CBCS SCHEME

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21MAT31

Third Semester B.E. Degree Examination, June/July 2024
Transform Calculus, Fourier Series & Numerical Techniques

Time: 3 hrs. Max. Marks: 100

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 Laplace Transform of, $\left(\dfrac{4t+5}{e^{2t}}\right)^2$. **(06 Marks)**

b. The square wave function f(t) with period 2a is defined by,
$f(t) = t\ ;\ 0 \le t \le a$
$\quad = 2a - t\ ;\ a \le t \le 2a$
Find L[f(t)]. **(07 Marks)**

c. Evaluate $L^{-1}\left[\dfrac{s^2}{(s^2+a^2)^2}\right]$ by applying convolution theorem. **(07 Marks)**

OR

2 a. Find inverse Laplace transform $\dfrac{2s^2-6s+5}{s^3-6s^2+11s-6}$. **(06 Marks)**

b. Express the following function in terms of unit step function and hence find the Laplace transform.
$f(t) = 1\ ;\ 0 < t \le 1$
$\quad = t\ ;\ 1 \le t \le 2$
$\quad = t^2\ ;\ t > 2$. **(07 Marks)**

c. Applying Laplace transform, solve the differential equation,
$y''(t) + 4y'(t) + 4y(t) = e^{-t}$,
Subject to the condition y(0) = y′(0) = 0. **(07 Marks)**

Module-2

3 a. Obtain the Fourier series of $f(x) = x^2$ over the interval $[-\pi, \pi]$, hence deduce that
$\dfrac{\pi^2}{12} = \dfrac{1}{1^2} - \dfrac{1}{2^2} + \dfrac{1}{3^2} - \dfrac{1}{4^2} + \dots\dots\dots + \infty$. **(06 Marks)**

b. Obtain the half range sine series of the function, $f(x) = x$ in the interval (0, 2). **(07 Marks)**

c. Obtain the constant term and co-efficient of first cosine and sine terms in the expansion of y from the following table :

x	0°	60°	120°	180°	240°	300°	360°
y	7.9	7.2	3.6	0.5	0.9	6.8	7.9

(07 Marks)

OR

4 a. Find the Fourier series of $f(x) = 2 - x\ ;\ 0 \le x \le 4$
$\qquad x - 6\ ;\ 4 \le x \le 8$ **(06 Marks)**

b. Obtain the half range sine series of the function, $f(x) = x^2$ over $(0, \pi)$. **(07 Marks)**

c. Obtain a_0, a_1, b_1 in the Fourier expansion of y using harmonic analysis for the data given,

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

(07 Marks)

Module-3

5 a. Find the Fourier sine and cosine transforms of $f(x) = e^{-\alpha x}$; $\alpha > 0$. **(06 Marks)**

b. Obtain the inverse z-transform of, $\dfrac{2z^2 + 3z}{(z^2 - 2z - 8)}$. **(07 Marks)**

c. Find the Fourier transform of,

$$f(x) = x^2; \ |x| < a$$
$$= 0; \ |x| > a$$

where a is +ve constant. **(07 Marks)**

OR

6 a. Find the Complex Fourier transform of the function,

$$f(x) = 1 \ \text{ for } |x| \le a$$
$$= 0 \ \text{ for } |x| > a$$

Hence deduce, evaluate $\displaystyle\int_0^\infty \frac{\sin x}{x} dx$. **(06 Marks)**

b. Evaluate $Z_T\left[2n + \sin\left(\dfrac{n\pi}{4}\right) + 1\right]$. **(07 Marks)**

c. Solve the difference equation, $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using Z-Transform. **(07 Marks)**

Module-4

7 a. Classify the following partial differential equation,

(i) $\dfrac{\partial^2 u}{\partial x^2} + 4\dfrac{\partial^2 u}{\partial x \partial y} + 4\dfrac{\partial^2 u}{\partial y^2} - \dfrac{\partial u}{\partial x} + 2\dfrac{\partial u}{\partial y} = 0$.

(ii) $x^2 \dfrac{\partial^2 u}{\partial x^2} + (1 - y^2)\dfrac{\partial^2 u}{\partial y^2} = 0$, $-\infty < x < \infty$, $-1 < y < 1$.

(iii) $(1 + x^2)\dfrac{\partial^2 u}{\partial x^2} + (5 + 2x^2)\dfrac{\partial^2 u}{\partial x \partial t} + (4 + x^2)\dfrac{\partial^2 u}{\partial t^2} = 0$

(iv) $(x + 1)\dfrac{\partial^2 u}{\partial x^2} - 2(x + 2)\dfrac{\partial^2 u}{\partial x \partial y} + (x + 3)\dfrac{\partial^2 u}{\partial y^2} = 0$ **(10 Marks)**

b. Find the numerical solution of the parabolic equation $\dfrac{\partial^2 u}{\partial x^2} = 2\dfrac{\partial u}{\partial t}$, using Schmidt formula. Given $u(0,t) = 0 = u(4,t)$ and $u(x, 0) = x(4 - x)$ by taking $h = 1$ find the values upto $t = 5$. **(10 Marks)**

OR

8 a. Solve $u_{xx} + u_{yy} = 0$ in the following square region with the boundary conditions as indicated in the Fig. Q8 (a). **(10 Marks)**

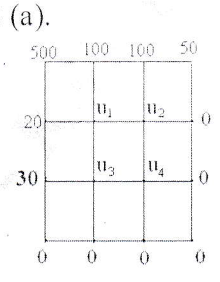

Fig. Q8 (a)

b. Solve numerically $u_{xx} = 0.0625\,u_{tt}$, subject to the conditions $u(0, t) = 0 = u(5, t)$, $u(x, 0) = x^2(x-5)$ and $u_t(x,0) = 0$ by taking $h = 1$ for $0 \le t \le 1$. **(10 Marks)**

Module-5

9 a. Use Runge-Kutta method to find y(0.2) for the equation, $\frac{d^2y}{dx^2} - x\frac{dy}{dx} - y = 0$. Given that $y = 1,\ y' = 0$ when $x = 0$. **(06 Marks)**

b. Find the curves on which the function, $\int_0^1 \{(y')^2 + 12xy\}dx$ with $y(0) = 0$ and $y(1) = 1$ can be extremised. **(07 Marks)**

c. Derive the Eulers equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$ **(07 Marks)**

OR

10 a. Solve the differential equation $y'' + xy' + y = 0$ for $x = 0.4$, using Milne's predictor-corrector formula given that, **(06 Marks)**

x	0	0.1	0.2	0.3
y	1	0.995	0.9802	0.956
$\frac{dy}{dx}$	0	-0.0995	-0.196	-0.2863

b. Find the curve on which functional $\int_0^{\frac{\pi}{2}} \left[(y')^2 - y^2 + 2xy\right]dx$ with $y(0) = y\left(\frac{\pi}{2}\right) = 0$ can be extremized. **(07 Marks)**

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

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21EC32

Third Semester B.E. Degree Examination, June/July 2024
Digital System Design using Verilog

Time: 3 hrs. Max. Marks: 100

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. The input to a combinational logic circuit is a valid single digit BCD data. Design the logic circuit using minimum hardware to detect whenever a number greater than 5 appears at the input. **(08 Marks)**

b. Expand $f_1 = a + ab + a\bar{c}d$ into minterm and $f_2 = a.(b + c).(a + c + \bar{d})$ into maxterm. **(06 Marks)**

c. Reduce the following function using K-map technique and implement using gates.
$f(P, Q, R, S) = \Sigma m(0, 1, 4, 8, 9, 10) + \Sigma d(2, 11)$ **(06 Marks)**

OR

2 a. Identify all prime implicants and essential prime implicants of the following function using K-map.
$f(a, b, c, d) = \Sigma m(0, 1, 2, 5, 6, 7, 8, 9, 10, 13, 14, 15)$ **(06 Marks)**

b. Simplify the following Boolean function using Quine McCluskey method.
$F(A, B, C, D) = \Sigma m(0, 2, 3, 6, 7, 8, 10, 12, 13)$ **(10 Marks)**

c. Minimize the expression using K-map
$Y = (A + B + \bar{C}) \cdot (A + \bar{B} + \bar{C}) \cdot (\bar{A} + \bar{B} + \bar{C}) \cdot (\bar{A} + B + C) \cdot (A + B + C)$ **(04 Marks)**

Module-2

3 a. Design 2-bit magnitude comparator. **(10 Marks)**

b. Implement $f(w, x, y, z) = \Sigma m(0, 4, 8, 10, 14, 15)$ using
i) 8 × 1 MUX with w, x, y as select lines.
ii) 4 × 1 MUX with w, x as select lines. **(06 Marks)**

c. Implement full adder using 74138 decoder. **(04 Marks)**

OR

4 a. Explain the general structure of PLDs. **(06 Marks)**

b. Construct 4 to 16 line decoder from 2 to 4 line decoder and implement the Boolean function.
$f(x_3, x_2, x_1, x_0) = \Sigma m(0, 6, 9, 11, 15)$ **(08 Marks)**

c. Design 3 bit binary full subtractor using logic gates. **(06 Marks)**

Module-3

5 a. With neat diagram explain Master Slave JK Flip Flop. **(08 Marks)**

b. Explain 4 bit universal shift register. **(08 Marks)**

c. Obtain the characteristics equation for SR and T Flip Flop. **(04 Marks)**

OR

6 a. Explain the working of Mod-4 twisted ring counter. **(07 Marks)**

b. Design 4 bit binary ripple counter using T Flip Flop. **(06 Marks)**

c. Design Mod-6 synchronous counter using clocked JK Flip Flop. **(07 Marks)**

Module-4

7 a. With general syntax and suitable examples, explain the shift operators available in verilog. **(06 Marks)**

b. List and explain the verilog data types. **(08 Marks)**

c. Realize full adder circuit using verilog data flow description. **(06 Marks)**

OR

8 a. Write a verilog code for a 2×1 multiplexer in dataflow description using signal assignment. **(06 Marks)**

b. List all the different styles of descriptions, explain the structure of dataflow description. **(06 Marks)**

c. Explain the following in data flow description:
i) Signal declaration and assignment statement
ii) Constant declaration and assignment statement
iii) Concurrent signal assignment statement
iv) Assigning a delay time to the signal assignment statement. **(08 Marks)**

Module-5

9 a. Explain CASE statement with syntax. Write a behavioral description of a positive edge triggered JK Flip Flop using CASE statement in verilog. **(10 Marks)**

b. Write verilog behavioral description of 8×1 MUX. **(06 Marks)**

c. Write a verilog program for half adder using structural description. **(04 Marks)**

OR

10 a. With example, explain the syntax of following sequential statements:
i) If ii) Else if **(06 Marks)**

b. List and explain all the loop statements in verilog. **(08 Marks)**

c. Write a verilog program for 3 bit binary counter using case statement. **(06 Marks)**

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21EC33

Third Semester B.E. Degree Examination, June/July 2024

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. Show that : W is a subspace of V(F) iff.
i) W is none empty
ii)$\forall$ a, b, $\in$ F and V_1 W $\in$ W, [av + b.w] $\in$ W. **(06 Marks)**

b. Determine whether or not each f the following form a basis x_1 = (2, 2, 1) ; x_2(1, 3, 1), x_3 = (1, 2, 2) in R^3. **(06 Marks)**

c. Evaluate u, v, w, are pair wise orthogonal vectors and find orthonormal vectors of

$$u = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix},\ v = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix},\ w = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}.$$ **(08 Marks)**

OR

2 a. Define vector subspace and explain the four fundamental subspace. **(06 Marks)**

b. Determine the linear transformation of 'T' from $R^2 \to R^2$ such that
T(1, 0) = (1, 1) and T(0, 1 = (–1, 2). **(06 Marks)**

c. Apply Gram – Schemidt process to vectors, V_1= (1, 1, 1), V_2 = (1, -1, 2), V_3 = (2, 1, 2) to obtain on orthonormal basis for V_3® with the standard inmer product. **(08 Marks)**

Module-2

3 a. Evaluate Eigen values and eigen vector for matrix :

$$A = \begin{bmatrix} -2 & 2 & 3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}.$$ **(10 Marks)**

b. Factorize the matrix A into $A = U\Sigma V^T$ using single value decomposition :

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}.$$ **(10 Marks)**

OR

4 a. Diagonalize the matrix :

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}.$$ **(10 Marks)**

Find an invertible matrix D and diagonal matrix D such that $D = PAP^{-1}$. **(06 Marks)**

b. Define positive definite matrix mention the methods of testing positive definite. **(04 Marks)**

c. Determine eigen values and eigen vectors for

$$A = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}.$$

Module-3

5 a. Find and sketch : i) $y_1(n) = x(4 - n)$ ii) $y_2(n) = x(2n - 3)$ for given $x(n) = [u(n) - u(n) - 8)]$. **(07 Marks)**

b. Obtain whether the givne system is linear, time invariance, memory causal :
i) $y_1(n) = n^2x(n - 1)$, ii) $y_2(n) = \log_{10}[x(n)]$. **(08 Marks)**

c. Describe the elementary signals. **(05 Marks)**

OR

6 a. Sketch : i) $Z(n) = x(2n)y(n - 4)$, given the signals x(n) and y(n) in the Fig.Q6(a).

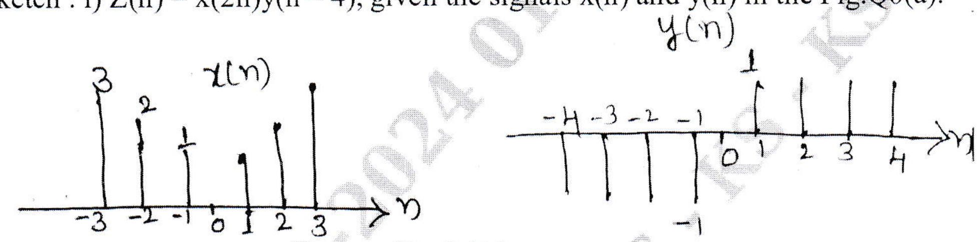

Fig.Q6(a) **(07 Marks)**

b. Check whether the following system is linear time invariance, memory causal.
i) $y(n) = x(n) + 2x^2(n)$, ii) $y(n) = g(n)x(n)$. **(08 Marks)**

c. What is system? Explain its properties. **(05 Marks)**

Module-4

7 a. Evaluate $y(n) = x(n) * h(n)$. If $x(n) = \alpha^n u(n)$. $\alpha < 1$ and $h(n) = u(n)$. **(06 Marks)**

b. Evaluate the step responses for the LTI system represented by the following impulse response : i) $h(n) = (1/2)^n u(n)$, ii) $h(n) = u(n)$. **(06 Marks)**

c. Check whether given LTI system is stable, causal and compute the h(n) for the sequence.
$y(n) = x(n + 1) + 5x(n) - 7x(n - 1) + 4x(n - 2)$. **(08 Marks)**

OR

8 a. Evaluate the discrete time convolution sum $y(n) = (1/2)^n u(n - 2) * u(n)$. **(10 Marks)**

b. Check whether the following system is memoryless, causal, stable
i) $h(n) = e^{2n}u(n - 1)$ ii) $h(n) = 2u(n) - 2u(n - 1)$. **(10 Marks)**

Module-5

9 a. State and prove the Differentiation in Z – domain in Z – Transformation. **(05 Marks)**

b. Evaluate Z – Transform of given $x(n) = n\left(\frac{1}{2}\right)^n u(n)$. **(08 Marks)**

c. Obtain Inverse Z – Transformation of given

$$X(Z) = \frac{-1 + 5z^{-1}}{1 - \frac{3}{2}Z^{-1} + \frac{1}{2}Z^{-2}} \quad \text{ROC } |Z| > 1.$$ **(07 Marks)**

OR

10 a. Compute H(z) and h(n) for LTI system is described by

$$y(n) - \frac{1}{4}y(n-1) - \frac{3}{8}y(n-2) = -x(n) + 2x(n-1)$$ **(08 Marks)**

b. Obtain Z – Transformation of signal. **(07 Marks)**

$$x(n) = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n).$$

c. What is ROC and list out the properties? **(05 Marks)**

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21EC34

Third Semester B.E. Degree Examination, June/July 2024

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 working of voltage-divider bias circuit. **(06 Marks)**

b. Derive the expression for A_v for the MOSFET amplifier circuit. **(06 Marks)**

c. Design the circuit shown in Fig.Q1(c) to establish $I_D = 0.5$ mA. MOSFET parameters are $V_t = 1V$, $k_n' W/L = 1\ mA/V^2$ and $\lambda = 0$.

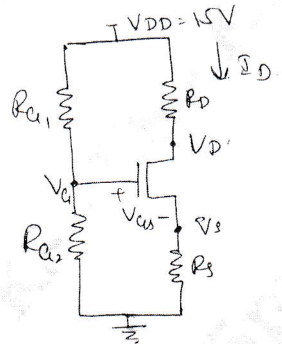

Fig.Q1(c) **(08 Marks)**

OR

2 a. Draw and explain the MOSFET biasing circuit using fixing V_G. **(06 Marks)**

b. Derive the expression for g_m. **(08 Marks)**

c. Consider the amplifier circuit shown in Fig.Q2(c). Let $V_{DD} = 5V$, $V_t = 0.7V$; $\lambda = 0$ and $k_n = 1\ mA/V^2$. Find V_{ov}, I_D, R_D and R_G to obtain a voltage gain of 25 and an input resistance of 0.5 MΩ. What is the maximum allowable input signal V_i ? **(06 Marks)**

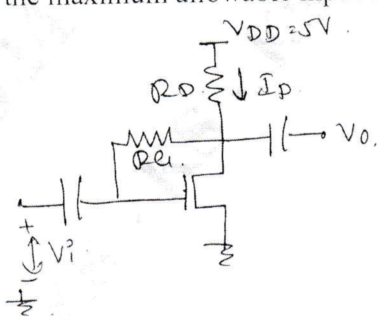

Fig.Q2(c)

Module-2

3 a. Write a note on 3 basic configuration of MOSFET amplifier. Derive the expressions for characterizing parameters of MOSFET amplifier. **(06 Marks)**

b. Draw the high frequency equivalent circuit of a MOSFET and explain the significance of the different elements of the circuit. **(08 Marks)**

c. An amplifier with an input resistance of 100 kΩ an open circuit voltage gain of 100V/V and an output resistance of 100 Ω is connected between a 20 kΩ signal source and a 2 kΩ load. Find the overall voltage gain G_V. **(06 Marks)**

OR

4 a. Derive the expression for characterizing parameters of CS amplifier with source resistance. **(06 Marks)**

b. With a neat diagram, explain the operation of a transistor pierce crystal oscillator. **(08 Marks)**

c. Consider CS amplifier with $I_D = 0.25mA$; $V_{ov} = 0.25$ V, $R_D = 20$ kΩ, $V_A = 50V$, $R_{sig} = 100$ kΩ and $R_L = 20$ K. Find R_{in}, A_{vo}, R_0, A_o and G_V. If to maintain reasonable linearity the peak of the input sine-wave signal is limited to 10% (2 V_{ov}). What is the peak of the sine wave voltage at the output? **(06 Marks)**

Module-3

5 a. Draw the block diagram of feedback amplifier and discuss the effect of negative feedback with respect to closed loop gain, bandwidth and distortion. **(06 Marks)**

b. How power amplifiers are classified? Discuss them briefly. **(06 Marks)**

c. In an amplifier has a bandwidth of 300 kHz and voltage gain of 100, what will be the new bandwidth and gain if 10% negative feedback is introduced? What will be the gain bandwidth product before and after feedback? What should be the amount of feedback if the bandwidth is to be limited to 800 kHz. **(08 Marks)**

OR

6 a. Explain how negative feedback effects acts on input and output impedance of a circuit. **(06 Marks)**

b. Draw the block diagram of current series feedback amplifier and derive an expression for input resistance, voltage gain and output resistance. **(08 Marks)**

c. Draw the circuit diagram and explain the operation of class B push pull amplifier with relevant waveforms. Show that the maximum conversion efficiency of the class B push pull amplifier is 78.5% **(06 Marks)**

Module-4

7 a. With neat circuit diagram explain the operation of R-2R D/A converter. **(06 Marks)**

b. Draw and explain the working of precision full wave rectifier. **(08 Marks)**

c. Explain the functional block diagram of IC555. **(06 Marks)**

OR

8 a. Write a note on Butterworth approximation. **(06 Marks)**

b. Write a note on monoshot multivibrator using IC555 **(06 Marks)**

c. Design a second order low pass Butterworth filter having high cutoff frequency of 1 kHz. Draw its frequency response. **(08 Marks)**

Module-5

9 a. Define power Electronics and brief its applications. **(06 Marks)**

b. Explain power electronics converters. **(08 Marks)**

c. Explain silicon controlled Rectifier with its characteristics. **(06 Marks)**

OR

10 a. Explain turn on and turn off methods of SCR. **(06 Marks)**

b. Explain gate triggering circuit of RC firing circuit with necessary diagram. **(06 Marks)**

c. With neat waveform and circuit diagram, explain UJT firing circuit. **(08 Marks)**

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