END TERM EXAMINATION

THIRD SEMESTER [B.TECH] JANUARY 2024

Paper Code: ES-201   Subject: Computational Methods

Time: 3 Hours   Maximum Marks: 75

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

Q1   Attempt all questions:

a)   The height of an observation tower was estimated to be 47m, whereas its actual height was 45m. Calculate the percentage relative error in the measurement. **(1.5)**

b)   Derive the formula for evaluating $\sqrt{12}$ by Newton's Raphson method. **(1.5)**

c)   Differentiate between partial and complete pivoting in solving linear system of algebraic equations. **(1.5)**

d)   Estimate the missing term in the following table: **(1.5)**

$x:$	0	1	2	3	4
$f(x):$	1	3	9	—	81

e)   Define cubic spline function and state the conditions required for cubic spline interpolation. **(1.5)**

f)   Find $\int_0^{\pi/2} \sqrt{\cos\theta}\,d\theta$ using Simpson's $1/3^{rd}$ rule for $n=6$. **(2.5)**

g)   Solve the IVP $\frac{dy}{dx} = xe^y, y(0)=0$ using Picard's method and estimate $y(0.2)$. **(3)**

h)   Determine which of the following equations are elliptic, parabolic, and hyperbolic. **(2)**

(i) $f_{xx} + 6f_{xy} + 9f_{yy} = 0$

(ii) $f_{xx} - 2f_{xy} + 2f_{yy} = 2x + 5y$

UNIT-I

Q2   a)   Find the root of the equation $x = e^{-x}$, correct to three decimal places by Secant method by performing six iterations. **(8)**

b)   Use Newton—Rapshon method to obtain a root of $\sin x = 1 - x$ to three decimal places. **(7)**

Q3   a)   Perform four iterations of Golden section search method to minimize $f(x) = x^4 - 14x^3 + 60x^2 - 70x$, $x \in (0,2)$ with $\varepsilon = 10^{-3}$. **(7.5)**

b)   Use steepest descent method for 3 iterations on $f(x_1, x_2, x_3) = (x_1 - 4)^4 + (x_2 - 3)^2 + 4(x_3 + 5)^4$ with initial point $x^{(0)} = [4, 2, -1]^T$ **(7.5)**

UNIT-II

Q4   a)   Prove that $\Delta = \frac{1}{2}\delta^2 + \delta\sqrt{(1 + \delta^2/4)}$. **(7)**

b)   The table gives the distance in nautical miles of the visible horizon for the given heights in feet above the earth's surface: **(8)**

P.T.O.

ES-201
P-1/3

x = height :	100	150	200	250	300	350	400
y = distance:	10.63	13.03	15.04	16.81	18.42	19.90	21.27

Find the value of y when $x = 410$ using Newton's backward interpolation formula.

Q5 a) Evaluate the integral $\int_0^6 \frac{e^x}{1+x}dx$ using Simpson's 1/3rd and Simpson's 3/8th rule respectively. Compare it with the exact value. **(7)**

b) Evaluate the integral $\int_0^{0.5}\left(\frac{x}{\sin x}\right)dx$ using Romberg's method, correct to three decimal places. **(8)**

UNIT-III

Q6 a) Investigate the values of λ and μ so that the system of equations **(7)**

$2x + 3y + 5z = 9$

$7x + 3y - 2z = 8$

$2x + 3y + \lambda z = \mu$

have (i) no solution, (ii) unique solution, (iii) an infinite number of solutions.

b) Solve the system of equations **(8)**

$\begin{cases} x_1 + 10x_2 - x_3 = 3 \\ 2x_1 + 3x_2 + 20x_3 = 7 \\ 10x_1 - x_2 + 2x_3 = 4 \end{cases}$

Using the Gauss elimination with partial pivoting.

Q7 a) Solve the system of equations using Dolittle factorisation method **(9)**

$\begin{cases} 3x + 2y + 7z = 4 \\ 2x + 3y + z = 5 \\ 3x + 4y + z = 7 \end{cases}$

b) Determine the numerically dominant eigenvalue and eigenvector of the matrix $A = \begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$ using Power method. Take the initial vector $X^{(0)} = [1,1,1]^T$. **(6)**

UNIT-IV

Q8 a) Employ Taylor's method to obtain the approximate value of y at $x = 0.2$ for the differential equation $dy/dx = 2y + 3e^x$, $y(0) = 0$. Compare the numerical solution obtained with the exact solution. **(7)**

P.T.O.

b) Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0.2, 0.4$. **(8)**

Q9 a) Solve the initial value problem $y\frac{dy}{dx} = x$, $y(0) = 1$, using Euler's method in $0 \le x \le 0.8$, with $h = 0.2$. Compare the results with the exact solution at $x = 0.8$. **(8)**

b) Solve the partial differential equation **(7)**

$u_{xx} + u_{yy} = x + y + 1$, $0 \le x \le 1$, $0 \le y \le 1$,

$u = 0$ on the boundary

Numerically up to three iterations with $h = 1/3$. Obtain the results correct to three decimal places.

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END TERM EXAMINATION

THIRD SEMESTER [B.TECH] JANUARY 2024

Paper Code: ECC-207   **Subject: Digital Logic & Computer Design**

Time: 3 Hours   **Maximum Marks: 75**

> 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 all questions: (3×5=15)
- a) Reduce the Boolean Expression $+^{-} (+^{-})$
- b) What are don't care terms?
- c) Differentiate a decoder from a Demultiplexer.
- d) Draw the state table and excitation table of T flip flop.
- e) Write about Virtual memory.

UNIT-I

Q2
- a) What is meant by duality in Boolean algebra? State and prove Associative and Distributive theorems.   **(7)**
- b) Minimize the expression $(, , ,) = \sum (0,1,2,5,8,9,10)$ using K-map and obtain (i) minimal SOP and (ii) minimal POS expression.   **(8)**

Q3
- a) Explain the operation of a magnitude comparator?   **(7)**
- b) Implement a full subtractor using 8:1 MUX.   **(8)**

UNIT-II

Q4
- a) What is Race Around condition? And how is it overcome in JK Flip-Flop? Explain with diagram.   **(5)**
- b) Design a Mod-5 synchronous counter using JK Flip-Flop.   **(10)**

Q5
- a) Explain designing of T Flip-Flop using JK Flip-Flop.   **(7)**
- b) Write short notes on: (i) Shift registers (ii) PLA & PAL   **(8)**

UNIT-III

Q6
- a) Differentiate between hardwired control and micro programmed control and explain organizations of micro programmed control unit with neat diagram.   **(10)**
- b) What is addressing mode? Explain different types of addressing modes.   **(5)**

Q7
- a) What are the different phases of an instruction cycle? Explain with the help of flowchart.   **(7)**
- b) What is assembly language? Explain basic computer instruction formats with suitable diagram.   **(8)**

P.T.O.

UNIT-IV

Q8
- a) Define DMA. Explain its need. Explain DMA transfer in detail with the help of suitable diagram.   **(7)**
- b) What is an interrupt? Explain interrupt cycle with the help of flowchart.   **(8)**

Q9   Write short notes on:
- a) Modes of data transfer   **(5)**
- b) Cache memory   **(5)**
- c) Associative memory   **(5)**

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END TERM EXAMINATION
THIRD SEMESTER [B.TECH] JANUARY 2024

Paper Code: CIC-205	Subject: Discrete Mathematics
Time: 3 Hours	Maximum Marks: 75

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 the following short answer type questions (Compulsory):-
    (a) Define a power set and give an example. **(2)**
    (b) State De Morgan's Laws in propositional logic. **(2)**
    (c) What is the principle of mathematical induction? **(2)**
    (d) Give an example of an equivalence relation. **(2)**
    (e) Define a Boolean Algebra. **(2)**
    (f) Explain the difference between a group and a monoid. **(2)**
    (g) What is Euler's formula in graph theory? **(2)**
    (h) Define a Hamiltonian circuit in a graph. **(1)**

UNIT-I
Q2   (a) Construct a Venn diagram for three sets A, B, C with the following conditions: $A \cap B = \emptyset, B \cap C \neq \emptyset, A \cap C \neq \emptyset$. **(5)**
    (b) Create a truth table for the proposition $p \to (q \wedge \neg r)$ and determine its logical equivalence. **(5)**
    (c) Define a binary relation R on the set {1, 2, 3, 4} where R contains (a, b) if and only if a divides b. Determine if R is reflexive, symmetric, and transitive, providing justification for each property. **(5)**

Q3   (a) Using the principle of inclusion and exclusion, find the number of integers between 1 and 100 that are divisible by 2, 3, or 5. Provide step-by-step calculations. **(5)**
    (b) Prove that in a group of six people, at least three people either all know each other or none of them knows the others. Use the pigeonhole principle in your proof. **(5)**
    (c) Given a set S of n elements, derive an expression for the number of ways to choose a non-empty subset of S. Validate your expression with n = 5. **(5)**

UNIT-II
Q4   (a) Let f(x) = 2x - 1 and g(x) = x/2 + 1. Find the compositions f(g(x)) and g(f(x)) and determine their domains. Illustrate each step and clarify the reasoning behind the determination of their domains. **(5)**
    (b) Show that every finite distributive lattice can be represented as a lattice of sets, using the lattice formed by the subsets of the set {a, b, c} as an example. Provide a detailed explanation. **(5)**
    (c) Design a logic circuit for the Boolean expression $\overline{(A + \overline{B})C} + \overline{AC}$ and simplify it using Karnaugh maps. Include a step-by-step process for the circuit and a detailed explanation of the Karnaugh map simplification. **(5)**

P.T.O.

Q5 (a) Define Euler's totient function $\varphi(n)$. Calculate $\varphi(30)$ and explain the significance of each step in your calculation process. **(5)**

(b) Demonstrate how generating functions can be used to solve the recurrence relation $a_n = a_{n-1} + n$ with $a_0 = 1$, providing a specific example. Illustrate your solution with a clear explanation. **(5)**

(c) Apply the Master's theorem to analyze the time complexity of the recursive algorithm $T(n) = 2T(n/2) + n\log n$. **(5)**

UNIT-III

Q6 (a) Prove that every element of a finite group has an order. Use this to show that every group of prime order is cyclic. Your proof should be detailed, covering all necessary steps and reasoning. **(5)**

(b) Given the group $G = \{1, 2, 3, 4, 5, 6\}$ under multiplication modulo 7, demonstrate how cosets of a subgroup H in G partition G, using $H = \{1, 2, 4\}$. Clearly demonstrate and provide a rationale for each step. **(5)**

(c) Discuss the significance of normal subgroups in group theory and provide an example of a non-trivial normal subgroup in the symmetric group S4. Provide a clear explanation with an illustrative example from S4. **(5)**

Q7 (a) Explain the concept of group homomorphism and prove that the kernel of a homomorphism is a subgroup of the domain. Include definitions and a thorough proof with clear logical steps. **(5)**

(b) Consider a group $G = \{1,2,3,4,5,6\}$ under the multiplication modulo 7. **(5)**
   (i) Find the multiplication table of G
   (ii) Find 2^{-1}, 3^{-1} and 6^{-1}
   (iii) Is G Cyclic?

(c) For the symmetric group S3, determine all subgroups and identify which are normal. Identify each subgroup and clearly explain why it is or is not a normal subgroup. **(5)**

UNIT-IV

Q8 (a) For a given graph G, show how to determine if it has an Eulerian path or circuit. Apply your method to the graph with vertices A, B, C, D, and edges AB, BC, CD, DA, AC. Provide a step-by-step methodology for your determination and apply it to the given graph. **(5)**
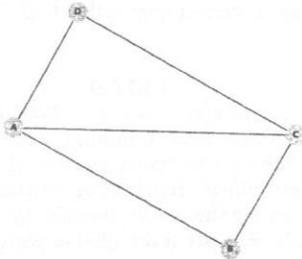
(b) Prove Euler's formula for planar graphs and use this formula to deduce the number of regions in a graph with 5 vertices and 7 edges. Include a detailed proof of Euler's formula and apply it step-by-step to the given graph scenario. **(5)**

P.T.O.

(c) Using Dijkstra's algorithm, find the shortest path in the given weighted graph from A to E. Detail each step in using Dijkstra's algorithm on the provided graph and discuss its time complexity with rationale. **(5)**


Q9 (a) Describe Kruskal's algorithm for finding a minimal spanning tree (MST) and apply it to a specific graph. Explain each step in Kruskal's algorithm and apply it to the provided graph, detailing the process. Discuss its time complexity. **(5)**
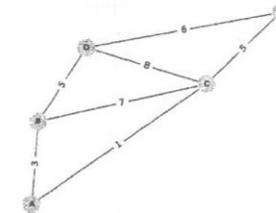
(b) Define the chromatic number of a graph. For the cycle graph composed of vertices A, B, C, D, with edges AB, BC, CD, DA, determine the chromatic number. Explain the reasoning behind your determination. **(5)**
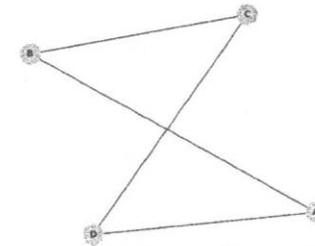
(c) Discuss the traveling salesman problem and illustrate its solution for a set of cities (Delhi, Jaipur, Agra, Chandigarh, Lucknow) and beginning from Delhi. Discuss its effectiveness and limitations. **(5)**

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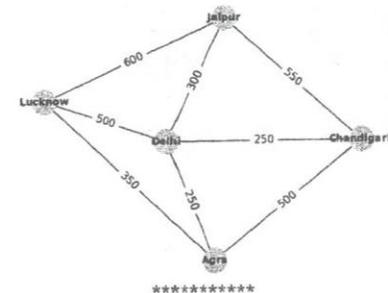
END TERM EXAMINATION

THIRD SEMESTER [B.TECH] JANUARY 2024

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Paper Code: CIC209	**Subject: Data Structures**

Time: 3 Hours	*Maximum Marks: 75*

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

Q1   Attempt the following: (5x3=15)
  a)   What do you understand by underflow and overflow in stack and queue data structures?
  b)   Why is it required to analyze the time complexity and space complexity of an algorithm?
  c)   Write short note on Bucket Hashing.
  d)   Write an algorithm to count the number of nodes of a binary tree.
  e)   Represent the following graph using Adjacency Matrix and Adjacency List representations:
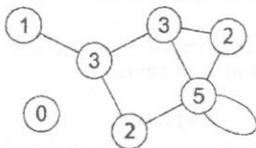
UNIT-I

Q2   a)   Convert the following infix expression into postfix expression using Stack: **(5)**

$(A + B) / C * (D - E)^\wedge F - G$

  b)   Write an algorithm to insert an element in the sorted doubly linked list.   **(5)**
  c)   Write short note on double ended queue (deque). Can we implement stack and queue data structures using deque? Comment.   **(5)**

Q3   a)   What are the different classifications of data structures? Explain briefly all types of data structures.   **(5)**
  b)   Consider a two-dimensional array or integers A [-11..10, 9..20]. Each element requires 4 bytes of memory storage. If the base address of the Array A is 100. You are required to derive the formula to locate the address of each element then determine the location (i.e. memory address) of A[5][15].   **(5)**
  c)   Explain similarities and dissimilarities between stack and queue data structures. Also list two applications of each.   **(5)**

UNIT-II

Q4   a)   Step by step construct the binary tree based on the below given traversals of the tree: **(5)**

Preorder: A B D C E G F H I
Inorder: B D A G E C H F I

  b)   What is AVL Tree? Explain different types of rotations used in AVL Tree.   **(5)**

P.T.O.

c) Write short note on B-Tree. **(5)**

Q5 a) Insert the following elements in the Binary Search Tree. Also show the binary search tree after each insertion. **(5)**

B D A G E C H F I

b) What is sparse matrix? Explain 3-tuple representation of sparse matrix. Give the node structure of linked list based 3-tuple representation of the sparse matrix. **(5)**

c) Insert the following elements in the max-heap tree. Also show the heap tree after each insertion. **(5)**

20 40 10 70 50 30 80 60 90

UNIT-III

Q6 a) Write an algorithm for merge sort. Sort the following list of numbers using merge sort: **(10)**

60, 2, 15, 20, 12, 115, 90, 50, 44, 85

b) Explain various collision resolution techniques used in hashing. **(5)**

Q7 a) What is hashing? What are the characteristics of a good hashing algorithm? Explain various hashing algorithm with help of examples. **(10)**

b) Differentiate between list search, sequential search and binary search. Also give an example of each. **(5)**

UNIT-IV

Q8 a) Find out the minimum spanning tree of the following graph using Kruskal's Algorithm. Clearly show every step. Also calculate the total cost of the obtained minimum spanning tree. **(5)**
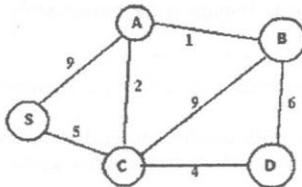

b) Write algorithms for DFS and BFS. **(5)**

c) Explain the following terms with examples: (i) Directed Graph, (ii) Undirected Graph, (iii) Path, (iv) Cycle, and (v) Degree of a vertex. **(5)**

Q9 a) Consider the following graph and find out the shortest path from vertex 1 to all other verticesusing Dijkstra's Algorithm. **(5)**
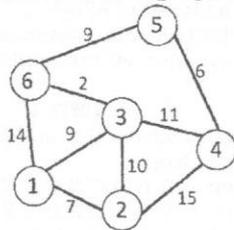
P.T.O.

b) Perform DFS and BFS on the following graph considering vertex A as start vertex. Show the resultant spanning trees generated using DFS and BFS. **(5)**
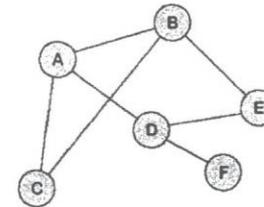
c) Write short note on disjoint sets representation. **(5)**

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END TERM EXAMINATION

THIRD SEMESTER [B.TECH] JANUARY 2024

Paper Code: CIC211 **Subject: Object Oriented Programming Using C++**

Time: 3 Hours   **Maximum Marks: 75**

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

Q1   Attempt all questions:
- a)   What is an inline function and why is it used in C++?   **[3]**
- b)   What is a generic function, explain with example?   **[3]**
- c)   What are different derived data types in C++?   **[3]**
- d)   What is a friend function and why is it used in C++?   **[3]**
- e)   Explain C++ Garbage Collection?   **[3]**

UNIT-I

Q2   a)   Differentiate between call by value and call by reference with program code?   **[7.5]**

   b)   What are different types of operators used in C++?   **[7.5]**

Q3   a)   Explain features of object Oriented Programming using suitable examples?   **[7.5]**

   b)   What is function overloading? Explain its usage using suitable examples?   **[7.5]**

UNIT-II

Q4   a)   Explain the use of constructor and destructor in a class using examples?   **[7.5]**

   b)   What is dynamic memory allocation? Explain with program code?   **[7.5]**

Q5   a)   What is operator overloading? Overload +operator to concatenate 2 strings?   **[7.5]**

   b)   Explain different types of constructors using suitable examples?   **[7.5]**

UNIT-III

Q6   a)   Define Inheritance and explain its different types using program code?   **[7.5]**

   b)   What is pure virtual function and explain when it is used with program code?   **[7.5]**

Q7   a)   Differentiate between composition and containership with program code?   **[7.5]**

   b)   What is run time polymorphism? Explain with program code? **[7.5]**

UNIT-IV

Q8   a)   Explain C++ stream classes using suitable examples?   **[7.5]**

   b)   Write a program in C++ to create generic class for stack operations?   **[7.5]**

Q9   a)   Write a program in C++ to read content from one file and write in another?   **[7.5]**

   b)   What is the standard template library and explain iterators and vectors?   **[7.5]**

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CIC-211
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