

QUESTION PAPER

Name of the Examination: CAT (FALL 2022-2023)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SA1+STA1

Date of Exam: 31/10/2022

Duration: 90 min

Total Marks: 50

Class ID: AP2022232000342

Q1. Define Rule of Inference. Verify the validity of the following argument, if it is valid then state which Rule of Inference is used in the argument?

H1: If Marcus is a poet, then he is poor.

H2: Marcus is a poet.

C : Marcus is poor.

[10M]

Q2. If n is a positive integer then prove that $n^7 - n$ is divisible by 7. Use proof by Exhaustion / proof by cases to prove this.

[10M]

Q3.

a) Find all positive integers less than 3000 which have remainders 2, 4, and 8 when divided by 9, 10, and 11 respectively.

[8M]

b) The ciphertext QTORHG was produced using an affine cipher on the English alphabet with encryption key (3, 7) is accomplished via the formula $y = 3x + 7 \pmod{26}$. Find the decryption key and then decrypt the message QTORHG.

[7M]

Q4.

a) From a group of 7 men and 6 women, five persons are to be selected to form a committee, so that at least 3 men are there in the committee. In how many ways can it be done?

[5M]

b) A young pair of rabbits (one of each gender) is placed on an island. A pair of rabbits does not breed until they are 2 months old. After they are 2 months old, each pair of rabbits produces another pair each month. Find a recurrence relation for the number of pairs of rabbits on the island after n months, assuming that rabbits never die.

[10M]

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	CO1, CO2	PO1, PO2			10
Q2	1	CO1, CO2	PO1, PO2			10
Q3a, Q3b	2	CO3	PO1, PO2			$8 + 7 = 15$
Q4a, Q4b	3	CO2, CO3	PO1, PO2			$5 + 10 = 15$

QUESTION PAPER

Name of the Examination: CAT (FALL 2022-2023)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SA2+STA2

Date of Exam: 31.10.22

Duration: 90 min

Total Marks: 50

Instructions: All the parts of a question must be answered at one place.

- Q1.** Prove the validity of the argument: If today is Tuesday, then I have a test in mathematics or physics. If my physics sir is sick then I do not have test in physics. Today is Tuesday and my physics sir is sick. Therefore, I have a test in mathematics. (10M)
- Q2.** Prove or find a counter example, to these universally quantified statements. Domain of x and y consists of all integers: (i) $\forall x (x^2 + x + 41 \text{ is prime})$ (ii) $\exists x \forall y (xy = 1)$ (iii) $\forall x \exists y (xy = 1)$ (iv) $\forall x \forall y (xy \geq x)$ (v) $\forall x \forall y (x^2 \neq y^3)$. (10M)
- Q3.** a) Find all positive integers less than 5000 which leave remainder 2, 4 and 8 respectively when divided by 9, 10 and 11 respectively. (10M)
- b) If an affine cipher $E(x) = (ax + b) \pmod{26}$ enciphers H as X and Q as Y. Find the cipher (that is, determine a and b). (5M)
- Q4.** a) Using pigeonhole principle, show that any $(n + 1)$ element subset of $\{1, 2, \dots, 2n\}$ contains two integers that are relatively prime. (5M)
- b) The number of virus affected files (initially) in a system is 1000 and this increases 250% every two hours. Form a recurrence relation and solve it by the generating function. Determine the number of virus affected files in the system after one day. (10M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	1	1,2			10
Q2	1	1	1,2			10
Q3	2	2	1,2			15
Q4	3	3	1,2			15

QUESTION PAPER

Name of the Examination: CAT (FALL 2022-2023)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SB2+TSB2

Date of Exam: 1-11-2022

Duration: 90 min

Total Marks: 50

Instructions:

1. Answer all questions
- Q1.** (a) Write the negation of the following statement "**Some Students like text book reading and writing class notes**". (5M)
(b) Translate the following English sentence into propositional logic using logical connectives.
"**I lock the doors and close the windows whenever I leave to go to work**". (5M)
- Q2.** **Premises:** A student in section A of the course has not read the book. Every one in section A of the passed the first exam.
Conclusion: Some one who passed the first exam has not read the book. (12M)
Determine the validity of the above argument.
- Q3.** To avoid enemy of knowing the number of soldiers he has, a general would count his soldiers in a certain way. He asks his soldiers to line up in rows of 11, then in rows of 17 and 29. Respectively, each time, he is reported with remainders 8, 5 and 16. Then he will calculate his soldiers in private. Compute the number of soldiers using Chinese remainder theorem. (10M)
- Q4.** (a) The first 9 digits of ISBN-10 of the European version of fifth edition of the book are 0-07-119881. What is the check digit. (6M)
(b) Suppose that in a bushel of 100 apples there are 20 that have worms in them and 15 that have bruises. Only those apples with neither worms nor bruises can be sold. If there are 10 bruised apples that have worms in them, how many of the 100 apples can be sold. (5M)
- Q5.** In how many ways can 6 distinct balls be distributed to 3 identical boxes so that every box contains at least one ball. (7M)



Discrete Mathematical Structures

Name of the Examination: CAT (FALL 2022-2023)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SC1

Date of Exam: 02 November 2022

Duration: 90 min

Total Marks: 50

Instructions: All questions must be answered.

1. Answer all the questions: 22 Marks
 - (a). Consider the conditional statement: 3 Marks

"If one side of a balance falls, there is more weight on that side than on the other."

 - (i). state the converse
 - (ii). determine whether the converse is a true statement
 - (iii). if the converse is true, restate the sentence as an \dots if and only if \dots statement.
 - (b). Verify validity of the argument: *If I go to the school, then I will get an A grade. If I study well, then I will get an A grade. I will get A grade when I write the exam well. I went to the school or I studied well or I wrote the exam well, therefore I got an A grade.* 8 Marks
 - (c). Are the statements $(P \vee Q) \rightarrow R$ and $(P \rightarrow R) \wedge (Q \rightarrow R)$ logically equivalent? 5 Marks
 - (d). Use rules of inference to show that if $\forall x (P(x) \vee Q(x))$ and $\forall x ((\neg P(x) \wedge Q(x)) \rightarrow R(x))$ are true, then $\forall x (\neg R(x) \rightarrow P(x))$ is also true, where the domains of all quantifiers are the same. 6 Marks
2. Anirudh has a basket full of apples. When he takes the apples out of the basket 2 at a time, there is 1 apple left over. When he takes them out 3 at a time, there are 2 apples left over. When he takes the 5 apples at a time there are 3 apples left over. What is the least amount of apples that could be in Anirudh's basket? 10 Marks
3. The encrypted version of a message is LJMKG M. If it was encrypted using the affine cipher $f(p) = (7p + 10) \bmod 26$, what was the original message? 6 Marks
4. Answer all the questions: $3+5+4 = 12$ Marks
 - (a). Show that if 30 dictionaries in a library contains a total of 61,327 pages, then one of the dictionaries must have at least 2045 pages.
 - (b). In how many different ways can eight identical cookies be distributed among three distinct children if each child receives at least two cookies and no more than four cookies?
 - (c). Find the coefficient of $\frac{a^2}{3^2}$ in the expansion $\left(\frac{3}{a} - \frac{a}{3}\right)^6$.

QUESTION PAPER

Name of the Examination: CAT FALL 2022-23

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SC2

Date of Exam: 02/11/2022

Duration: 90 min

Total Marks: 50

- Q1. a) State the converse, contrapositive, and inverse of the conditional statement,
"If it snows today, I will ski tomorrow."
b) Show that $p \vee (q \wedge r)$ and $(p \vee q) \wedge (p \vee r)$ are logically equivalent. (6+6 Marks)
- Q2. Determine whether the given below argument is correct or incorrect and explain which rules of inference are used for each step.
"John, a student in this class, knows how to write programs in JAVA. Everyone who knows how to write programs in JAVA can get a high-paying job. Therefore, someone in this class can get a high-paying job."
(8 Marks)
- Q3. a) Find an inverse of 89 modulo 232 using Bézout's identity.
b) A foreign exchange student joins VIT-AP University; your friend sends her an encrypted message LO WI PBSOXN. Decrypt the message encrypted using the shift cipher $f(p) = (p + 10) \bmod 26$. (9+6 Marks)
- Q4. a) How many ways are there for a horse race with three horses to finish if ties are possible? [Note: Two or three horses may tie.]
b) Find a recurrence relation for the number of ways to climb n stairs if the person climbing the stairs can take one stair or two stairs at a time. What are the initial conditions? In how many ways can this person climb a flight of eight stairs? (6+9 Marks)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	1	1, 2			12
Q2	1	2	1, 2			8
Q3	2	3	1, 2			15
Q4	3	5	1, 4			15

QUESTION PAPER

Name of the Examination: CAT – 2 (Winter 2021-2022)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: G1+TG1

Date of Exam: 25-4-2022

Duration: 90 min

Total Marks: 50

Classid:- AP2021 22 5000081

Instructions:

1. Answer all questions.
2. Any assumptions made should be clearly stated.

Q1.

Three students are writing their exam in exam hall, the invigilator asks them “Does everyone want extra page?” The first student says: “I don’t know”. The second student then says: “I don’t know”. Finally the third student says: “No, not everyone wants extra page.” The examiner gives to the student who wants it. How did he figure out who wanted extra page? (7M)

Q2.

Verify whether $(m \rightarrow n) \rightarrow (o \rightarrow p)$ and $(m \rightarrow o) \rightarrow (n \rightarrow p)$ are logically equivalent or not. (10M)

Q3.

All workers of a petrochemical industry lives within 3 km of the industry. Some workers never suffered from lung disease. Using rules of inference, show that, someone who lives within 3 km of the industry has never affected by the lung disease. (10M)

Q4.

Prove by contradiction that “If $3a + 2$ is odd, then a is odd.” (7M)

Q5.

Using Euclidean algorithm find the greatest common divisor of (34, 55) and express as a linear combination of these integers. Find Be’zout coefficients of these integer. (16M)

QP Mapping

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	CO1	PO1, PO2			7
Q2	1	CO1	PO1, PO2			10
Q3	1	CO1	PO1, PO2			10
Q4	1	CO1	PO1, PO2			7
Q5	2	CO2	PO1, PO2			16

QUESTION PAPER

Name of the Examination: CAT (FALL 2022-2023)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: SB1+STB1

Date of Exam: 01-11-2022

Duration: 90 min

Total Marks: 50

Instructions:

1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. Let $C(x)$ be the statement "x has a cat," let $D(x)$ be the statement "x has a dog," and let $F(x)$ be the statement "x has a ferret." Express each of these statements in terms of $C(x)$, $D(x)$, $F(x)$, quantifiers, and logical connectives. Let the domain consist of all students in your class $S(x)$.

- a) A student in your class has a cat, a dog, and a ferret.
- b) All students in your class have a cat, a dog, or a ferret.
- c) Some student in your class has a cat and a ferret, but not a dog.
- d) No student in your class has a cat, a dog, and a ferret.
- e) For each of the three animals, cats, dogs, and ferrets, there is a student in your class who has this animal as a pet.

(10M)

Q2. Check whether the following argument is valid or not (without using the truth table)

If Rakesh sleeps early in the night, he will not wake up late in the morning.

If he will not play videogame in the late evening, he will sleep early in the night.

Rakesh wakes up late in the morning.

Therefore, Rakesh must have played videogame in the late evening.

(10M)

Q3. (a) A parking lot has 31 visitor spaces, numbered from 0 to 30. Visitors are assigned parking spaces using the hashing function $h(k) = k \bmod 31$, where k is the number formed from the first three digits on a visitor's license plate. Which spaces are assigned by the hashing function to cars that have these first three digits on their license plates: 038, 918, 007, 100, 111, 113, 317?

(7M)

(b) Decipher the message "HANX" which was encrypted by the following affine cipher $C = (5p+8) \bmod 26$.

(8M)

Q4. (a) Find a recurrence relation for the number of bit strings of length n that do not contain three consecutive 0s. Determine the initial conditions. Also, find the number of bit strings of length 7 that do not contain three consecutive 0s with the help of obtained recurrence relation.

(8M)

(b) A bag contains 2 white balls, 3 black balls and 4 red balls. In how many ways can 3 balls be drawn from the bag if at least one black ball is to be included in the draw?

(7M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	1	1	1, 2	-	-	10
Q2	1	1	1, 2	-	-	10
Q3(a)	2	2	1, 2	-	-	07
Q3(b)	2	2	1, 2	-	-	08
Q4(a)	3	3	1, 2	-	-	08
Q4(b)	3	3	1, 2	-	-	07

QUESTION PAPER

Name of the Examination: CAT (Long Summer 2022)

Course Code: MAT1003 Course Title: Discrete Mathematical Structures

Slot: E/TE/TEE

Date of Exam: 06-07-2022

Duration: 90 min

Total Marks: 50 M

Instructions:

1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. (a). There are two Chinese restaurant next to each other in Vijaywada one with sign board as 'good food is not cheap' and second with sign board as 'cheap food is not good'. do they mean same? **(5M)**

(b). Check wheather $p \vee (q \vee r) \rightarrow (p \vee q) \wedge (p \vee r)$ is a tautology or contradiction. **(5M)**

Q2. For each of the following implications find the contraposition, inverse, converse and negation

(a). Rohan's crecket team wins whenever he score 100. **(5M)**

(b). If Mohini do not dance and she do not feel happy then she do not sing. **(5M)**

Q3. Let the universe of discourse for n is the set $A=\{2,3,4,5\}$ and for y is the set $B=\{3,4,5,6\}$ and the predicate $Q(x,y)$ is defined as

$Q(x,y) : x$ is greater than y

Find the truth values of the propositions $\forall x \forall y Q(x,y)$ and $\forall y \exists x Q(x,y)$. **(10M)**

Q4. (a). Find the remainder when 13^{1792} is divisible by 5. **(5M)**

(b). Prove the statement "if $3n+2$ is even then n is even number" utilizing the method of proof by contradiction. **(5M)**

Q5. (a). Check wheather the following congruence relations has a sulation or not. If yes find it.

(i). $14 \equiv 3 \pmod{2}$ (2M)

(ii). $2x \equiv 1 \pmod{5}$ (3M)

(b). Find the remainder using Fermat's little thorem when 3^{10000} is divided by 53. (5M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1 (a),(b)	1	1	1			10
Q2 (a),(b)	1	1	1			10
Q3	1	1	1			10
Q4 (a),(b)	2	2	4			10
Q5 (a),(b)	2	3	4			10

QUESTION PAPER

Name of the Examination: FAT (Winter 2021-2022)

Course Code: MAT1003

Course Title: Discrete Mathematical Structures

Slot: G1+TG1

Date of Exam: 30-05-2022

Duration: 120 Min

Total Marks: 60

Instructions:

1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

Q1. Messages are transmitted over a communications channel using two signals. The transmittal of one signal requires 1 microsecond, and the transmittal of the other signal requires 2 microseconds.

a) Find a recurrence relation for the number of different messages consisting of sequences of these two signals, where each signal in the message is immediately followed by the next signal, which can be sent in n microseconds.

b) What are the initial conditions? (7 M)

Q2. Find the check digit of the following **Universal Product Codes (UPCs)**



(7 M)

Q3. Determine whether the relation R on the set of all integers is reflexive, symmetric, antisymmetric, and/or transitive, where $(x, y) \in R$ if and only if $x \equiv y \pmod{7}$

(6 M)

Q4. a) Find all solutions of the recurrence relation

$$a_n = 2a_{n-1} + 3^n$$

b) Find the solution of the recurrence relation in part (a) with initial condition $a_1=5$.

(11 M)

Q5. Decrypt these message encrypted using the shift cipher
 $f(p) = (p + 10) \bmod 26$. "DSWOPYBPEX"

(10 M)

Q6. Solve the following recurrence relation

$$a_n = 4a_{n-1} - 4a_{n-2} \text{ for } n \geq 2, a_0 = 6, a_1 = 8$$

(12 M)

Q7. Show that the set $Z_n = \{0, \dots, n-1\}$ for $n \geq 1$ is a group under addition modulo n .

(7M)

QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	3	CO5	PO1, PO4			7
Q2	2	CO3	PO1, PO2			7
Q3	5	CO2	PO1, PO2			6
Q4	3	CO5	PO1, PO4			11
Q5	2	CO3	PO1, PO2			10
Q6	3	CO5	PO1, PO4			12
Q7	4	CO4	PO1, PO2			7

QUESTION PAPER

Name of the Examination: FAT (Long Summer 2022)

Course Code: **MAT1003**

Course Title: **Discrete Mathematical Structures**

Slot: **E+TE+TEE**

Date of Exam: **02-08-2022**

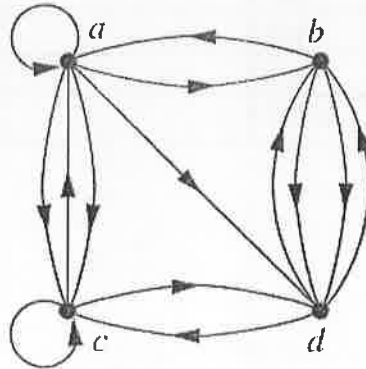
Duration: **120 min**

Total Marks: **60 M**

Instructions:

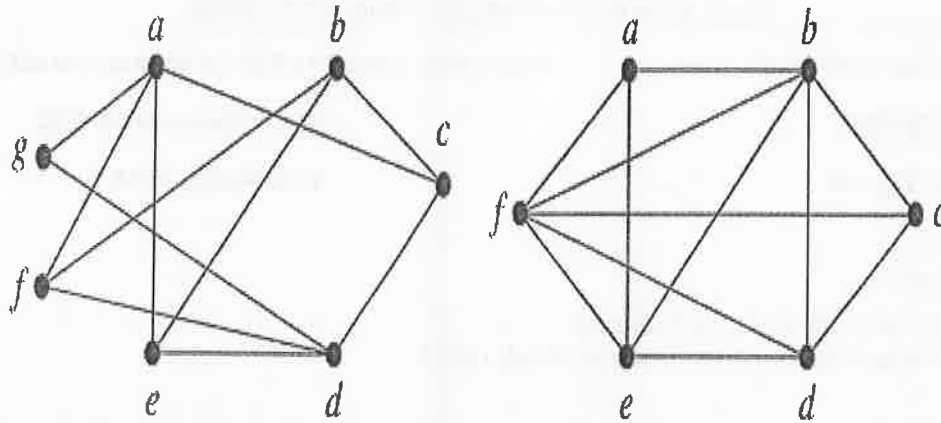
1. Assume data wherever necessary.
2. Any assumptions made should be clearly stated.

- Q1** Hitesh wants to find out the smallest positive integer x such that when he divides x by 3 he got remainder 2, when he divides x by 7 he got remainder 4, and when he divides x by 10 he got remainder 6. Find the value of x . **(12M)**
- Q2.** The relation defined on the set of students of VIT-AP university by (a,b) such that a and b can speak same language. Check whether the above relation is equivalence or not. **(12M)**
- Q3.** Find the in-degree, out-degree and adjacency matrix for the given graph. **(12M)**



- Q4.** Examine whether $(A, |)$, where $A = \{1, 2, 3, 6, 12, 24, 36, 48\}$ and " $|$ " denotes divisibility is a partial order set or not? If yes then construct Hasse diagram. **(12M)**

- Q5. Are the given graphs are bipartite? Also find the incidence matrix for both the graph (12M)



QP MAPPING

Q. No.	Module Number	CO Mapped	PO Mapped	PEO Mapped	PSO Mapped	Marks
Q1	2	1	1, 2			12
Q2	5	2	1, 3, 4			12
Q3	6	6	1, 3, 4			12
Q4	5	5	1, 3, 4			12
Q5	6	6	1, 2, 3, 4, 5			12