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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S, FE) (FT/WP/S1PT) Examinations May/June 2026 (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 Determine the truth values of the following implications. (3)

(i.) If 3+4=12, then 3+2=16.

(ii.) If 3+3=6, then 3+4=9.

2 Show that the statement $\forall x \; \exists y \; p(x,y)$ and $\exists y \; \forall x \; p(x,y)$ are not logically equivalent in the universe of integers. (3)

3 Find the number of non negative integer solutions of (3)

$$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 < 10.$$

4 Find the coefficient of a^5b^2, in the expansion of $(2a - 3b)^7$.

5 Define irreflexive relation on a set. Give an example. (3)

6 Define a relation R on $\mathbb{Z}$ by $a\text{R}b$ if $a - b$ is a nonnegative even integer. Verify that $\mathbb{R}$ defines a partial order for $\mathbb{Z}$. (3)

7 Find the exponential generating function for the sequences (3)

(i) 1,-1, 1, -1, 1, -1.....

(ii) $a, a^3, a^5, a^7 \ldots \ldots \ldots$

8 If $a_n, n \geq 0$, is the unique solution of the recurrence relation (3)

$a_{n+1} - da_n = 0, a_3 = \frac{153}{49}, a_5 = \frac{1377}{2401}$, what is d?

9 Let $A = \{0,1,2,3 \ldots.\}$. Define * on A by $x * y = \max\{x, y\}$. Verify $(A,*)$ is a commutative monoid. (3)

10 Define a group. Give an example. (3)

PART B

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

Module 1

11(a) For any primitive statements r, q and s, show that $(r \wedge s) \rightarrow q \Leftrightarrow \neg(r \wedge s) \vee q$. (7)

(b) Show that $p\wedge(\neg q\vee r)$ and $p\vee(q\vee\neg r)$, where p, q and r are primitive statements are not logically equivalent. (7)

12(a) For primitive statements p, q,

(i.) Verify that $p \rightarrow [q \rightarrow (p\wedge q)]$ is a tautology.

(ii.) Is $(p\vee q) \rightarrow [q \rightarrow (p\wedge q)]$ a tautology? (7)

(b) (i) Consider the two statements in the set of all integers,

$$p(x): x \text{ is odd}, q(x): x^2 - 1 \text{ is even}.$$

Find the truth or falsity of the statement $\forall\, x[p(x) \rightarrow q(x)]$ and find It's negation.

(iii.) Let $p(x,y), q(x,y)$ and $r(x,y)$ represents three open statements, with the replacement for the variables x, y chosen from the prescribed universes. Find the negation of the following statement. (7)

$$\forall\, x\, \exists\, y\big[\big(p(x,y)\wedge q(x,y)\big) \rightarrow r(x,y)\big].$$

Module 2

13(a) Determine the number of integers between 1 and 10,000 inclusive, which are divisible by none of 5, 6, or 8. (9)

(b) List all derangements of 1,2,3,4. (5)

14(a) Determine in how many ways can the letters in the word ARRANGEMENT be arranged so that (9)

(i.) There are exactly two pairs of consecutive identical letters.

(ii.) At least two pairs of consecutive identical letters.

(b) Find the number of arrangements of the letters in TALLAHASSEE with no adjacent A's. (5)

Module 3

15(a) Define R on $A = \{1,2,3,4,5,6,7,8,9,10,11,12\}$ by $x\text{R}y$ 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 A.

(b) Define the followings with examples. (6)

(i.) Maximal and minimal elements.

(ii.) Least element and greatest element.

(iii.) Upper bound and lower bound.

16(a) Let $A = \{1,2,3,12\}$, with divides (8)

(i) Construct the matrix tables for $glb\{x, y\}$ and $lub\{x, y\}$ in$(A, |)$.

(ii) Construct the meet –join table.

(iii) Is (A,|) a lattice?

(iv) Is $lub(12,18) = \text{lcm}\{12,18\}$?

(b) Define the following terms with examples. (6)

(i.) Poset

(ii.) Lattice

(iii.) Hasse diagram

Module 4

17 Solve the recurrence relations (7)

(a) (i) $a_{n+1} - a_n = 2n + 3, n \geq 0, a_0 = 1$,

(ii) $a_n - a_{n-1} = 3n^2, n \geq 0, a_0 = 7$.

(b) Solve the recurrence relation $2a_{n+3} = 2a_{n+2} + 2a_{n+1} - a_n, n \geq 0$, (7)

$a_0 = 0, a_1 = 1, a_2 = 2$.

18 (7)

(a) Find the unique solution of the recurrence relation,

(i) $6a_n - 7a_{n-1} = 0, n \geq 1, a_3 = 343$,

(ii) $3a_{n+1} - 4a_n = 0, n \geq 0, a_1 = 5$.

(b) A person invests Rs.100,000 at 12% interest compounded annually.

(i) Find the amount at the end of 1st, 2nd and 3rd year. (7)

(ii) Write the general explicit formula.

Module 5

19(a) Let $A = \{1,2,3,6,12\}$, define * on A by $a * b = \text{gcd}\{a, b\}$. Show that $(A,*)$ is a monoid. (7)

(b) State Lagrange's theorem. Use Lagrange's theorem find all possible subgroups of the group $\mathbb{Z}_{12}$. (7)

20(a) For a group G, prove the following. (8)

(i.) The identity of G is unique.

(ii.) The inverse of each element of G is unique.

(iii.) If $a, b, c \in G$ and $ab = ac$, then $b = c$. (Left cancellation property)

(iv.) If $a, b, c \in G$ and $ba = ca$, then $b = c$. (Right cancellation property)

(b) Show that any group G is Abelian if and only if $(ab)^2 = a^2b^2,\ \forall\, a, b$ in G. (6)

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