CBCS SCHEME

USN 1KS20CS083

18MAT31

Third Semester B.E. Degree Examination, July/August 2022
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.

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,
(i) $e^{-2t}(2\cos 5t - \sin 5t)$ (ii) $\cosh^2 3t$ **(06 Marks)**

b. Find the Laplace transform of the full wave rectifier $f(t) = E\sin\omega t \quad 0 < t < \frac{\pi}{\omega}$ having a period $\frac{\pi}{\omega}$. **(07 Marks)**

c. Find the inverse Laplace transform $\left[\frac{s^2+4}{s(s+4)(s-4)}\right]$. **(07 Marks)**

OR

2 a. Find the Laplace transform, $\frac{\cos at - \cos bt}{t}$. **(06 Marks)**

b. Solve by using Laplace transform method $y'''(t) + 2y''(t) - y'(t) - 2y(t) = 0$, given $y(0) = y'(0) = 0$ and $y''(0) = 6$ **(07 Marks)**

c. Express the function f(t) in terms of unit step function and hence find its inverse LT,

$$f(t) = \begin{cases} \cos t & 0 < t \le \pi \\ 1 & \pi < t \le 2\pi \\ \sin t & t > 2\pi \end{cases}$$ **(07 Marks)**

Module-2

3 a. Obtain the Fourier series of $f(x) = \frac{\pi - x}{2}$, in $0 < x < 2\pi$. Hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots = \frac{\pi}{4}$. **(06 Marks)**

b. Show that the sine half range series for the function, $f(x) = Lx - x^2$, in $0 < x < L$ is $\frac{8L^2}{\pi^3}\sum_{0}^{\infty}\frac{1}{(2n+1)^3}\sin\left(\frac{2n+1}{L}\right)\pi x$. **(07 Marks)**

c. Obtain the Fourier series of y up to the first harmonics 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	2.6	3.4

(07 Marks)

OR

4 a. Expand the function $f(x) = x\sin x$, as a Fourier series in the interval $-\pi \le x \le \pi$. Deduce that $\frac{1}{1,3} - \frac{1}{3,5} + \frac{1}{5,7} \ldots\ldots = \frac{\pi - 2}{4}$ **(06 Marks)**

b. Obtain the half range cosine series of $f(x) = x\sin x \quad 0 \le x \le \pi$. **(07 Marks)**

c. Obtain the constant term and the first three coefficients in the Fourier cosine series for y using the following data :

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

(07 Marks)

Module-3

5 a. Find the complex Fourier transform of the function, $f(x) = \begin{cases} 1 & \text{for } |x| \le a \\ 0 & \text{for } |x| > a \end{cases}$.

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

b. If $\overline{f(z)} = \frac{2z^2 + 3z + 12}{(z-1)^4}$ find the value of u_0, u_1, u_2, u_3 **(07 Marks)**

c. Solve by using z-transforms, $u_{n+2} + 5u_{n+1} + 6u_n = 2^n$: $u_1 = 0$, $u_0 = 0$ **(07 Marks)**

OR

6 a. Find the Fourier sine transform of e^{-ax}, $a > 0$. **(06 Marks)**

b. Find the Fourier sine and cosine transform of $2e^{-3x} + 3e^{-2x}$. **(07 Marks)**

c. Solve by using Z-transforms,
$y_{n+2} + 2y_{n+1} + y_n = n$, with $y(0) = 0 = y_1$ **(07 Marks)**

Module-4

7 a. Use Taylor's series method to find y(4.1) given that $\frac{dy}{dx} = \frac{1}{x^2 + y}$ and $y(4) = 4$. **(06 Marks)**

b. Use Fourth order Runge-Kutta method to solve $(x + y)\frac{dy}{dx} = 1$, $y(0.4) = 1$ at $x = 0.5$. Correct to four decimal places. **(07 Marks)**

c. The following table gives the solution of $5xy^1 + y^2 - 2 = 0$, find the value of y at x = 4.5 using Milne's Predictor and Corrector formulae, use the corrector formulae twice.

x	4	4.1	4.2	4.3	4.4
y	1	1.0049	1.0097	1.0143	1.0187

(07 Marks)

OR

8 a. Using modified Euler's method find y at x = 0.2 given $\frac{dy}{dx} = 3x + \frac{y}{2}$, with $y(0) = 1$ taking $h = 0.1$. **(06 Marks)**

b. Using Runge-Kutta method of fourth order find y(0.2) for the equation $\frac{dy}{dx} = \frac{y - x}{y + x}$, $y(0) = 1$ taking $h = 0.2$ **(07 Marks)**

c. Apply Adams-Bashforth method to solve the equation $(y^2 + 1)dy - x^2 dx = 0$, at x = 1, given y(0) = 1, y(0.25) = 1.0026, y(0.5) = 1.0206, y(0.75) = 1.0679. Apply the corrector formulae twice. **(07 Marks)**

Module-5

9 a. Given $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} - 2xy = 1$, $y(0) = 1$, $y'(0) = 0$, Evaluate $y(0.1)$ using Runge-Kutta method of order 4. **(06 Marks)**

b. A necessary condition for the integral $I = \int_{x_1}^{x_2} f(x, y, y')dx$ where $y(x_1) = y_1$ and $y(x_2) = y_2$ to be extremum that $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(07 Marks)**

c. Show that the extremal of the functional $\int_0^1 y^2\{3x(y'^2 - 1) + yy'^3\}dx$, subject to the conditions $y(0) = 0$, $y(1) = 2$, is the circle $x^2 + y^2 - 5x = 0$. **(07 Marks)**

OR

10 a. Apply Milne's method to compute $y(0.8)$. Given that $\frac{d^2y}{dx^2} = 1 - 2y\frac{dy}{dx}$ and the following table of initial values. **(06 Marks)**

x	0	0.2	0.4	0.6
y	0	0.02	0.0795	0.1762
y′	0	0.1996	0.3937	0.5689

b. Find the extremal of the functional $\int_a^b (x^2y'^2 + 2y^2 + 2xy)dx$. **(07 Marks)**

c. Prove that Geodesics on a plane are straight line. **(07 Marks)**

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CBCS SCHEME

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18MATDIP31

Third Semester B.E. Degree Examination, July/August 2022
Additional Mathematics – I

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

b. If $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$. Find the value of 'ρ' such that $\vec{a} - \rho\vec{b}$ is perpendicular to $\vec{c}$. **(07 Marks)**

c. Find the angle between the vector $\vec{a} = 5\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} - 3\hat{j} + 6\hat{k}$. **(07 Marks)**

OR

2 a. Find the modulus and amplitude of the complex number $1 + \cos\alpha + i\sin\alpha$. **(06 Marks)**

b. Prove that $\left(\dfrac{1+\cos\theta + i\sin\theta}{1+\cos\theta - i\sin\theta}\right)^n = \cos n\theta + i\sin n\theta$. **(07 Marks)**

c. Find the sine of the angle between $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$. **(07 Marks)**

Module-2

3 a. Find the n^{th} derivative of cosx cos2x. **(06 Marks)**

b. Obtain the Maclaurin's series expansion of the function $\sqrt{1+\sin 2x}$ upto the term containing x^4. **(07 Marks)**

c. If $u = f(y-z, z-x, x-y)$ prove that $\dfrac{\partial u}{\partial x} + \dfrac{\partial u}{\partial y} + \dfrac{\partial u}{\partial z} = 0$. **(07 Marks)**

OR

4 a. If $u = \tan^{-1}\left(\dfrac{x^3+y^3}{x-y}\right)$ prove that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = \sin 2u$. **(06 Marks)**

b. If $z = xy^2 + x^2y$ where $x = at^2$ and $y = 2at$. Find $\dfrac{dz}{dt}$. **(07 Marks)**

c. If $x = e^u \sec v$, $y = e^u \tan v$. Find $J\left(\dfrac{x, y}{u, v}\right)$. **(07 Marks)**

Module-3

5 a. A particle moves along the curve $\vec{r} = \cos 2t\hat{i} + \sin 2t\hat{j} + t\hat{k}$ where t is the time variable. Determine the components of velocity and acceleration vectors at $t = \pi/8$ in the direction of $\sqrt{2}\hat{i} + \sqrt{2}\hat{j} + \hat{k}$. **(06 Marks)**

b. Find $\text{div}\vec{f}$ for $\vec{f} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. **(07 Marks)**

c. Show that $\vec{f} = (2xy + z^2)\hat{i} + (x^2 + 2yz)\hat{j} + (y^2 + 2xz)\hat{k}$ is irrotional and find φ such that $\vec{f} = \nabla\varphi$. **(07 Marks)**

OR

6 a. Find the unit normal to the surface $x^3y^3z^2 = 4$ at the point P(-1, -1, 2). **(06 Marks)**

b. If $\vec{f} = 2x^2\hat{i} - 3yz\hat{j} + xz^2\hat{k}$ and $\varphi = 2z - x^3y$, find $\vec{f} \bullet (\nabla\varphi)$ and $\vec{f} \times (\nabla\varphi)$ at (1, -1, 1). **(07 Marks)**

c. Show that $\vec{f} = \dfrac{xi + yj}{x^2 + y^2}$ is both solenoidal and irrotational. **(07 Marks)**

Module-4

7 a. Obtain a reduction formula for $\int_0^{\pi/2} \sin^n x\, dx \,(n > 0)$. **(06 Marks)**

b. Evaluate $\int_0^{2a} x^2\sqrt{2ax - x^2}\, dx$. **(07 Marks)**

c. Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz\, dz\, dy\, dx$. **(07 Marks)**

OR

8 a. Obtain a reduction formula for $\int_0^{\pi/2} \cos^n x\, dx \,(n > 0)$. **(06 Marks)**

b. Evaluate $\iint_R xy\, dx\, dy$ where R is the first quadrant of the circle $x^2 + y^2 = a^2$, $x \geq 0$, $y \geq 0$. **(07 Marks)**

c. Evaluate $\int_{-1}^{1} \int_0^{z} \int_{x-z}^{x+z} (x + y + z)\, dy\, dx\, dz$. **(07 Marks)**

Module-5

9 a. Solve $x^2 \dfrac{dy}{dx} - 2xy - x + 1 = 0$. **(06 Marks)**

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

c. Solve $3x(x + y^2)dy + (x^3 - 3xy - 2y^3)dx = 0$. **(07 Marks)**

OR

10 a. Solve $\left[y\left(1 + \dfrac{1}{x}\right) + \cos y\right]dx + [x + \log x - x\sin y]dy = 0$. **(06 Marks)**

b. Solve $\dfrac{dy}{dx} + y\cot x = \sin x$. **(07 Marks)**

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

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CBCS SCHEME

USN | | | | | | | | | | | **18CS32**

Third Semester B.E. Degree Examination, July/August 2022
Data Structures and Applications

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define data structures. Explain the classification of data structures with examples. **(06 Marks)**

b. Explain the dynamic memory allocation functions supported by 'C' with syntax and examples. **(06 Marks)**

c. Consider the pattern P = ababab. Construct the table and the corresponding labeled directed graph used in the fast or second pattern matching algorithm. Trace it for the input text T = abaababababba. **(08 Marks)**

OR

2 a. Differentiate between structures and unions. Show examples for both. **(06 Marks)**

b. Explain any four string handling functions supported by 'C' with syntax and examples. **(06 Marks)**

c. Explain the representation of linear arrays in memory. Also, consider the linear arrays AAA (5:50) and BBB(-5:10).

i) Find the number of elements in each array.

ii) Suppose Base (AAA) = 300, Base (BBB) = 500 and 4 words per memory cell for AAA, 2 words per memory cell for BBB, find the address of AAA[15], AAA[55], BBB[8] and BBB[0]. **(08 Marks)**

Module-2

3 a. Define a stack. Explain the different operations that can be performed on stacks with suitable 'C' functions and examples. **(07 Marks)**

b. Convert the following infix expression into postfix expression using stack.
A + (B * C – (D / E ^ F) * G) * H. **(05 Marks)**

c. Develop a C recursive program for tower of Hanoi problem. Trace it for 3 disks with schematic call tree diagram. **(08 Marks)**

OR

4 a. Develop C functions to implement insertion, deletion and display operations of a circular queue. **(07 Marks)**

b. Write an algorithm to evaluate a postfix expression. Trace the algorithm for the following expression showing the stack contents 6 5 1 – 4 * 23 ^ / +. **(06 Marks)**

c. Define Ackermann function recursively and evaluate A(3, 0). Also, develop C code for the same. **(07 Marks)**

Module-3

5 a. Write the differences between arrays and linked lists. **(04 Marks)**

b. Develop C functions to implement the following in a singly linked list:
i) Delete a node from the front ii) Concatenate two linked lists. **(08 Marks)**

c. Develop a C function to add two polynomials using singly linked list. **(08 Marks)**

OR

6 a. Show the diagrammatic linked representation for the following sparse matrix:

$$\begin{bmatrix} 0 & 1 & 2 \\ 3 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

(04 Marks)

b. Develop C functions to implement the following in a doubly linked list:
   i) Insert a node at the front
   ii) Delete a node from the end. **(08 Marks)**

c. Develop C functions to implement the various operations of queues using linked list. **(08 Marks)**

Module-4

7 a. With suitable examples, define the following:
   i) Degree of a node
   ii) Level of a binary tree
   iii) Complete binary tree
   iv) Full binary tree. **(06 Marks)**

b. Construct binary search tree for the given set of values 14, 15, 4, 9, 7, 18, 3, 5, 16, 20. Also, perform inorder, preorder and postorder traversals of the obtained tree. **(06 Marks)**

c. Explain threaded binary trees and their representation with a neat diagram. Also, develop a C function to do the inorder traversal of a threaded binary tree. **(08 Marks)**

OR

8 a. Explain the array and inked representation of binary trees with suitable examples. **(06 Marks)**

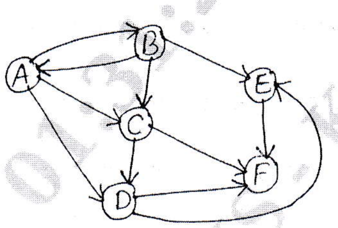
b. A binary tree has 9 nodes. The inorder and preorder traversals yield the following sequences of nodes:
Inorder: E A C K F H D B G
Preorder: F A E K C D H G B
Draw the binary tree. Also, perform the post order traversal of the obtained tree. **(06 Marks)**

c. Develop C functions to implement the following:
   i) Search a key value in a binary search tree
   ii) Copying a binary tree. **(08 Marks)**

Module-5

9 a. Define a graph. For the graph shown in Fig.Q.9(a), show the adjacency matrix and adjacency list representations. **(06 Marks)**

Fig.Q.9(a)



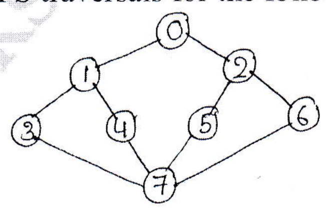
b. Suppose an array contains 8 elements as follows: 77, 33, 44, 11, 88, 22, 66, 55. Sort the array using insertion sort algorithm. **(06 Marks)**

c. What is hashing? Explain the following hash functions with proper examples:
   i) Division ii) Midsquare iii) Folding. **(08 Marks)**

OR

10 a. Briefly explain Breadth-First Search (BFS) and Depth-First Search (DFS) traversal of a graph. Also, show the BFS and DFS traversals for the following graph in Fig.Q.10(a).

Fig.Q.10(a)



(06 Marks)

b. Suppose 9 cards are punched as follows: 348, 143, 361, 423, 538, 128, 321, 543, 366. Apply radix sort to sort them in 3 phases. **(06 Marks)**

c. What is Collision? Explain the collision resolution techniques with proper examples. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **18CS33**

Third Semester B.E. Degree Examination, July/August 2022
Analog and Digital Electronics

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 principal of photodiode and discuss its applications. **(08 Marks)**

b. Design a monostable multivibrator circuit using 555 Timer IC to generate an output pulse of 100 ms. Choose C = 0.47 μF. Draw the circuit. **(06 Marks)**

c. Give the typical application of A/D and D/A converters with a block diagram. **(06 Marks)**

OR

2 a. Obtain the expression for collector to emitter voltage for voltage divider bias of BJT using accurate analysis. **(08 Marks)**

b. Design and draw astable multivibrator circuit using 555 Timer IC to generate 1 kHz square wave (Duty cycle = 50 %). Assume C = 0.1 μF. **(06 Marks)**

c. Explain R-2R ladder type DAC with a neat diagram. **(06 Marks)**

Module-2

3 a. Define prime implicant and essential prime implicant. Give an example. **(04 Marks)**

b. Use a Karnaugh map to find the minimum sum-of-products form for,
$F(A,B,C,D) = \sum m(0,2,4,10,11,14,15) + \sum d(6,7)$ **(06 Marks)**

c. Find a minimum sum-of-products solution using the Quine-McClusky method for given function,
$f(w,x,y,z) = \sum m(1,3,6,7,8,9,10,12,13,14)$ **(10 Marks)**

OR

4 a. Obtain the minimum product of sums for $f(w,x,y,z) = \bar{x}\bar{z} + wyz + \bar{w}\bar{y}\bar{z} + \bar{x}y$ using Karnaugh map. **(08 Marks)**

b. Find all prime implicants of the given function $F = \sum m(0,1,2,5,6,7)$, and find all minimal solutions using Petrick's method. **(08 Marks)**

c. Explain simplification of logic functions using map-entered variables. **(04 Marks)**

Module-3

5 a. Realize the given function $f = \bar{b}\bar{c} + a\bar{b} + \bar{a}b$ using only two-input NAND gates. **(06 Marks)**

b. Discuss different types of hazards in combinational logic circuits. **(06 Marks)**

c. What is Programmable Array Logic (PAL)? Show the implementation of a full adder using a PAL. **(08 Marks)**

OR

6 a. What is a multiplexer? Write the logic diagram for 8 : 1 multiplexer using 4 input AND and OR gates. **(08 Marks)**

b. Discuss the four kinds of three state buffers. **(08 Marks)**

c. Explain programmable logic array structure. **(04 Marks)**

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Module-4

7 a. What is VHDL? Show how to model the 4-to-1 multiplexer using a VHDL conditional assignment statement. **(06 Marks)**

b. Derive the characteristic equation for S-R flip-flop and J-K flip-flop in product-of-sums form. **(06 Marks)**

c. What is D flip-flop? Illustrate the operation of the clear and preset inputs in D-flip-flop with timing diagram. **(08 Marks)**

OR

8 a. Show how to construct a VHDL module using an entity architecture pair. **(06 Marks)**

b. Explain switch debouncing with an S-R latch. **(06 Marks)**

c. What is T flip-flop? Show how to convert D-flip-flop into T-flip-flop. **(08 Marks)**

Module-5

9 a. What is a register? Build a parallel adder with an accumulator using registers. **(06 Marks)**

b. Design 3-bit synchronous counter using T-flip-flops. **(08 Marks)**

c. Design a sequential parity checker for serial data. **(06 Marks)**

OR

10 a. Explain the working of a 3 bit shift register. **(06 Marks)**

b. Distinguish ring counter and Johnson counter. Also give the general form of a shift register counter. **(06 Marks)**

c. Design 3-bit binary synchronous down counter using J-K flip-flops. **(08 Marks)**

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CBCS SCHEME

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18CS34

Third Semester B.E. Degree Examination, July/August 2022
Computer Organization

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.
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Module-1

1 a. With neat diagram, explain the basic operational concepts of computer. (10 Marks)

b. Explain:
(i) Processor clock
(ii) Clock rate
(iii) Basic performance equation
(iv) Performance measurement (10 Marks)

OR

2 a. Explain all addressing modes with assembler syntax. (10 Marks)

b. State and explain the possibilities of encoding of machine instruction of 32 bit word. (10 Marks)

Module-2

3 a. Explain interrupt and interrupt hardware. State steps in enabling and disabling interrupts. (10 Marks)

b. Explain interrupt nesting and handling simultaneous requests in interrupts. (10 Marks)

OR

4 a. Explain DMA transfer with bus arbitration. (10 Marks)

b. Explain USB tree structure and protocols. (10 Marks)

Module-3

5 a. Draw the internal organization of a 2M × 8 dynamic memory chip and explain working with fast page mode. (10 Marks)

b. State and explain the types of read only memory and memory hierarchy. (10 Marks)

OR

6 a. What is cache memory? Explain different mapping functions with diagrams. (10 Marks)

b. Explain memory interleaving with diagram. State hit rate and miss penalty. (10 Marks)

Module-4

7 a. Explain different types of number representations with example and draw the addition/substraction logic unit. (10 Marks)

b. Design and explain the 4-bit carry look-ahead adder. (10 Marks)

OR

8 a. Explain Booth algorithm. Perform (+13) × (−6) using Booth algorithm. (10 Marks)

b. Draw the circuit arrangement for binary division. Perform (1000) ÷ (11) using restoring division. (10 Marks)

Module-5

9 a. With neat diagram, explain single-bus organization of computer and fundamental concepts. **(10 Marks)**

b. State the steps required in execution of Add (R_3), R_1, and explain the execution of branch instruction. **(10 Marks)**

OR

10 a. Explain the information required to generate control signals and structure of micro programmed control unit. **(10 Marks)**

b. Explain basic idea of pipe lining and 4-stage pipeline structure. **(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | 18CS35

Third Semester B.E. Degree Examination, July/August 2022
Software Engineering

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. What is software engineering and why it is important? Explain software engineering ethics. **(10 Marks)**

b. With a neat block diagram, explain the requirement elicitation and analysis process. **(06 Marks)**

c. What is requirement validation? Explain the different types of checks carried out during the process. **(04 Marks)**

OR

2 a. What do you mean by software design and implementation? With neat block diagram, explain the general model of the design process. **(10 Marks)**

b. Write note on the following:
(i) Non-functional requirements with example.
(ii) Notations used for writing system requirements. **(10 Marks)**

Module-2

3 a. What a Object Oriented Development? Explain the different stages of object oriented development. **(10 Marks)**

b. Write note on the following:
(i) Association End Names.
(ii) Purposes of Model. **(10 Marks)**

OR

4 a. Write note on :
(i) OO Themes
(ii) The Three models. **(10 Marks)**

b. Describe the various OCL (Object Constraint Language) constructs for traversing class models with example. **(10 Marks)**

Module-3

5 a. Describe Event-driven model with a state diagram of microwave oven application. **(10 Marks)**

b. What do you mean by design pattern? Explain the essential elements of design pattern. **(10 Marks)**

OR

6 a. Describe the three main aspects of implementation important to software engineering. **(10 Marks)**

b. Describe interaction models with example. **(10 Marks)**

Module-4

7 a. Describe the three different types of user testing. **(10 Marks)**

b. Explain software reengineering process with a neat block diagram. **(10 Marks)**

OR

8 a. Describe the Lehman's laws of program evolution dynamics. (10 Marks)

b. Discuss the following with respect to Legacy system management :

(i) Strategic options

(ii) Clusters of system. (10 Marks)

Module-5

9 a. Describe the following with respect to project plan development :

(i) Sections of project plan.

(ii) Project scheduling. (10 Marks)

b. Discuss the software review process and inspections of quality assurance. (10 Marks)

OR

10 a. Describe the key stages in the process of product measurement. Also briefly explain the factors affecting software pricing. (10 Marks)

b. Write note on the following:

(i) Static software product metrics.

(ii) Algorithmic cost modeling. (10 Marks)

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CBCS SCHEME

USN

18CS36

Third Semester B.E. Degree Examination, July/August 2022
Discrete Mathematical Structures

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. Define Tautology. Prove that for any propositions p, q, r the compound proposition : $\{p \to (q \to r)\} \to \{(p \to q) \to (p \to r)\}$ is a tautology. (06 Marks)

b. Test the validity of the arguments using rules of inference.

$$\begin{array}{l} (\neg p \vee q) \to r \\ r \to s \vee t \\ \neg s \wedge \neg u \\ \neg u \to \neg t \\ \hline \therefore p \end{array}$$

(06 Marks)

c. Give an indirect proof and proof by contradiction for, "If m is an even integer, then m + 7 is odd". (08 Marks)

OR

2 a. Prove the following logical equivalences using laws of logic:
$[\neg p \wedge (\neg q \wedge r)] \vee [(q \wedge r) \vee (p \wedge r)] \Leftrightarrow r$ (06 Marks)

b. Consider the following open statements with the set of all real numbers as the universe:
$p(x): x \geq 0$, $q(x): x^2 \geq 0$, $r(x): x^2 - 3x - 4 = 0$
$s(x): x^2 - 3 > 0$. Determine the truth values of the following statements.

(i) $\exists x, p(x) \wedge q(x)$
(ii) $\forall x, p(x) \to q(x)$
(iii) $\forall x, q(x) \to s(x)$
(iv) $\forall x, r(x) \vee s(x)$
(v) $\exists x, p(x) \wedge r(x)$
(vi) $\forall x, r(x) \to p(x)$ (06 Marks)

c. Establish the validity of the following :

$$\begin{array}{l} \forall x, [p(x) \vee q(x)] \\ \exists x, \neg p(x) \\ \forall x, [\neg q(x) \vee r(x)] \\ \forall x, [s(x) \to \neg r(x)] \\ \hline \therefore \exists x, \neg s(x) \end{array}$$

(08 Marks)

Module-2

3 a. Prove by mathematical induction $4n < (n^2 - 7)$ for all positive integers $n \geq 6$. (06 Marks)

b. A certain question paper contains two parts A and B each containing 4 questions. How many different ways a student can answer 5 questions by selecting atleast 2 questions from each part? (06 Marks)

c. Determine the coefficient of,
(i) xyz^2 in $(2x - y - z)^4$ (ii) x^9y^3 in the expansion of $(2x - 3y)^{12}$. (08 Marks)

OR

4 a. Prove by mathematical induction, $1.3 + 2.4 + 3.5 + ... + n(n+2) = \frac{n(n+1)(2n+7)}{6}$. **(06 Marks)**

b. Find the number of permutations of the letters of the word MASSASAUGA. In how many of these all four A's are together? How many of them begin with S? **(06 Marks)**

c. In how many ways can we distribute eight identical white balls into four distinct containers so that,
   (i) no container is left empty?
   (ii) the fourth container has an odd number of balls in it? **(08 Marks)**

Module-3

5 a. State pigeonhole principle. ABC is an equilateral triangle whose sides are of length 1 cm each. If we select 5 points inside the triangle, prove that atleast two of these points are such that the distance between them is less than $\frac{1}{2}$ cm. **(08 Marks)**

b. If $A = A_1 \cup A_2 \cup A_3$ where $A_1 = \{1,2\}$, $A_2 = \{2, 3, 4\}$ and $A_3 = \{5\}$, define a relation R on A by xRy if x and y are in the same subset A_i for $1 \le i \le 3$. Is R an equivalence relation. **(06 Marks)**

c. Let $f, g : R \to R$ where $f(x) = ax+b$ and $g(x) = 1 - x + x^2$. If $(gof)(x) = 9x^2 - 9x + 3$ determine a, b. **(06 Marks)**

OR

6 a. Prove that if $f : A \to B$, $g : B \to C$ are invertible functions, then $gof : A \to C$ in invertible and $(gof)^{-1} = f^{-1} o g^{-1}$. **(06 Marks)**

b. For A = {a, b, c, d, e} the Hasse diagram for the poset (A, R) is shown in Fig. Q6 (b).
   (i) Determine the relation matrix for R.
   (ii) Construct the directed graph G that is associated with R. **(06 Marks)**

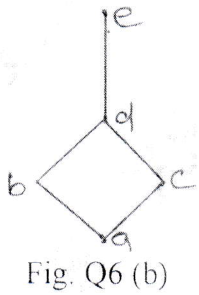

Fig. Q6 (b)

c. If R is an equivalence relation on a set A and $x, y \in A$ then prove
   (i) $x \in [x]$
   (ii) xRy if and only if $[x] = [y]$ and
   (iii) if $[x] \cap [y] \neq \varphi$ then $[x] = [y]$. **(08 Marks)**

Module-4

7 a. Find the number of permutations of a, b, c ......x, y, z in which none of the patterns spin, game, path or net occurs. **(08 Marks)**

b. For the positive integers 1, 2, 3, ...n there are 11660 derangements where 1, 2, 3, 4 and 5 appear in the first five positions. What is the value of n? **(06 Marks)**

c. Solve the recurrence relation $a_n + a_{n-1} - 6a_{n-2} = 0$ where $n \ge 2$ and $a_0 = -1$, $a_1 = 8$. **(06 Marks)**

OR

8 a. Determine the number of integers between 1 and 300 (inclusive) which are, (i) divisible by exactly two of 5, 6, 8 .... (ii) divisible by atleast two of 5, 6, 8. **(06 Marks)**

b. Describe the expansion formula for Rook polynomials. Find the Rook polynomial for 3×3 board using expansion formula. **(08 Marks)**

c. The number of bacteria in a culture is 1000 (approximately) and this number increases 250% every two hours. Use a recurrence relation to determine the number of bacteria present after one day. **(06 Marks)**

Module-5

9 a. Define with examples, (i) Subgraph, (ii) Spanning subgraph (iii) Complete graph (iv) Induced subgraph (v) Complement of a graph (vi) path. **(06 Marks)**

b. Merge sort the list,
$-1, 7, 4, 11, 5, -8, 15, -3, -2, 6, 10, 3$ **(06 Marks)**

c. Define isomorphism of two graphs. Determine whether the following graphs G_1 and G_2 are isomorphic or not.

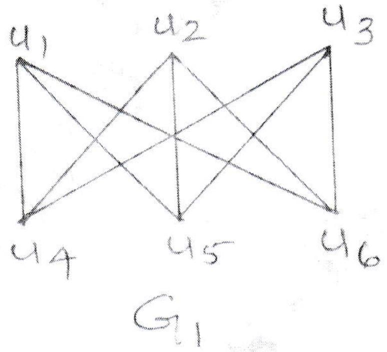

Fig. Q9 (c) – i

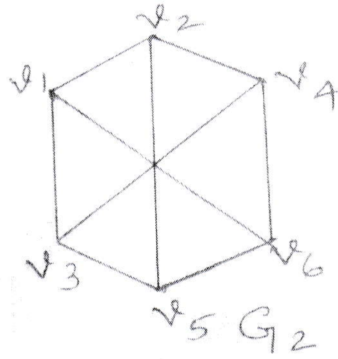

Fig. Q9 (c) - ii

(08 Marks)

OR

10 a. Let G = (V, E) be the undirected graph in Fig. Q10 (a). How many paths are there in G from a to h? How many of these paths have length 5? **(06 Marks)**

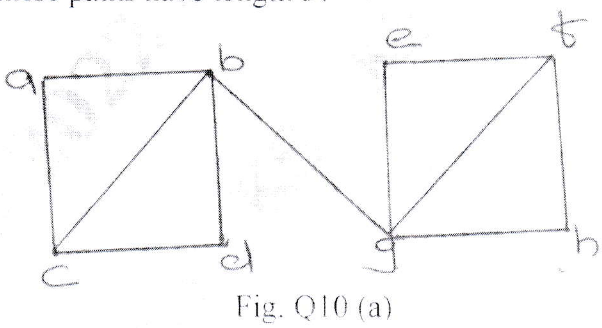

Fig. Q10 (a)

b. Prove that in every tree $T = (V, E)$, $|V| = |E| + 1$ **(06 Marks)**

c. Construct an optimal prefix code for the symbols a, o, q, u, y, z that occur with frequencies 20, 28, 4, 17, 12, 7 respectively. **(08 Marks)**

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