

**Course Code: 20MCA101****Course Name: MATHEMATICAL FOUNDATIONS FOR COMPUTING**

Max. Marks: 60

Duration: 3 Hours

**PART A***Answer all questions, each carries 3 marks.*

Marks

1 If  $A = \{1, 2, 3, 4\}$  give an example of a relation  $\mathfrak{R}$  on  $A$  that is (3)

- a. Reflexive and symmetric, but not transitive.
- b. Reflexive and transitive, but not symmetric.
- c. Symmetric and transitive, but not reflexive.

2 Consider a relation  $\mathfrak{R}$  on  $A = \{1, 2, 3\}$  whose matrix representation is given. (3)

Determine its inverse.  $M_{\mathfrak{R}} = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

31, 21

3 Use the Euclidean algorithm to obtain integers  $x, y$  satisfying (3)

$$\gcd(1769, 2378) = 1769x + 2378y$$

4 Solve the recurrence relation  $a_n = 5a_{n-1} + 6a_{n-2}$  (3)5 Prove that the sum of the degrees of all vertices of a graph  $G$  is twice the number (3)  
of edges in it.

6 Define a planar graph with examples. (3)

7 State the fundamental theorem for linear systems. (3)

8 How to convert a matrix into row echelon form? What are the information obtained (3)  
from this form?9 In a partially destroyed laboratory record, only lines of regression  $y$  on  $x$  and  $x$  on (3)  
 $y$  are available as  $4x - 5y + 33 = 0$ ,  $20x - 9y = 107$  respectively. Calculate  
the coefficient of correlation between  $x$  and  $y$ .10 Form the normal equations for fitting a straight line in least squares method with (3)  
n-data.

$$\begin{matrix} (1,1) & (1,1) \\ (1,1) & (1,1) \end{matrix}$$
**PART B***Answer any one question from each module. Each question carries 6 marks.***Module I**

- 11 Let  $A = (1,2,3,4,5) \times (1,2,3,4,5)$  and define  $\mathcal{R}$  on  $A$  by  $(x_1, y_1) \mathcal{R} (x_2, y_2)$  if  $x_1 + y_1 = x_2 + y_2$ . Verify that  $\mathcal{R}$  is an equivalence relation on  $A$ . (6)

**OR**

- 12 Using Warshall's algorithm, find the transitive closure of the relation  $R = [(1,2), (2,3), (3,3)]$  on the set  $A = \{1,2,3\}$ . (6)

**Module II**

- 13 a. Show that the square of any integer is of the form  $3k$  or  $3k + 1$ . (2)  
 b. Find the remainders when  $2^{50}$  and  $41^{65}$  are divided by 7. (4)

**OR**

- 14 Find the solution for the following set of congruent equations using Chinese Remainder theorem,

$$\begin{aligned} x &\equiv 2 \pmod{3} & n_1 = n_2 = n_3 \\ x &\equiv 3 \pmod{5} & n_1 = \frac{n}{n_1}, n_2 = \frac{n}{n_2} & n_1 x \equiv 1 \pmod{n_1} \\ x &\equiv 2 \pmod{7} & n_3 = a_1 n_1 x_1 \pmod{n} \end{aligned} \quad (6)$$

**Module III**

- 15 a. Prove that a non-empty connected graph  $G$  is Eulerian if and only if its vertices are all of even degree. (4)  
 b. Represent the Konigsberg bridge problem by means of a graph. Does it have a solution? Justify. (2)

**OR**

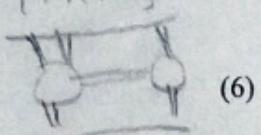
- 16 Give an example of a connected graph that has  
 a. Neither an Euler circuit nor a Hamiltonian cycle. (3)  
 b. Both a Hamiltonian cycle and Euler circuit. (3)

**Module IV**

17 Let  $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 5 & -2 \\ 1 & 1 & 2 \end{bmatrix}$

$$\lambda^3 - (5 + 1 + 1) \lambda^2 + [1 + 1 + 1] - 1A = 0$$

Find eigenvalues and eigen vectors of  $A$ .

**OR**

$$\begin{matrix} (1,3) & (2,3) \\ (1,3) \end{matrix}$$

- 18 Solve the following system of linear equations by Gauss Elimination method,

$$x_1 - x_2 + x_3 = 0 \quad (3)$$

$$-x_1 + x_2 - x_3 = 0 \quad (3)$$

$$10x_2 + 25x_3 = 90$$

$$20x_1 + 10x_2 = 80$$

**Module V**

- 19 Employ the method of least squares to fit a parabola  $y = a + bx + cx^2$  to the following data  $(x, y): (-1, 2), (0, 0), (0, 1), (1, 2)$  (6)

**OR**

- 20 Compute Spearman's rank correlation coefficient  $r$  for the following data (6)

Person	A	B	C	D	E	F	G	H	I	J
Rank in Statistics	9	10	6	5	7	2	4	8	1	3
Rank in Income	1	2	3	4	5	6	7	8	9	10

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Course Code: 20MCA103

## Course Name: DIGITAL FUNDAMENTALS &amp; COMPUTER ARCHITECTURE

Max. Marks: 60

Duration: 3 Hours

## PART A

*Answer all questions, each carries 3 marks.*

Marks

- 1 Express the number -173 as a 12-bit number in Sign Magnitude, 1's Complement and 2's Complement notation. (3)
- 2 Convert decimal no  $4.248 \times 10^4$  to a single precision floating point binary number (3)
- 3 What is a D Flip-flop? Derive a D flip-flop from RS flip-flop. (3)
- 4 Design a mod-6 asynchronous Up counter using T flip-flops (3)
- 5 Differentiate between fixed length encoding and variable length encoding (3)
- 6 What is an addressing mode? Mention the addressing modes used for the branch and jump instructions. (3)
- 7 Diagrammatically explain the Daisy Chain arrangement for handling simultaneous arrivals of interrupt requests (3)
- 8 What are the datapath elements used for Load/Store instructions? (3)
- 9 Draw a SRAM Cell and explain how the read and write operations are performed? (3)
- 10 Sketch the internal organization of a  $2M \times 8$  dynamic memory chip. (3)

## PART B

*Answer any one question from each module. Each question carries 6 marks.*

## Module I

- 11 Optimize the Boolean function,  $F(A, B, C, D) = m_0 + m_1 + m_7 + m_{13} + m_{15}$  with (6) don't care conditions  $d(A, B, C, D) = m_2 + m_6 + m_8 + m_9 + m_{10}$  using K-Map.

OR

- 12 What is a multiplexer? Using an 8-to-1 MUX, implement the Boolean function (6)  $F(A, B, C, D) = \sum(1, 3, 4, 11, 12, 13, 14, 15)$ .

## Module II

- 13 a. Mention any four applications of shift registers. (2)  
b. Describe the working of a Parallel in Serial Out register. (4)

OR

- 14 Draw the state diagram and logic diagram of a 3 bit up down synchronous counter. (6)

**Module III**

15 Explain the five classic components of a computer with diagram. (6)

**OR**

16 Calculate and Compare the average execution time between instructions of a non-pipelined implementation to a pipelined implementation. The operation times for the major functional units are 200ps for memory access, 200ps for ALU operation, and 100ps for register file read or write. Consider the 3 consecutive load instructions. (Eg: lw \$t1,100(\$t2))

**Module IV**

17 What is Direct Memory Access? Explain two types of bus arbitration schemes (6)

**OR**

18 List different types of pipeline hazards with examples. (6)

**Module V**

19 What is virtual memory? Explain the process of address translation. (6)

**OR**

20 Illustrate the different mapping methods of Cache Memory (6)

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## APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

First Semester MCA (Two Years) Degree (R, S) Examination December/January 2023-24

Course Code: 20MCA105

Course Name: ADVANCED DATA STRUCTURES

Max. Marks: 60

Duration: 3 Hours

## PART A

*Answer all questions, each carries 3 marks.*

Marks

- |           |   |     |
|-----------|---|-----|
| <u>1</u>  | What is meant by Hash collision?  | (3) |
| <u>2</u>  | Explain Set implementation using bit strings. Give an example.          | (3) |
| <u>3</u>  | What is meant by Splay Trees?   | (3) |
| <u>4</u>  | What is a Balanced Binary Search Tree? Give an example.                 | (3) |
| <u>5</u>  | What is a Binomial Heap? Give an example.                               | (3) |
| <u>6</u>  | List out any three operations of Fibonacci Heaps.                       | (3) |
| <u>7</u>  | What is a Minimum Cost Spanning Tree? Give an example.                  | (3) |
| <u>8</u>  | Write down the Prim's algorithm.  | (3) |
| <u>9</u>  | Explain on any three problems to be solved in Blockchain Data Analysis. | (3) |
| <u>10</u> | What is Contract Data?  | (3) |

## PART B

*Answer any one question from each module. Each question carries 6 marks.***Module I**

- |           |   |     |
|-----------|---|-----|
| <u>11</u> | Write in detail on the operations of disjoint sets. | (6) |
|-----------|---|-----|

**OR**

- 12 Explain amortized analysis using aggregate method. Illustrate using Multipop Stack example. (6)

**Module II**

- 13 What is a B-Tree? State its various properties. Explain the insertion operation in a B-Tree. (6)

*OR*

- 14 What is a Red-Black-Tree? State its various properties. Explain the rotation operations in a Red- Black tree. (6)

**Module III**

- 15 How is a delete key operation performed in a Binomial Heap? Give an example. (6)

*OR*

- 16 How is a delete key operation performed in a Fibonacci Heap? Give an example. (6)

**Module IV**

- 17 Explain Depth First Search algorithm with an example. (6)

*OR*

- 18 Explain Kruskal's algorithm with an example. (6)

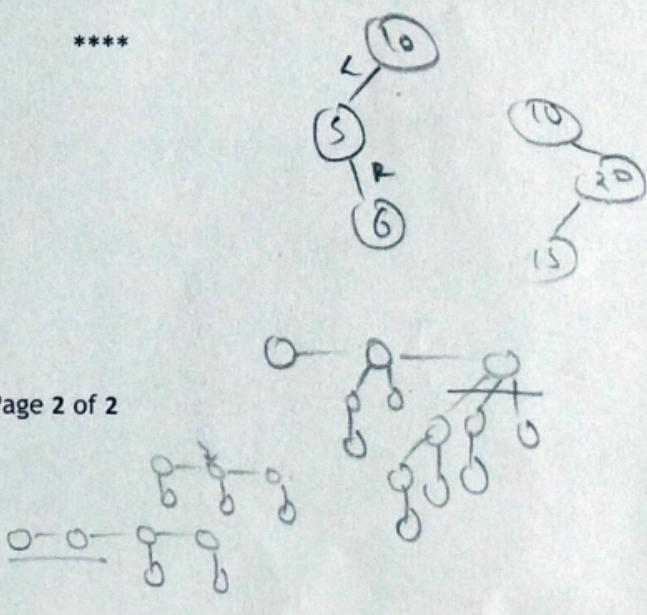
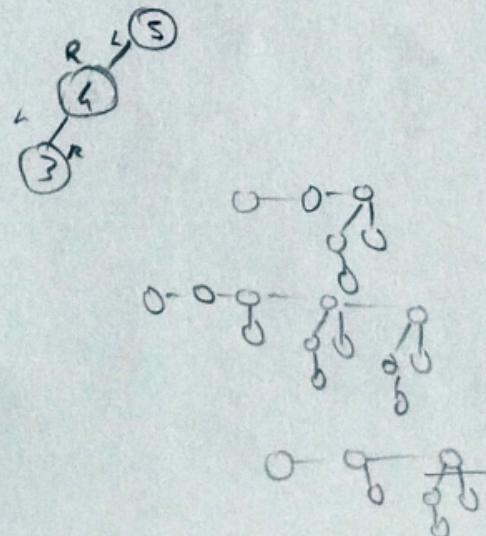
**Module V**

- 19 Explain the blockchain architecture with the help of a neat diagram. (6)

*OR*

- 20 Write notes on blockchain data structure. (6)

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**Course Code: 20MCA107****Course Name: ADVANCED SOFTWARE ENGINEERING**

Max. Marks: 60

Duration: 3 Hours

**PART A***Answer all questions, each carries 3 marks.*

Marks

- |    |  |     |
|----|--|-----|
| 1  | List and explain the key characteristics of software.  | (3) |
| 2  | Describe the key elements of requirement specifications.   | (3) |
| 3  | Provide examples of coding standards or conventions commonly used in a specific programming language, like Python or Java. | (3) |
| 4  | How do you resolve conflicts in Git when merging or rebasing branches?   | (3) |
| 5  | How do you select an appropriate design pattern for a given problem or scenario?   | (3) |
| 6  | Discuss the importance of testing for expected errors in unit testing.   | (3) |
| 7  | What is agile process? Mention its characteristics.  | (3) |
| 8  | Explain pairwise testing and its advantages in reducing the number of test cases.  | (3) |
| 9  | What are the prerequisites for implementing continuous integration in a software development project?                      | (3) |
| 10 | Provide an example of a use case where Ansible can be beneficial in a software project.                                    | (3) |

**PART B***Answer any one question from each module. Each question carries 6 marks.***Module I**

- |    |   |     |
|----|---|-----|
| 11 | Describe the typical phases in the software development life cycle. | (6) |
|----|---|-----|

**OR**

- |    |  |     |
|----|--|-----|
| 12 | Discuss the important concepts in software requirements engineering. | (6) |
|----|--|-----|

**Module II**

- |    |  |     |
|----|--|-----|
| 13 | Compare and contrast literate programming and traditional code documentation approaches. | (6) |
|----|--|-----|

**OR**

- |    |  |     |
|----|--|-----|
| 14 | How can you set up Git on your local machine and configure it for your projects? | (6) |
|----|--|-----|

**Module III**

- 15 Describe the concepts of encapsulation, inheritance, and polymorphism in OOP. (6)

**OR**

- 16 Explain the concept of anti-patterns and why they should be avoided in software design. (6)

**Module IV**

- 17 Explain the concept of black-box testing and its various techniques. (6)

**OR**

- 18 With a neat diagram, explain scrum framework. (6)

**Module V**

- 19 Describe the process of managing build and deployment environments in a software development project. (6)

**OR**

- 20 Discuss the best practices for incorporating test automation into your software development process. (6)

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