



NATIONAL INSTITUTE OF TECHNOLOGY PATNA
MID-SEMESTER EXAMINATION, OCTOBER 2024

Program: B.Tech-M.Tech-DD-CSE-DS

Department: CSE

Full Marks: 30

Semester: 3rd

Course Code: CS34105

Course Name: Object Oriented Programming

Duration of Examination: 2 Hours

INSTRUCTIONS

- Please mention your section at the top of the answer script.
- Answer all the questions. Assume Missing data, if any.
- Each question includes the corresponding marks, Course Outcome (CO), and Bloom's Level (BL).

1. Explain the roles of the Java Development Kit (JDK), Java Runtime Environment (JRE), and Java Virtual Machine (JVM) in the Java programming ecosystem. How do they interact with each other during the development and execution of a Java application? (5M)[CO1][L1,L2]

2. You are working on a sensor monitoring system where each bit of a 4-bit integer represents the status of four different sensors. A bit value of 1 means the sensor is active, and a bit value of 0 means the sensor is inactive. The bits are assigned as follows:

Bit 3: Temperature Sensor, Bit 2: Pressure Sensor, Bit 1: Humidity Sensor, Bit 0: Light Sensor

Given the current sensor status represented by the integer *sensorStatus* = 14 (decimal)

Part A: Determine which sensors are active and which are inactive using bitwise operations.

Part B: Write a Java code to deactivate the Pressure Sensor and activate the Light Sensor using bitwise operators, and display the new *sensorStatus* in both binary and decimal form. (1M+4M)[CO4][L3,L6]

3. What is the role of static variables and methods in Java? Provide an example to illustrate their usage and discuss how they differ from instance methods. (6M)[CO2,CO3][L2,L4]

4. Explain the concept of constructor in Java. Write a Java program to demonstrate the concept of default and parametrized constructor. (4M)[CO4][L4,L6]

5. Design a Java class called Shape that contains overloaded methods named area to calculate the area of different shapes. Implement methods to calculate the area of a rectangle, circle, triangle, and square. In the main method, demonstrate the use of each overloaded area method and explain how method overloading enhances code readability and flexibility. (6M)[CO6][L6]

6. What will be the output of the following code snippet/program? Provide a step-by-step explanation of how the output is derived

i. int a= -12; (4M)[CO3][L5]

System.out.println(a>>2); 1073741821

ii. class Test1 {

 static int x = 10; 2020

 public static void main(String[] args) {

 Test1 t1 = new Test1();

 Test1 t2 = new Test1();

 t1.x = 20;

 System.out.print(t1.x + " ");

 System.out.println(t2.x);

 }

NATIONAL INSTITUTE OF TECHNOLOGY PATNA
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MID-SEMESTER EXAMINATION - October, 2024

B.Tech-CSE, B.Tech-M.Tech-DD-CSE-CS, B.Tech-M.Tech-DD-CSE-DS, 3rd Semester

CS34111– Operating Systems
Max.Marks:30, Max. Time: 2 Hours

Answer All questions

Q. No	Question	Marks	CO	BL															
1	<p>a. Compare and contrast between time-sharing, real time, and parallel operating systems.</p> <p>b. Assess the impact of increasing or decreasing the time quantum in Round Robin scheduling algorithm.</p>	4 M 2M	CO-1 CO-1	BL-1 and 2 BL-3															
2	<p>a. Analyse the impact of preemptive and non-preemptive scheduling algorithms on system performance in a multi-tasking environment.</p> <p>b. Analyse the impact of context switching on CPU scheduling and system's performance.</p>	3M 3M	CO-1 CO-1	BL-4 BL-4															
3	<p>Assume the following four processes with arrival time (in milliseconds) and their length of CPU burst (in milliseconds) as shown below:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Process</th><th style="text-align: center;">Arrival Time</th><th style="text-align: center;">CPU Time</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">P₁</td><td style="text-align: center;">0</td><td style="text-align: center;">3</td></tr> <tr> <td style="text-align: center;">P₂</td><td style="text-align: center;">1</td><td style="text-align: center;">1</td></tr> <tr> <td style="text-align: center;">P₃</td><td style="text-align: center;">3</td><td style="text-align: center;">3</td></tr> <tr> <td style="text-align: center;">P₄</td><td style="text-align: center;">4</td><td style="text-align: center;">X</td></tr> </tbody> </table> <p>All the processes run on a single processor using pre-emptive shortest remaining time first scheduling algorithm. If the average waiting time of the processes is 1 millisecond, then find the value of X? (Show all the intermediate steps including the Gantt Chart)</p>	Process	Arrival Time	CPU Time	P ₁	0	3	P ₂	1	1	P ₃	3	3	P ₄	4	X	6M	CO-1	BL-2 and 3
Process	Arrival Time	CPU Time																	
P ₁	0	3																	
P ₂	1	1																	
P ₃	3	3																	
P ₄	4	X																	
4	<p>Assume the following three processes are running on a uniprocessor system. If the objective is to find the completion order of execution of these processes under RR with 2 quantum time and the largest job first, then show the order of execution with a detailed illustration.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Process</th><th style="text-align: center;">Arrival Time</th><th style="text-align: center;">CPU Time</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">P₁</td><td style="text-align: center;">0</td><td style="text-align: center;">4</td></tr> <tr> <td style="text-align: center;">P₂</td><td style="text-align: center;">1</td><td style="text-align: center;">7</td></tr> <tr> <td style="text-align: center;">P₃</td><td style="text-align: center;">3</td><td style="text-align: center;">4</td></tr> <tr> <td style="text-align: center;">P₄</td><td style="text-align: center;">6</td><td style="text-align: center;">5</td></tr> </tbody> </table>	Process	Arrival Time	CPU Time	P ₁	0	4	P ₂	1	7	P ₃	3	4	P ₄	6	5	6M	CO-1	BL-3 and 4
Process	Arrival Time	CPU Time																	
P ₁	0	4																	
P ₂	1	7																	
P ₃	3	4																	
P ₄	6	5																	

5

Consider four processes such as P_1 , P_2 , P_3 , and P_4 , which are to be scheduled in a uniprocessor system using a round-robin algorithm with two quantum times. The arrival time and the CPU burst time of these processes are given in the following table. Include process life cycle diagram to illustrate a detailed breakdown of the process transitions, highlighting how each process moves between states at each step of the scheduling. Also, illustrate the status of different queues at each transition point.

6M CO-I BL-4

Process	Arrival Time	CPU Time
P_1	0	3
P_2	1	1
P_3	3	3
P_4	4	3

***** ALL THE BEST *****

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

Mid Semester Exam, July- December 2024

Social and Professional Ethics (HS34151)

B. Tech. Sem. 3 (CSE)/ B.Tech. + M. Tech. DD (CS & DS) Sem. 3

Time: 2 hours

M.M. 30

Note: Answer the following questions in maximum 350- 400 words each. Each question carries equal marks.

1. Do you find this subject (Social and Professional Ethics) relevant for you? Justify your answer by indicating its relevance.
2. What is the difference between character and personality?
3. Differentiate between value and spirituality.

नोट: निम्नलिखित प्रत्येक प्रश्न का उत्तर अधिकतम 300-350 शब्दों में दें। प्रत्येक प्रश्न समान अंक का है।

1. क्या आपको यह विषय (सामाजिक और व्यावसायिक नैतिकता) आपके लिए प्रासंगिक लगता है? इसकी प्रासंगिकता बताकर अपने उत्तर की पुष्टि करें।
2. चरित्र और व्यक्तित्व में क्या अंतर है?
3. मूल्य और आध्यात्मिकता के बीच अंतर बताएं।



NATIONAL INSTITUTE OF TECHNOLOGY PATNA
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MID-SEMESTER EXAMINATION – OCTOBER, 2024
B. Tech CSE/ B.Tech-M.Tech-DD-CSE-CS/B.Tech-M.Tech-DD-CSE-DS
IIIrd Semester CS34104– Data Structures Max.Marks:30
Answer All questions

Q. No.	Question	Marks	CO	BL
1	<p>Note: Answer all parts of this question at the same place:</p> <p>a. Apply the master theorem for inferring the tight asymptotic bounds for the following two recurrences: i) $T(n) = 4T(n/2) + O(n)$ ii) $T(n) = 64 T(n/8) + \Theta(n^2)$ iii) $T(n) = T(n/2) + 1$</p> <p>b. Consider a multidimensional array $a[5][6][4]$, and its base address is 1064. Compute the address of $a[2][3][2]$ by assuming each element takes four bytes of memory.</p> <p>c. Consider that you have 32000 elements stored in an array in the ascending order. We want to apply a binary search to this data. Assume that the element we are trying to find is in the second half of the array, the lower index and higher index of the array are stored in integer variables, and the size of the integer variable is two bytes (it can store a maximum element of 32767). Can you identify the problem in finding the middle element position in this situation and figure out a solution to overcome this problem?</p> <p>d. Define Time Complexity and Big-Oh notations.</p>	3M 2M 3M 2M	CO6 CO1, CO4 CO2, CO3, CO4 CO5 CO1, CO6	Remember, Understand, Evaluate, Analyze, Understand, Remember Apply Analyze, Create Evaluate
2	<p>a. Given an array of elements, write the function/pseudo code/procedure for converting this array in the following order: $a < b > c < d > e < f \dots$ and so on (Here a, b, c, d, ... are the elements in the array). For example, if the given array is {3, 7, 1, 12, 2, 5, 23}, your function should output the following: {1, 3, 2, 5, 12, 7, 23}.</p> <p><i>Hint: Think about arranging and swapping elements</i></p> <p>b. Identify the kind of task performed by the following functions:</p> <p>i) <i>void Fun(List *L) // L holds the first node address in a singly linked list</i> $\{ List *t1, *t2; t1 = L;$ $if(t1) \{ while(t1->next) \{ t2 = t1->next; free(t1); t1 = L = t2; \} \}$</p> <p>ii) <i>void rearrange (List *L) // L is the first node address in a singly linked list</i> $\{ List *p, *q; int t;$ $if(!L !L->next) return;$ $p = L; q = L->next;$ $while (q)$ $\{ t = p->value; p-> value = q ->value; q-> value = t;$ $p = q-> next;$ $q = p ? p->next : NULL; \}$</p>	6M 4M	CO2, CO6 CO2, CO4	
3	Design a singly linked list-based ADT for storing polynomials, and your ADT should include the operations for creating a polynomial of the given degree, adding two given polynomials, multiplying two given polynomials, and displaying the specified polynomial. Also, develop the code for creating a polynomial (reading and storing polynomial) and multiplying the given two polynomials. (Suppose, the polynomial $p = (5x^3 + 6x + 3)$ and polynomial $q = (6x^2 + 6)$ then $p * q = (30x^5 + 66x^3 + 18x^2 + 36x + 18)$)	10M	CO1, CO2, CO3, CO4	Understand, Create

NATIONAL INSTITUTE OF TECHNOLOGY PATNA
 Department of Computer Science & Engineering
MID SEMESTER EXAMINATION, Oct. 2024

B. GTech. (UG)
Course Name: Database Management System
Maximum Time: 2 hours

Semester- 05
Code: CS34109
Max. Marks: 30

Instruction:

1. Attempt All questions.
2. You may answer the questions in any order. However, all parts of the same question must be answered together.
3. Assume any suitable data, if necessary. Clearly state any reasonable assumption you make.
4. The Marks, CO (Course Outcome), and BL (Bloom's Level) related to questions are on the right-hand margin.

		Mark s	CO	BL
1.	A university wants to effectively manage its data, ensuring data integrity, security, and flexibility while meeting the needs of various stakeholders like end users, software developers (frontend and backend, and database administrator), and the system administrators who are involved in managing the database server. Most important requirement is if any changes are made in the lower level that will not affect the design and performance of the upper level, that is all the users will be independent of each other. Suggest proper architecture for the database design. Justify your answer with a diagram.	10	CO 1	A
2.	A small public library wants to create a computerized system to manage its books, patrons, and borrowing activities. The goals are to maintain a record of each book, including title, author, ISBN, publication year, and availability status; Store information about patrons, such as name, address, contact details, and library card number; and keep a log of books borrowed and returned by patrons, including due dates and fines. A book can have many authors and an author can write many books. The library also has a policy that a book can be borrowed by a patron, and a patron can borrow a maximum of 3 books at a time. (i) Identify all the entities and their attributes, mark attribute types. (ii) Identify all the relationships and their type and degree. (iii) Carefully design the ER diagram to create a robust and efficient system to manage its resources and services.	2+3+ 5	CO2	C

3. A university assigns roll_numbers as a unique key to every newly admitted student, however each student carries many unique identities by which they can be uniquely identified.
- (i) Explain why the university assigned a new unique key?
 (ii) Identify the type of key "roll_number" is?
 (iii) Consider STUDENT(roll_number, first name, last name, address, date of birth, gender, emailID, phone), identify best possible superkey for STUDENT. List down all possible candidate keys for STUDENT.

3+2+ CO E
5 3,

****End of Questions****

Learning Outcomes:

- CO 1. define data independence, data models, schema, and database instances. Also, distinguish among different database models and their practical implications.
- CO 2. translate queries to Relational Algebra, Relational calculus and using Structure Query Language statements used in the creation and manipulation of database
- CO 3. identify the methodology of conceptual modelling through Entity Relationship
- CO 4. analyze and design an actual database application and develop and evaluate an actual database application
- CO 5. Describe basic database storage structures, access techniques, and transaction processing.

Level I	Bloom's Taxonomy
1	Remembering (R)
2	Understanding (U)
3	Applying (P)
4	Analyzing (A)
5	Evaluate (E)
6	Create (C)



राष्ट्रीय प्रौद्योगिकी संस्थान पटना

Mid-Semester Exam (Jul-Dec'24)

National Institute of Technology Patna

Session: 2023-24 Autumn'24 Semester

Department: Computer Science and Engineering

Programme: BTech(CSE-I,II,III), BTech(DD)(CSE-CS,DS)

Semester: 3rd

Course Code: CS34110

Course: Discrete Mathematics and Graph Theory

Full Marks: 30

Duration: 2 hours

[Attempt all questions; Answer concisely only in blue/black ink; Use pencil only for artwork;
Assume missing data; No mobile phones]

[Marks, Course Outcome and Bloom's Level are mentioned on right-hand side of each question]

Sl.	Questions	CO BL	
1. a.	What is the division rule of counting the number of ways to perform any event by a procedure, which comprises of just 1 task? (2) डिवीजन (विभाजन) रूल क्या हैं, जिसके जरिए किसी भी घटना को 1 टास्क (कार्य) से युक्त प्रोसीजर (प्रक्रिया) द्वारा निष्पादित करने के तरीकों की संख्या की काउंटिंग (गणना) करता हैं? [Course outcome evaluated: CO-1(Remember/Recall)]	CO-1	Level-1
b.	Is the set of all rational numbers between closed interval [0,1] countable, or uncountable? (4) क्या क्लोज्ड इंटर्वल [0,1] के बीच सभी रॅशनल (परिमेय) संख्याओं का सेट गणनीय हैं, या अगणनीय हैं? [Course outcome(s) evaluated: CO-4(Apply/Solve)]	CO-4	Level-3
c.	What are forward substitution and backward substitution techniques used to obtain closed formula of recursively defined sequence? (2) रिकर्सिवली डिफाइंड सीकेंस के क्लोज्ड फॉर्मूला प्राप्त करने के लिए उपयोग की जाने वाली फॉरवर्ड सब्स्टीट्यूशन (अग्र प्रतिस्थापन) और बैकवर्ड सब्स्टीट्यूशन (पश्च प्रतिस्थापन) तकनीकें क्या हैं? [Course outcome evaluated: CO-1(Remember/Recall)]	CO-1	Level-1
d.	For each $n \in \mathbb{N} \setminus \{0\}$, where $\mathbb{N} = \{0,1,2,3,\dots\}$ is the set of all natural numbers, let the set A_n be: $A_n = \{n, 2 \cdot n, 3 \cdot n, \dots\}$. Determine $\bigcup_{i \in P} A_i$, where $P = \{2,3,5,7,\dots\}$ is the set of all prime numbers. (2) प्रत्येक $n \in \mathbb{N} \setminus \{0\}$ के लिए, जहाँ $\mathbb{N} = \{0,1,2,3,\dots\}$ सभी प्राकृतिक संख्याओं का सेट हैं, मान लों सेट A_n इस प्रकार हैं: $A_n = \{n, 2 \cdot n, 3 \cdot n, \dots\}$ । निर्धारित करों $\bigcup_{i \in P} A_i$ क्या हैं, जहाँ $P = \{2,3,5,7,\dots\}$ सभी प्राइम (अभाज्य) संख्याओं का सेट हैं। [Course outcome(s) evaluated: CO-4(Apply/Solve)]	CO-4	Level-3
2. a.	Define a multiset, and write down two different representations of multiset (using roster notation). Also write down the union and intersection properties of two given multisets (using set-builder notation). (1+2+3) मल्टीसेट की परिभाषा लिखों, तथा मल्टीसेट के दो अलग-अलग रिप्रेजेन्टेशन लिखों (रोस्टर नोटेशन का उपयोग करके)। दो दिए गए मल्टीसेट के यूनियन और इंटरसेक्शन को भी लिखों (सेट-बिल्डर नोटेशन का उपयोग करके)। [Course outcome evaluated: CO-1(Remember/Recall)]	CO-1	Level-1
b.	Define composition of functions $f: A \rightarrow B$ and $g: B \rightarrow C$. What is the composition of $f: A \rightarrow B$ and its inverse f^{-1} ? Also, what is the	CO-1	Level-1

Sl.

Questions

COBL

2. b. composition of f^{-1} and f ? (2+1+1)
 फलन $f: A \rightarrow B$ और $g: B \rightarrow C$ के कॉम्पोज़िशन अपरेशन की परिभाषा लिखो। $f: A \rightarrow B$ और इसके इन्वर्स f^{-1} का कॉम्पोज़िशन क्या है? साथ ही, f^{-1} और f का कॉम्पोज़िशन क्या है?
 [Course outcome evaluated: CO-1(Remember/Recall)]
3. a. Explain that $\exists x(P(x) \vee Q(x))$ and $(\exists xP(x)) \vee (\exists xQ(x))$ are logically equivalent to each other, for any predicates $P(x)$ and $Q(x)$, and any domain of discourse \mathbb{D} . (Write proper reason for every step; do not use truth table for explanation.) (6)
 व्याख्या करों कि किसी भी प्रेडिकेट $P(x)$ और $Q(x)$ तथा किसी भी डोमेन \mathbb{D} में $\exists x(P(x) \vee Q(x))$ और $(\exists xP(x)) \vee (\exists xQ(x))$ लॉजिकाली इक्विवलेंट हैं। (प्रत्येक स्टेप के लिए उचित कारण लिखें; व्याख्या के लिए दृथ्यू टैबल का उपयोग माना है।)
 [Course outcome(s) evaluated: CO-2(Understand/Explain)]
- b. (i) For a set of n distinct elements, if the number of r -permutations $P(n, r) = 72$, determine n . ($r = 2$) (2)
 (ii) Determine the number of committees, consisting of a chairperson and 4 other members, that can be selected from 12 people. (2)
 (i) n अलग-अलग एलिमेंट का एक सेट के लिए, यदि r -परमुटेशन $P(n, r)$ की संख्या 72 है, तो n निर्धारित करो। ($r = 2$)
 (ii) समितियों की संख्या निर्धारित करों, जिसमें एक अध्यक्ष और 4 अन्य सदस्य शामिल हों, जिन्हें 12 व्यक्तियों में से चुना जा सकता है।
 [Course outcome(s) evaluated: CO-4(Apply/Solve)]

List of Course Outcomes of "Discrete Mathematics and Graph Theory": After completing this course, a student should be able to —

- CO-1. **recall** mathematical logic terminologies and principles, discrete structures terminologies and principles, counting principles, recurrence relation terminologies and principles, graph terminologies and principles, tree terminologies and principles, as well as graph coloring and covering principles;
 [Bloom level: Remember; Mapped to: PO-1]
- CO-2. **explain** concepts of logical equivalence, quantification, sum rule, product rule, inclusion-exclusion, pigeonhole, generating functions, graph connectedness, Euler trails and Hamilton paths, shortest path rule, tree traversal, spanning tree, graph planarity, coloring rule, covering and partitioning of graph;
 [Bloom level: Understand; Mapped to: PO-1, PO-2]
- CO-3. **represent** given instructions on contemporary scenarios through graphs and trees; [Bloom level: Understand; Mapped to: PO-1, PO-2]
- CO-4. **solve** problems on propositional and predicate logic, set properties and operations, relation properties and operations, function properties and operations, sequence properties and operations, product and sum rules, inclusion-exclusion principle, pigeonhole principle, permutations and combinations, recurrence relation properties, generating functions, graph isomorphism, graph traversal properties and principles, tree traversal properties and operations, planar graph properties and rules, coloring rules of graphs, graph covering and partitioning;
 [Bloom level: Apply; Mapped to: PO-1, PO-2, PO-3]
- CO-5. **use** graph and tree models, as well as planar representations and chromatic numbering of graphs to fulfil given objectives on contemporary network infrastructures;
 [Bloom level: Apply; Mapped to: PO-1, PO-2, PO-3]
- CO-6. **prove** by constructing argument form to establish given properties of specified discrete structures.
 [Bloom level: Analyze; Mapped to: PO-3, PO-5]

----- "BEST WISHES" -----

END

SEM |