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RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

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Academic year 2023-2024 (Even Sem)
DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING

Date	22^{nd} July 2024	Maximum Marks	60
Course Code	CS241AT	Duration	120 Min
Sem-IV	Test-II	Staff: HKK/ASP/SMS/SGR/MNV	

DISCRETE MATHEMATICAL STRUCTURES AND COMBINATORICS
(Common to CSE, ISE & AIML)

	PART-A	Marks	BT	CO
1.1	Let A={1, 2, 3, 4}. How many relations on A which are antisymmetric? How many relations on A which are neither reflexive nor irreflexive?	2	1	2
1.2	Let R be the relation on the set A={1, 2, 3, 4, 5} containing the ordered pairs R={(1, 3), (2, 4), (3, 1), (3, 5), (4, 3), (5, 1), (5, 2), (5, 4)}. Find R^4.	2	2	1
1.3	For the POSET (A, |) where A={2, 4, 6, 9, 12, 18, 27, 36, 48, 60, 72} find the upper bounds, lower bounds, LUB and GLB of {2, 6, 9, 18}.	2	2	2
1.4	How many ways can one distribute 4 distinct objects among 3 identical containers?	1	1	1
1.5	If A={1, 2, 3, 4, 5} and there are 6720 injective functions f: A→B, what is |B|?	1	1	1
1.6	Let P(x, y) denote the sentence: x divides y. What are the truth values of $\forall x \exists y P(x, y)$, $\forall x \forall y P(x, y)$, where the domain of x, y is the set {1, 2, 4, 6, 12}?	1	1	1
1.7	Express the negation of the below statement so that all negation symbols immediately precede predicates. $\forall x \exists y (P(x, y) \rightarrow Q(x, y))$	1	1	1
	PART-B			
2a.	For the following statement state the *converse*, *inverse*, and *contrapositive*. Also determine the truth value for the given statement, as well as the truth value for its *converse*, *inverse*, and *contrapositive*. "For all real numbers x, if $x^2+4x-21>0$, then $x>3$ or $x<-7$.	05	3	2

2b.	Test the validity of the following argument: *Some rational numbers are powers of 7.* *All integers are rational numbers.* ——————————————— *Some integers are power of 7.*	05	4	3
3a.	Let A={1, 2, 3, 4} and R={(1, 2), (2, 3), (3, 4), (2, 1)}. Write the matrix for R. Find the R^{∞} by computing matrices for R^2, R^3,....	04	2	2
3b.	Suppose A is a set, R is an equivalence relation on A, and a and b are elements of A. Prove the following. i. If aRb, then [a]=[b]. ii. [a]=[b] or $[a]\cap[b]=\emptyset$. iii. Distinct equivalence classes of R form a partition of A.	06	4	1
4a.	Define POSET. Show that the set A={1, 2, 3, 6, 12, 15, 24, 36, 48} under the divisibility (|) operation forms a POSET. Draw the Hasse diagram for (A, |)	05	2	2
4b.	Let U={1, 2, 3, 4, 5, 6, 7}, with A=P(U) (power set of U), and R be the subset relation on A. For B={{1}, {2}, {2, 3}}$\subseteq$ A, determine each of the following. a) The number of upper bounds of B that contains 4 elements. b) The number of upper bounds that exists for B. c) The lub of B d) The number of lower bounds that exists for B. e) The glb of B.	05	3	2
5a.	i. Let $f(x)=x^3$ and $g(x)=x-1$ for all real numbers x. Find g o f and f o g. Verify whether g o f equals f o g. ii. Let f, g: R→R, where $g(x)=1-x+x^2$ and $f(x)=ax+b$. If $(g \circ f)(x)=9x^2-9x+3$, determine a and b.	04	3	2
5b.	If f: A→B and g: B→C are invertible functions, then g o f: A→C is an invertible function and $(g \circ f)^{-1}=f^{-1} \circ g^{-1}$. Prove this.	06	4	3
6a.	Let f: A→B, g: B→C and h: C→D. Prove the following. i. If f and g are one-to-one, then g o f is one-to-one. ii. If f and g are onto, then g o f is onto. iii. (h o g) o f=h o (g o f).	06	4	3
6b.	Let A={1, 2, 3, 4, 5} and B={6, 7, 8, 9, 10, 11, 12}. i. How many functions f: A→B are there? ii. How many functions are one-to-one? iii. How many functions f: A→B are such that $f^{-1}(\{6, 7, 8\})=\{1, 2\}$?	04	3	2

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars	CO1	CO2	CO3	CO4	CO5	L1	L2	L3	L4	L5	L6
	Max Marks	12	31	17	-	-	6	13	18	23	-	-