

**M.C.A./M.Sc. Semester I Examination 2024-25****Computer Science****CS-204: Object Oriented Programming****Time : Three hours****Max. Marks : 70****(Write your Roll No. at the top immediately on the receipt of this question paper)****Note: Question 1 is compulsory; attempt any four questions from the remaining six questions.**

1. (a) Which of the following can be used to create a new thread in Java? [1 mark]

(I) Extending the Thread class (II) Implementing the Runnable interface (III) Both (I) and (II)  
(IV) None of the above

- (b) Which of the following classes is immutable in Java? [1 mark]

(I) StringBuffer (II) String (III) ArrayList (IV) HashMap

- (c) What is the output of the following code snippet? [1 mark]

```
1 int x = 10;
2 int y = ++x * 10 + x--;
3 System.out.println(y);
```

- (d) Which of the following statements is true about Java interfaces? [1 mark]

(I) An interface can have static methods (II) An interface can have default methods (III) An interface can have private methods (IV) All of the above

- (e) In Java, which of the following exceptions is a checked exception? [1 mark]

(I) NullPointerException (II) ArrayIndexOutOfBoundsException (III) FileNotFoundException  
(IV) ArithmeticException

- (f) What will be the output of the following code? [2 marks]

```
1 class Test {
2     public static void main(String[] args) {
3         int x = 5;
4         int y = 10;
5         System.out.println(x + y + " Java " + x + y);
6     }
7 }
```

- (g) What is the purpose of the final keyword in Java? [1 mark]

(I) To define a constant variable (II) To prevent method overriding (III) To prevent inheritance of a class (IV) All of the above

- (h) Which principle of OOP allows a child class to provide a specific implementation of a method already defined in its parent class? [1 mark]

(I) Encapsulation (II) Inheritance (III) Polymorphism (IV) Overriding

- (i) What happens when you use the equals() method for comparing two String objects in Java? [1 mark]

(I) Compares references of the strings (II) Compares content of the strings (III) Throws an exception if strings are null (IV) It is the same as the == operator

- (j) What is the result of the following code? [2 marks]

```
1 String str = null;
2 System.out.println(str + "Java");
```

- (k) What will be the result of the following code? [2 marks]

```
1 String s1 = "Java";
2 String s2 = new String("Java");
3 System.out.println(s1 == s2);
```

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2. (a) What is exception handling in Java? Write a program to demonstrate try, catch, finally, and multiple catch blocks. [7 marks]
- (b) What is polymorphism in Java? Write a program that demonstrates compile-time polymorphism and runtime polymorphism. [7 marks]
3. (a) What is exception handling in Java, and how many types of exceptions exist? Illustrate your explanation with an appropriate example. [5 marks]
- (b) Describe the process of exception propagation in Java with an appropriate example. [4 marks]
- (c) Write a Java program to demonstrate constructor overloading and how the appropriate constructor is invoked based on the number of arguments passed during object creation. [5 marks]
4. (a) Create a Java program with a *Person* class where the *name* field is private, the *age* field is protected, and the *address* field is public. Demonstrate how each access modifier restricts or allows access within a main method. [5 marks]
- (b) Write a Java program to convert a given number of seconds into hours, minutes, and seconds. [5 marks]

Data: Enter the number: 6578894.

- (c) Write a Java program to demonstrate the differences between primitive and non-primitive data types by declaring variables of both types and performing simple operations on them. [4 marks]
5. (a) What is the Java Collections Framework? Describe its main components, such as lists, sets, maps, and queues, and explain their use with examples. [7 marks]
- (b) What is event-driven programming, and how is it implemented in Java? Describe how you can handle user actions such as button clicks or key presses in a GUI application using event listeners. [7 marks]
6. (a) Write a Java program to demonstrate the difference between string literals and string objects. Create two string variables: one using a string literal and the other using the new keyword. Compare them using the == operator and explain the result. [5 marks]
- (b) Write a Java program to demonstrate inheritance by creating a base class *Animal* with a method *sound()*, and two subclasses *Dog* and *Cat* that override the *sound()* method. Show how polymorphism works by calling the *sound()* method on an *Animal* reference that points to both *Dog* and *Cat* objects. [5 marks]
- (c) What are the key features of the Object-Oriented concept? Explain each feature with an appropriate example. [4 marks]
7. (a) Write a Java program to demonstrate the execution order of a method, instance block, and static block in a class. The program should include:
- (I) A static block that prints a message when the class is loaded.
  - (II) An instance block that prints a message each time an object is instantiated.
  - (III) A method *initialize()* that is called from the constructor and prints a message.
  - (IV) A constructor that calls the *initialize()* method and prints a message when an object is created.
- Create multiple objects of the class and explain the execution order of the blocks and methods, both at the time of class loading and object creation. [10 marks]
- (b) What are the typical scenarios where Java exceptions occur? [4 marks]



## M.Sc. Semester I Examination 2024-25

## Computer Science

## CS-202: Theory of Computation

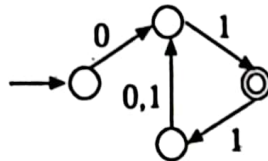
Time : Three hours

Max. Marks : 70

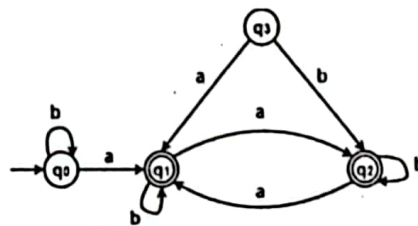
(Write your Roll No. at the top immediately on the receipt of this question paper)

Note: Attempt five questions from the following including Question No. 1, which is compulsory.

- |  | Marks |
|--|-------|
| 1 (a) Find the language generated by the grammar $S \rightarrow AB$ , $A \rightarrow A0 1$ , $B \rightarrow B1 2$ . Can the above language be generated by a grammar of higher type?               | [3]   |
| (b) Is it possible for a Regular grammar to be ambiguous? Explain  | [2]   |
| (c) What is the Chomsky hierarchy? Where do context-sensitive grammars fit in this hierarchy?  | [3]   |
| (d) Construct a grammar that generates all odd integers up to 1000.  | [3]   |
| (e) Take $\Sigma = \{a, b\}$ and $\Gamma = \{0, 1\}$ . Define $h$ by $h(a)=01$ , $h(b)=10$ . If $L$ is a Regular language denoted by $r = (a+b^*)ab$ then find homomorphic image of $L$ .          | [3]   |
| 2 (a) What are the key differences between DFA, NFA, and $\epsilon$ -NFA?  | [3]   |
| (b) Design an $\epsilon$ -NFA that accepts the language $L = \{a^m b^n c^p \mid m, n, p \geq 0\}$ of all strings over $\{a, b, c\}$ , convert it to its equivalent NFA and then convert it to DFA. | [5]   |
| (c) Suppose you have two keywords, the keyword $\{this, throw\}$ , design a single NFA accepting both keywords. Take $\Sigma = \{t, h, i, s, r, o, w\}$ .  | [3]   |
| (d) Write a regular expression equivalent to the following NFA.  | [3]   |



- 3 (a) Construct a minimum state automaton which is equivalent to a given automaton [5]



- (b) Construct Moore machine that counts the occurrence of sequence 'bab' in any input string and convert it to its equivalent Mealy Machine. [4]
- (c) Use the Pumping Lemma to show that the language  $L = \{a^n b^n c^n \mid n \geq 0\}$  is not regular. [5]
- 4 (a) Convert the following grammar (over the alphabet  $\{a, b, c, d\}$ ) to the Chomsky normal form. [4]

$S \rightarrow aSd \mid T$   
 $T \rightarrow bTc \mid \epsilon$

- (b) Remove all unit-productions, all useless productions, and all  $\epsilon$  productions from the grammar [5]

$S \rightarrow XY \mid Z$   
 $X \rightarrow aX \mid \epsilon$   
 $Y \rightarrow bY \mid a$   
 $Z \rightarrow XZ \mid b$

P.T.O.

- (c) Consider the context-free grammar  $G$  over  $\{a,b\}$ , with start symbol  $S$ , and with the following productions. [5]  
 $P: S \rightarrow aaB|Abb$   
 $A \rightarrow a|aA$   
 $B \rightarrow b|bB$
- What is  $L(G)$ ?
  - Prove that this CFG is ambiguous.
- 5 (a) What are PDA and NPDA? which one is more powerful and why? Why stack is used in PDA. [5]  
 (b) Construct PDA which accepts the language  $L = \{a^m b^n c^n : m, n \geq 1\}$ . [5]  
 (c) Is the language  $L = \{a^n b^n c^n\}$  context-free? Explain. [4]
- 6 (a) Give the mathematical definition of a Turing machine. How does a Turing machine differ from other computational models like finite automata or pushdown automata? [5]  
 (b) Consider the unrestricted grammar over the singleton alphabet  $\Sigma = \{a\}$ , having the start symbol  $S$ , and with the following productions. [4]  
 $S \rightarrow AS|aT$   
 $Aa \rightarrow aaaA$   
 $AT \rightarrow T$   
 $T \rightarrow \epsilon$   
  - Show a derivation of  $a^9$  using this grammar.
  - What is the language generated by this unrestricted grammar? Justify.
 (c) Construct a Turing Machine for recognizing strings of the form  $a^n b^n$  then find an unrestricted grammar for it. [5]

*J* Write Short notes on the following:

[3.5\*4]

- The Halting problem
- P vs. NP Problems
- Rice's theorem
- Post Correspondence Problem

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**M.C.A./M.Sc. Semester I Examination 2024-25****Computer Science/Applications****CS-206: Computer Networks****Time : Three hours****Max. Marks : 70****(Write your Roll No. at the top immediately on the receipt of this question paper)****NOTE: Answer any five questions. Question number one is compulsory.**

- 1) Write a short note on any four out of six techniques: 3.5 x 4 = [14]
- a) Dynamic Host Configuration Protocol (DHCP)
  - b) User Datagram Protocol (UDP)
  - c) Subnet Mask
  - d) TELNET
  - e) File Transfer Protocol (FTP)
  - f) Symmetric and Asymmetric keys
- 2) a) Discuss the Reverse Address Resolution Protocol (RARP). [6]  
b) An ISP is granted the block 80.70.56.0/21. The ISP needs to allocate addresses for two organizations each with 500 addresses, two organizations each with 250 addresses, and three organizations each with 50 addresses. [8]
- I. Find the number and range of addresses in the ISP block.
  - II. Find the range of addresses for each organization and the range of unallocated addresses.
- 3) a) What is a routing table in network layer? Discuss the common fields in a routing table. [6]  
b) In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. What will be the position of the datagram, the sequence numbers of the first and the last bytes of the payload? [8]
- 4) a) What is Transmission Control Protocol (TCP)? Discuss its features in details. [6]  
b) Describe the working of Link State Routing protocol with suitable diagrams. [8]
- 5) a) What is Congestion Control? Discuss the Open-Loop Congestion Control techniques. [6]  
b) What is Quality of Service (QoS)? Discuss the techniques to improve QoS. [8]
- 6) a) What is Domain Name System (DNS)? What do you understand by Domain Name Space? [6]  
b) What is Simple Network Management Protocol (SNMP)? Describe the functions of SNMP. [8]

**\*\*\*END\*\*\***

**M.Sc. Semester I Examination 2024-25****Computer Science****CS-201: Probability and Statistics for Computer Science****Time : Three hours****Max. Marks : 70****(Write your Roll No. at the top immediately on the receipt of this question paper)****Note:** Attempt total Five question including compulsory question 1. The figures in right margin indicate the marks.

1. (a) Give Kolmogorov axiomatic definition of probability. 2
  - (b) Define conditional probability. 2
  - (c) Discuss concept of statistical independence of events. 2
  - (d) Discuss the concept of total probability. 2
  - (e) Define random variable. What do you understand by continuous and discrete random variable? Give one example of each. 3
  - (f) Define probability mass function (PMF), probability density function (pdf) 3
  2. (a) Define Bernoulli trial and give associated random variable. Find the expected value, variance, moment generating function, and factorial moment of second order. 8
  - (b) A coin is tossed 10 times. Given that there are 6 heads in the 10 tosses, what is the expected number of heads in the first 5 tosses? 2
  - (c) Four fair coins are tossed. If the outcomes are assumed to be independent, find the PMF of the number of heads obtained. 4
  3. (a) Probability of the events  $A$ ,  $B$ , and  $A \cap B$  are 0.6, 0.3 and 0.2 respectively. Find the probability of event  $\bar{A} \cap \bar{B}$ . 2
  - (b) Suppose a random variable  $X$  has a probability density function (pdf) given by: 9
- $$f_X(x) = \begin{cases} k(x-3)(1-x), & 1 \leq x \leq 3 \\ 0, & \text{elsewhere} \end{cases}$$
- i. Find the value of  $k$  that makes this function a pdf.
  - ii. Find mean and variance of  $X$ .
  - iii. Find the probability of events  $(-1 \leq X \leq 1)$ ,  $(1 \leq X \leq 3)$ , and  $(0 \leq X < \infty)$

P.T.O.



- (c) A random variable  $Y$  is defined using random variable  $X$  as  $Y = aX + b$ , where  $a$  and  $b$  are constant. Show that  $E[Y] = aE[X] + b$ ,  $E[.]$  stands for expectation. 3
4. (a) Assume that we roll two dice and define three events  $A$ ,  $B$ , and  $C$ , where  $A$  is the event that the first die is odd,  $B$  is the event that the second die is odd, and  $C$  is the event that the sum is odd. Show that these events are pairwise independent but the three are not independent. 7
- (b) Ken was watching some people play poker, and he wanted to model the PMF of the random variable  $N$  that denotes the number of plays up to and including the play in which his friend Joe won a game. He conjectured that if  $p$  is the probability that Joe wins any game and the games are independent, then the answer the following: 7
- Give PMF of  $N$ .
  - Find CDF of  $N$ .
  - Find the expected value of  $N$ .
  - Find the variance of  $N$ .
  - Find the moment generating function of  $N$ .
5. Consider the following set of the data: 3
- 2, 3, 5, 5, 6, 7, 7, 7, 8, 9, 9, 10, 10, 11, 12, 14, 14, 16, 18, 18, 22, 24, 26, 28, 28, 32, 45, 50, and 55.
- Plot the box and whiskers diagram of the set. 3
  - Determine if there are any outliers in the data set. 3
  - Plot the histogram of the data set 2
  - Plot the frequency polygon of data set. 2
  - Determine the skewness of the data. 4
6. Let  $X$  and  $Y$  are random variable denotes the life time of the component  $A$  and  $B$  respectively. The pdf of the  $X$  and  $Y$  are as follows: 14
- $$f_X(x) = \lambda e^{-\lambda x}, f_Y(y) = \mu e^{-\mu y},$$
- where  $\lambda > 0, \mu > 0, x > 0, y > 0$ . Find the pdf and expectation of following random variable:

$$W = \max(X, Y)$$

Counti -- (3)

7. (a) The CDF of the time  $T$  it takes a bank teller to serve a customer is defined by 7

$$F_T(t) = \begin{cases} 0, & t < 2 \\ A(t-2), & 2 \leq t < 6 \\ 1, & t \geq 6 \end{cases}$$

- i. What is the value of  $A$ ?
- ii. With the above value of  $A$ , what is  $P[T > 4]$ ?
- iii. With the above value of  $A$ , what is  $P[3 \leq T \leq 5]$ ?
- iv. Find the density function of this CDF.
- v. Find the expected value, if it exists.
- vi. Find the variance, if it exists.
- vii. Find second order factorial moment, if it exists.

- (b) Suppose a random sample of size  $n$  is drawn from the Bernoulli distribution. 7

What is the maximum likelihood estimate of  $p$ , the success of probability?

8. Observations are made on the water level of Ganga river at Assi Ghat of Varanasi every day morning during rainy season. If  $x_1, x_2, x_3, \dots, x_n$  denotes the water levels then what should be value of  $a$  if: 14

- i.  $\sum_{i=1}^n (x_i - a)^2$  is minimum.
- ii.  $\sum_{i=1}^n |x_i - a|$  is minimum

— 0 —