

END TERM EXAMINATION

VLSI/CS

THIRD SEMESTER [B.TECH] DECEMBER-2024

Paper Code: ES-201

Subject: Computational Methods

Time: 3 Hours

Maximum Marks: 60

Note: Attempt five questions in all including Q. no.1 which is compulsory. Select one question from each unit. Scientific calculator is allowed.

- Q1 (a) Determine the decimal number that correspond to the machine word $[45DE4000]_{16}$ (2)
- (b) Using secant method find the root of $x \sin(x) - 3 \cos(x) = 0$ between (0.0, 1.8) with accuracy of 2 digits after decimal point. (3)
- (c) For following given set of data for x & y, formulate the Newton divided differences table. (3)

x	0.00	2.00	4.00	6.0	8.0
y	0.00	8.00	64.00	216.00	512.00

- (d) Compute $\int_0^1 \frac{\sin(x)}{x} dx$ by using the composite Trapezoid rule with six uniform points. Assign the value $\left(\frac{\sin x}{x}\right) = 1$ at $x = 0$. (3)
- (e) Define Decomposition of any matrix. Explain the required condition for Doolittle and Crout decomposition method. (2)
- (f) Find the value of λ for which the system of equations $x+y+4z=1$, $x+2y-2z=1$ & $\lambda x+y+z=1$, will have unique solution. (3)
- (g) Using Euler's method find the value of y at $x=0.10$ of the ODE $\frac{dy}{dx} = x + y + xy$ Where initial conditions are $x_0 = 0.00$ & $y_0 = 1.00$ and using step size 0.10. (3)
- (h) Give an example and conditions of Parabolic, Hyperbolic and Elliptic partial differential equations. (1)

UNIT - I

- Q2 (a) Find the value of function $f(x) = 1 - \cos(x)$ at $x = 0.1$. Modify the expression so that loss of significant digits can be avoided and calculate the value again. Compare two values with the true value 0.4996×10^{-2} . (5)
- (b) Define rate of convergence and stability of iterative method. Prove that the rate of convergence of Newton-Raphson method is 2. (5)
- Q3 (a) Define Multivariate unconstraint minimization problem with an example. Using Newton Method to minimize multivariate function, minimize $f(x^k) = 4x_1^2 + x_2^2 - 2x_1x_2$ starting at $x_0^k = [1, 1]^T$, where $x^k = [x_1, x_2]^T$ (5)
- (b) Determine the minimum point of the function $f(x) = x^2 - 7x + 12$ by Fibonacci search method, if the first uncertainty interval is [2,4] . (5)

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UNIT-II

- Q4 (a) Explain error estimation in Newton-Gregory Forward interpolation. Also prove that the maximum error in Newton's Forward interpolation is 1 when $|x-x_0| < h$, where h is step size of the given data. (5)
- (b) For the given set of data for X and Y construct the table of forward differences. Find the interpolated value of Y at X=4.60 using Newton forward interpolation formula. Also find the estimated error in interpolated value. (5)

X	1.0	2.0	3.0	4.0	5.0	6.0
Y	7.0	13.0	21.0	32.0	48.0	70.0

- Q5 (a) Find $I = \int_0^1 x dx$, by Gaussian Quadrature formula for $n=4$. Where the values of 'abscissae and Weights' corresponding to $n=4$ are given.
Abcissae = $(\pm 0.33998 \text{ \& } \pm 0.86114)$ and corresponding Weights = $(0.65214 \text{ \& } 0.34785)$ (4)
- (b) Evaluate the definite integral $\int_0^1 \frac{1}{1+x} dx$ correct to three decimal point using the basic trapezoidal rule with $h = 0.5, 0.25$ and 0.125 then obtain a better estimate using Romberg's method. Compare the results with the true value. (6)

UNIT-III

- Q6 (a) Test the consistency of the system of following given equations:

$$\begin{cases} 5x_1 + 3x_2 + 7x_3 = 4 \\ 3x_1 + 26x_2 - 2x_3 = 9 \\ 7x_1 + 2x_2 + 10x_3 = 3 \end{cases}$$

If the system is consistent, is the system have finite solution or infinite solution? (4)

- (b) Explain the concept of partial pivoting and hence solve the following given system of linear equation by Gauss-Jordan method. The system of linear. (6)

$$\begin{aligned} x_1 + x_2 + x_3 &= 1 \\ \text{equations is: } 4x_1 + 3x_2 - x_3 &= 6 \\ 3x_1 + 5x_2 + 3x_3 &= 4 \end{aligned}$$

- Q7 (a) Obtain the linear Spline for the function $f(x)$ define by the data given below

x	1	2	4	8
f(x)	3	7	21	73

Evaluate the function at $x=3$. (4)

- (b) Solve the following given system of linear equations using Cholesky factorization method: (6)

$$\begin{aligned} 25x + 15y - 5z &= 35 \\ 15x + 18y &= 33 \\ -5x + 11z &= 6 \end{aligned}$$

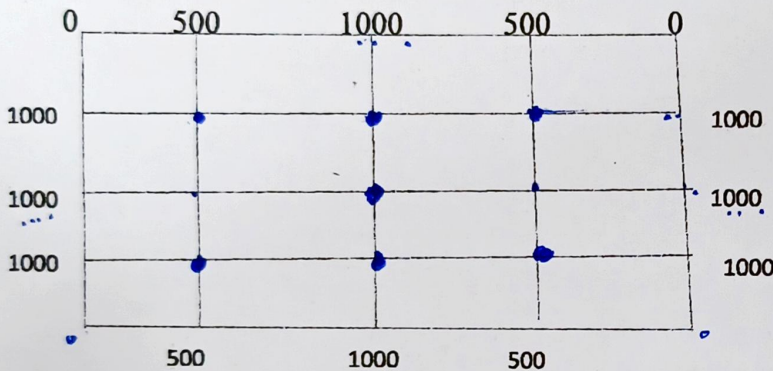
UNIT-IV

Q8 (a) Using Picard method, compute $y(0.2)$ to three decimal precision from $\frac{dy}{dx} = x + y$ given that $y(0) = 1$. Compare the result with the exact result for the value of y at 0.2. (4)

(b) Consider the initial value problem $\begin{cases} \frac{dx}{dt} = t + x^2 \\ x(0) = 1 \end{cases}$
Using Runge-Kutta method of 4th order find $x(0.2)$ taking $h=0.1$. (6)

Q9 (a) Solve the initial value problem $\frac{dy}{dx} = x - y^2$ in the range $0 \leq x \leq 1$, for the initial condition $y(0) = 0$. (4)

(b) Solve the elliptical equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values given as (6)



END TERM EXAMINATION

THIRD SEMESTER [B.TECH] DECEMBER 2024

Paper Code: CIC-205

Subject: Discrete Mathematics

Time: 3 Hours

Maximum Marks: 60

Note: Attempt five questions in all including Q. No.1 which is compulsory. Select one question from each unit. Assume missing data, if any.

- Q1 Answer all of the following questions briefly: (4x5=20)
- (a) Explain chromatic number of graph with example.
 - (b) Determine the contrapositive of the statement "if John is a poet, then he is poor."
 - (c) Define cyclic permutation. Give an example.
 - (d) Differentiate between oriented and unoriented graph.
 - (e) Shows that $(P \wedge q) \rightarrow (p \vee q)$ is tautology.

UNIT-I

- Q2 (a) Define the following term with the help of an example: (4)
- (i) Equality of set
 - (ii) Power set
 - (iii) Equivalent set
 - (iv) Disjoint set
- (b) Shows that the premises "A student in the class has not read the book" and "everyone in the class passed the first exam" implies the conclusion "someone who passed the first exam has not read the book". (6)
- Q3 (a) Using proof of contrapositive prove that "if $xy \in z$ (set of integer) such that xy is odd then both x and y are odd. (5)
- (b) State and prove the principle of inclusion and exclusion for n number of set. (5)

UNIT-II

- Q4 (a) Prove that a given set $B = \{1, 2, 3, 5, 30\}$ is lattice for the given condition "is divisible by". (4)
- (b) Evaluate the condition of function to be: (3)
- (i) Injective
 - (ii) Surjective
 - (iii) Bijective
- (c) Find out the sequence generated by the recurrence relation $T_n = 2T_{n-1}$ with $T_1 = 4$ (initial condition). (3)
- Q5 (a) Minimize the given function using K-map (5)
- $$\overline{A}BCD + \overline{A}BC\overline{D} + ABCD + \overline{A}BC\overline{D} + ABC\overline{D} + \overline{A}BCD + ABC\overline{D}$$
- (b) For the first order linear recurrence relation, proved that $a_n = c^n a_0$ (5)

UNIT-III

- Q6 (a) Let G be the set of all positive rational number and $*$ be the binary operation on G define by $a*b = ab/7$ for all $a, b \in G$. Prove that $(G, *)$ is an abelian group. (5)
- (b) Find the all coset of $H = \{0, 4\}$ in the group $G = (\mathbb{Z}_8, +_e)$ (5)

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CIC-205

- Q7 (a) State and prove Coset Lagrange's theorem. (5)
(b) Explain homomorphism and isomorphism with example. (2)
(c) Prove that $Z_4 = \{0, 1, 2, 3\}$ is an abelian group with respect to addition modulo 4. (3)

UNIT-IV

- Q8 (a) State and prove five color theorem. (5)
(b) Define Euler path and Euler circuit with the help of example. (2)
(c) If there are 20 vertices, each of degree 3, then into how many regions does a representation of this planer graph split the plane? (3)
- Q9 (a) State and prove Euler's formula. (5)
(b) Explain BFS algorithm in detail with a suitable example. (5)

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END TERM EXAMINATION

THIRD SEMESTER [B.TECH] DECEMBER-2024

Paper Code: ECC-207

Subject: Digital Logic & Computer Design

Time: 3 Hours

Maximum Marks: 60

Note: Attempt five questions in all including Q. no.1 which is compulsory. Select one question from each unit.

- Q1 Attempt all Questions
- (a) Convert $(1111000100)_2$ to gray, XS-3 and BCD. (4)
 - (b) Implement half adder using NAND gate only. (4)
 - (c) What is race around condition in flip-flops? How can it be overcome? (4)
 - (d) Differentiate between Ring and Johnson counter. (3)
 - (e) What is an Input-Output processor (IOP), and how does it contribute to the efficiency of I/O operations? (3)
 - (f) Differentiate between RISC and CISC. (2)

UNIT-I

- Q2
- (a) Simplify the following boolean function using Quine-McCluskey Method. (6)
 $f\{A,B,C,D\} = \sum m(1, 2, 4, 5, 7, 8, 10, 11, 12, 14)$.
 - (b) Find a minimal SOP using K-Map and draw the circuit of minimal expression. (4)
 $f\{A,B,C,D\} = \sum m(1, 3, 4, 5, 9, 10, 11) + d(6,8)$.
- Q3
- (a) Design a 4-bit magnitude comparator circuit. Provide the truth table for the comparator. (5)
 - (b) Design a 16-to-1 multiplexer using 8-to-1 multiplexers. Provide the logic diagram and truth table for your design. (5)

UNIT-II

- Q4
- (a) Explain the concept of a modulus counter. Design a synchronous counter with a modulus of 9 using JK flip-flops. (5)
 - (b) How does a serial-in-parallel-out (SIPO) shift register differ from a parallel-in-serial-out (PISO) shift register? Consider a 4-bit serial-in, serial-out (SISO) shift register with an initial state of 1101. Assume a clock signal that triggers the shift operation on each rising edge. The input data is 1010. Illustrate the state transitions of the shift register for each clock cycle, showing the output after each shift operation. After four clock cycles, what will be the final state of the shift register? (5)

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ECC-207

- Q5 (a) Design a sequence detector which detects 1100 (non overlapping) from any given sequence. Implement using D flip flop. (5)
- (b) Describe the architecture of a Programmable Array Logic (PAL) device. How does it differ from a PLA in terms of structure and functionality? (5)

UNIT-III

- Q6 (a) Explain the role of the control unit, ALU, and registers in the CPU. How do they work together to execute instructions? (5)
- (b) Describe arithmetic micro-operations in the context of computer organization. Provide examples of arithmetic operations and how they are performed at the micro-operation level. (5)
- Q7 (a) Define assembly language and describe its relationship with machine language. (5)
- (b) Explain the concept of microprogrammed control in computer architecture. How does it differ from hardwired control, and what are its advantages? (5)

UNIT-IV

- Q8 (a) Discuss the principles of cache mapping, including direct-mapped, set-associative, and fully associative cache mapping. (5)
- (b) Describe the role of direct memory access (DMA) in input-output operations. (5)
- Q9 (a) Define virtual memory. How does virtual memory address the limitations of physical memory? (5)
- (b) Discuss the binary subtraction process and describe how borrow is handled in binary subtraction. (5)

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END TERM EXAMINATION

THIRD SEMESTER [B. TECH] DECEMBER 2024

Paper Code: CIC-200

Time: 3 Hours

Subject: Data Structures

Maximum Marks: 60

Note: Attempt five questions in all including Q. No. 1 which is compulsory. Select one question from each unit. Assume missing data, if any.

- Q1 Attempt any five. (4x5=20)
- (a) Differentiate between primitive and non-primitive data structures
 - (b) Define complexity? Explain Big(O) notation with the help of a example?
 - (c) Calculate the address of element at X[4,3] in a 2D array X[1..5][1..4] stored in a row major order. Assume the base address to be 1000 and each element requires 4 words of storage.
 - (d) Write a program/algorithm to evaluate a postfix expression using stack?. Consider the following:
(A+(B*C-(D/E*F)*G)*H)
 - (e) What is a threaded binary tree? Write the advantages of threaded binary tree.
 - (f) Write Kruskal's Algorithm for finding minimum spanning tree.

UNIT-I

- Q2 (a) What is meant by term Row Major Order and Column Major Order in Array? How do we calculate the address of an element in a row major 2-D array? (5)
- (b) Differentiate between pointer of arrays and array of pointers. (5)
- Q3 (a) How a linked list can be used to represent a polynomial $5x^3+4x^2+3x+2$? Give an algorithm to perform addition of two polynomials using linked list. (5)
- (b) Write an Algorithm/program to insert an element in the beginning into the circular linked list. (5)

UNIT-II

- Q4 (a) Define an AVL tree. What are the different AVL tree rotations? Construct an AVL tree for the following list of numbers: (7)
10 5 8 12 18 22 1 4 6 30
- (b) What are the properties of B-tree? (3)
- Q5 (a) Draw Binary tree when Preorder and Inorder follows and Write an algorithm for the same. (5)
Pre: 1 2 4 8 5 3 6 7
In: 4 8 2 5 1 6 3 7
- (b) Construct a Binary Search Tree by inserting the following sequence of numbers. (5)
10,12,5,4,20,8,7,15 and 13

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P.T.O.

UNIT-III

Q6

- (a) What do you mean by internal and external sorting? Sort the following elements using Bubble sort. (5)
 8, 22, 7, 9, 31, 19, 5, 13, 58, 93, 1, 45.
- (b) Define Hashing. How do collision happen during hashing? Explain the different techniques resolving of collision. (5)

Q7

- (a) Write algorithm/Program for binary search. (5)
- (b) Using the Binary Search algorithm, search for elements 23 and 47 in the given set of elements [12 23 27 35 39 42 50]. (5)

UNIT-IV

Q8

- (a) Draw the directed graph that corresponds to this adjacency matrix: (5)

	A	B	C	D
A	1	0	1	0
B	1	0	0	0
C	0	0	0	1
D	1	0	1	0

- (b) Give the algorithm for BFS graph traversal. (5)
- (a) Describe taking an example linked representation of graph. (5)
- (b) Define In-degree and Out-degree of a node in a graph using suitable example. (5)

END TERM EXAMINATION

THIRD SEMESTER [B. TECH] DECEMBER 2024-JANUARY 2025

Paper Code: CIC-211

Subject: Object-Oriented Programming Using C++

Time: 3 Hours

Maximum Marks: 60

Note: Attempt five questions in all including Q. No.1 which is compulsory. Select one question from each unit.

- Q1 Attempt **any five**, from the following questions:- (5x4=20)
- (a) Explain the concept of return by reference
 - (b) Data Abstraction vs Encapsulation.
 - (c) Write properties of static member functions. How to call it? Give suitable example.
 - (d) Namespaces in C++ are used for organizing and avoiding naming conflicts in a program", Justify whether the given statement is **True or False**, using proper example.
 - (e) Why we use generic classes in C++? Give example.
 - (f) Runtime vs Compile Time polymorphism

UNIT-I

- Q2 (a) Develop a C++ program to represent a complex number using a class. Create a **Complex** class with private real and imaginary parts. Implement a **friend function** named **add**, that takes two **Complex** objects as parameters and returns a new **Complex** object representing the sum of the two complex numbers. (5)
- (b) Explain the concept of function overloading with suitable example. (5)
- OR**

- Q3 (a) Differentiate between: (2x3=6)
- (i) Implicit and explicit type conversion
 - (ii) Call by Value and Call by Reference
- (b) Explain the concept of inline function. Where it should not be used? Develop a program to calculate the factorial of a number using an inline function. (4)

UNIT-II

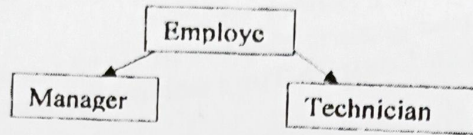
- Q4 (a) What is an array of objects? How it is stored inside memory? Develop a program in C++ to manage student database for 'n' number of students, using an array of student objects. Each student should have attributes like name, id, and marks. Implement functionalities to input and display students' details. (6)
- (b) Discuss the use of a constructor in C++. What are its various types? Write a program using different types of constructors in C++. Can constructors be inherited in derived class? (4)

OR

- Q5 (a) Write short note on the following with example: (4)
- (i) Use of destructor and its order of calling
 - (ii) Dynamic memory allocation in C++
- (b) Define operator overloading. Which operators in C++ cannot be overloaded? Implement a C++ class representing time (hours, minutes, seconds). Overload the + operator to enable the addition of two-time instances. (6)

UNIT-III

- Q6 (a) Define pure virtual functions and abstract classes. What are their properties? Provide an example illustrating their use. **(5)**
 (b) Design a program in C++ to represent an employee hierarchy using inheritance. Create a base class Employee with attributes like name, ID, and salary. Derive classes for different types of employees, such as Manager and Technician, each with specific attributes. Include functions to display details of each employee type. **(5)**



OR

- Q7 (a) Write short note on the following: (with example) **(5)**
 (i) Function overriding
 (ii) Aggregation vs Composition
 (b) What is generic programming? Design a generic C++ template function that swaps the values of two variables. Write a program that uses this template function to swap integers, doubles, and characters. Ensure that your template function works for various data types. **(5)**

UNIT-IV

- Q8 (a) Write a C++ program to copy one file to another after converting upper case character to lower case characters. **(4)**
 (b) Distinguish between the following: **(4x1.5=6)**
 (i) List and vectors
 (ii) Queue and deque
 (iii) Arrays and vectors
 (iv) Sets and maps

OR

- Q9 (a) Write short note on any two of the following: **(2x3=6)**
 (i) Persistent objects
 (ii) Exception handling in C++
 (iii) Vectors
 (b) What is a standard template library (STL)? What are its various components? Discuss the purpose of iterators in C++ STL? Explain the concept of initialize vector iterators using the begin() and end() functions. **(4)**

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