SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

D2 SLOT
SET - A

SRM Institute of Science and Technology
College of Engineering and Technology
DEPARTMENT OF MATHEMATICS

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, Tamilnadu

Academic Year: 2022-23 (Even)

Test: CLAT- II
Course Code &Title : 18MAB302T-Discrete Mathematics for Engineers
Year & Sem: III & VI

Date: 05/04/2023
Duration: 2 Periods (100 minutes)
Max. Marks: 50

	Part – A (10 x 1 = 10 Marks) **Instructions: Answer all Questions**						
Q. No	**Question**	**Answer**	**Marks**	**BL**	**CO**	**PO**	**PI Code**
1	If 51 bicycles are colored with 7 colors then at least how many bicycles will have same color? (a) 6 (b) 7 (c) 8 (d) 9	C	1	1	2	2	1.1.1
2	In how many different ways 5 Indians and 4 Americans can be seated around a round table if all the four Americans sit together? (a) $5! \times 4!$ (b) $5! \times 3!$ (c) $5!$ (d) $8!$	A	1	2	2	2	1.1.1
3	If $gcd(a,b) = d$ and for any non-zero integer m such that $m\|a$ and $m\|b$, which of the followings is not a correct statement. (a) $d\|m$ (b) $m\|d$ (c) $d\|m(a-b)$ (d) $d\|(ma+b)$	A	1	1	2	2	1.1.1
4	The GCD and LCM of two numbers are 24 and 168 and the numbers are in the ratio 1 : 7. The greater of the two numbers is (a) 72 (b) 144 (c) 168 (d) 172	C	1	1	2	2	1.1.1
5	The number of divisors of $\binom{12}{4}$ is (a) 7 (b) 8 (c) 10 (d) 12	D	1	2	2	2	1.1.1
6	The statement $\neg(P \longrightarrow Q)$ is equivalent to (a) $\neg P \vee \neg Q$ (b) $P \wedge Q$ (c) $P \wedge \neg Q$ (d) $\neg P \wedge Q$	C	1	1	3	2	1.1.1
7	Which of the following statement is not true (a) $P \longrightarrow Q \equiv Q \vee \neg P$ (b) $P \vee T \equiv T$ (c) $P \wedge (Q \vee P) \equiv Q$ (d) $P \longrightarrow Q \equiv \neg Q \longrightarrow \neg P$	C	1	2	3	2	1.1.1
8	Identify the dual of the statement $P \longrightarrow (Q \wedge R)$ is (a) $P \longrightarrow (Q \vee R)$ (b) $P \wedge (Q \vee R)$ (c) $\neg P \wedge (Q \vee R)$ (d) $\neg P \vee (Q \wedge R)$	C	1	2	3	2	1.1.1
9	The name of the law $P \wedge F \equiv F$ is (a) Idempotent (b) Absorption (c) Compliment (d) Dominant	D	1	1	3	2	1.1.1
10	If for all $n \in \mathbb{N}$, $10^n + 3 \cdot 4^{n+2} + k$ is divisible by 9, then the least positive integral value of k is (a) 1 (b) 3 (c) 5 (d) 7	C	1	2	3	2	1.1.1

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Year & Sem: II & IV | **Max. Marks:** 50

Part – B (4 x 4 = 16 Marks)

Instructions: Answer any two questions from Q11-Q13 and another two questions from Q14-Q16

Q. No	Question	Marks	BL	CO	PO	PI Code
11	Estimate the gcd(2420, 230) and lcm(2420, 230) by prime factorization technique. $2420 = 2^2 \times 5^1 \times 11^2$; $230 = 2^1 \times 5^1 \times 23^1$ [2M] $gcd(2420, 230) = 2^{Min(2,1)} \times 5^{Min(1,1)} \times 11^{Min(2,0)} \times 23^{Min(0,1)}$ $= 10$ [1M] $LCM(2420, 230) = 2^{Max(2,1)} \times 5^{Max(1,1)} \times 11^{Max(2,0)} \times 23^{Max(0,1)}$ $= 55660$ [1M]	4	2	2	2	1.1.1
12	How many positive integers n can be formed using the digits 3,4,4,5,5,6,7, if n has to exceed 50,00,000? When 5 occupies the first place, the remaining 6 places are to be occupied by 3, 4, 4, 5, 6, 7 The number of such numbers $= \frac{6!}{2!} = 360$ (1M) Similarly when 6 or 7 occupies the first place, the number of such numbers $= \frac{6!}{2!2!} = 180$ (2M) So total number $= 360 + 180 + 180 = 720$ (1M)	4	3	2	2	1.1.1
13	Show that among any group of five (not necessarily consecutive) integers, there are two with the same remainder when divided by 4. When an integer is divided by 4, the possible remainders are 0, 1, 2, 3. $m = 4, n = 5$ (2M) By Pegionhole Principle, $\lfloor \frac{n-1}{m} \rfloor + 1 = \lfloor \frac{4}{4} \rfloor + 1 = 2$ (2M)	4	3	2	2	1.1.1

Hence there are two with the same remainder when divided by 4 .

14 Construct the truth table for the compound proposition

4 | 4 | 3 | 2 | 1.1.1

$$(\neg P \land Q) \leftrightarrow (P \longrightarrow R)$$

P	Q	R	¬P	A: ¬P∧Q	B: P→R	A↔B
T	T	T	F	F	T	F
T	T	F	F	F	F	T
T	F	T	F	F	T	F
T	F	F	F	F	F	T
F	T	T	T	T	T	T
F	T	F	T	T	T	T
F	F	T	T	F	T	F
F	F	F	T	F	T	F

[4M]

15 Using indirect method, show that

4 | 3 | 3 | 2 | 1.1.1

$$P, P \longrightarrow Q \Longrightarrow Q$$

To show

$P, P \to Q, \neg Q \Rightarrow F$

① P (rule P)

② $P \to Q$ (rule P)

③ $\neg Q$ (rule P, additional premis)

④ $\neg P \vee Q$ (rule T, equivalence, ②)

⑤ $(\neg P \vee Q) \wedge \neg Q$ (rule T, Conjunction, ③, ④)

⑥ $(\neg P \wedge \neg Q) \vee (Q \wedge \neg Q)$ (rule T, equivalence, ⑤)

⑦ $\neg P \wedge \neg Q$ (rule T, equi)

⑧ $\neg P$ (rule T, Simplification)

⑨ $P \wedge \neg P$ (rule T, Conjunction)

⑩ F (rule T, equivalence)

[4M]

16 Using the principle of Mathematical induction show that for all $n \geq 1$, $\begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}^n = \begin{pmatrix} a^n & 0 \\ 0 & b^n \end{pmatrix}$.

4 | 3 | 3 | 2 | 1.1.1

$P(n)$: $\begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}^n = \begin{pmatrix} a^n & 0 \\ 0 & b^n \end{pmatrix}$, $n \geq 1$

$P(1)$ is true [1M]

Let $P(k)$ is true

ie, $\begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}^k = \begin{pmatrix} a^k & 0 \\ 0 & b^k \end{pmatrix}$ [1M]

$$\begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}^{k+1} = \begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}^k \begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}$$

$$= \begin{pmatrix} a^k & 0 \\ 0 & b^k \end{pmatrix} \begin{pmatrix} a & 0 \\ 0 & b \end{pmatrix}$$

$$= \begin{pmatrix} a^{k+1} & 0 \\ 0 & b^{k+1} \end{pmatrix}$$

So $P(n)$ is true for all $n \geq 1$ [2M]

Part – C (2 x 12 = 24 Marks)

Instructions: Answer all the Questions

17 (a) There are 2500 students in an engineering college. Of these 188 have taken a course in Fortran, 100 have taken a course in C and 35 have taken a course in Java. Further 88 have taken a course in both Fortran and C, 23 have taken a course in both C and Java and 29 have taken a course in both Fortran and Java. If 19 of these students have taken all of these three courses, how many of these 2500 students have not taken a course in any of these three courses.

12 | 4 | 2 | 2 | 1.1.1

12 | 4 | 2 | 2 | 1.1.1

$|F| = 188$, $|C| = 100$, $|J| = 35$, $|F \cap C| = 88$, $|C \cap J| = 23$, $|F \cap J| = 29$, $|F \cap C \cap J| = 19$ [5M]

$|F \cup C \cup J| = |F| + |C| + |J| - |F \cap C| - |C \cap J| - |F \cap J| + |F \cap C \cap J|$

$|F \cup C \cup J| = 188 + 100 + 35 - 88 - 23 - 29 + 19$

$= 202$ [5M]

	$\therefore \lvert A\cup B\cup C\cup D\rvert^c = 2500 - \lvert A\cup B\cup C\cup D\rvert$ $= 2500 - 202 = 2298$ [2M] OR					
17 (b)	Using Euclidean algorithm estimate the gcd (38472, 95774). Hence evaluate m and n such that gcd (38472, 95774) = $38472m + 95774n$. $95774 = 2\times 38472 + 18830$ $38472 = 2\times 18830 + 812$ $18830 = 23\times 812 + 154$ $812 = 5\times 154 + 42$ $154 = 3\times 42 + 28$ $42 = 1\times 28 + 14$ $28 = 2\times 14 + 0$ $14 = 42 - 28$ $= 42 - (154 - 3\times 42)$ $= 4\times 42 - 154$ $= 4\times(812 - 5\times 154) - 154$ $= 4\times 812 - 21\times 154$ $= -21\times 18830 + 487\times 812$ $= 487\times 38472 - 995\times 18830$ $= 2477\times 38472 - 995\times 95775$ gcd(38472, 95774) = 14 [6M] $m = 2477$, $n = -995$ [6M]					
18 (a)	Show that the following set of premises is inconsistent. "If the contract is valid, then John is liable for penalty. If John is liable for penalty, he will go bankrupt. If the bank will loan him money, he will not go bankrupt. As a mater of fact, the contract is valid and the bank will loan him money." To show $A\to B,\ B\to C,\ D\to\neg C,\ A\wedge D \Rightarrow F$ A: The Contract is Valid B: John is liable for penalty C: He will go bankrupt D: Bank will loan him money [2M] Premises $A\to B$. $B\to C$ $D\to\neg C$ $A\wedge D$ [4M] ① $A\to B$ (rule P) ② $B\to C$ (rule P) ③ $A\to C$ (rule T, HS, ①,②) ④ $D\to\neg C$ (rule P) ⑤ $C\to\neg D$ (rule T, equi, ④) ⑥ $A\to\neg D$ (rule T, HS, ③,⑤) ⑦ $\neg A\vee\neg D$ (rule T, equi ⑥) ⑧ $\neg(A\wedge D)$ (rule T, equi, ⑦) ⑨ $A\wedge D$ (rule P) ⑩ $\neg(A\wedge D)\wedge(A\wedge D)$ (rule T, Conjunc, ⑧,⑨) ⑪ F (rule T, equi, ⑩) [6M] OR	12	4	3	2	1.1.1
18 (b)	Using CP rule show that $\neg S \longrightarrow R$ can be derived from the premises $P \vee Q$, $P \longrightarrow R$ and $Q \longrightarrow S$. To show $P\vee Q,\ P\to R,\ Q\to S,\ \neg S \Rightarrow R$ [2M] ① $P\vee Q$ (rule P) ② $\neg P\to Q$ (rule T, equi, ①) ③ $Q\to S$ (rule P) ④ $\neg P\to S$ (rule T, HS, ②,③) ⑤ $\neg S\to P$ (rule T, equi, ④) ⑥ $P\to R$ (rule P) ⑦ $\neg S\to R$ (rule T, HS, ⑤,⑥) ⑧ $\neg S$ (rule P, additional premis) ⑨ R (rule T, MP, ⑦,⑧) ⑩ $\neg S\to R$ (rule CP) [10M]	12	4	3	2	1.1.1