CBCS SCHEME

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15MAT31

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

Time: 3 hrs. Max. Marks: 80

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. Obtain the Fourier series for the function,

$$f(x)=\begin{cases}1+\dfrac{2x}{\pi} & -\pi \le x \le 0\\ 1-\dfrac{2x}{\pi} & 0 \le x \le \pi\end{cases}$$

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

b. Find the constant term and first two harmonics in the Fourier series for f(x) given by the following table:

x	0	π/3	2π/3	π	4π/3	5π/3	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(08 Marks)

2 a. Expand $f(x)=\sqrt{1-\cos x}$ in $0 \le x \le 2\pi$ in a Fourier series. Evaluate $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+.....$ **(08 Marks)**

b. Obtain the Fourier series for $f(x) = |x|$ in $(-\ell, \ell)$ and hence evaluate $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+.....=\frac{\pi^2}{8}$ **(08 Marks)**

3 a. Find the Fourier transform of $f(x)=\begin{cases}1-|x| & \text{for} \quad |x|\le 1\\ 0 & \text{for} \quad |x|>1\end{cases}$ and hence deduce that $\int_0^\infty \frac{\sin^2 t}{t^2}dt$ **(06 Marks)**

b. Find the Fourier sine transform of $e^{-|x|}$. Hence show that $\int_0^\infty \frac{x\sin mx}{1+x^2}dx=\frac{\pi}{2}e^{-m}$ where $m>0$. **(05 Marks)**

c. Find the z-transform of (i) $(2n-1)^2$ (ii) $\cos\left(\frac{n\pi}{2}+\frac{\pi}{4}\right)$ **(05 Marks)**

4 a. Find the Fourier transform of $f(n)=\begin{cases}1 & |x|\le 1\\ 0 & |x|>a\end{cases}$. Hence deduce $\int_0^\infty \frac{\sin ax}{x}dx$. **(06 Marks)**

b. Find the inverse z-transform of $\frac{4z^2-2z}{z^3-5z^2+8z-4}$. **(05 Marks)**

c. Solve the differential equation $u_{n+2}+6u_{n+1}+9u_n=2^n$ with $u_0 = u_1 = 0$ using z-transform method. **(05 Marks)**

5 a. Find the coefficient of correlation and the two lines of regression for the following data:

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

(06 Marks)

b. Fit a curve of the form $y = ae^{bx}$ to the following data:

x	77	100	185	239	285
y	2.4	3.4	7.0	11.1	19.6

(05 Marks)

c. Use Regula Falsi method, find the root of the equation $x^2 - \log_e x - 12 = 0$. (05 Marks)

6 a. The two regression equations of the variables x and y are $x = 19.13 - 0.87y$ and $y = 11.64 - 0.5x$. Find:
(i) Means of x
(ii) Means of y
(iii) The correlation coefficient (06 Marks)

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

x	−3	−2	−1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.58

(05 Marks)

c. Use Newton-Raphson method to find the real root of $3x = \cos x + 1$, take $x_0 = 0.6$ perform 2 iterations. (05 Marks)

7 a. Find the cubic polynomial by using Newton forward interpolating formula which takes the following values.

x	0	1	2	3
y	1	2	1	10

(06 Marks)

b. Apply Lagrange's formula inversely to obtain a root of the equation f(x) = 0 given that $f(30) = -30$, $f(34) = -13$, $f(38) = 3$, $f(42) = 18$. (05 Marks)

c. Use Weddle's rule to evaluate $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ dividing the interval $\left[0, \frac{\pi}{2}\right]$ into six equal parts. (05 Marks)

8 a. A survey conducted in a slum locality reveals the following interpolating information as classified below:

Income/day in rupees : x	Under 10	10-20	20-30	30-40	40-50
Number of persons : y	20	45	115	210	115

Estimate the probable number of persons in the income group 20 to 25. (06 Marks)

b. Using Newton divided difference formula fit an interpolating polynomial for the following data:

x	0	1	4	5
f(x)	8	11	68	123

(05 Marks)

c. Using Simpson's 1/3rd rule evaluate $\int_0^1 \frac{x^2}{1+x^3}dx$ taking four equal strips. (05 Marks)

9 a. Find the extremal of the functional $I = \int_0^{\pi/2} (y^2 - y'^2 - 2y\sin x)dx$ under the conditions $y(0) = y\left(\frac{\pi}{2}\right) = 0$. **(06 Marks)**

b. If $\vec{F} = x^2 i + xyj$ evaluate $\int_C \vec{F}.d\vec{r}$ from (0, 0) to (1, 1) along

(i) the line $y = x$ (ii) the parabola $y = \sqrt{x}$ **(05 Marks)**

c. Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which when rotated about the x-axis gives a minimum surface area. **(05 Marks)**

10 a. Verify Green's theorem in a plane for $\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where c is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$. **(06 Marks)**

b. Using divergence theorem evaluate $\int \vec{A} \cdot \hat{n}\, ds$ where $\vec{A} = x^3 i + y^3 j + z^3 k$ and s is the surface of the surface $x^2 + y^2 + z^2 = a^2$. **(05 Marks)**

c. Find the geodesics on a surface given that the arc length on the surface is $s = \int_{x_1}^{x_2} \sqrt{x(1 + y'^2)}dx$. **(05 Marks)**

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15CS32

Third Semester B.E. Degree Examination, July/August 2021
Analog and Digital Electronics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Explain the working of a N-chennel ∈-MOSFET with neat diagram. Explain with output characteristics of the same. **(10 Marks)**
b. Write the differences between JFET and MOSFET. **(06 Marks)**

2 a. List and explain any five performance parameter of op-amp. **(10 Marks)**
b. Explain peak detector circuit with neat diagram and waveform. **(06 Marks)**

3 a. Using K-map find the reduced SOP and POS form for $f(A, B, C, D) = \Sigma m\ (1, 3, 5, 6, 7, 8, 9, 12, 13)$ **(08 Marks)**
b. Write verilog code for given expression using structural modeling Y = AB + CD. **(04 Marks)**
c. Explain the concept of positive logic and negative logic. **(04 Marks)**

4 a. Find the prime implicants with the help of Quine-McClusky method. $F(w, x, y, z) = \Sigma m(1, 2, 8, 9, 10, 12, 13, 14)$ **(08 Marks)**
b. What are hazard? Explain types of hazard. How to design hazard free circuits? **(08 Marks)**

5 a. What is multiplexer? Implement the following Boolean function using 8:1 multiplexer: $F(A, B, C, D) = \Sigma m(2, 3, 4, 5, 12, 13, 15)$ **(10 Marks)**
b. What is Magnitude Comparator? Explain a 1 bit comparator with truth table and circuit diagram. **(06 Marks)**

6 a. Explain Full adder and Half adder with neat diagram. **(08 Marks)**
b. Design 7-segment decoder using PLA. **(08 Marks)**

7 a. With a neat diagram, explain the working of a Master Slave J.K flip flop. Also write JK flip flop excitation table and state transition diagram. **(10 Marks)**
b. Write the difference between synchronous and asynchronous counter. **(06 Marks)**

8 a. Explain Johnson counter with neat diagram. **(08 Marks)**
b. With a neat diagram, explain 4 bit Serial In Serial Out register (SISO). **(08 Marks)**

9 a. Design self correcting modulo-6 counter using JK Flip Flop. **(10 Marks)**
b. Explain Digital Clock, with neat diagram. **(06 Marks)**

10 a. Explain the concept of successive approximation of A/D converter. **(10 Marks)**
b. With the help of neat diagram, explain binary ladder with digital input 1000. **(06 Marks)**

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

Time: 3 hrs. Max. Marks: 80

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

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

b. Find the modulus and amplitude of the complex number $1+\cos\alpha + i\sin\alpha$. **(05 Marks)**

c. If $\vec{a} = \hat{i}+2\hat{j}-2\hat{k}$, $\vec{b} = -\hat{i}+2\hat{j}+\hat{k}$, $\vec{c} = \hat{i}-2\hat{j}+2\hat{k}$, then find $\vec{a}\times(\vec{b}\times\vec{c})$. **(05 Marks)**

2 a. Prove that $\left[\dfrac{1+\cos\theta+i\sin\theta}{1+\cos\theta-i\sin\theta}\right]^n = \cos n\theta + i\sin n\theta$. **(06 Marks)**

b. Find the cube root of $1+i\sqrt{3}$. **(05 Marks)**

c. Show that the vectors $\vec{a} = \hat{i}-2\hat{j}+3\hat{k}$, $\vec{b} = -2\hat{i}+3\hat{j}-4\hat{k}$ and $\vec{c} = \hat{i}-3\hat{j}+5\hat{k}$ are coplanar. **(05 Marks)**

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

b. With usual notations prove that $\tan\phi = r\,.\,\dfrac{d\theta}{dr}$. **(05 Marks)**

c. If $u = \tan^{-1}\left(\dfrac{x^3+y^3}{x-y}\right)$ then show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = \sin 2u$. **(05 Marks)**

4 a. Find the n^{th} derivative of $\dfrac{x}{(x-2)(x-3)}$. **(06 Marks)**

b. Find the angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$. **(05 Marks)**

c. Given $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **(05 Marks)**

5 a. Obtain the reduction formula for $\int_0^{\pi/2}\sin^n x\, dx$. **(06 Marks)**

b. Evaluate $\int_0^{\pi/16}\cos^5(8x)\sin^6(16x)\,dx$. **(05 Marks)**

c. Evaluate $\int_1^2\int_1^3 x\,y^2\,dx\,dy$. **(05 Marks)**

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

b. Evaluate $\int_0^{\pi}\dfrac{\sin^4\theta}{(1+\cos\theta)^2}\,d\theta$. **(05 Marks)**

c. Evaluate $\int_{-3}^{3}\int_0^1\int_1^2 (x+y+z)\,dx\,dy\,dz$. **(05 Marks)**

7 a. Find velocity and acceleration of a particle moving along the curve $\vec{r} = e^{-2t}\,\hat{i} + 2\cos 5t\,\hat{j} + 5\sin t\,\hat{k}$ at anytime t. Find their magnitudes at t = 0. **(06 Marks)**

b. If $\phi = x^3 + y^3 + z^3 - 3xyz$ find $\nabla\phi$ at (1, -1, 2). **(05 Marks)**

c. Show that $\vec{F} = (x + 3y)\,\hat{i} + (y - 3z)\,\hat{j} + (x - 2z)\,\hat{k}$ is Solenoidal. **(05 Marks)**

8 a. Find the unit tangent vector of the space curve $\vec{r} = \cos t\,\hat{i} + \sin t\,\hat{j} + t\,\hat{k}$. **(06 Marks)**

b. If $\vec{F} = x^2y\,\hat{i} + yz^2\,\hat{j} + zx^2\,\hat{k}$, then find div (curl $\vec{F}$). **(05 Marks)**

c. Find the constants a, b and c such that the vector $\vec{F} = (x + y + az)\,\hat{i} + (x + cy + 2z)\,\hat{j} + (bx + 2y - z)\,\hat{k}$ is irrotational. **(05 Marks)**

9 a. Solve $\dfrac{dy}{dx} = 1 + y/x + \left(y/x\right)^2$. **(06 Marks)**

b. Solve $\dfrac{dy}{dx} + y\cot x = \sin x$. **(05 Marks)**

c. Solve $\dfrac{dy}{dx} = \dfrac{x^2 - 2xy}{x^2 - \sin y}$. **(05 Marks)**

10 a. Solve $(2x^3 - xy^2 - 2y + 3)dx - (x^2y + 2x)dy = 0$. **(06 Marks)**

b. Solve $(1 + xy)y\,dx + (1 - xy)\,x\,dy = 0$. **(05 Marks)**

c. Solve $x\dfrac{dy}{dx} + y = x^3y^6$. **(05 Marks)**

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