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Question Paper Code: R1M04

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

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. If A is any statement, then which of the following is a tautology? CO6- U
(a) $A \wedge F$ (b) $A \vee F$ (c) $A \vee \neg A$ (d) $A \wedge T$
2. A compound proposition that is neither a tautology nor a contradiction is called a _____. CO1- U
(a) Contingency (b) Tautology (c) Contradiction (d) Equivalence
3. $8^n - 3^n$ is divisible by CO2- App
(a) 8 (b) 3 (c) 24 (d) 5
4. The particular integral of $a_n + 6a_{n-1} + 8a_{n-2} = 45$ CO2- App
(a) 4 (b) 3 (c) 7 (d) 0
5. A trivial subgroup consists of _____. CO3- U
(a) Identity element (b) Coset (c) Inverse element (d) Ring
6. The intersection of two subgroup of a group G is a CO3- U
(a) Subgroup (b) Semigroup (c) group (d) Monoid
7. $\int_0^4 3\sqrt{x} dx$ CO4- App
(a) 8 (b) 3 (c) 16 (d) 24

8. $\int_2^6 \frac{dx}{x}$ CO4- App
 (a) $\log 4$ (b) $\log 6$ (c) $\log 8$ (d) $\log 3$
9. The value of integral $\int_0^1 \int_0^2 \int_0^3 dx dy dz$ is equal to CO5- App
 (a) 2 (b) 3 (c) 4 (d) 6
10. The value of integral $\int_1^b \int_1^a \frac{dx dy}{xy}$ CO5- App
 (a) $\log a + \log b$ (b) $\log a$ (c) $\log b$ (d) $\log a \log b$

PART – B (5 x 2= 10 Marks)

11. Derive S from the premises $P \vee Q, Q \rightarrow S$ and $\neg P$ CO1-App
12. Compute the particular solution of the recurrence relation $a_n - 5a_{n-2} = 8n$. CO2-App
13. For a Group $G = \{1, -1, -i, i\}$ under multiplication, Find order of all elements CO3-App
14. Compute y_2 if $x = \cos t, y = \sin t$ CO4-App
15. Solve $\int_0^1 \int_1^2 x(x+y) dy dx$ CO4-App

PART – C (5 x 16= 80 Marks)

16. (a) (i) Calculate PCNF and PDNF for $\neg((P \vee Q) \wedge R) \wedge (P \vee R)$ CO1-App (8)
 (ii) Using the rules of inference derive & using CP Rule. CO1-App (8)
 $P \rightarrow (Q \rightarrow R), Q \rightarrow (R \rightarrow S) \Rightarrow P \rightarrow (Q \rightarrow S)$
- Or
- (b) (i) Prove that following Premises inconsistent: CO1-App (8)
 If Raj misses many classes through illness than he fails high school.
 If Raj fails high school then he is uneducated.
 If Raj reads a lot of books then he is not uneducated.
 Raj misses many classes through illness and reads a lot of books.
- (ii) Prove the following by Indirect method. CO1-App (8)
 $(x)(P(x) \vee Q(x)) \Rightarrow (x)P(x) \vee (\exists x)Q(x)$
17. (a) (i) Using mathematical induction show that CO2-App (8)
 $n^3 + (n+1)^3 + (n+2)^3$ is a multiple of 9.
 (ii) Solve $a_n - 8a_{n-1} + 16a_{n-2} = 4^n, a_0 = 2, a_1 = 8$ CO2-App (8)

Or

- (b) (i) Using generating functions Solve $a_n = 3a_{n-1} + 5^n, a_0 = 4$ CO2-App (8)
(ii) Calculate the number of positive integers not exceeding 750 that are divisible by 2, 3, 5 or by 7. CO2-App (8)
18. (a) (i) 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 (10)
(ii) The binary operation * is defined on Q^+ such that $a * b = \frac{ab}{2}, a, b \in Q^+$, Show that $(Q^+, *)$ is an abelian Group CO3-App (6)
- Or
- (b) (i) A group homomorphism preserves identities, inverse and CO3-App (8)
(ii) If H and K is a sub group of G, Prove that $H \cup K$ is a subgroup of G if either $H \subseteq K$ or $K \subseteq H$. CO3-App (8)
19. (a) (i) Compute $\int_0^{\frac{\pi}{2}} \log \cos x dx$ CO4-App (8)
(ii) If $y = e^{ax} \sin bx$ Prove that $\frac{d^2y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0$ CO4-App (8)
- Or
- (b) (i) Evaluate $\int_0^1 \log \left(\frac{1}{x} - 1 \right) dx$ CO4-App (8)
(ii) Compute the value of a,b,c if $\lim_{x \rightarrow 0} \frac{ae^x - b \cos x + ce^{-x}}{x \sin x} = 2$ CO4-App (8)
20. (a) (i) Change the order of integration and hence evaluate $\int_0^a \int_{\sqrt{a^2 - y^2}}^a xy dx dy$ CO5-App (8)
(ii) Compute the area between the parabola $y^2 = 4x$ and $2x - 3y + 4 = 0$ CO5-App (8)
- Or
- (b) Compute the volume of sphere $x^2 + y^2 + z^2 = a^2$ CO5-App (16)

