CBCS SCHEME

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15MAT31

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Engineering Mathematics - III

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Obtain Fourier series expansion of f(x) = |x| in the intercal (-π , π) and hence deduce $\pi^2/8 = \sum_{1}^{\infty} 1/(2n-1)^2$. **(08 Marks)**

b. Obtain half range cosine series of $f(x) = \begin{cases} x, & 0 < x < \pi/2 \\ \pi - x, & \pi/2 < x < \pi \end{cases}$. **(08 Marks)**

OR

2 a. Obtain Fourier series expansion of $f(x) = \frac{\pi - x}{2}$, $0 \le x \le 2\pi$. **(06 Marks)**

b. Obtain half range sine series of $f(x) = x^2$ in the interval $(0, \pi)$. **(05 Marks)**

c. Obtain the Fourier series for the following function neglecting the terms higher than first harmonic. **(05 Marks)**

x :	0	1	2	3	4	5
y :	9	18	24	28	26	20

Module-2

3 a. Find the Fourier transform of $f(x) = \begin{cases} 1 - |x|, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$ and hence deduce $\int_0^{\infty} \frac{\sin^2 x}{x^2} dx = \pi/2$. **(06 Marks)**

b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$. **(05 Marks)**

c. Find the Inverse Z – transform of $\frac{8z^2}{(2z-1)(4z-1)}$. **(05 Marks)**

OR

4 a. Find the Fourier Cosine transform of $f(x) = \begin{cases} 4x, & 0 < x < 1 \\ 4 - x, & 1 < x < 4 \\ 0, & x > 4 \end{cases}$. **(05 Marks)**

b. Find the Z – transform of i) $\sinh n\theta$ ii) n^2. **(06 Marks)**

c. Solve the difference equation : $U_{n+2} - 5U_{n+1} + 6U_n = 2$, $U_0 = 3$, $U_1 = 7$. **(05 Marks)**

Module-3

5 a. Compute the coefficient of correlation and the equation of lines of regression for the data.

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

(06 Marks)

b. Fit a second degree parabola $y = ax^2 + bx + c$ for the following data :

x	0	1	2	3	4	5	6
y	14	18	27	29	36	40	46

(05 Marks)

c. Using Newton Raphson method, find a real root of $x \sin x + \cos x = 0$ near $x = \pi$, corrected to four decimal places. (05 Marks)

OR

6 a. Obtain the lines of regression and hence find coefficient of correlation for the following data

x	1	2	3	4	5
y	2	5	3	8	7

(06 Marks)

b. By the method of Least square, find a straight line that best fits the following data :

x	5	10	15	20	25
y	16	19	23	26	30

(05 Marks)

c. Using Regula – Falsi method to find a real root of $x \log_{10} x - 1.2 = 0$, carry out 3–iterations. (05 Marks)

Module-4

7 a. Find the interpolating formula f(x), satisfying $f(0) = 0$, $f(2) = 4$, $f(4) = 56$, $f(6) = 204$, $f(8) = 496$, $f(10) = 980$ and hence find f(3). (06 Marks)

b. Use Newton's divided difference formula to find f(9), given

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

(05 Marks)

c. Evaluate $\int_0^1 \frac{x}{1+x^2}\,dx$ by applying Simpson's ⅜ th rule, taking 7 ordinates. (05 Marks)

OR

8 a. Using Newton's backward interpolation formula, find f(105), given

x	80	85	90	95	100
f(x)	5026	5674	6362	7088	7854

(06 Marks)

b. Apply Lagrange formula to find root of the equation f(x) = 0, given $f(30) = -30$, $f(34) = -13$, $f(38) = 3$ and $f(42) = 18$. (05 Marks)

c. Evaluate $\int_0^{0.3} \sqrt{1-8x^3}\,dx$, taking 6 – equal strips by applying Weddle's rule. (05 Marks)

Module-5

9 a. If $\vec{F} = (3x^2 + 6y)i - 14yzj + 20xz^2k$, evaluate $\int \vec{F}.d\vec{r}$ from (0, 0, 0) to (1, 1, 1) along the curve given by $x = t$, $y = t^2$, $z = t^3$. **(06 Marks)**

b. Find the extremal of the functional $\int_0^{\pi/2} (y^2 - y'^2 - 2y\sin x)dx, y(0) = y(\pi/2) = 0$. **(05 Marks)**

c. Prove that geodesics on a plane are straight lines. **(05 Marks)**

OR

10 a. Find the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ with the help of Green's theorem in a plane. **(06 Marks)**

b. Verify Stoke's theorem for $\vec{F} = yi + zj + xk$. Where S is the upper half of the sphere $x^2 + y^2 + z^2 = 1$ and C is it boundary. **(05 Marks)**

c. A heavy chain hangs freely under the gravity between two fixed points. Show that the shape of the chain is a Catenary. **(05 Marks)**

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CBCS SCHEME

USN 1KT17EC409 **15EC33**

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Digital Electronics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Write the following equation in proper canonical form:
   i) $P = f(a,b,c) = a\bar{b} + \bar{a}b + bc$
   ii) $T = f(a,b,c) = (a+\bar{b}).(\bar{b}+c)$ **(06 Marks)**

b. Find all the prime-implicant and essential prime implicant for the given function.
   i) $D = f(a, b, c, d) = \sum_m(6, 7, 9, 10, 13) + \sum_d(1, 4, 5, 11, 15)$ using K-map and draw the logic diagram.
   ii) $P = \pi_m(0, 1, 2, 3, 7, 8, 10, 11, 15).\pi_d(9, 14)$ using K-map and draw the logic diagram. **(10 Marks)**

OR

2 a. Simplify the following three-variable equation using K-map. List all the prime-implicant and essential prime implicants. $J = F(x, y, z) = \sum(0, 2, 3, 4, 5, 7)$ **(04 Marks)**

b. Find all the prime implicant and essential prime implicant of the function $S = f(a, b, c, d) = \sum(1, 3, 13, 15) + \sum_d(8, 9, 10, 11)$ using Quine-McClusky's algorithm. Draw the logic diagram. **(12 Marks)**

Module-2

3 a. Implement the following multiple output function using 74LS138 3:8 decoder and external gates
   $F_1(A, B, C) = \sum_m(1, 4, 5, 7)$
   $F_2(A, B, C) = \pi_m(2, 3, 6, 7)$ **(06 Marks)**

b. What do you mean by priority encoder? Explain 8 to 3 encoder, with highest number having the highest priority with the help of a truth table. (No need of logic circuit). **(06 Marks)**

c. Design a 1-bit comparator using logic gates. **(04 Marks)**

OR

4 a. Implement full-Adder using 4:1 Multiplexer. **(06 Marks)**

b. Design a 4-bit ripple parallel adder using full adder-blocks. **(05 Marks)**

c. Design a full-subtractor using logic gates. **(05 Marks)**

Module-3

5 a. Explain the working of switch debouncer using SR latch. **(06 Marks)**

b. Obtain the characteristic equation of i)SR flip-flops ii) JK flip-flops. **(04 Marks)**

c. Explain clocked SR flip-flop using NAND gates. **(06 Marks)**

OR

6 a. Explain the working of Master-Slave JK flip-flop with functional table and timing diagram. Show how race around condition is overcome. **(12 Marks)**

b. What is meant by triggering of flip-flops? Name the different triggering methods. **(04 Marks)**

Module-4

7 a. Explain the different types of shift register SISO, PISO, SIPO, PIPO with relevant circuit diagram. **(10 Marks)**

b. Design 4-bit asynchronous down counter and explain, using negative edge triggered JK flip flops. **(06 Marks)**

OR

8 a. Design synchronous MOD-8 counter using clocked JK flip-flops. **(08 Marks)**

b. Design synchronous MOD-6 counter using clocked T-flip-flops. **(08 Marks)**

Module-5

9 a. Explain the Mealy model and Moore model of a clocked synchronous sequential network. **(08 Marks)**

b. Design a clocked sequential circuit that operates according to the state diagram shown in Fig.9(b). Implement the circuit using D-flip-flop. **(08 Marks)**

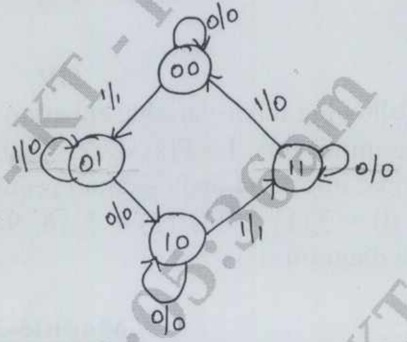

Fig.9(b)

OR

10 a. Give recommended steps for the design of a clocked synchronous sequential networks. **(06 Marks)**

b. Design a synchronous counter using JK flip-flops to count the sequence 0, 1, 2, 4, 5, 6, 0, 1, 2. Use state diagram and state table. **(10 Marks)**

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CBCS SCHEME

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15EC34

Third Semester B.E. Degree Examination, Jan./Feb.2021
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. Define the terms with an example,
 (i) Linear and non linear elements.
 (ii) Lumped and distributed elements.
 (iii) Unilateral and Bilateral elements.
 (iv) Active and Passive elements. **(08 Marks)**

b. Find the current in 28 Ω resistor using mesh analysis in Fig. Q1 (b). **(08 Marks)**

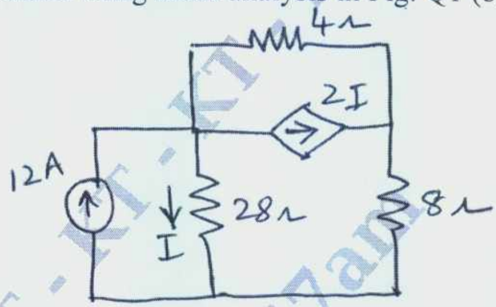

Fig. Q1 (b)

OR

2 a. Reduce the network in Fig. Q2 (a) to a single voltage source in series with a resistance using source shift and source transformation.

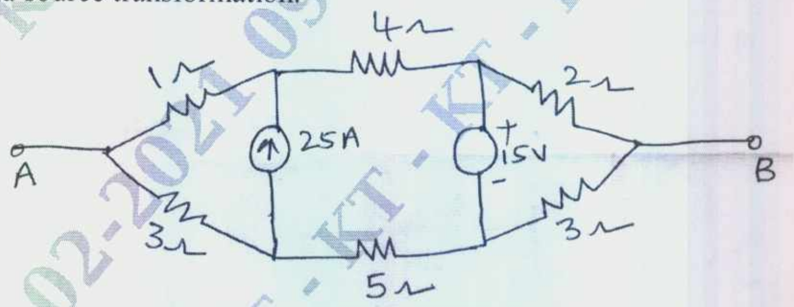

Fig. Q2 (a)

(08 Marks)

b. The node voltage equations of a network are,

$$\left[\frac{1}{5}+\frac{1}{j2}+\frac{1}{4}\right]V_1-\frac{1}{4}V_2=\frac{50\angle 0^0}{5}$$

and

$$-\frac{1}{4}V_1+\left[\frac{1}{4}+\frac{1}{-2j}+\frac{1}{2}\right]V_2=\frac{50\angle 90^0}{2}.$$

Derive the network. **(08 Marks)**

Module-2

3 a. State and prove superposition theorem. **(08 Marks)**

b. For the circuit shown in fig. Q3 (b), find the current through R_L using Thevenins theorem. **(08 Marks)**

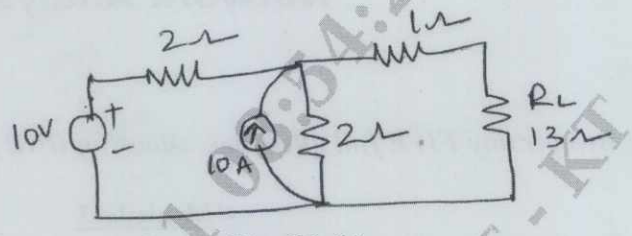

Fig. Q3 (b)

OR

4 a. State and prove Millers theorem. **(08 Marks)**

b. Find the value of Z_L for which power transferred to the load is maximum and also determine the maximum power for the circuit shown in Fig. Q4 (b). **(08 Marks)**

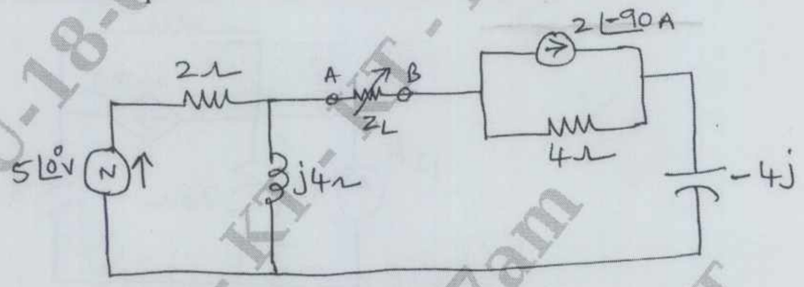

Fig. Q4 (b)

Module-3

5 a. In the circuit of Fig. Q5 (a). Switch K is opened at t = 0. Find the value of V, $\frac{dV}{dt}$ and $\frac{d^2V}{dt^2}$ at $t = 0^+$. **(08 Marks)**

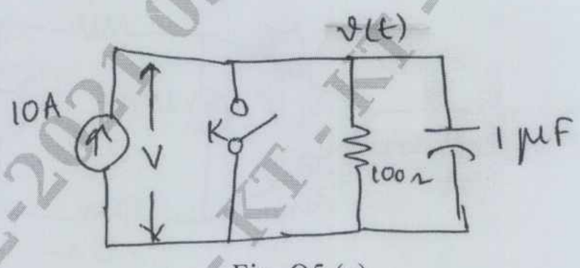

Fig. Q5 (a)

b. Obtain the Laplace transform of the square wave shown in Fig. Q5 (b). **(08 Marks)**

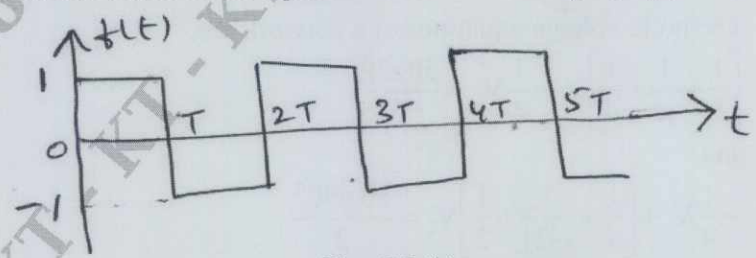

Fig. Q5 (b)

OR

6 a. State and prove initial value and final value theorem. **(08 Marks)**

b. For the network shown in Fig. Q6 (b) the switch is moved from position 1 to position 2 at $t = 0$ the steady state has been reached before switching. Calculate $i, \frac{di}{dt}, \frac{d^2i}{dt^2}$ at $t = 0^+$. **(08 Marks)**

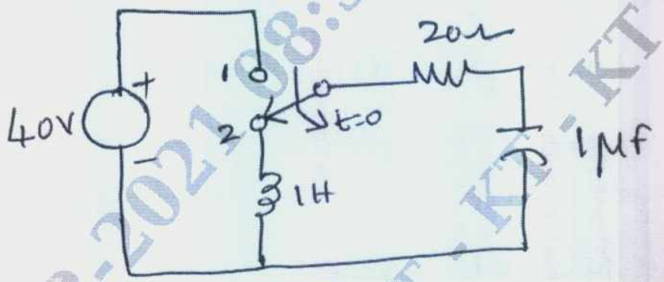

Fig. Q6 (b)

Module-4

7 a. Define the following terms :
   (i) Resonance
   (ii) Q-factor
   (iii) Bandwidth
   (iv) Selectivity. **(04 Marks)**

b. Derive an expression for frequency of resonance of a parallel resonant circuit containing resistance in both the branches. **(06 Marks)**

c. It is required that a series RLC circuit should resonate at 500 kHz. Determine the values of R, L and C if the bandwidth of the circuit is 10 kHz and its impedence is 100 Ω at resonance. Also find the voltages across L and C at resonance if the applied voltage is 75 volts. **(06 Marks)**

OR

8 a. Show that a two branch parallel resonant circuit is resonant at all the frequencies if $R_L = R_C = \sqrt{\frac{L}{C}}$ where R_L = Resistance in the inductor branch, R_C = Resistance in the capacitor branch. **(06 Marks)**

b. Give the comparison between series and parallel resonance. **(04 Marks)**

c. Find the value of R_1 such that the circuit given in Fig. Q8 (c) is resonant. **(06 Marks)**

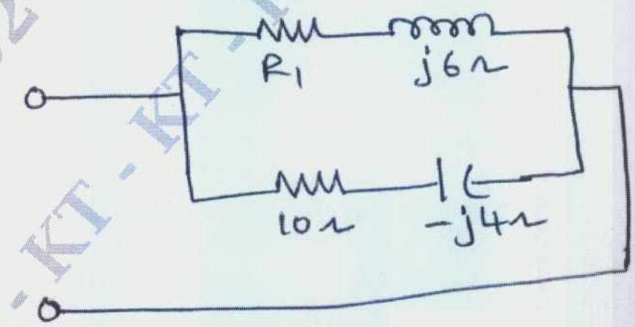

Fig. Q8 (c)

Module-5

9 a. Express Y parameters in terms of Z and T parameters. **(08 Marks)**

b. Find the transmission parameters for the network shown in Fig. Q9 (b). **(08 Marks)**

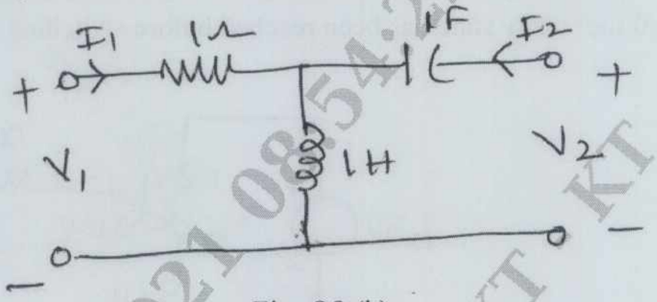

Fig. Q9 (b)

OR

10 a. Express ABCD parameters in terms of Y and h parameters. **(08 Marks)**

b. Find the h parameters of the network shown in Fig. Q10 (b). **(08 Marks)**

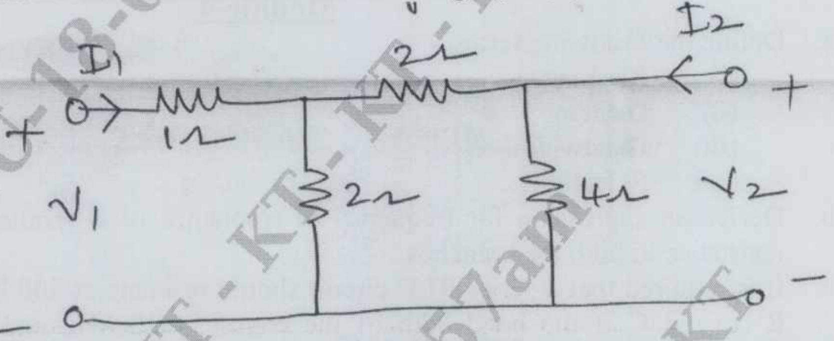

Fig. Q10 (b)

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CBCS SCHEME

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15EC36

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Engineering Electromagnetics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. A charge $Q_A = -20\ \mu C$ is located at A(−6, 4, 7) and a charge $Q_B = 50\ \mu C$ is located at B(5, 8, −2) in free space. If distances are given in meters, find the vector force exerted on Q_A by Q_B. **(06 Marks)**

b. A charge of −0.3 μC is located at A(25, −30, 15) (in cm) and a second charge of 0.5 μC is located at B(−10, 8, 12) cm. Find Electric field intensity (E) at
(i) the origin (ii) P(15, 20, 50,)cm. **(08 Marks)**

c. Define electric flux density. **(02 Marks)**

OR

2 a. Calculate the total charge within the universe of $\rho_v = \frac{e^{-2r}}{r^2}$. **(04 Marks)**

b. Infinite uniform line charges of 5 nC/m lie along the (positive and negative) x and y axes in free space. Find Electric field intensity (E) at $P_A(0, 0, 4)$ **(04 Marks)**

c. Calculate Electric flux Density (D) in rectangular coordinates at point P(2, −3, 6) produced by
(i) a point charge QA = 55 mC at Q(−2, 3, −6);
(ii) a uniform line charge ρ_{LB} = 20 mC/m on the x-axis. **(08 Marks)**

Module-2

3 a. State and explain Gauss law in electrostatics. **(04 Marks)**

b. Derive the expression for electric field intensity due to an infinite line charge using Gauss law. **(04 Marks)**

c. In the region of free space that includes the volume 2 < x, y, z < 3, $D = \frac{2}{z^2}(yza_x + xza_y - 2xya_z)\ c/m^2$.
(i) Evaluate the volume integral side of the divergence theorem for the volume defines here.
(ii) Evaluate surface integral side for the corresponding closed surface. **(08 Marks)**

OR

4 a. Derive an expression for continuity equation in point form. **(04 Marks)**

b. If $\hat{E} = 120\ a_\rho$ V/m, find the incremental amount of work done in moving a 50 μC charge a distance of 2 mm from (i) P(1, 2, 3) toward Q(2, 1, 4) (ii) Q(2, 1, 4) toward P(1, 2, 3). **(05 Marks)**

c. Current density is given in cylindrical coordinates as $J = -10^6 z^{1.5} a^z$ A/m^2 in the region $0 \le \rho \le 20\ \mu m$; for $\rho \ge 20\ \mu m$ J = 0.
(i) Find the total current crossing the surface z = 0.1 m in the a_z direction.
(ii) If the charge velocity is 2×10^6 m/s at z = 0.1m, find ρ_v (volume charge density). **(07 Marks)**

Module-3

5 a. Starting from Gauss law, derive Poisson's and Laplace's equation. (04 Marks)

b. Calculate numerical value for potential V and volume charge density ρ_v at $P\left(3, \frac{\pi}{3}, 2\right)$ if $V = 5\rho^2 \cos 2\phi$. (06 Marks)

c. Given the spherically symmetric potential field in free space, $V = V_0 e^{-r/a}$, find: (i) ρ_v at r = a (ii) the electric field at r = a (iii) total charge. (06 Marks)

OR

6 a. State and explain Ampere's law. (04 Marks)

b. Evaluate both sides of Stoke's theorem for the field $H = 10 \sin\theta\, a_\phi$ and the surface r = 3, $0 \le \theta \le 90°$, $0 \le \phi \le 90°$. Let the surface have the a_r direction. (06 Marks)

c. Using the concept of vector magnetic potential, find the magnetic flux density at a point due to long straight filamentary conductor carrying current 'I' in the a_z direction. (06 Marks)

Module-4

7 a. Derive an expression for the force on a differential current element placed in a magnetic field. (04 Marks)

b. A point charge for which $Q = 2 \times 10^{-16}$ C and $m = 5 \times 10^{-26}$ kg is moving in the combined fields $E = 100\, a_x - 200\, a_y + 300\, a_z$ V/m and $B = -3a_x + 2a_y - a_z$ mT. If the charge velocity at t = 0 is V(0). $V(0) = (2a_x - 3a_y - 4a_z)10^5$ m/s.

(i) Give the unit vector showing the direction in which the charge is accelerating at t = 0.

(ii) Find the kinetic energy of the charge at t = 0. (06 Marks)

c. A rectangular loop of wire in free space joins points A(1, 0, 1) to B(3, 0, 1) to C(3, 0, 4) to D(1, 0, 4) to A. The wire carries a current of 6 mA, flowing in the a_z direction from B to C. A filamentary current of 15A flows along entire z axis in the a_z direction.
(i) Find 'F' on side BC (ii) Find 'F' on side AB (iii) Find F_{total} on the loop. (06 Marks)

OR

8 a. Given a material for which $x_m = 3.1$ and within which $B = 0.4 y a_z$ T, find:
(i) H (ii) μ (iii) μ_r (iv) M (v) J (04 Marks)

b. Let $\mu_{r_1} = 2$ in region 1 defined by $2x + 3y - 4z > 1$ while $\mu_{r_2} = 5$ in region 2 where $2x + 3y - 4z < 1$. In region 1, $H_1 = 50a_x - 30a_y + 20a_z$ A/m. Find:
(i) H_{N_1} (ii) H_{t_1} (iii) H_{t_2} (iv) H_{N_2} (v) θ_1 the angle between H_1 and a_{N21} (08 Marks)

c. Obtain an expression for the total energy stored in a steady magnetic filed in which 'B' is linearly related to 'H'. (04 Marks)

Module-5

9 a. Write Maxwell's equations in integral and point forms. (06 Marks)

b. Using Faraday's law, deduce Maxwell's equation, to relate time varying electric and magnetic fields. (06 Marks)

c. Explain the displacement current and displacement current density. (04 Marks)

OR

10 a. Derive wave equations for uniform plane wave in free space. (06 Marks)

b. Derive an expression for propagation constant intrinsic impedance and phase velocity for a uniform plane wave propagating in a conducting media. (06 Marks)

c. In free space $E(x,t) = 50\cos(\omega t - \beta x) a_y$ V/m. find the average power crossing a circular area of radius 5m in the plane x = constant. (04 Marks)

CBCS SCHEME

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15MATDIP31

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Find the real and imaginary parts of $\frac{2+i}{3-i}$ and express in the form of x + iy. **(05 Marks)**

b. Reduce 1 − cos α + j sin α to the modulus amplitude form [r(cos θ + i sin θ)] by finding r and θ. **(06 Marks)**

c. If $\vec{a} = 4i+3j+k$ and $\vec{b} = 2i - j + 2k$ find the unit vector perpendicular to both the vectors $\vec{a}$ and $\vec{b}$. Hence show that $\sin\theta = \frac{\sqrt{185}}{3\sqrt{26}}$ where 'θ' is angle between $\vec{a}$ and $\vec{b}$. **(05 Marks)**

OR

2 a. Find the modulus and amplitude of $\frac{3+i}{1+i}$. **(05 Marks)**

b. Find 'a' such that the vectors 2i – j + k, i + 2j – 3k and 3i + aj + 5k are coplanar. **(06 Marks)**

c. Show that for any three vectors $\bar{a}, \bar{b}, \bar{c}$ $[\bar{b}\times\bar{c}, \bar{c}\times\bar{a}, \bar{a}\times\bar{b}] = [\bar{a}, \bar{b}, \bar{c}]^2$. **(05 Marks)**

Module-2

3 a. Find the n^{th} derivative of sin (5x) cos (2x). **(05 Marks)**

b. 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)**

c. If $u = \sin^{-1}\frac{x+y}{\sqrt{x}-\sqrt{y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$. **(05 Marks)**

OR

4 a. Expand $e^{\sin x}$ by Maclaurin's series upto the term containing x^4. **(05 Marks)**

b. Give $u - \sin\left(\frac{x}{y}\right)$ $x = e^t$ $y = t^2$ find $\frac{du}{dt}$ as a function of t. **(06 Marks)**

c. If x = r cos θ, y = r sin θ find $\frac{\partial(x,y)}{\partial(r,\theta)}$ and $\frac{\partial(r,\theta)}{\partial(x,y)}$. **(05 Marks)**

Module-3

5 a. State reduction formula for $\int_0^{\pi/2}\sin^n x\,dx$ and evaluate $\int_0^{\pi/2}\sin^9 x\,dx$. **(05 Marks)**

b. Evaluate $\int_0^{\infty}\frac{dx}{(1+x^2)^{7/2}}$. **(06 Marks)**

c. Evaluate : $\int_0^1\int_0^2\int_0^2 x^2yz\,dx\,dy\,dz$. **(05 Marks)**

OR

6 a. Evaluate : $\int_0^{\pi} \sin^4 x \cos^6 x \, dx$. **(05 Marks)**

b. Evaluate : $\int_0^5 \int_0^{x^2} y(x^2 + y^2) dx \, dy$. **(06 Marks)**

c. Evaluate : $\int_0^1 \int_0^2 \int_1^2 x^3 y^2 z^3 \, dx \, dy \, dz$. **(05 Marks)**

Module-4

7 a. A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 3$ where t is the time. Find the velocity and acceleration at time $t = 1$. **(05 Marks)**

b. Find the unit normal vector to the surface $xy^3z^2 = 4$ at the point $(-1, -1, 2)$. **(06 Marks)**

c. What is solenoid vector field? Demonstrate that vector $\overline{F}$ given by $\overline{F} = 3y^2z^3 i + 8x^2 \sin(z) j + (x + y)k$ is solenoidal. **(05 Marks)**

OR

8 a. Find div F and Curl F if $\overline{F} = (3x^2 - 3yz)i + (3y^2 - 3xz)j + (3z^2 - 3xy)k$. **(05 Marks)**

b. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$. **(06 Marks)**

c. Show that the fluid motion $\vec{V} = (y + z)i + (z + x)j + (x + y)k$ is irrotational. **(05 Marks)**

Module-5

9 Find the solution of :

a. $(x^2 + 2e^x)dx + (\cos y - y^2)dy = 0$. **(05 Marks)**

b. $\frac{dy}{dx} = \frac{y/x}{1 + y/x}$. **(06 Marks)**

c. $(x^2 - ay)dx + (y^2 - ax)dy = 0$. **(05 Marks)**

OR

10 a. Find the solution of :

$\frac{dy}{dx} = \frac{x^3}{y^3}$. **(05 Marks)**

b. $(x^2y^3 + \sin x)dx + (x^3y^2 + \cos y)dy = 0$. **(06 Marks)**

c. $\cos y \frac{dy}{dx} + \sin y = 1$. **(06Marks)**

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