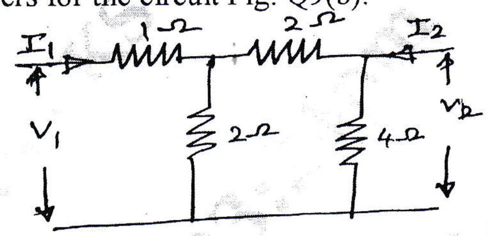
9 a. Determine Z – parameters for the circuit Fig. Q9(a). Using interrelationship between parameters, find Y parameters. **(08 Marks)**

Fig. Q9 (a)



b. Determine the h – parameters for the circuit Fig. Q9(b). **(08 Marks)**

Fig. Q9 (b)

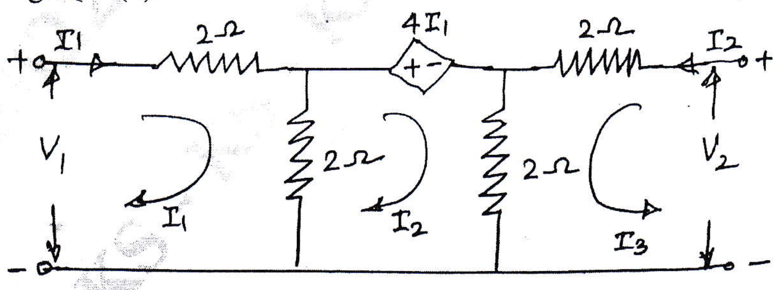


OR

10 a. Define Z – parameters and obtain the condition for symmetry. **(08 Marks)**

b. Determine Z – parameters, using Interrelationship between parameters, determine h parameters for the circuit Fig. Q10(b). **(08 Marks)**

Fig. Q10 (b)



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CBCS SCHEME

USN | | | | | | | | | | 15EC36

Third Semester B.E. Degree Examination, July/August 2022
Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. State and prove Coulomb's law. (05 Marks)

b. Three equal charges of 1 μC each are located at the three corners of a square of 10 cm side. Find the electric field intensity at the forth vacant corner of the square. (06 Marks)

c. A charge $Q_1 = -20\mu C$ is located at P(−6,4,6) and a charge $Q_2 = 50\mu C$ is located at R(5, 8, −2) in a free space. Find the force exerted on Q_2 by Q_1 in vector form. The distance given in meter. (05 Marks)

OR

2 a. Derive the expression of electric field intensity for infite line charge. (08 Marks)

b. Find the electric field $\vec{E}$ at the origin, if the following charge distributions are present in free space:

(i) Point charge 12 nC at P(2, 0, 6)

(ii) Uniform line charge of linear 3 nC at x = 2, y = 3. (08 Marks)

Module-2

3 a. State and prove the Gauss's law. (05 Marks)

b. State and prove Divergence theorem. (05 Marks)

c. If $\vec{D} = xy^2z^2\hat{a}_x + x^2yz^2\hat{a}_y + x^2y^2z\,\hat{a}_z\ C/m^2$.

Find :

(i) An expression for ρ_v

(ii) The total charge within the cube defined by $0 \le x \le 2,\ 0 \le y \le 2,\ 0 \le z \le 2$. (06 Marks)

OR

4 a. Derive the expression for work done interms of line integral. (06 Marks)

b. Given $V = \dfrac{\cos 2\phi}{r}$ in the free space, in cylindrical system:

(i) Find $\vec{E}$ at B(2, 30°, 1).

(ii) Find the volume charge density at point A(0.5, 60°, 1). (10 Marks)

Module-3

5 a. Derive the expression for Poisson's and Laplace's equation. (04 Marks)

b. Determine whether or not the following potential field satisfy the Laplace's equation:

(i) $V = x^2 - y^2 + z^2$

(ii) $V = r\cos\phi + z$ (04 Marks)

c. Use Laplace's equation to find the capacitance per unit length of a co-axial cable of inner radius 'a' in and outer radius 'b' m . Assume $V = V_0$ at r = a, V = 0 at r = b. (08 Marks)

OR

6 a. State and explain Biot-Savart law. (05 Marks)

b. State and prove the Stoke's theorem. (06 Marks)

c. Given $\vec{A} = (\sin 2\phi)\hat{a}_\phi$ in cylindrical coordinates. Find curl of $\vec{A}$ at $\left(2, \frac{\pi}{4}, 0\right)$. (05 Marks)

Module-4

7 a. Derive the expression for the force on a differential current element. (06 Marks)

b. A point charge of Q = 1.2C has velocity $\vec{v} = (5\hat{a}_x + 2\hat{a}_y - 3\hat{a}_z)$ m/s. Find the magnitude of the force exerted on the charge if,

(i) $\vec{E} = -18\hat{a}_x + 5\hat{a}_y - 10\hat{a}_z$ V/m

(ii) $\vec{B} = -4\hat{a}_x + 4\hat{a}_y + 3\hat{a}_z$ T. (10 Marks)

OR

8 a. Write short notes on Magnetization and Permeability. (06 Marks)

b. Derive the boundary condition for tangential component in magnetic field. (05 Marks)

c. A coil of 500 turns is wound on a closed iron ring of mean radius 10 cm and cross section area of 3 cm^2. Find the self inductance of the winding if the relative permeability of iron is 800. (05 Marks)

Module-5

9 a. Write the Maxwell equations in point form and integral form. (06 Marks)

b. Given $\vec{E} = E_m \sin(\omega t - \beta z)\hat{a}_y$ in free space. Find $\vec{D}$, $\vec{B}$ and $\vec{H}$. (06 Marks)

c. Prove that $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$. (04 Marks)

OR

10 a. Derive the general expression for uniform plane in free space. (05 Marks)

b. State and prove Poynting theorem. (07 Marks)

c. Calculate the attenuation constant and phase constant for a uniform plane wave with frequency of 10 GHz in polythelene for which $\mu = \mu_0$, $\varepsilon_r = 2.3$ and $\sigma = 256 \times 10^{-4}$ ℧/m. (04 Marks)

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