Code No: R2021054 **R20** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, January - 2023
MATHEMATCIAL FOUNDATIONS OF COMPUTER SCIENCE
(Com to CS,CSD, CSE, CSE-AI, CST,CSE,CSE-AI&ML,(AI&ML), CSE-AI&DS,CSE-AIDS, CSE-DS, CSE-IOT, CSE(CS), CSE-IOT & Incl BCT, CSBS, IOT, AIDS, AUML)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Construct the truth table of the compound proposition $(p \vee \neg q) \rightarrow (p \wedge q)$. [7M]

b) How can this English sentence be translated into a logical expression? [7M]
"You cannot ride the roller coaster if you are under 4 feet tall unless you are older than 16 years old."

OR

2 a) Show that $\neg (p \vee q)$ and $\neg p \wedge \neg q$ are logically equivalent. [7M]

b) Show that the premises "It is not sunny this afternoon and it is colder than yesterday," "We will go swimming only if it is sunny," "If we do not go swimming, then we will take a canoe trip," and "If we take a canoe trip, then we will be home by sunset" lead to the conclusion "We will be home by sunset." [7M]

UNIT-II

3 a) Prove that if A and B are sets, then $\overline{A \cap B} = \overline{A} \cup \overline{B}$. [7M]

b) State and prove the principle of Inclusion-Exclusion. [7M]

OR

4 a) A total of 1232 students have taken a course in Spanish, 879 have taken a course in French, and 114 have taken a course in Russian. Further, 103 have taken courses in both Spanish and French, 23 have taken courses in both Spanish and Russian, and 14 have taken courses in both French and Russian. If 2092 students have taken at least one of Spanish, French, and Russian, how many students have taken a course in all three languages? [7M]

b) Does the following table define a semi group or a monoid? [7M]

*	a	b	c
a	c	b	a
b	b	c	b
c	a	b	c

UNIT-III

5 a) How many permutations of the letters *ABCDEFGH* contain the string *ABC* ? [7M]

b) Suppose that a department contains 10 men and 15 women. How many ways are there to form a committee with six members if it must have more women than men? [7M]

OR
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6 a) Find the prime factorization of each of these integers **i)** 143, **ii)** 289 and **iii**) 899. [7M]

b) Find the greatest common divisor of 414 and 662 using the Euclidean algorithm. [7M]

UNIT-IV

7 a) Build a generating function for a_r, the number of integral solutions to the equation $e_1 + e_2 + e_3 = r$ if $0 \le e_i \le 3$ for each i. [7M]

b) Write an expression for a_r which is the coefficient of X^r in the following generating function $A(X)$: $\frac{1}{1-X} - \frac{4}{3(X+1)} + \frac{13}{12(X-2)} + \frac{9}{4(2+X)}$. [7M]

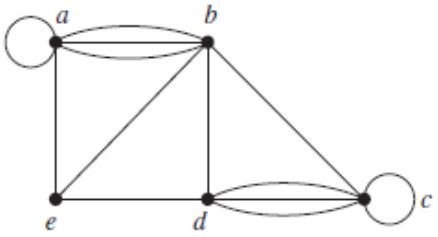
OR

8 a) Solve the following recurrence relation using generating function [7M]
$a_n - 5a_{n-1} + 6a_{n-2} = 0$ for $n \ge 2$, $a_0 = 0$, $a_1 = -2$.

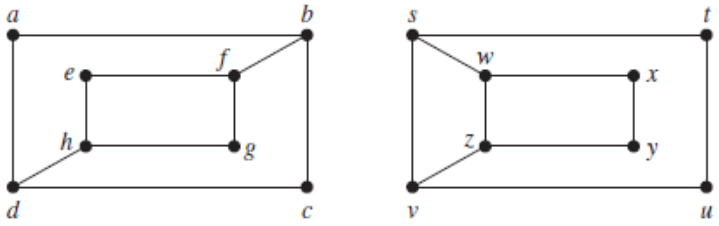
b) Solve the recurrence relation $a_n - 3a_{n-1} + 2a_{n-2} = 3^n$. [7M]

UNIT-V

9 a) Find the number of vertices, the number of edges, and the degree of each vertex in the given undirected graph. Identify all isolated and pendant vertices. [7M]



b) Determine whether the following graphs are isomorphic. [7M]



G H

OR

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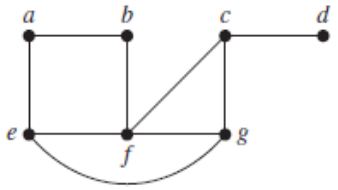
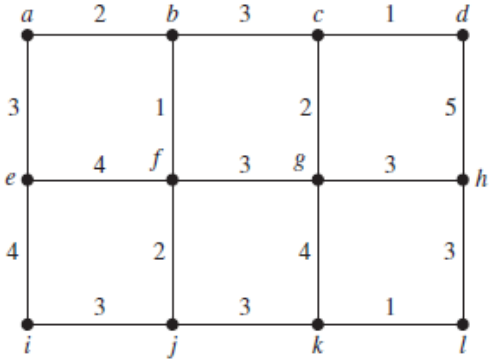
10 a) Find a spanning tree of the following Graph. [7M]



b) Use Kruskal's algorithm to find a minimum spanning tree in the weighted graph given. [7M]



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Code No: R2021054 **R20** SET - 2

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Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Construct the truth table of the compound proposition $(p \wedge q) \rightarrow (p \vee q)$. [7M]

b) Translate the given statement into propositional logic using the propositions provided. You cannot edit a protected Wikipedia entry unless you are an administrator. Express your answer in terms of e :"You can edit a protected Wikipedia entry" and a : "You are an administrator." [7M]

OR

2 a) Show that $p \vee (q \wedge r)$ and $(p \vee q) \wedge (p \vee r)$ are logically equivalent. [7M]

b) Show that the premises "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." [7M]

UNIT-II

3 a) Prove that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ for all sets A, B and C. [7M]

b) Find $f \circ g$ and $g \circ f$, where $f(x) = x^2 + 1$ and $g(x) = x + 2$, are functions from **R** to **R**. [7M]

OR

4 a) Suppose that there are 1807 freshmen at your school. Of these, 453 are taking a course in computer science, 567 are taking a course in mathematics, and 299 are taking courses in both computer science and mathematics. How many are not taking a course either in computer science or in mathematics? [7M]

b) Does the following table define a semi group or a monoid? [7M]

*	a	b	c
a	a	c	b
b	c	b	a
c	b	a	c
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UNIT-III

5 a) How many ways are there to select a first-prize winner, a second-prize winner, and a third-prize winner from 100 different people who have entered a contest? [7M]

b) Suppose that a department contains 10 men and 15 women. How many ways are there to form a committee with six members if it must have the same number of men and women? [7M]

OR

6 a) Find the prime factorization of each of these integers **i)** 88 , **ii)** 126 and **iii)** 729**.** [7M]

b) Find the greatest common divisor of 123 and 277 using the Euclidean algorithm. [7M]

UNIT-IV

7 a) Build a generating function for a_r = the number of integral solutions to the equation $e_1 + e_2 + e_3 = r$ if $2 \le e_i \le 5$ for each i. [7M]

b) Write an expression for a_r is the coefficient of X^r in the following generating function $A(X)$: $\frac{8}{(3+2X)^2} + \frac{1}{(5+X)^3}$. [7M]

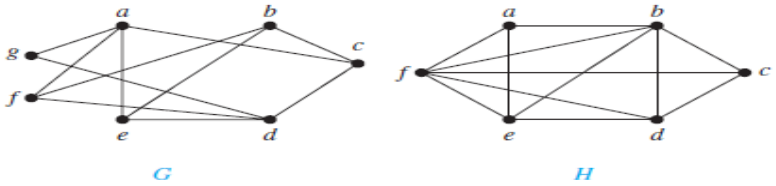
OR

8 a) Solve the following recurrence relation using generating function [7M]
$a_n - 3a_{n-2} + 2a_{n-3} = 0$ for $n \ge 3$, $a_0 = 1$, $a_1 = 0$, $a_2 = 0$.

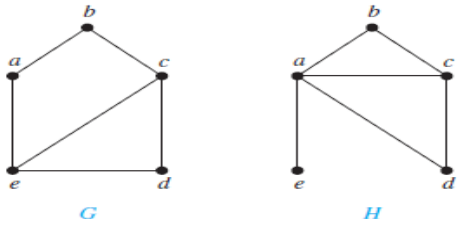
b) Solve the recurrence relation [7M]
$a_n - 6a_{n-1} + 8a_{n-2} = n\,4^n$ where $a_0 = 8$ and $a_1 = 22$.

UNIT-V

9 a) Are the graphs G and H bipartite [7M]

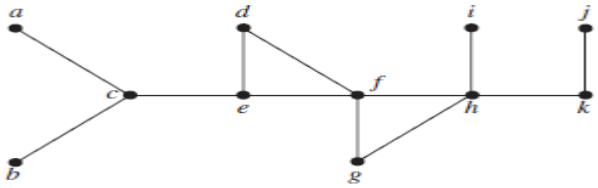


b) Show that the graphs displayed are not isomorphic. [7M]

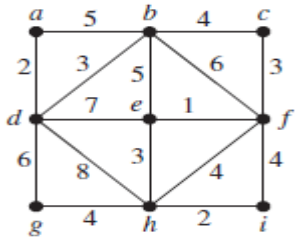


OR

10 a) Use depth-first search to find a spanning tree for the graph *G*. [7M]



b) Use Prim's algorithm to find a minimum spanning tree in the graph [7M]



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Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) Construct the truth table of the compound proposition $(q \rightarrow \neg p) \leftrightarrow (p \leftrightarrow q)$ [7M]

b) Translate the given statement into propositional logic using the propositions provided. You can see the movie only if you are over 18 years old or you have the permission of a parent. Express your answer in terms of *m*: "You can see the movie," *e*: "You are over 18 years old," and *p*: "You have the permission of a parent." [7M]

OR

2 a) Show that $\neg(p \rightarrow q)$ *and* $p \wedge \neg q$ are logically equivalent. [7M]

b) Show that the premises "Everyone in this discrete mathematics class has taken a course in computer science" and "Marla is a student in this class" imply the conclusion "Marla has taken a course in computer science." [7M]

UNIT-II

3 a) Prove that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ for all sets A, B and C. [7M]

b) Let f and g be the functions from the set of integers to the set of integers defined by $f(x) = 2x+3$ and $g(x) = 3x+2$. What is the composition of f and g? What is the composition of g and f? [7M]

OR

4 a) There are 345 students at a college who have taken a course in calculus, 212 who have taken a course in discrete mathematics, and 188 who have taken courses in both calculus and discrete mathematics. How many students have taken a course in either calculus or discrete mathematics? [7M]

b) Let $(S_1, *_1), (S_2, *_2)$, and $(S_3, *_3)$ be semi groups and $f: S_1 \rightarrow S_2$ and $g: S_2 \rightarrow S_3$ be homeomorphisms. Prove that $g \circ f$ is a homomorphism from S_1 to S_3. [7M]

UNIT-III

5 a) Suppose that there are eight runners in a race. The winner receives a gold medal, the second place finisher receives a silver medal, and the third-place finisher receives a bronze medal. How many different ways are there to award these medals, if all possible outcomes of the race can occur and there are no ties? [7M]

b) How many poker hands of five cards can be dealt from a standard deck of 52 cards? Also, how many ways are there to select 47 cards from a standard deck of 52 cards? [7M]

OR
~~~~~~~~~~~~~~~~~~~~~~~~~

6 a) Determine whether each of these integers is prime **i)** 97, **ii)** 111 and **iii)** 143. [7M]

b) Find the greatest common divisor of 1001 and 1331 using the Euclidean algorithm. [7M]

UNIT-IV

7 a) Find a generating function for a_r = the number of integral solutions to the equation $e_1 + e_2 + e_3 = r$ if $0 < e_i$ for each i. [7M]

b) Write an expression for a_r is the coefficient of X^r in the following generating function $A(X)$: $\frac{3}{(1-X)^2} - \frac{7}{(1-2X)^3} + \frac{8}{3+2X}$. [7M]

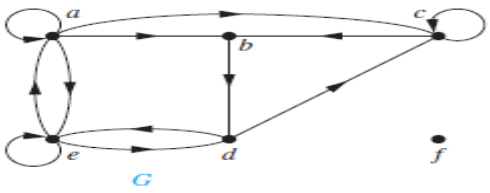
OR

8 a) Solve the following recurrence relation using generating function [7M]
$a_n - 4a_{n-2} = 0$ for $n \geq 2, a_0 = 0, a_1 = 1$.

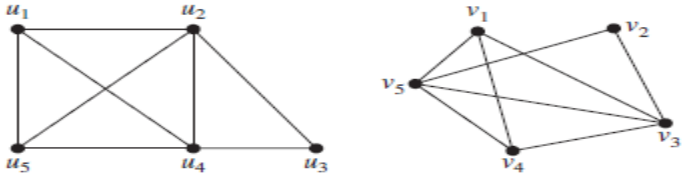
b) Solve the recurrence relation $a_n - 6a_{n-1} + 8a_{n-2} = 3^n$ where $a_0 = 3$ and $a_1 = 7$. [7M]

UNIT-V

9 a) Find the in-degree and out-degree of each vertex in the graph *G* with directed edges . [7M]



b) Determine whether the given pair of graphs is isomorphic. [7M]



OR

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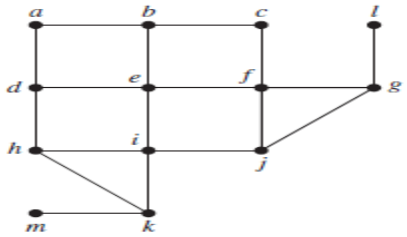
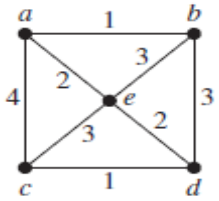
10 a) Use breadth-first search to find a spanning tree for the graph. [7M]



b) Use Kruskal's algorithm to find a minimum spanning tree in the weighted graph. [7M]



Code No: R2021054 **R20** SET - 4

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Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~~

UNIT-I

1 a) Construct the truth table of the compound proposition $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$. [7M]

b) Translate the given statement into propositional logic using the propositions provided. You can graduate only if you have completed the requirements of your major and you do not owe money to the university and you do not have an overdue library book. Express your answer in terms of *g*: "You can graduate," *m*: "You owe money to the university," *r*: "You have completed the requirements of your major," and *b*: "You have an overdue library book." [7M]

OR

2 a) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent. [7M]

b) Show that the premises "A student in this class has not read the book," and "Everyone in this class passed the first exam" imply the conclusion "Someone who passed the first exam has not read the book." [7M]

UNIT-II

3 a) Prove that if A and B are sets, then $\overline{A \cup B} = \overline{A} \cap \overline{B}$. [7M]

b) Let *g* be the function from the set {*a, b, c*} to itself such that *g(a)* = *b*, *g(b)* = *c*, and *g(c)* = *a*. Let *f* be the function from the set {*a, b, c*} to the set {1, 2, 3} such that *f (a)* = 3, *f (b)* = 2, and *f (c)* = 1. What is the composition of *f* and *g*, and what is the composition of *g* and *f* ? [7M]

OR

4 a) In a discrete mathematics class every student is a major in computer science or mathematics, or both. The number of students having computer science as a major (possibly along with mathematics) is 25; the number of students having mathematics as a major (possibly along with computer science) is 13; and the number of students majoring in both computer science and mathematics is 8. How many students are in this class? [7M]

b) What is an algebraic system? How to represent it? Give its properties. [7M]

UNIT-III

5 a) How many permutations of the letters *ABCDEFGH* contain the string *ED*? [7M]

b) How many ways are there to select five players from a 10-member tennis team to make a trip to a match at another school? [7M]

OR

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6 a) Determine whether each of these integers is prime **i)** 21 , **ii)** 29 and **iii)** 71 . [7M]

b) Find the greatest common divisor of 1000 and 5040 using the Euclidean algorithm. [7M]

UNIT-IV

7 a) Build a generating function for a_r = the number of integral solutions to the equation $e_1 + e_2 + e_3 = r$ if $0 \le e_i \le 6$ and e_i is even ; $2 \le e_i \le 7$ and e_i is odd ; $5 \le e_i \le 7$. [7M]

b) Write an expression for a_r is the coefficient of X^r in the following generating function $A(X)$: $\frac{1}{1-X} + \frac{5}{1+2X} + \frac{7}{(1-X)^5}$. [7M]

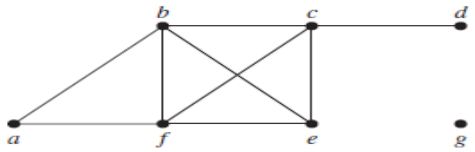
OR

8 a) Solve the following recurrence relation using generating function $a_n - 9a_{n-1} + 20a_{n-2} = 0$ for $n \ge 2, a_0 = -3, a_1 = -10$. [7M]

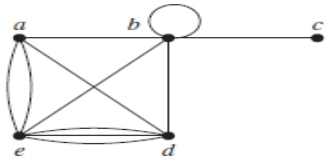
b) Solve the recurrence relation $a_n - 6a_{n-1} + 8a_{n-2} = 9$ where $a_0 = 10$ and $a_1 = 25$. [7M]

UNIT-V

9 a) What are the degrees and what are the neighbourhoods of the vertices in the graphs *G* and *H*? [7M]

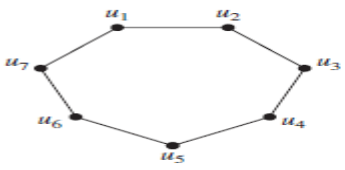


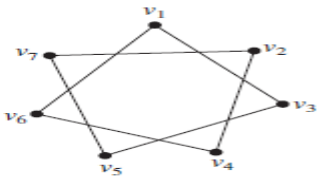
G



H

b) Determine whether the given pair of graphs is isomorphic. [7M]





OR

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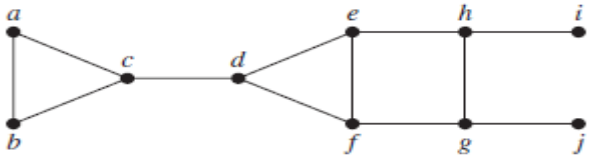
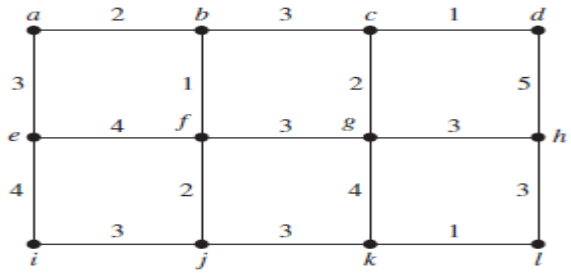
10 a) Use depth-first search to find a spanning tree for the graph *G*. [7M]



b) Use Prim's algorithm to find a minimum spanning tree in the graph. [7M]



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