A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code:R1M04

B.E./B.Tech. DEGREE EXAMINATION, DEC 2025

First Semester

Computer Science and Business systems

R21UMA104- DISCRETE STRUCTURE AND ANALYSIS

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The truth value "If 71 is prime then 3 is even" , The truth value "1 > 3 and 3 is a positive integer " CO6-U

(a) T,F (b) F,T (c) T,T (d) F,F

2. $(Q \vee \neg P)$ is a CO6-U

(a) Contradiction (b) Tautology (c) Contingency (d) PDNF

3. Calculate how many integers between 1 to 496 are divisible by 2 and 6 CO6-U

(a) 41 (b) 248 (c) 82 (d) 114

4. $12^n - 4^n$ is divisible by CO6-U

(a) 12 (b) 4 (c) 8 (d) 16

5. For a Group $(Z, *)$, * is defined by $a * b = a + b + 1$ then identity element is CO6-U

(a) 0 (b) 1 (c) -1 (d) 0 and 1

6. The order of the element [2] in a group $(Z_8, \oplus_8)$ CO6-U

(a) 4 (b) 3 (c) 2 (d) None

7. $\lim_{t \to 1} \left(\frac{t^4 - 1}{t - 1} \right)$ CO6-U

(a) $\frac{4}{3}$ (b) $\frac{3}{4}$ (c) 4 (d) 3

8. $\int_0^4 3\sqrt{x}\,dx$ CO6-U

(a) 8 (b) 3 (c) 16 (d) 24

9. The value of integral $\int_0^1 \int_0^2 \int_0^3 dxdydz$ is equal to CO6-U

(a) 2 (b) 3 (c) 4 (d) 6

10. The value of integral $\int_0^2 \int_0^2 \int_0^2 3xdxdydz$ is equal to he friction between a car's tires CO6-U

and the road is:

(a) 6 (b) 18 (c) 12 (d) 24

PART – B (5 x 2= 10 Marks)

11. Apply the procedure for constructing a truth table to test whether a conclusion R for $P \to Q, Q \to R$ and P. CO1-App

12. Apply the recurrence relation technique to compute solution of the given sequence $a_n - 9a_{n-2} = 0$. CO2-App

13. Define Group and give an example. CO3-App

14. Apply algebraic manipulation to compute y_{25} from the equation CO4-App

$y = \frac{1}{x}$.

15. Apply the concept of double integration to evaluate $\int_0^1 \int_0^2 (x+y)dxdy$. CO5-App

PART – C (5 x 16= 80 Marks)

16. (a) (i) Apply the truth table method to compute the given logical expression PCNF and PDNF for $(\neg P \to R) \wedge (Q \leftrightarrow P)$. CO1-App (8)

(ii) Use the CP Rule to prove a simple implication such as. $P \to (Q \to S), \neg R \vee P, Q \Rightarrow R \to S$. CO1-App (8)

Or

(b) (i) Use rules of inference theory to derive the consequences, for the following set of premises CO1-App (8)

"If the contract is valid, then John is liable for penalty. If John is liable for penalty, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. As a matter of fact, the contract is valid and the bank will loan him money".

(ii) Apply De Morgan's law to negate compound quantified statements $(x)(P(x) \vee Q(x)) \Rightarrow (x)P(x) \vee (\exists x)Q(x)$. CO1-App (8)

17. (a) (i) Using mathematical induction to prove that CO2-App (8)

$$\frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+\ldots..+\frac{1}{n(n+1)}=\frac{n}{(n+1)}.$$

(ii) Apply the divisibility rules to determine the number of positive integers not exceeding 850 that are divisible by 2 ,3 ,5 or by 7. CO2-App (8)

Or

(b) (i) Apply the recurrence relation technique to compute solution of the given Fibonacci sequence 0,1,1,2,3,5,8,….. CO2-App (8)

(ii) Apply the generating functions technique to compute solution of the given sequence $a_n = 2a_{n-1} + 3^n, a_0 = 1$. CO2-App (8)

18. (a) (i) Use the given binary operation * is defined on $R - \{1\}$ such that $a * b = a + b - ab, a, b \in R - \{1\}$, Show that $(R - \{1\}, *)$ is a Group. CO3-App (8)

(ii) Use Lagrange's theorem to determine whether a given subset of a group can be a subgroup. Let G be a finite group of order 'n' and H be any subgroup of G. Then Show that the order of H divides the order of G. (i.e) O(H) / O(G). CO3-App (8)

Or

(b) (i) Use the addition modulo 7 to prove that G = {0, 1, 2, 3, 4, 5, 6} is an abelian group of order 7. CO3-App (8)

(ii) Use the homomorphism property to prove that the Fundamental theorem on homomorphism of groups. CO3-App (8)

19. (a) (i) Apply the concept of definite integrals to evaluate CO4-App (8)

$$\int_0^{\frac{\pi}{2}} \frac{dx}{1+\sqrt{\tan x}}.$$

(ii) Apply the differential equation to verify the identity $\frac{d^2y}{dx^2} - 2a\frac{dy}{dx} + (a^2 + b^2)y = 0$, if $y = e^{ax}\cos bx$. CO4-App (8)

Or

(b) (i) Apply algebraic simplification to combine like terms CO4-App (8)

$$\lim_{x \to \frac{\pi}{2}} \left(\frac{1 + \cos 2x}{(\pi - 2x)^2} \right).$$

(ii) Apply the concept of definite integrals to evaluate CO4-App (8)

$$\int_0^{\frac{\pi}{2}} \log \cos x \, dx$$

20. (a) (i) Apply the Triple integration to compute the volume of the Ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b}+\frac{z^2}{c^2}=1$. CO5-App (8)

(ii) Apply the rule of double integration to change the order of integration in $\int_0^{4a}\int_{\frac{x^2}{4a}}^{2\sqrt{ax}} xy\,dy\,dx$. CO5-App (8)

Or

(b) (i) Apply the triple integration to compute the volume bounded by the cylinder $x^2+y^2=4$ and the planes $z=0$, $y+z=4$. CO5-App (8)

(ii) Apply the double integral to compute the area between the parabola $y^2 = 4ax$ and $x^2 = 4ay$. CO5-App (8)