CBCS SCHEME

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21MAT31

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Transform Calculus, Fourier Series and Numerical Techniques

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the Laplace transform of
$te^{2t} - \frac{2\sin 3t}{t}$. **(06 Marks)**

b. Given that $f(t) = \begin{cases} E, & 0 < t < a/2 \\ -E, & a/2 < t < a \end{cases}$

where f(t + a) = f(t) show that $L\{f(t)\} = \frac{E}{S} \tan h\left(\frac{as}{4}\right)$. **(07 Marks)**

c. Using convolution theorem obtain the inverse. Laplace transform of the following function :
$\frac{1}{(s-1)(s^2+1)}$. **(07 Marks)**

OR

2 a. Find the inverse Laplace transform of :
$\frac{s+5}{s^2-6s+13}$. **(06 Marks)**

b. Express the following function interms of unit step function and hence find their Laplace transform.

$f(t) = \begin{cases} 1, & 0 < t < 1 \\ t, & 1 < t \le 2 \\ t^2 & t > 2. \end{cases}$ **(07 Marks)**

c. Solve the following intial value problem by using Laplace transform :
$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}, y(0) = 0, \; y'(0) = 0.$ **(07 Marks)**

Module-2

3 a. Obtain Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$. Hence deduce that

$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \text{------} = \frac{\pi}{4}$. **(06 Marks)**

b. Find a cosine Fourier series for $f(x) = (x-1)^2, 0 \le x \le 1$. **(07 Marks)**

c. Obtain the Fourier series of y upto the First harmonic for the following values.

x°	45	90	135	180	225	270	315	360
y	4.0	3.8	2.4	2.0	–1.5	0	2.8	3.4

(07 Marks)

OR

4 a. Obtain Fourier series for

$$f(x) = \begin{cases} \pi x & \text{in } 0 \le x \le 1 \\ \pi(2-x) & \text{in } 1 \le x \le 2 \end{cases}.$$ **(06 Marks)**

b. Obtain the sine half range series for the function :

$$f(x) = 1 - \left(\frac{x}{\pi}\right) \text{in } \; 0 \le x \le \pi.$$ **(07 Marks)**

c. The following values of y and x are given. Find Fourier series of upto first harmonics.

x	0	2	4	6	8	10	12
y	9.0	18.2	24.4	27.8	27.5	22.0	9.0

(07 Marks)

Module-3

5 a. If $f(x) = \begin{cases} 1-x^2, & |x| < 1 \\ 0, & |x| \ge 1 \end{cases}$. Find Fourier transform of f(x) and hence find the value of

$$\int_0^\infty \frac{x\cos x - \sin x}{x^3}\,dx.$$ **(06 Marks)**

b. Find the Fourier sine transform of $f(x) = e^{-|x|}$ and hence evaluate

$$\int_0^\infty \frac{x \sin mx}{1+x^2}\,dx, \; m > 0.$$ **(07 Marks)**

c. Solve by using Z-Transforms $U_{n+2} + 2U_{n+1} + U_n = n$ with $U_0 = 0 = U_1$. **(07 Marks)**

OR

6 a. Obtain the Fourier cosine transform of the function :

$$f(x) = \begin{cases} 4x, & 0 < x < 1 \\ 4-x, & 1 < x \le 4 \\ 0, & x > 4. \end{cases}$$ **(06 Marks)**

b. Obtain the Z-transform of $\cos n\theta$ and $\sin n\theta$ **(07 Marks)**

c. Compute the inverse Z-transform of $\dfrac{3z^2+2z}{(5z-1)(5z+2)}$. **(07 Marks)**

Module-4

7 a. Classify the following partial differential equations :

i) $x^2 u_{xx} + (1-y^2)u_{yy} = 0, \; -\infty < x < \infty, -1 < y < 1$

ii) $(1+x^2)u_{xx} + (5+2x^2)u_{xt} + (4+x^2)u_{tt} = 0$

iii) $(x+1)u_{xx} - 2(x+2)u_{xy} + (x+3)u_{yy} = 0$. **(10 Marks)**

b. Solve $u_t = u_{xx}$ subject to the conditions $u(0, t) = 0 = u(1, t)$ and $u(x, 0) = \sin(\pi x)$ by taking $h = 0.2$ for 5 levels. Further write down the following values from the table

i) u(0.2, 0.04)

ii) u(0.4, 0.08)

iii) u(0.6m 0.06). **(10 Marks)**

OR

8 a. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square Mesh with boundary values as shown. Find the iterative values of u_i(1 to 9) to the nearest integer.

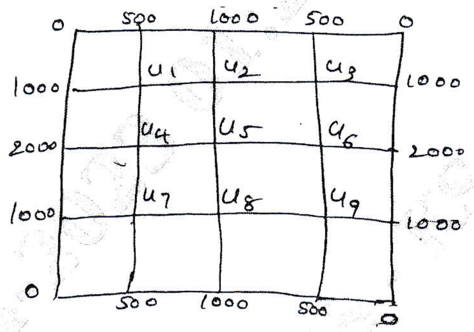

Fig.Q8(a) **(10 Marks)**

b. Solve $25u_{xx} = u_{tt}$ at the pivotal points given $u(0, t) = 0 = u(5, t)$, $u_t(x, 0) = 0$ and $u(x,0) = \begin{cases} 20x, & 0 \le x \le 1 \\ 5(5-x), & 1 \le x \le 5 \end{cases}$ by taking $h = 1$ compute $u(x, t)$ for $0 \le t \le 1$. **(10 Marks)**

Module-5

9 a. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, $y'(0) = 0$ compute $y(0.2)$ using fourth order Runge – Kutta method. **(06 Marks)**

b. Derive the Euler's equation. **(07 Marks)**

c. Find the extremal of the functional.

$$\int_{x_1}^{x_2} (y^2 + y'^2 + 2ye^x)dx.$$ **(07 Marks)**

OR

10 a. Obtain the solution of the equation $2\frac{d^2y}{dx^2} = 4x + \frac{dy}{dx}$ by computing the value of $y(1.4)$ by applying Milne's method using following data :

x	1	1.1	1.2	1.3
y	2	2.2156	2.4649	2.7514
y′	2	2.3178	2.6725	3.0657

(06 Marks)

b. Find the curve on which the functional $\int_0^1 \left[[y']^2 + 12xy\right]dx$ with $y(0) = 0$ and $y(1) = 1$ can be determined. **(07 Marks)**

c. Prove that the shortest distance between two points in a plane is straight line. **(07 Marks)**

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CBCS SCHEME

USN 1KS21EC089

21EC32

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Digital System Design using Verilog

Time: 3 hrs.

Max. Marks: 100

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

Module-1

1 a. What are combinational circuits? Give example. Explain combinational circuit with block diagram. **(04 Marks)**

b. Define canonical form representation and solve the following equation using canonical form
i) $P = f(a,b,c) = ab' + ac' + bc$
ii) $G = f(w,x,y,z) = w'x + yz'$. **(08 Marks)**

c. Simplify the following Boolean function using K – Map
i) $D = f(x, y, z) = \Sigma m(0, 2, 4, 6)$
ii) $K = f(a, b, c) = \Sigma m(1, 2, 3, 6,7)$. **(08 Marks)**

OR

2 a. Define K-Map solve the following expression using K – Map.
i) $K = f(w, x, y, z) = \Sigma m(0, 1, 4, 5, 9, 11, 13, 15)$
ii) $D = f(a, b, c, d) = \Sigma m(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14)$. **(10 Marks)**

b. Define Quine-McClusky method and solve the following Boolean expression using Quine-McClusky method.
i) $D = f(a, b, c, d) = \Sigma m(0, 1, 2, 3, 6, 7, 8, 9, 14, 15)$
ii) $K = f(w, x, y, z) = \Sigma m(1, 3, 13, 15) + \Sigma d(8, 9, 10, 11)$. **(10 Marks)**

Module-2

3 a. Explain binary Adders with K–map and logical representation of equations for SUM and CARRY. **(06 Marks)**

b. Explain carry look ahead Adder with General and Sigma block. **(06 Marks)**

c. Explain working of decimal adder with neat block diagram (take example of BCD addition). **(08 Marks)**

OR

4 a. What are comparator circuits? Explain 2-bit magnitude comparators. **(08 Marks)**

b. Realize the Boolean expression using 3 : 8 decoder and two OR gates
i) $f_1(x_2, x_1, x_0) = \Sigma m(1, 2, 4, 5)$
ii) $f_2(x_2, x_1, x_0) = \Sigma m(1, 5, 7)$. **(06 Marks)**

c. Implement $D = (w, x, y, z) = \Sigma m(0, 1, 2, 4, 5, 7, 8, 9, 12, 13)$ using 8 : 1 MUX. **(06 Marks)**

Module-3

5 a. Write a note on Master Slave JK Flip-Flops with function table and timing diagram. **(08 Marks)**

b. What are Edge Triggered Flip-Flops. Explain positive edge Triggered and negative edge Triggered Flip-Flops. **(06 Marks)**

c. Write characteristic equation for : i) JK Flip-Flop ii) SR Flip-Flop. **(06 Marks)**

OR

6 a. Define Counters. Explain Binary Ripple counter with neat diagram. (08 Marks)
b. What are Registers? Explain any two classification registers with neat block diagram. (06 Marks)
c. Design synchronous MOD-6 counter using clocked JK Flip-Flops for sequences : 0 – 2 – 3 – 6 – 5 – 1. (06 Marks)

Module-4

7 a. Define HDL and types of HDL. Give structure of verilog module with example. (06 Marks)
b. Explain verilog logical operators with example. (06 Marks)
c. i) Write a note on verilog Data type
ii) Write verilog code for 8 × 1 MUX. (08 Marks)

OR

8 a. Give classification of Styles(Types) of description with example. (08 Marks)
b. Write verilog code for Full Adder. (06 Marks)
c. Write a note on Arithmetic and shift, Rotate relational operators with example. (06 Marks)

Module-5

9 a. Write a note on structure of Behavioural Description with example. (08 Marks)
b. Write a note on Signal Assignment and Variable Assignment with example. (06 Marks)
c. Write a note on sequential statement with example. (06 Marks)

OR

10 a. Write a verilog code for 2 × 1 MUX using if ELSE STATEMENT. (06 Marks)
b. Explain structural description with example. (08 Marks)
c. Explain structural description of 3-bit Ripple Carry Adder. (06 Marks)

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CBCS SCHEME

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21EC33

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Basic Signal Processing

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain vector spaces and its necessary axioms. And also explain four fundamental subspaces with example. **(08 Marks)**

b. Write the vector V = (1, 3, 9) as a linear combination of the vectors u_1 = (2, 1, 3), u_2 = (1, −1, 1) and u_3 = (3, 1, 5) and thereby show that the system is consistent. **(08 Marks)**

c. Let I : $V_1(R) \rightarrow V_2(R)$ be a mapping f(x) = (3x, 5x) show that 'f' is linear transformation. **(04 Marks)**

OR

2 a. Let 'w' be the subspace of R^5 spanned by
x_1 = (1, 2, −1, 3, 4), x_2 = (2, 4, −2, 6, 8), x_3 = (1, 3, 2, 2, 6),
x_4 = (1, 4, 5, 1, 8), x_5 = (2, 7, 3, 3, 9).
Find a subset of vectors which forms a basis of 'w'. **(06 Marks)**

b. Solve Ax = b by least square and find $P = A\hat{x}$ if

$$A = \begin{bmatrix} 4 & 0 \\ 0 & 2 \\ 1 & 1 \end{bmatrix}_{3\times2} \text{ and } b = \begin{bmatrix} 2 \\ 0 \\ 11 \end{bmatrix}_{3\times1}$$

. Also, write a program to solve linear equation Ax = b. **(07 Marks)**

c. Apply Gram – Schmidth process to the vectors $V_1(1, 1, 1)$, $V_2(1, -1, 2)$, $V_3(2, 1, 2)$ to obtain an orthonormal basis for $V_3(R)$ with standard inner product and thereby write a program for Gram – Schimdth process. **(07 Marks)**

Module-2

3 a. If $A = \begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$ find Eigen values and corresponding Eigen vector for matrix 'A' and diagonalize the matrix. **(10 Marks)**

b. If $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$. Show that matrix 'A' is positive definite matrix using the following approaches :
i) By finding its Eigen value
ii) By finding its pivots. **(10 Marks)**

OR

4 a. Compute A^TA and AA^T, find Eigen values and Eigen vectors, if $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}_{3\times2}$, thereby multiply $U \ \varepsilon \ V^T$ to recover matrix 'A'. Also write a program to find SVD. **(12 Marks)**

b. Diagonalize the matrix A, if $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ by finding its eigen value and eigen vector. **(08 Marks)**

Module-3

5 a. Define signal and system and also explain basic discrete elementary signals with neat sketch and expressions. **(04 Marks)**

b. A discrete time signal x(n) is shown below Fig.Q5(b).

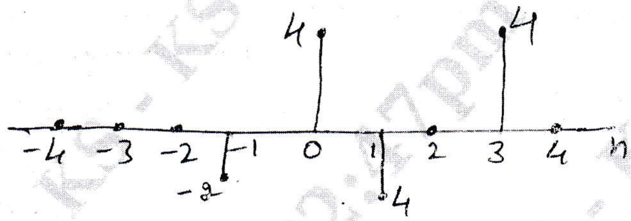

Fig.Q5(b)

Sketch :
i) $2x(n-2)$
ii) $3 - x(n)$
iii) $2x(-n) - 4$. **(08 Marks)**

c. Sketch : $x(n) = \begin{cases} 1; & -1 \le n \le 3 \\ \frac{1}{2}; & n = 4 \\ 0; & \text{otherwise} \end{cases}$ and $y(n) = \begin{cases} \frac{1}{2}n; & |n| \le 4 \\ 0; & \text{othewise} \end{cases}$

Also sketch $x(n+2)\,y(1-2n)$. **(08 Marks)**

OR

6 a. For the following discrete time systems, determine whether the system is linear, time invariance, memoryless, causal and stable :

i) $y(n) = 2x(n) + \dfrac{1}{x(n-2)}$

ii) $y(n) = \ln(3 + |x(n)|)$

iii) $y(n) = \cos x(n)$

iv) $y(n) = r^n x(n)\ ;\ r > 1$. **(16 Marks)**

b. Write a program to generate exponential and triangular waveforms. **(04 Marks)**

Module-4

7 a. Compute the discrete time convolution for the sequences $x_1(n)$ and $x_2(n)$ given below :
$x_1(n) = \alpha^n u(n)$; $x_2(n) = \beta^n u(n)$. **(08 Marks)**

b. Consider the input signal x(n) and the impulse response h(n) given below :

$$x(n) = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & \text{othwerise} \end{cases} \quad \text{and} \quad h(n) = \begin{cases} \alpha^n; & 0 \le n \le 6, \alpha > 1 \\ 0; & \text{othwerise} \end{cases}$$

compute the output signal y(n). **(12 Marks)**

OR

8 a. The following are the impulse responses of discrete time LTI systems. Determine whether each system is memoryless, causal and stable :

i) $h(n) = e^{-n}\cos(n)\cdot u(n)$

ii) $h(n) = (0.99)^n u(n+3)$

iii) $h(n) = n\left(\frac{1}{2}\right)^n u(n)$. **(10 Marks)**

b. Evaluate the step response of LTI system represented by the impulse response
$h(n) = (-1)^n \{u(n+2) - u(n-3)\}$.
Also write a program to compute the step response from the given impulse response. **(10 Marks)**

Module-5

9 a. Define Z-transform. Explain the properties of ROC. **(06 Marks)**

b. Let $x(n) = \left(\frac{1}{2}\right)^{|n|}$.

i) Sketch x(n)

ii) Find x(z) and sketch pole zero plot and ROC. **(08 Marks)**

c. Find the Z-transform of $x(n) = \left(+\frac{1}{2}\right)^n u(n) * \left(\frac{1}{3}\right)^n u(n)$. **(06 Marks)**

OR

10 a. Explain the properties of Z-transform with proof :

i) Convolution

ii) Initial value theorem

iii) Final value theorem. **(08 Marks)**

b. Determine the describe time sequence x(n) of the sequence using partial fraction expression:

$$X(z) = \frac{-1 + 5z^{-1}}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}}; \text{ROC}: |z| > 1$$ **(08 Marks)**

c. Write a program to find Z-transform of the sequence. **(04 Marks)**

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CBCS SCHEME

USN 1KS21EC016 **21EC34**

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Analog Electronic Circuits

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the classical discrete circuit bias (voltage divider bias) method of BJT. **(08 Marks)**
b. Explain the three biasing methods to bias MOS Amplifier circuits. **(12 Marks)**

OR

2 a. Explain the T equivalent circuit model of MOSFET. **(08 Marks)**
b. Derive an expression for voltage gain of MOSFET with necessary waveforms. **(06 Marks)**
c. Explain biasing a BJT using collector to base feedback resistor. **(06 Marks)**

Module-2

3 a. Explain the common source amplifier and derive the expression for voltage gain. **(10 Marks)**
b. A transistor amplifier is fed with a signal source having an open circuit voltage Vsig of 10mV and an internal resistance risig of 100KΩ. The voltage V_i at the amplifier input and the output voltage V_0 are measured both without and with load resistance R_L = 10KΩ connected to the amplifier output. The measured results are as follows :

	V_i (mv)	V_0 (mv)
Without R_L	9	90
With R_L connected	8	70

Find all the amplifier parameters. **(10 Marks)**

OR

4 a. With a neat diagram, explain the three frequency bands of MOSFET. **(06 Marks)**
b. Explain the high frequency model of MOSFET. **(06 Marks)**
c. Explain common source follower and derive the expression of voltage gain. **(08 Marks)**

Module-3

5 a. Explain the properties of negative feedback. **(10 Marks)**
b. Explain the transformer coupled class – A power amplifier and show that efficiency is 50%. **(10 Marks)**

OR

6 a. Explain the circuit operation of class – B power amplifier and also explain the transfer characteristics. **(08 Marks)**
b. Explain the Four basic feedback topologies of the amplifier. **(12 Marks)**

Module-4

7 a. Explain R and 2R resistor digital to analog (D/A) converter and also derive the expression of output voltage. **(10 Marks)**
b. Explain the first order lowpass Butterworth filter with necessary voltage gain. **(10 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.

OR

8 a. Explain the operation of monostable multivibrator. (10 Marks)
b. Explain the two types of Bandpass filters. (10 Marks)

Module-5

9 a. Explain the block diagram of power electronic system. (06 Marks)
b. List and explain the applications of power electronics. (06 Marks)
c. Explain the static anode – Cathode characteristics of SCR. (08 Marks)

OR

10 a. Explain the turn on methods of a Thyristor. (10 Marks)
b. Explain the construction and working of UJT. (10 Marks)

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