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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S, FE) (FT/WP) / S1 PT Examination December 2025 (2019 Scheme)

Course Code: MAT203

Course Name: Discrete Mathematical Structures

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1	For the following statement state the converse, inverse and contrapositive "For all real numbers x if $x^2+4x-21 > 0$ then $x > 3$ or $x < -7$"	(3)
2	Verify that $[p \rightarrow (q \rightarrow r)] \rightarrow [(p \rightarrow q) \rightarrow (p \rightarrow r)]$ is a tautology using truth tables.	(3)
3	Find the coefficient of $x^5 y^2$ in the expansion of (i) $(x+y)^7$ (ii) $(2x - 3y)^7$	(3)
4	How many derangements are there for 1, 2,3,4,5?	(3)
5	A secret is spread as follows: The originator calls three people. Each of these people phone five friends, each of whom in turn call eight associates. If no one receives more than one call, how many people now know the secret?	(3)
6	If A = { 1, 2 , 3, 4},give an example of a relation $\mathcal{R}$ on A that is a)reflexive and symmetric , but not transitive b)reflexive and transitive but not symmetric	(3)
7	Find the unique solution for the recurrence relation $2a_n - 3a_{n-1} = 0, n \geq 1$, $a_4 = 81$	(3)
8	Find the coefficient of x^{60} in $(x^8+x^9+x^{10}+........)^7$	(3)
9	If S= NxN , the set of ordered pairs of positive integers with the operation * defined by (a,b)* (c,d) = (ad+bc,bd) , prove that (S,*) is a semi group	(3)
10	Is (N,*) a commutative monoid where x*y = max(x,y)	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11(a)	Show that $s \rightarrow r$ follows logically from the premises $p \rightarrow (q \rightarrow r)$, $p \vee \neg s$ and q	(6)

(b) Show that $(x)(P(x) \vee Q(x)) \Rightarrow (x)P(x) \vee \exists x\, Q(x)$,using the indirect method (8)

OR

12(a) Show that the compound statement $[p \wedge (p \rightarrow q)] \rightarrow q$ is a tautology. (6)

(b) Test the validity of the following argument: (8)

If I join KTU then I will get best education. If I get best education, then I will get a good job. If I get a good job, then I will be happy. I joined KTU. Therefore I will be happy.

Module 2

13(a) i. In how many ways can 6 boys and 4 girls sit in a row? (6)

ii. In how many ways can they sit in a row if the boys are to sit together and the girls are to sit together?

(b) How many positive integers less than 10,00,000 have the sum of their digits equal to 19? (8)

OR

14(a) Prove that any subset of size 6 from the set $S = \{1,2,3,4,5,6,7,8,9\}$ must contain two elements whose sum is 10. (6)

(b) Among the first 1000 positive integers determine the number of integers which are not divisible by 5 nor by 7 nor by 9 (8)

Module 3

15(a) Draw the Hasse diagram and determine whether poset is a lattice (i) $(D_{24}, |)$ (ii)$(D_{42}, |)$ (6)

(b) Define R on $A = \{1,2,3,4,5,6,7,8,9,10,11,12\}$ by $(x,y) \in R$ if $x - y$ is a multiple of 5. (8)

(i) Show that R is an equivalence relation on A.

(ii)Determine the equivalence classes and partition of A induced by R.

OR

16(a) Draw the Hasse diagram of the poset $(P(A), \subseteq)$ where $A = \{1,2,3\}$. Find the maximal and minimal elements of the poset. (6)

(b) If $R = \{(1,1), (1,3), (3,2), (3,4), (4,2)\}$ and $S = \{(2,1), (3,3), (3,4), (4,1)\}$. Find the following: $R \circ S$, $S \circ R$, $R \circ R$, $S \circ S$, $(R \circ S) \circ R$, $R \circ (S \circ R)$ (8)

Module 4

17(a) Find the generating function for the number of n combinations of apples, (6) bananas, oranges and pears wherein each n-combination the number of apples is even, the number of bananas is odd, the number of oranges is between 0 and 4 and there is at least one pear.

(b) Solve the recurrence relation $a_{n+2} - 8\,a_{n+1} + 16\,a_n = 8(5^n) + 6(4^n)$ where $n \geq 0$ and $a_0 = 12$, $a_1 = 5$. (8)

OR

18(a) Solve the recurrence relation $2a_n = 7\,a_{n-1} - 3\,a_{n-2}$; $a_0 = 2$, $a_1 = 5$ (6)

(b) Use the method of generating function to solve the recurrence relation $a_n - 3\,a_{n-1} = n$, $n \geq 1$ $a_0 = 1$ (8)

Module 5

19(a) Prove that the order of a subgroup of a finite group is a divisor of the order of the group (6)

(b) Show that the direct product of two groups is a group. (8)

OR

20(a) Prove that every subgroup of a cyclic group is cyclic (6)

(b) Consider an algebraic system (G,*) where G is the set of all non-zero real numbers and* is binary operation defined by a*b = (ab)/4. Show that (G,*) is an abelian group. (8)

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