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Question Paper Code: R1M04

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

First Semester

Computer Science and Business systems

R21UMA104- DISCRETE STRUCTURE AND ANALYSIS

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- $P \vee (P \rightarrow Q)$ is Equivalent to CO6- U
(a) Q (b) P (c) T (d) F
- $\neg A \vee \neg B$ is logically equivalent to? CO6- U
(a) $\neg A \rightarrow \neg B$ (b) $\neg A \wedge \neg B$ (c) $A \rightarrow \neg B$ (d) $B \vee A$
- The numbers between 1 and 520, including both, are divisible by 2 and 6 is CO2- App
(a) 260 (b) 86 (c) 303 (d) 389
- What is the generating function for the sequence with closed formula $a_n = 4(7)^n + 6(-2)^n$? CO2- App
(a) $(4/1-7x) + 6!$ (b) $(3/1-8x)$ (c) $(4/1-7x) + (6/1+2x)$ (d) $(6/1-2x)+8$
- $(z, .)$ is _____ CO3- U
(a) Monoid (b) Semigroup (c) Abelian Group (d) Group
- $(\mathbb{N}, +)$ is CO3- U
(a) Monoid (b) Semigroup (c) Abelian Group (d) Group
- $\int_0^{\infty} e^{-x} x^4 dx$ CO4- App
(a) 4 (b) 4! (c) 5 (d) 5!
- $\lim_{n \rightarrow \infty} \left(\frac{n}{n+1} \right)$ CO4- App

- (a) 1 (b) ∞ (c) 0 (d) n
9. The value of integral $\int_1^2 \int_1^4 \frac{dx dy}{xy}$ CO5- App
- (a) $\log 8$ (b) $(\log 2)^2$ (c) $\log 6$ (d) None
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. Compute the PCNF for $P \wedge (P \rightarrow Q)$ CO1-App
12. Compute the solution of the recurrence relation $a_n - 9a_{n-2} = 0$ CO2-App
13. Prove that the intersection of two subgroups of a group is a subgroup of G. CO3-App
14. Compute y_2 if $x^2 + y^2 = 4$ CO4-App
15. Solve $\int_0^2 \int_0^2 \int_0^3 x^2 y^2 z^2 dz dy dx$ CO4-App

PART – C (5 x 16= 80 Marks)

16. (a) (i) Calculate PCNF and PDNF for $P \wedge ((P \rightarrow Q) \leftrightarrow R) \wedge (\neg R \vee Q)$ CO1-App (8)
- (ii) Prove that the premises $R \rightarrow \neg Q, R \vee S, S \rightarrow \neg Q, P \rightarrow Q, P$ are inconsistent CO1-App (8)
- Or
- (b) (i) Show that the premises “one student in this class knows how to write programs in JAVA” and “Everyone who knows how to write programs in JAVA can get a high- paying job” imply the conclusion “someone in this class can get high paying job” CO1-App (8)
- (ii) Prove the following by direct method CO1-App (8)
- $(\exists x)(P(x) \wedge Q(x)) \Rightarrow (\exists x)P(x) \wedge (\exists x)Q(x)$
17. (a) (i) Using mathematical induction prove that $1.1!+2.2!+3.3!+\dots + n. n! = (n+1)! - 1$ CO2-App (8)
- (ii) Solve: $S(k) - 7S(k-1) + 10S(k-2) = 8k + 6,$ CO2-App (8)
with $S(0) = 1, S(1) = 2.$

Or

- (b) (i) How many prime numbers not exceeding 120 are there? CO2-App (8)
- (ii) Find the formula for the general term of the Fibonacci sequence $0, 1, 1, 2, 3, 5, 8, \dots$ CO2-App (8)
18. (a) (i) A group G is abelian iff $(a * b)^2 = a^2 * b^2$ CO3-App (8)
- (ii) The necessary and sufficient condition for a non-empty subset H of a group $(G, *)$ to be a subgroup is $a, b \in H \Rightarrow a * b^{-1} \in H$. CO3-App (8)
- Or
- (b) (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 . CO3-App (8)
- (i.e.,) $O(H) / O(G)$
- (ii) The binary operation $*$ is defined on $\mathbb{R} - \{1\}$ such that $a * b = a + b - ab$, $a, b \in \mathbb{R} - \{1\}$, Show that $(\mathbb{R} - \{1\}, *)$ is a Group. CO3-App (8)
19. (a) (i) If $y = e^{ax} \cos bx$ Prove that $\frac{d^2y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0$ CO4-App (8)
- (ii) Evaluate $\lim_{x \rightarrow \frac{\pi}{4}} \frac{1 - \tan x}{1 - \sqrt{2} \sin x}$ CO4-App (8)
- Or
- (b) (i) If $y = a \cos(\log x) + b \sin(\log x)$ Show that $x^2 y_2 + xy_1 + y = 0$ CO4-App (8)
- (ii) Evaluate $\lim_{x \rightarrow \frac{\pi}{2}} \left(\frac{1 + \cos 2x}{(\pi - 2x)^2} \right)$ CO4-App (8)
20. (a) (i) Change the order of integration and hence evaluate $\int_0^1 \int_y^{2-y} xy dx dy$ CO5-App (8)
- (ii) Compute the area between the parabola $y^2 = 4ax$ and $x^2 = 4ay$ CO5-App (8)
- Or

- (b) (i) Compute the volume bounded by the cylinder $x^2 + y^2 = 9$ and the planes $z = 0$, $y + z = 4$

CO5-App (8)

(ii) Evaluate $\int_0^{\log a} \int_0^x \int_0^{x+y} e^{x+y+z} dz dy dx$

CO5-App (8)