



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

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

Department: CSE

Full Marks: 30

Semester: 3<sup>rd</sup>

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 (4M)[CO3][L5]

i. int a = -12;  
System.out.println(a>>2);  
ii. class Test1 {  
    static int x = 10;  
    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**  
**MID- SEMESTER EXAMINATION, OCTOBER 2023**

**Program: B.Tech. (CSE)**

**Department: CSE**

**Full Marks: 30**

**Semester: 3<sup>rd</sup>**

**Course Code: CS34111**

**Course Name: Operating Systems**

**Duration of Examination: 2 hours**

**INSTRUCTIONS**

- Assume Missing data if any
- Answer all the question
- SECTION I is common to CSE-I, CSE-II and CSE-III students
- SECTION II is to be attempted by CSE-I and CSE-II Students
- SECTION III is to be attempted only by CSE-III students
- Students are requested to write the Section they belong on top of the first page of the answer script.

**SECTION I**

| S.No. | QUESTION  | CO   | BL | Marks |
|-------|---|------|----|-------|
| 1.    | A system is having 3 user processes P1, P2 and P3 where P1 requires 21 units of resource R, P2 requires 31 units of resource R, P3 requires 41 units of resource R. The minimum number of units of R that ensures no deadlock is _____?   | CO-2 | 2  | 2     |
| 2.    | A process using a semaphore has a start value of 1 for its semaphore. Since the start of execution of the program, 12 signal operations were completed. How many wait operations have been completed so far if the current value of semaphore is 6?   | CO-2 | 2  | 2     |
| 3.    | Each process $P_i$ , $i = 1, 2, \dots, 9$ is coded as follows. Let the initial value of mutex=1;<br><br>repeat<br>wait(mutex)<br>{<br>Critical Section<br>}<br>signal(mutex)<br>forever<br><br>The code for $P_{10}$ is identical except that it uses signal(mutex) in place of wait(mutex). What is the largest number of processes that can be inside the critical section at any moment? | CO-2 | 4  | 4     |
| 4.    | A single processor system has three resource types X, Y and Z, which are shared by three processes. There are 5 units of each resource type. Consider the following scenario, where the column alloc denotes the number of units of each resource type allocated to each process, and the column request denotes the number of units of each resource type requested by a process in        | CO-2 | 4  | 5     |

## SECTION II

| S.No. | QUESTION  | CO   | BL | Marks |
|-------|---|------|----|-------|
| 1.    | Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. Perform the allocation of processes using- First Fit Algorithm, Best Fit Algorithm and Worst Fit Algorithm. | CO-3 | 3  | 3     |
| 2.    | Consider a single level paging scheme. The virtual address space is 16 GB and page table entry size is 4 bytes. What is the minimum page size possible such that the entire page table fits well in one page?   | CO-3 | 4  | 5     |

## SECTION III

| S.No. | QUESTION   | CO   | BL | Marks |
|-------|--|------|----|-------|
| 1.    | <p>1. What will be values printed by parent process and child process?</p> <pre>a=10; if (fork() == 0) {     a = a + 5;     printf("%d", a); } else {     a = a - 5;     printf("%d", a); }</pre>  | CO-1 | 2  | (2+2) |
| 2.    | <p>Achieve bounded waiting using TestAndSet function using hardware atomic function to solve critical section problem. Some part of the code for process <math>P_i</math> is shown where shared resource is used. Fill in the four blanks to complete the code.</p> <pre>/* Shared variables lock and waiting[n] vector initialized to false and individual variable key initialized to false */</pre> | CO-2 | 3  | 4     |

```
boolean lock;  
boolean waiting[n];  
boolean key;
```

```
while(1){
```

```
    waiting[i] = true;  
    key = true;  
    while(_____ && _____)  
        key = TestAndSet(lock);  
        waiting[i] = false;
```

### **critical section**

```
    j = (i+1)%n;  
    while(_____ && _____)  
        j = (j+1) % n;  
        if(j == i)  
            lock = false;  
        else  
            waiting[j] = false;
```

### **remainder section**

```
}
```

**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, 3<sup>rd</sup>**  
**Semester**

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

**Answer All questions**

| Q.<br>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<br><br>2M | CO-I<br><br>CO-I | BL-1 and 2<br><br>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<br><br>3M  | CO-I<br><br>CO-I | BL-4<br><br>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: left; padding: 2px;">Process</th> <th style="text-align: left; padding: 2px;">Arrival Time</th> <th style="text-align: left; padding: 2px;">CPU Time</th> <th style="text-align: left; padding: 2px;">BT</th> </tr> </thead> <tbody> <tr> <td style="text-align: left; padding: 2px;">P<sub>1</sub></td> <td style="text-align: left; padding: 2px;">0</td> <td style="text-align: left; padding: 2px;">3</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>2</sub></td> <td style="text-align: left; padding: 2px;">1</td> <td style="text-align: left; padding: 2px;">1</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>3</sub></td> <td style="text-align: left; padding: 2px;">3</td> <td style="text-align: left; padding: 2px;">3</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>4</sub></td> <td style="text-align: left; padding: 2px;">4</td> <td style="text-align: left; padding: 2px;">X</td> <td style="text-align: left; padding: 2px;"> </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               | BT | P <sub>1</sub> | 0 | 3 |  | P <sub>2</sub> | 1 | 1 |  | P <sub>3</sub> | 3 | 3 |  | P <sub>4</sub> | 4 | X |  | 6M | CO-I | BL-2 and 3 |
| Process        | Arrival Time   | CPU Time      | BT               |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>1</sub> | 0  | 3             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>2</sub> | 1  | 1             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>3</sub> | 3  | 3             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>4</sub> | 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: left; padding: 2px;">Process</th> <th style="text-align: left; padding: 2px;">Arrival Time</th> <th style="text-align: left; padding: 2px;">CPU Time</th> <th style="text-align: left; padding: 2px;">BT</th> </tr> </thead> <tbody> <tr> <td style="text-align: left; padding: 2px;">P<sub>1</sub></td> <td style="text-align: left; padding: 2px;">0</td> <td style="text-align: left; padding: 2px;">4</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>2</sub></td> <td style="text-align: left; padding: 2px;">1</td> <td style="text-align: left; padding: 2px;">7</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>3</sub></td> <td style="text-align: left; padding: 2px;">3</td> <td style="text-align: left; padding: 2px;">4</td> <td style="text-align: left; padding: 2px;"> </td> </tr> <tr> <td style="text-align: left; padding: 2px;">P<sub>4</sub></td> <td style="text-align: left; padding: 2px;">6</td> <td style="text-align: left; padding: 2px;">5</td> <td style="text-align: left; padding: 2px;"> </td> </tr> </tbody> </table>  | Process       | Arrival Time     | CPU Time               | BT | P <sub>1</sub> | 0 | 4 |  | P <sub>2</sub> | 1 | 7 |  | P <sub>3</sub> | 3 | 4 |  | P <sub>4</sub> | 6 | 5 |  | 6M | CO-I | BL-3 and 4 |
| Process        | Arrival Time   | CPU Time      | BT               |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>1</sub> | 0  | 4             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>2</sub> | 1  | 7             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>3</sub> | 3  | 4             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |
| P <sub>4</sub> | 6  | 5             |                  |                        |    |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |    |      |            |

GANTT CHART

P<sub>1</sub> P<sub>3</sub> |

5

| 5              | Consider four processes such as P <sub>1</sub> , P <sub>2</sub> , P <sub>3</sub> , and P <sub>4</sub> , 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     |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |
|----------------|--|----------|--------------|----------|--|----------------|---|---|--|----------------|---|---|--|----------------|---|---|--|----------------|---|---|--|--|--|--|
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| Process        | Arrival Time   | CPU Time |              |          |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |
| P <sub>1</sub> | 0  | 3        |              |          |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |
| P <sub>2</sub> | 1  | 1        |              |          |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |
| P <sub>3</sub> | 3  | 3        |              |          |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |
| P <sub>4</sub> | 4  | 3        |              |          |  |                |   |   |  |                |   |   |  |                |   |   |  |                |   |   |  |  |  |  |

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

**NATIONAL INSTITUTE OF TECHNOLOGY PATNA**

**Mid Semester Exam, July- December 2023**

**Social and Professional Ethics (HS34151)**

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

**M.M. 30**

**Time: 2 hours**

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

1. Discuss the role of this subject (SPE) for you in your life.
2. What is personality? How can we improve our personality?
3. Differentiate between professional ethics and social ethics?

**नोट:** निम्नलिखित प्रत्येक प्रश्न का उत्तर अधिकतम 350-400 शब्दों में दें।  
प्रत्येक प्रश्न समान अंक का है।

1. अपने जीवन में इस विषय (एसपीई) की भूमिका पर चर्चा करें।
2. व्यक्तित्व क्या है? हम अपने व्यक्तित्व को कैसे सुधार सकते हैं?
3. पेशेवर नैतिकता और सामाजिक नैतिकता के बीच अंतर बताएं?

**NATIONAL INSTITUTE OF TECHNOLOGY PATNA**  
**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**  
**MID-SEMESTER EXAMINATION - OCTOBER, 2023**  
**B. Tech (Computer Science & Engineering) III<sup>rd</sup> Semester (SECTION – A, B, and C)**  
**CS3401/ CS34104– Data Structures Max.Marks:30**

**Instruction:**

1. Answer all parts of questions at the same place.
2. Answer all questions.
3. The Marks, CO (Course Outcome) and BL (Bloom's Level) related to questions are mentioned on the right-hand side margin.

| Q. No. | Question   | Marks          | CO                   | BL  |
|--------|--|----------------|----------------------|---|
|        |  |                |                      |   |
| 1      | <p>a. Define data structure and discuss about the different types of data structures with the proper examples.</p> <p>b. Consider an empty stack that is used to store integers. Let the numbers 1, 2, 3, 4, 5, and 6 be pushed into this stack in the order they appear from left to right. Let P indicate a push operation and Z indicate a pop operation. What is the output (the collection of pop operations) generated for the following permutation with six push operations (P) and six pop operations (Z)?</p> <p style="text-align: center;"><math>\begin{matrix} 6 &amp; 5 &amp; 4 &amp; 3 &amp; 2 &amp; 1 \end{matrix}</math></p> <p>P P P Z Z P Z P P Z Z Z</p> <p>c. Find the time complexity for the following code snippet</p> <pre>for(i=1; i&lt;=n; i++) {for(j=1; j&lt;=n; j=j*2) { a = 1; }}</pre> | 2M<br>2M<br>2M | CO-1<br>CO-2<br>CO-1 | Understand & Apply<br>Evaluate & Analyze<br>Analyze |
| 2      | <p>a. Mention any two limitations of arrays. Write the time complexities for the following operations in Big-Oh notation.</p> <ol style="list-style-type: none"> <li>i. Searching an element in an unsorted array (Array contains <math>n</math> elements).</li> <li>ii. Removing all the duplicate elements in the array (Array contains <math>n</math> elements).</li> <li>iii. Merging two sorted lists and storing them in another array (The first array contains <math>m</math> elements; the second array contains <math>n</math> elements).</li> </ol> <p>b. Sort the following elements using bubble sort and show the output after every step: 23, 12, 34, 65, 21, 76, 35, 19</p>  | 3M<br>3M       | CO-1 & CO-2<br>CO-4  | Understand & Remember<br>& Apply                    |
| 3      | Convert the below given Infix expression to Postfix expression using STACK and show the details of STACK at each step of conversion, and also show how to evaluate the converted postfix expression using STACK.<br><br>Expression: $(1 + 3 * 4 ^ 2) * (6 + 10 / 5)$ .   | 6M             | CO-2                 | Understand & Apply                                  |
| 4      | Write a program which takes a SLL 'S' as input and move all even positioned nodes of S to the end of S. While moving nodes, keep the relative order of all even positioned and odd positioned nodes same. For example, if the given list is $a \rightarrow b \rightarrow c \rightarrow 3 \rightarrow d \rightarrow 4$ , then your program should convert it to $a \rightarrow b \rightarrow c \rightarrow d \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4$ . (Assume a, b, c, ..., 1, 2, 3, ... are all addresses of the nodes)  | 6M             | CO-2                 | Understand & Apply                                  |
| 5      | <p>a. Given two singly linked lists <math>L_1</math> and <math>L_2</math>. Both <math>L_1</math> and <math>L_2</math> stores integers and are in the sorted order. Write a pseudo code/ algorithm which takes these linked lists as an input and creates a new sorted singly linked list <math>L_3</math>, which is the result of the merging of these two sorted lists <math>L_1</math> and <math>L_2</math>.</p> <p>b. Represent the following sparse matrix of size (4 x 5) in the triplet form using the data structure array.</p>   | 4M<br>2M       | CO-2<br>CO-4         | Create & Apply                                      |
|        | $\begin{matrix} 0 & 0 & 1 & 0 & 2 \\ 4 & 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 9 & 6 \end{matrix}$   |                |                      |   |



राष्ट्रीय प्रौद्योगिकी संस्थान पटना

National Institute of Technology Patna

Mid Semester Examination (Jul-Dec'23)

Session: 2023-24 Autumn'23 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

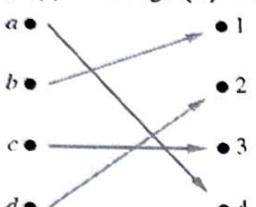
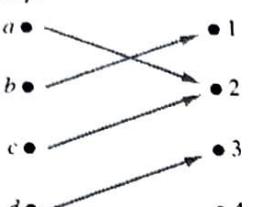
Full Marks: 30

Duration: 2 hours

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

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

| SI | Questions (Symbols have their usual meaning)   | CO                   | BL                            |
|----|--|----------------------|-------------------------------|
| 1. | <p>a. What is the product rule of counting the number of ways to perform any event by a procedure, which comprises of <math>m</math> separate tasks? (2)<br/>प्रॉडक्ट रूल क्या है, जिसके जरिए किसी भी घटना को <math>m</math> अलग-अलग टास्क्स (कार्यों) से युक्त प्रोसेजर (प्रक्रिया) द्वारा निष्पादित करने के तरीकों की संख्या की काउंटिंग (गणना) करता है?<br/>[Course outcome evaluated: CO-1(Remember/Recall)]</p> <p>b. In an auditorium of 1000 people, some of them celebrate their birthday on same day. Answer the following questions using the generalized pigeonhole principle, considering 366 birthdays per year.</p> <p>(i) At least how many of them share a birthday? (2)<br/>(ii) How many pigeons and pigeonholes are involved in solving the above problem? (1+1=2)<br/>एक सभागार में 1000 लोग हैं, और उनमें से कुछ लोगों का जन्मदिन एक ही दिन है। जनरलाईज़ड पिजनहोल प्रिसिपल (सिद्धांत) का प्रयोग करके निम्नलिखित प्रश्नों के उत्तर दीजिए। मान लें कि प्रति वर्ष 366 जन्मदिन होते हैं।<br/>(i) 1000 में से कम से कम कितने लोगों का जन्मदिन एक ही होगा?<br/>(ii) उपरोक्त प्रश्न को समाधान करने में कितने पिजनों (pigeons) और पिजनहोलों (pigeonholes) का उपयोग किया गया है?<br/>[Course outcome(s) evaluated: CO-4(Apply/Solve)]</p> <p>c. (i) How many permutations of the letters A, B, C, D, E, F, G contain the string BCD together? (2)<br/>(ii) How many different ways are there to purchase 10 mangoes from a vendor selling 4 varieties of mangoes? Assume enough mangoes of each variety are available. (2)<br/>(i) A,B,C,D,E,F,G अक्षरों के कितने परमुटेशन्स हैं जिनमें स्ट्रिंग BCD एक साथ होती है?<br/>(ii) 4 प्रकार के आम बेचने वाले विक्रेता से 10 आम खरीदने के कितने अलग-अलग तरीके हैं?<br/>मान लें कि प्रत्येक प्रकार के आम पर्याप्त मात्रा में उपलब्ध हैं।<br/>[Course outcome(s) evaluated: CO-4(Apply/Solve)]</p> | CO-1<br>CO-4<br>CO-4 | Level-1<br>Level-3<br>Level-3 |
| 2. | <p>a. Explain briefly. [संक्षेप में व्याख्या कीजिए]</p> <p>b. Consider any two sets A and B, and the universal set <math>U</math>. If <math>(A \cup B) \subseteq (A \cap B)</math>, explain how can you conclude that <math>A = B</math>? (5)</p>  | CO-2                 | Level-2                       |

|    |  |                 |   |
|----|--|-----------------|---|
| Sl | Questions (Symbols have their usual meaning)   | CO BL           |   |
| 2. | a. मान लो कोई भी दो सेट्स A और B, तथा यूनिवर्सल सेट U। यदि $(A \cup B) \subseteq (A \cap B)$ है, समझाएं कि आप यह कैसे कंकलूड कर सकते हैं कि $A = B$ ?<br>[Course outcome evaluated: CO-2(Understand/Explain)]  | CO-2<br>Level-2 | 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 portioning of graph;<br>[Bloom level: Understand; Mapped to: PO-1, PO-2]  |
|    | b. Consider two functions $f:A \rightarrow B$ and $g:A \rightarrow B$ , where $A = \{a, b, c, d\}$ and $B = \{1, 2, 3, 4\}$ . The element-wise mapping of f and g from A to B are shown in Fig. (i) and Fig. (ii) respectively.  |                 | CO-3. represent given instructions on contemporary scenarios through graphs and trees;<br>[Bloom level: Understand; Mapped to: PO-1, PO-2]  |
|    | <br>Fig. (i): $f: A \rightarrow B$ .  | CO-2<br>Level-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;<br>[Bloom level: Apply; Mapped to: PO-1, PO-2, PO-3] |
|    | <br>Fig. (ii): $g: A \rightarrow B$ .   |                 | CO-5. use graph and tree models, as well as planar representations and chromatic numbering of graphs to fulfill given objectives on contemporary network infrastructures;<br>[Bloom level: Apply; Mapped to: PO-1, PO-2, PO-3]  |
|    | Explain the nature of correspondences present in both $f:A \rightarrow B$ and $g:A \rightarrow B$ .<br>( $2\frac{1}{2} + 2\frac{1}{2} = 5$ )   |                 | CO-6. prove by constructing argument form to establish given properties of specified discrete structures.<br>[Bloom level: Analyze; Mapped to: PO-3, PO-5]  |
| 3. | a. For propositions $p, q, r, s$ , show that $\neg p \rightarrow (q \rightarrow r)$ and $q \rightarrow (p \vee r)$ are logically equivalent. (Show proper reason for every step.) (2)<br>प्रैपोज़िशन्स $p, q, r, s$ के लिए दिखाएँ कि $\neg p \rightarrow (q \rightarrow r)$ और $q \rightarrow (p \vee r)$ लॉजिकाली इकुईवलेंट (तार्किक रूप से समतुल्य) हैं। (प्रत्येक स्टेप के लिए उचित कारण बताएं।)<br>[Course outcome evaluated: CO-4(Apply/Solve)] |                 |   |
|    | b. Show whether the following quantifiers are logically equivalent or not. (Show proper reason for every step.) (3)<br>$\neg \exists x(Q(x) \wedge R(x)) \quad \forall x(Q(x) \rightarrow \neg R(x))$<br>दिखाएँ कि ऊपरोक्त कांटिफ़ायरस लॉजिकाली इकुईवलेंट (तार्किक रूप से समतुल्य) हैं या नहीं। (प्रत्येक स्टेप के लिए उचित कारण बताएं।)<br>[Course outcome(s) evaluated: CO-4(Apply/Solve)]   | CO-4<br>Level-3 |   |
|    | c. Consider the following linear recurrence: $a_n = 5a_{n-1} - 6a_{n-2} + 7^n$ . Find all solutions of the given recurrence. (Note: no initial conditions are given.) (5)<br>निम्नलिखित तीनियर रेकरेंस (पुनरावृत्ति) दिया हुआ है: $a_n = 5a_{n-1} - 6a_{n-2} + 7^n$ । दी गई रेकरेंस के सभी समाधान ढूँढ़िए। (ध्यान दें: कोई प्रारंभिक शर्त नहीं दी गई है।)<br>[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 portioning 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 fulfill 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 OF LUCK" -----



NATIONAL INSTITUTE OF TECHNOLOGY PATNA  
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING  
MID-SEMESTER EXAMINATION, OCTOBER 2023  
**BTech: 3<sup>rd</sup> Semester (CSUG-1, CSUG-2, CSUG-3, CSDD, ECE)**  
**Course Name: Database Management Systems**  
**Maximum Time: 2 hours**

**Course Code: CS34109/CS5401**  
**Maximum Marks: 30**

Answer all questions & sub-questions must be answered sequentially in one place

| Q.No. | Question  | Marks  | CO         |
|-------|---|--------|------------|
| 1     | <p>a. Explain the difference between two-tier and three-tier application architectures. Which is better suited for web applications? Why?</p> <p>b. Describe the following with a suitable example.</p> <ol style="list-style-type: none"><li>Generalization and Specialization.</li><li>Attributes (Simple, Composite, Single-valued, Multi-valued, and Derived)</li></ol>   | 4<br>6 | CO1<br>CO2 |
| 2     | <p>An insurance company in Patna named LVInsurance insured life and vehicles. They are interested in hiring a person who designs a database related to the collected information such as Every insurance company has its own policies. A Policy has policy_number, term_price, life_policy, we have its ID, value, minimum age and maximum age. For vehicle_policy, we have or more vehicles/life and associated premium payments. Each payment has its id, due date, vehicle has its vnumber, plate, registered state, colour, year and model. For motorcycles, we should keep track of their weight, and types. We need car type, transmission type (automatic, manual), and size for cars. For each customer, we have his/her cust_id, driving id, name, telephone and address. When a vehicle accident happens, a report should be prepared including report number, date, location, and damage cost. Accidents are also associated with a customer, so the report should mention driving licenses.</p> <ol style="list-style-type: none"><li>Construct an EER diagram for the above descriptions. Make sure to indicate primary keys, cardinality constraints, weak entities (if any), and participation constraints. Make any assumptions if you want to make in the process but with an explanation.</li><li>Map the EER diagram into relational database tables (i.e., give only the SQL DDL statements). Make sure that the translation captures key constraints (primary keys and foreign keys if applicable) and participation constraints in the EER diagram.</li></ol> | 5<br>5 | CO2        |
| 3     | <p>Write down relational algebra and SQL of the following queries considering the relational database which is given below:</p> <p><b>Person (driver_id, name, address),</b><br/><b>Car (license, model, year)</b><br/><b>Accident (report_no, date, location),</b><br/><b>Owns (driver_id, license)</b>,<br/><b>Participated (report_no, license, driver_id, damage_amount)</b></p> <ol style="list-style-type: none"><li>Retrieve the name, and address of all persons who have a BMW car and have reported an accident at Patna.</li><li>Retrieve the damage amount and license number of the driver of the Wagonar car of the 2019 model which was reported accident on 5-JUNE-2023 at Kolkata.</li><li>Retrieve the name and address of all the persons who have not reported any accident.</li><li>Retrieve the name, and address of the person who reported the maximum damage amount on 5-MAY-2023.</li><li>Retrieve the name of the person who has all categories of car.</li></ol>  | 10     | CO3        |

*Wish you all the best*



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

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

| CO<br>BL | Questions  |                 |
|----------|--|-----------------|
| SI.      | <p>1. Write a Java program to create a class "BankAccount" with details like account_holder_name of type String, account_number of type long and balance of type int. The class BankAccount has two methods for showing the account details, as well as for deposit and withdrawal of money. Create another class Demo to show the functionality of the BankAccount class by creating two separate account holder objects of class BankAccount. (6)</p> <p>एक क्लॉस "बैंकअकाउंट" ("BankAccount") बनाने के लिए एक Java प्रोग्रेम लिखों, जिसमें स्ट्रिंग (String) टाइप के अकाउंट_होल्डर_नाम (account_holder_name), लॉन्ग (long) टाइप के अकाउंट_नंबर (account_number) और इंट (int) टाइप के बैलेंस (balance) इंस्टेंस वेरिएबल शामिल हों। क्लॉस बैंकअकाउंट (BankAccount) में खाता विवरण दिखाने, और पैसे जमा करने और निकालने के लिए दो मेथड्स हैं। क्लॉस बैंकअकाउंट (BankAccount) के दो अलग-अलग खाताधारक ऑब्जेक्ट बनाकर बैंकअकाउंट (BankAccount) की कार्यक्षमता दिखाने के लिए एक और क्लॉस डेमो (Demo) बनाएं।</p> <p>[Course outcome(s) evaluated: CO-5(Apply/Use)]</p>   | Level-3         |
| (2)      | <p>Write a Java program to create a class "Book" having two instance variables no_of_pages and price of type int. Create an array of objects that is referring 500 Book objects. Initially when a Book object is created, set the value of no_of_pages as three and price as five. Write a method countObject() of return type int, that returns the total number of Book objects created in the program. Write another method combineBook(Book b) of return type Book, that adds two Book objects, i.e. it adds the price and no_of_pages. Create another Demo class that demonstrates the above said functionalities. (9)</p> <p>एक क्लॉस "बुक" ("Book") बनाने के लिए एक Java प्रोग्रेम लिखों, जिसमें दो इंट (int) टाइप के इंस्टेंस वेरिएबल नो_ऑफ_पेज (no_of_pages) और मूल्य (price) हों। ऑब्जेक्ट्स की एक अर्द्ध (सरणी) बनाएं जो 500 बुक (Book) ऑब्जेक्ट्स की ओर इशारा कर रही हों। प्रारंभ में जब कोई बुक (Book) ऑब्जेक्ट बनाओगे, तो नो_ऑफ_पेज (no_of_pages) का मान तीन और मूल्य (price) का मान पांच निर्धारित करों। रिटर्न टाइप इंट (int) की एक मेथड countObject () लिखों, जो प्रोग्रेम में बनाई गई बुक (Book) ऑब्जेक्ट्स की कुल संख्या लौटाती है। रिटर्न टाइप</p> | CO-5<br>Level-3 |

| Questions  |   |                 |      |                 |       |
|--|---|-----------------|------|-----------------|-------|
| SI.  | CO-BL   | CO-5            | CO-3 | CO-2            | CO-BL |
| 2.   | बुक (Book) की एक और मेथड combineBook(Book b) लिखो, जो दो बुक (Book) ऑब्जेक्ट्स जोड़ती हैं। यानी यह मूल्य (price) और नो ऑफ पेज (no of pages) जोड़ती है। एक और डेमो (Demo) क्लॉस बनाओ जो उपरोक्त कार्यात्मकताओं को प्रदर्शित करता हो।<br>[Course outcome(s) evaluated: CO-5(Apply/Use)]   |                 |      |                 |       |
| 3.   | Check whether the following programs are correct or not. If not, identify the error(s) in 2-3 sentences.<br><br>a. class Books {<br>String title;<br>String author;<br>}<br><br>class BooksTestDrive {<br>public static void main(String[] args) {<br>Books[] myBooks = new Books[3];<br>int x = 0;<br>myBooks[0].title = "The Grapes of Java";<br>myBooks[1].title = "The Java Gatsby";<br>myBooks[2].title = "The Java Cookbook";<br>myBooks[0].author = "bob";<br>myBooks[1].author = "sue";<br>myBooks[2].author = "ian";<br>while (x < 3) {<br>System.out.print(myBooks[x].title);<br>System.out.print(" by ");<br>System.out.println(myBooks[x].author);<br>x = x + 1;<br>}<br>}<br>}   | CO-4<br>Level-3 |      |                 |       |
| b. class Hobbits {<br>String name;<br>public static void main(String[] args) {<br>Hobbits[] h = new Hobbits[3];<br>int z = 0;<br>while (z < 4) {<br>z = z + 1;<br>h[z] = new Hobbits();<br>h[z].name = "bilbo";<br>if (z == 1) {<br>h[z].name = "frodo";<br>}<br>if (z == 2) {<br>h[z].name = "sam";<br>}<br>System.out.print(h[z].name + " is a ");<br>System.out.println("good Hobbit name");<br>}<br>}<br>} |   | CO-4<br>Level-3 |      |                 |       |
|  | जांचों कि क्या उपरोक्त प्रोग्रेम सही हैं या नहीं। यदि नहीं हैं, तो 2-3 वाक्यों में एरोर(एरोर) को पहचान करो।<br>[Course outcome(s) evaluated: CO-4(Apply/Solve)]   |                 |      |                 |       |
| a.   | What is the purpose of 'call by reference' in passing argument to a method in Java?<br><br>Java के मेथड में आर्गमेंट को पारित करने के लिए 'कॉल बाई रेफरेंस' का उद्देश्य क्या है?<br>[Course outcome(s) evaluated: CO-1(Remember/Recall)]  | CO-1<br>Level-1 |      |                 |       |
| SI.  | 4. b. Explain in 2-3 sentences the output of the following program.<br><br>public class Demo {<br>public static void increment(int x) {<br>x=x+1;<br>}<br>public static void main(String[] args) {<br>int x = 0;<br>while(x<5) {<br>increment(x);<br>System.out.println(x);<br>}<br>}<br>}  |                 |      | CO-3<br>Level-2 | (3)   |
|  | ऊपर दिया गया प्रोग्रेम के आउटपुट 2-3 वाक्यों में व्याख्या करो।<br>[Course outcome evaluated: CO-3(Understand/Explain)]  |                 |      |                 |       |
| c.   | Consider the following two recursive methods.<br><br>public int f(int x) {<br>if (x == 1)<br>return 1;<br>else<br>return x * f(x-1);<br>}<br><br>public int g(int x) {<br>if (x == 0)<br>return 0;<br>else<br>return f(x) + g(x-1);<br>}<br><br>Explain in 2-3 sentences why the output of g(4) is 33.<br>मान लों उपरोक्त दो रिकर्सिव (पुनरावर्ती) मेथड्स दिया गया हैं। 2-3 वाक्यों में व्याख्या करो कि g(4) का आउटपुट 33 क्यों है।<br>[Course outcome evaluated: CO-3(Understand/Explain)]   |                 |      | CO-3<br>Level-2 | (3)   |
|  | List of Course Outcomes of "Object Oriented Programming": After completing this course, a student should be able to —<br>CO-1. recall object oriented programming terminologies and principles, as well as fundamental concepts and programming practices of object oriented programming platforms;<br>[Bloom level: Remember; Mapped to: PO-1]<br>CO-2. recognise object oriented programming structures for building multidimensional data arrays, inherited and polymorphic data structures, exception handlers, input/output handlers, multithreading;<br>[Bloom level: Remember; Mapped to: PO-1]<br>CO-3. explain concepts of object orientation, arrays, control blocks, looping, nesting, access modifiers, overloading, inheritance, polymorphism, overriding, dynamic method lookup and dispatch, abstract classes, interfaces, packages, checked and unchecked exceptions, chained exceptions, input/output streams, multithreading;<br>[Bloom level: Understand; Mapped to: PO-1, PO-2]<br>CO-4. solve problems on selections, iterations, arrays, objects, classes, fields, methods, access modifiers, object passing and return, overloading, boxing, wrapper class, objects of arrays, string handling, overriding, inheritance hierarchy, abstract class, upcasting, downcasting, association, composition, compile-time polymorphism, runtime polymorphism, dynamic method dispatch, interface implementation, class nesting, try-catch, throwing, rethrowing, byte streams, character streams, multithreading;<br>[Bloom level: Apply; Mapped to: PO-1, PO-2, PO-3] |                 |      |                 |       |



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.  | <p>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)<br/>डिवीजन (विभाजन) रूल क्या है, जिसके जरिए किसी भी घटना को 1 टास्क (कार्य) से युक्त प्रोसीजर (प्रक्रिया) द्वारा निष्पादित करने के तरीकों की संख्या की काउंटिंग (गणना) करता है?<br/>[Course outcome evaluated: CO-1(Remember/Recall)]</p> <p>b. Is the set of all rational numbers between closed interval [0,1] countable, or uncountable? (4)<br/>क्या क्लोज्ड इंटरवल [0,1] के बीच सभी रैशनल (परिमेय) संख्याओं का सेट गणनीय है, या अगणनीय है?<br/>[Course outcome(s) evaluated: CO-4(Apply/Solve)]</p> <p>c. What are forward substitution and backward substitution techniques used to obtain closed formula of recursively defined sequence? (2)<br/>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?<br/>[Course outcome evaluated: CO-1(Remember/Recall)]</p> <p>d. For each <math>n \in \mathbb{N} \setminus \{0\}</math>, where <math>\mathbb{N} = \{0, 1, 2, 3, \dots\}</math> is the set of all natural numbers, let the set <math>A_n</math> be: <math>A_n = \{n, 2 \cdot n, 3 \cdot n, \dots\}</math>. Determine <math>\bigcup_{l \in P} A_l</math>, where <math>P = \{2, 3, 5, 7, \dots\}</math> is the set of all prime numbers. (2)<br/>प्रत्येक <math>n \in \mathbb{N} \setminus \{0\}</math> के लिए, जहाँ <math>\mathbb{N} = \{0, 1, 2, 3, \dots\}</math> सभी प्राकृतिक संख्याओं का सेट है, मान लो सेट <math>A_n</math> इस प्रकार है: <math>A_n = \{n, 2 \cdot n, 3 \cdot n, \dots\}</math>। निर्धारित करों <math>\bigcup_{l \in P} A_l</math> क्या है, जहाँ <math>P = \{2, 3, 5, 7, \dots\}</math> सभी प्राइम (अभाज्य) संख्याओं का सेट है।<br/>[Course outcome(s) evaluated: CO-4(Apply/Solve)] , element as repeated may have</p> | CO-1<br>Level-1 |
| 2.  | <p>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)<br/>मल्टीसेट की परिभाषा लिखें, तथा मल्टीसेट के दो अलग-अलग रिप्रेजेन्टेशन लिखें (रोस्टर नोटेशन का उपयोग करके)। दो दिए गए मल्टीसेट के यूनियन और इंटरसेक्शन को भी लिखें (सेट-बिल्डर नोटेशन का उपयोग करके)।</p> <p>[Course outcome evaluated: CO-1(Remember/Recall)]</p> <p>b. Define composition of functions <math>f: A \rightarrow B</math> and <math>g: B \rightarrow C</math>. What is the composition of <math>f: A \rightarrow B</math> and its inverse <math>f^{-1}</math>? Also, what is the</p>   | CO-1<br>Level-1 |

## Questions

- Sl. No. (2+1+1)
2. b. composition of  $f^{-1}$  and  $f$ ?  
 फ़ंक्शन  $f: A \rightarrow B$  और  $g: B \rightarrow C$  के कॉम्पोज़िशन ऑपरेशन 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  $D$ . (Write proper reason for every step; do not use truth table for explanation.) (6)  
 व्याख्या करो कि किसी भी प्रेडिकेट  $P(x)$  और  $Q(x)$  तथा किसी भी डोमेन  $D$  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 लिखो; व्याख्या के लिए दृथ 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 करो, 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 fulfill 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" -----

**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? *धृति*
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**  
**III<sup>rd</sup> Semester      CS34104– Data Structures      Max.Marks:30**  
**Answer All questions**

| Q.<br>No. | Question   | Marks                | CO  | BL   |
|-----------|--|----------------------|---|--|
| 1         | <p><b>Note: Answer all parts of this question at the same place:</b></p> <p>a. Apply the master theorem for inferring the tight asymptotic bounds for the following two recurrences:<br/>           i) <math>T(n) = 4T(n/2) + O(n)</math> ii) <math>T(n) = 64 T(n/8) + \Theta(n^2)</math> iii) <math>T(n) = T(n/2) + 1</math></p> <p>b. Consider a multidimensional array <math>a[5][6][4]</math>, and its base address is 1064. Compute the address of <math>a[2][3][2]</math> 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> <p style="text-align: center;"><i>↳ no. of times loop branches</i></p> | 3M<br>2M<br>3M<br>2M | CO6<br>CO1, CO4<br>CO2, CO3, CO4, CO5<br>CO1, CO6 | Remember, Understand, Evaluate<br>Understand, Evaluate, Analyze<br>Understand, Evaluate, Analyze<br>Remember, Apply, Analyze, Create |
| 2         | <p>a. Given an array of elements, write the function/pseudo code/procedure for converting this array in the following order: <math>a &lt; b &gt; c &lt; d &gt; e &lt; f \dots</math> 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><br/> <i>{ List *t1, *t2; t1 = L;</i><br/> <i>    if(t1) { while(t1-&gt;next) { t2 = t1-&gt;next; free(t1); t1 = L = t2; } }</i></p> <p>ii) <i>void rearrange (List *L) // L is the first node address in a singly linked list</i><br/> <i>{ List *p, *q; int t;</i><br/> <i>    if(!L    !L-&gt;next) return;</i><br/> <i>    p = L; q = L-&gt;next;</i><br/> <i>    while (q)</i><br/> <i>        { t = p-&gt;value; p-&gt; value = q -&gt;value; q-&gt; value = t;</i><br/> <i>        p = q-&gt; next;</i><br/> <i>        q = p ? p-&gt;next : NULL; }</i></p>                          | 6M<br>4M             | CO2, CO6<br>CO2, CO4                              | Evaluate   |
| 3         | <p>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 <math>p = (5x^3 + 6x + 3)</math> and polynomial <math>q = (6x^2 + 6)</math> then <math>p * q = (30x^5 + 66x^3 + 18x^2 + 36x + 18)</math>)</p>  | 10M                  | CO1, CO2, CO3, CO4                                | Understand, Create   |