CBCS SCHEME

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17MAT31

Third Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics - III

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Obtain the Fourier series for the function

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$$

Hence deduce $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots\ldots$ **(08 Marks)**

b. Find the Fourier series for the function $f(x) = 2x - x^2$ in $0 < x < 3$. **(06 Marks)**

c. Obtain the constant term and the first sine and cosine terms of the Fourier for y using the following table :

x :	0	1	2	3	4	5
y :	4	8	15	7	6	2

(06 Marks)

2 a. Obtain the Fourier series for the function $f(x) = |\cos x|$, $-\pi < x < \pi$. **(08 Marks)**

b. Find the Half range cosine series for $f(x) = x(\ell - x)$, $0 \le x \le \ell$. **(06 Marks)**

c. Express y as a Fourier series upto first harmonic given :

x :	0	$\pi/3$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
y :	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

(06 Marks)

3 a. If $f(x) = \begin{cases} 1 - x^2, & |x| < 0 \\ 0, & |x| \ge 1 \end{cases}$

Find the Fourier transform of f(x) and hence find the value of $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3}\right) dx$ **(08 Marks)**

b. Find the Fourier sine transform of $f(x) = e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x \sin mx}{1+x^2} dx$ $(m > 0)$ **(06 Marks)**

c. Find $Z_T^{-1}\left[\frac{3z^2 + 2z}{(5z-1)(5z+2)}\right]$. **(06 Marks)**

4 a. Find the Fourier transform of

$f(x) = \begin{cases} 1 - |x|, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2} dt$. **(08 Marks)**

b. Find the Z – transform of $2n + \sin\left(\frac{n\pi}{4}\right) + 1$. **(06 Marks)**

c. Solve by using Z – transforms $Y_{n+2} - 4\ Y_n = 0$ given that $Y_0 = 0$, $Y_1 = 2$. **(06 Marks)**

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.

5 a. Obtain the lines of regression and hence find the coefficient of correlation for the data :

x :	1	3	4	2	5	8	9	10	13	15
y :	8	6	10	8	12	16	16	10	32	32

(08 Marks)

b. Fit a Second degree parabola in the least Square sense for the following data:

x :	1	2	3	4	5
y :	10	12	13	16	19

(06 Marks)

c. Use the Regula-Falsi method to obtain the real root of the equation $\cos x = 3x - 1$ correct to 3 decimal places in $(0, 1)$. (06 Marks)

6 a. Given the equation of the regression lines $x = 19.13 - 0.87y$, $y = 11.64 - 0.5x$. Compute the mean of x's , mean of y's and the coefficient of correlation. (08 Marks)

b. Fit a curve of the form, $y = a e^{bx}$ for the data:

x :	0	2	4
y :	8.12	10	31.82

(06 Marks)

c. Using Newton-Raphson method to find a real root of $x \log_{10}^{x} = 1.2$ upto 5 decimal places near $x = 2.5$. (06 Marks)

7 a. Given $\sin 45^\circ = 0.7071$, $\sin 50^\circ = 0.7660$, $\sin 55^\circ = 0.8192$, $\sin 60^\circ = 0.8660$, find $\sin 57^\circ$ using an Backward Interpolation formula. (08 Marks)

b. Applying Lagrange's Interpolation formula inversely find x when y = 6 given the data

x :	20	30	40
y :	2	4.4	7.9

(06 Marks)

c. Using Simpson's $\frac{1}{3}^{rd}$ rule with Seven ordinates to evaluate $\int_2^8 \frac{dx}{\log_{10} x}$. (06 Marks)

8 a. Fit an Interpolating polynomial for the data $u_{10} = 355$, $u_0 = -5$, $u_8 = -21$, $u_1 = -14$, $u_4 = -125$ by using Newton's Divided difference formula and hence find u_2. (08 Marks)

b. Use Lagrange's Interpolation formula to fit a polynomial for the data :

x :	0	1	3	4
y :	-12	0	6	12

Hence estimate y at x = 2. (06 Marks)

c. Evaluate $\int_4^{5.2} \log_e x \, dx$ taking six equal strips by applying Weddle's rule. (06 Marks)

9 a. 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 $y = \frac{2}{\pi}x$. (08 Marks)

b. Using Divergence theorem evaluate $\int_S \vec{F} \cdot ds$, where $\vec{F} = 4x\,i - 2y^2 j + z^2 K$ and S is the surface bounding the region $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. (06 Marks)

c. Show that the Geodesics on a plane are straight lines. (06 Marks)

10 a. Verify Stoke's theorem for the vector field $\vec{F} = (2x - y)i - yz^2 j - y^2 z\ K$ over the upper half surface of $x^2 + y^2 + z^2 = 1$ bounded by its projection on the xy - plane. **(08 Marks)**

b. Derive Euler's equation in the standard form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left[\frac{\partial f}{\partial y^1}\right] = 0$. **(06 Marks)**

c. Find the Extremals of the functional

$$\int_{x_0}^{x_1} \frac{{y^1}^2}{x^3}\,dx.$$ **(06 Marks)**

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CBCS SCHEME

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17EE32

Third Semester B.E. Degree Examination, July/August 2021
Electric Circuit Analysis

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

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.

1 a. Differentiate the following :
(i) Linear and Non-Linear networks
(ii) Active and Passive Elements
(iii) Lumped and Distributed Network.
(iv) Ideal and Practical sources **(04 Marks)**

b. Reduce the given network to a single voltage source in series with a resistance using source shifting and source transformation techniques. [Refer Fig.Q1(b)]

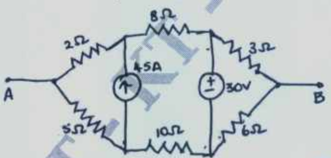

Fig.Q1(b) **(08 Marks)**

c. Find the equivalent resistance between the terminals A and B using star-delta transformation for Fig.Q1(c). **(08 Marks)**

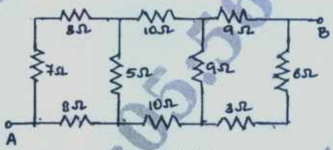

Fig.Q1(c)

2 a. Using Mesh Analysis, find I_x and V_x for the circuit shown in Fig.Q2(a). **(05 Marks)**

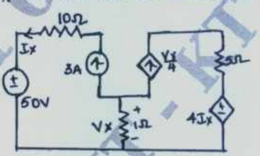

Fig.Q2(a)

b. Apply the nodal voltage technique to obtain the voltages at all nodes for the circuit in Fig.Q2(b).

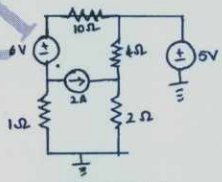

Fig.Q2(b) **(07 Marks)**

c. For the network in Fig.Q2(c), draw the dual and write the mesh and nodal equations.

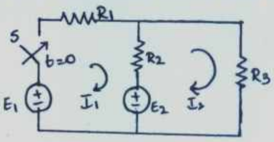

Fig.Q2(c) **(08 Marks)**

3 a. State and prove Superposition theorem. **(06 Marks)**

b. Obtain the Thevnian's equivalent of the network shown in Fig.Q3(b) between terminals X and Y.

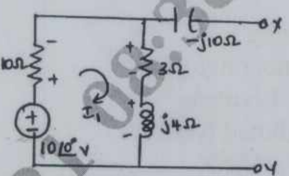

Fig.Q3(b) **(07 Marks)**

c. Find V_{ab} for the circuit in Fig.Q3(c) using superposition principle between terminals a and b.

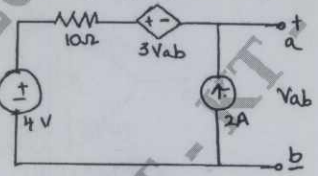

Fig.Q3(c) **(07 Marks)**

4 a. State and prove Maximum Power Transfer theorem. **(06 Marks)**

b. Obtain Norton's Equivalent for the network in Fig.Q4(b) and determine the current through 5 Ω.

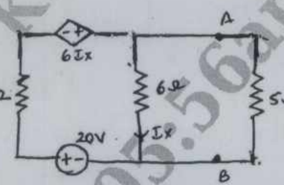

Fig.Q4(b) **(07 Marks)**

c. Find voltage V_x and verify Reciprocity theorem for the network in Fig.Q4(c).

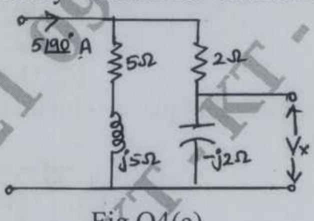

Fig.Q4(c) **(07 Marks)**

5 a. Define the following :

(i) Resonance (ii) Bandwidth (iii) Q factor (iv) Selectivity **(04 Marks)**

b. Show that in a series resonant circuit, the resonant frequency is the geometric mean of the half power frequencies. **(08 Marks)**

c. For the circuit shown in Fig.Q5(c), find the values of capacitor to achieve resonance. Derive the formula used and take f = 50 Hz.

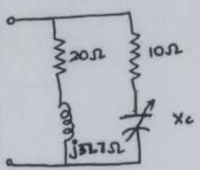

Fig.Q5(c) **(08 Marks)**

6 a. Explain the behavior of circuit elements under switching action [t = 0 and t = ∞]. **(06 Marks)**

b. In the network shown, switch K is closed at t = 0, with the capacitor uncharged. Find the values of i(t), di/dt, d^2i/dt^2 at $t = 0^+$. [Refer Fig.Q6(b)]

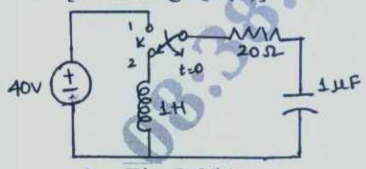

Fig.Q6(b) **(08 Marks)**

c. Derive an expression for transient response of a series RC circuit under DC excitation. **(06 Marks)**

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

b. Obtain the Laplace transform of (i) δ(t) (ii) U(t). **(04 Marks)**

c. Using initial and final value theorems, find f(0) and f(∞) for the following :

(i) $\dfrac{s^3 + 7s^2 + 5}{s(s^3 + 3s^2 + 4s + 2)}$ (ii) $\dfrac{s(s+4)(s+8)}{(s+1)(s+6)}$ **(08 Marks)**

8 a. Obtain the Laplace transform for the waveform shown in Fig.Q8(a).

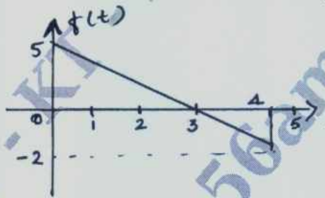

Fig.Q8(a) **(10 Marks)**

b. Synthesize the waveform shown in Fig.Q8(b) and also find its Laplace transform.

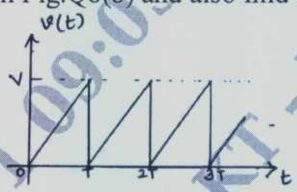

Fig.Q8(b) **(10 Marks)**

9 a. A 3 phase, 3 wire 208 V, ABC system has a star connected unbalanced load with $Z_A = 5\angle 0^\circ$, $Z_B = 5\angle 30^\circ$, $Z_C = 10\angle -60^\circ$. Obtain the line currents and voltages across each impedance, using star-delta transformation technique. **(10 Marks)**

b. Three equal inductors connected in star, take 5 kW at 0.7 power factor when connected to a 400V, 50Hz, 3 phases, 3 wire supply. Calculate the line currents if (i) One of the inductors is disconnected. (ii) One of the inductors is short circuited. **(10 Marks)**

10 a. Explain Z parameters and express Z-parameters in terms of Y parameters. **(10 Marks)**

b. Find the transmission parameters for the bridge circuit shown in Fig.Q10(b).

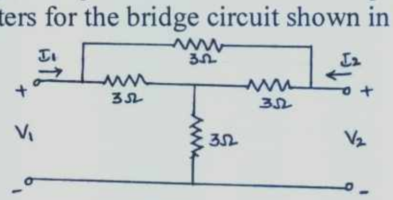

Fig.Q10(b) **(10 Marks)**

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Third Semester B.E. Degree Examination, July/August 2021
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. Find the modulus and amplitude of $\frac{4+2i}{2-3i}$. **(06 Marks)**

b. Find a unit vector normal to both the vectors $4i - j + 3k$ and $-2i + j - 2k$. Find also sine of the angle between them. **(07 Marks)**

c. Show that $\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right] = 2\left[\vec{a}, \vec{b}, \vec{c}\right]$. **(07 Marks)**

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

b. Find the modulus and amplitude of $1+\cos\theta+i\sin\theta$. **(07 Marks)**

c. Find λ so that $\vec{a} = 2\hat{i} - 3\hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{c} = \hat{j} + \lambda\hat{k}$ are coplanar. **(07 Marks)**

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

b. Find the angle of intersection of the curves $r = \sin\theta + \cos\theta$ and $r = 2\sin\theta$. **(07 Marks)**

c. If, $z = f(x, y)$ where $x = e^u + e^{-v}$, $y = e^{-u} - e^v$. Prove that $x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y} = \frac{\partial z}{\partial u} - \frac{\partial z}{\partial v}$. **(07 Marks)**

4 a. If $y = \tan^{-1}x$, then show that $(1+x^2)y_{n+2} + 2(n+1)xy_{n+1} + n(n+1)y_n = 0$. **(06 Marks)**

b. Find the pedal equation for the curve $\frac{2a}{r} = 1+\cos\theta$. **(07 Marks)**

c. If, $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$, then find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$. **(07 Marks)**

5 a. Obtain the reduction formula for $\int \cos^n x\,dx$. **(06 Marks)**

b. Using reduction formula, find the value of $\int_0^1 x^2(1-x^2)^{\frac{3}{2}}dx$. **(07 Marks)**

c. Evaluate $\int_{-1}^{1}\int_{0}^{2}\int_{x-z}^{x+z}(x+y+z)\,dx\,dy\,dz$. **(07 Marks)**

6 a. Evaluate $\int_0^{\pi} x\sin^8 x\,dx$. (06 Marks)

b. Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y\,dx\,dy$. (07 Marks)

c. Evaluate $\int_0^{\pi} x\sin^2 x\cos^4 x\,dx$. (07 Marks)

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

b. Find the angle between the tangents to the surface $x^2y^2 = z^4$ at (1, 1, 1) and (3, 3, −3). (07 Marks)

c. Find div $\vec{F}$ and curl $\vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. (07 Marks)

8 a. Find the angle between the tangents and to the curve $\vec{r} = \left(t - \frac{t^3}{3}\right)\hat{i} + t^2\hat{j} + \left(t + \frac{t^3}{3}\right)\hat{k}$ at $t = \pm 3$. (06 Marks)

b. Find the directional derivative of $f = x^2yz + 4xz^2$ at (1,−2,−1) along $2\hat{i} - \hat{j} - 2\hat{k}$. (07 Marks)

c. Prove that $\text{div}(\text{curl}\,\vec{F}) = 0$. (07 Marks)

9 a. Solve $\frac{dy}{dx} = e^{3x-2y} + x^2e^{-2y}$. (06 Marks)

b. Solve $x^2y\,dx - (x^3 + y^3)dy = 0$. (07 Marks)

c. Solve $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$. (07 Marks)

10 a. Solve $x\,dy - y\,dx = \sqrt{x^2 + y^2}\,dx$. (06 Marks)

b. Solve $(5x^4 + 3x^2y^2 - 2xy^3)dx + (2x^3y - 3x^2y^2 - 5y^4)dy = 0$. (07 Marks)

c. Solve $\frac{dy}{dx} - \frac{y}{x+1} = e^{3x}(x+1)$. (07 Marks)

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