Fall Semester - 2017 - 18

Continuous Assessment Test - II, October - 2017

Instructions: *Students are allowed to carry their self-hand written notebooks/papers and prescribed textbooks or its photo copy to the examination.*

Course Code : MAT1014

Course Name : Discrete Mathematics and Graph Theory

Faculty Name: G.S.G.N.Anjaneyulu

Duration : 90 Miniutes

Slot : B2 Slot

Date : 03.10.2017

Max. Marks : 50

ANSWER ALL QUESTIONS (50 marks)

1.(a). Let $a*b = a + b + ab$, for all a, b in G. Then explain about the structure (G, *) if

(i) G is set of Natural Numbers (ii). G is set of Real Numbers

(b). Let G be any group. Then prove that the intersection of finite number of subgroups is again subgroup. (6 + 6 Marks)

2.(a). Define a homomorphism on Groups. Let $f: G_1 \rightarrow G_2$ be an homomorphism, then

(i). $f(e_1) = e_2$, for e_1, e_2 are identities in G_1 and G_2 respectively

(ii). $f(a^{-1}) = f(a)^{-1}$ and $f(a^n) = f(a)^n$ for all a in G_1

(b). Explain Group Code in three digits with diagram. How to identify single digit error in three digit group code using redundancy digit? Explain (6 + 7 Marks)

3.(a). Define a lattice and Show that set of all divisors of 70 forms a Lattice with Hasse diagram

(b). If $< L, \leq >$ is a lattice , then $x*(y \oplus z) = (x*y) \oplus (x*z) \Leftrightarrow x \oplus (y*z) = (x \oplus y) *(x \oplus z)$ for all x, y, z in the lattice L. (6 + 7 Marks)

4. (a). In any Boolean algebra, prove that $(a + b')(b + c')(c + a') = (a' + b)(b' + c)(c' + a)$

(b). Suppose that there are five members in a committee, but the Smith and Jones always vote the opposite of Marcus. Design a circuit that implements majority voting of the committee using this relationship between the votes. Adams and Burton are other two members in the committee. (6 + 6 Marks)

Satyaprakash Swain

SCHOOL OF ADVANCED SCIENCES

Department of Mathematics

Winter Semester – 2016 – 2017

Continuous Assessment Test – II, April – 2017

Course Code : MAT 1014 **Slot:C2+TC2**

Course Name : Discrete Mathematics and Graph Theory

Max. Marks : 50 **Duration: 90 Minutes**

Answer ALL Questions(5 x 10 = 50 Marks)

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1. Construct a systematic (7,4) cyclic code using generator polynomial $g(x) = x^3 + x + 1$ with the decoding table. Also if the received word is 110110, determine the transmitted data word. 10

2. (a) Prove that if l_1 and l_2 are elements of a lattice $\langle L; \vee, \wedge \rangle$ then $(l_1 \vee l_2 = l_2) \Leftrightarrow (l_1 \wedge l_2 = l_1) \Leftrightarrow (l_1 \le l_2)$. 5

   (b) For any positive integer n, let $I_n = \{x \mid 1 \le x \le n\}$. Let the relation "divides" be written as $a|b$ iff a divides b or b = ac for some integer c. Draw the Hasse diagram and determine whether $[I_{12}; |]$ is a lattice.

3. (a) Determine the closure property of the structure [5×5 Boolean matrices, $\wedge, \vee, (\bullet)$] with respect to the operations $\wedge, \vee$ and $(\bullet)$. Illustrate using examples and give the identity element, if it exists for all the binary operations. 5

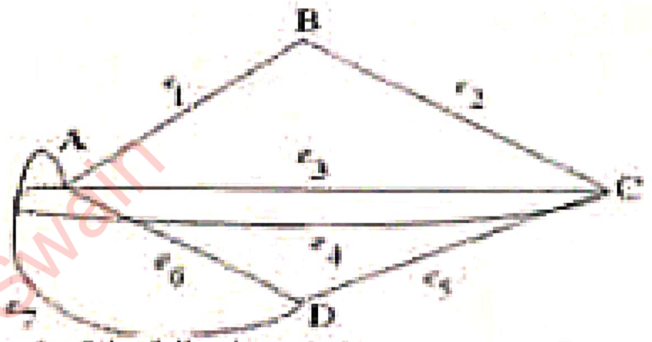
   (b) Draw the Hasse diagram for the poset $(P(A), \subseteq)$ where A = {1, 2, 3, 4} and $P(A)$ is the power set of A. 5

4. (a) Simplify the Boolean function: $F(w,x,y,z) = \sum (0, 1, 2, 3, 4, 6, 8, 9, 12, 13, 14)$ 5

   (b) Use Karnaugh map to simplify the following Boolean expression 5

   $w x \bar{y} \bar{z} + w \bar{x} y z + w \bar{x} y \bar{z} + \overline{w} \bar{x} \bar{y} \bar{z} + \bar{w} x \bar{y} \bar{z} + \bar{w} x y \bar{z} + \bar{w} \bar{x} \bar{y} \bar{z}$

5. (a) Obtain the incidence matrix and the adjacency matrix of the graph given below 5



   (b) Draw a diagraph for each of the following relation 5

   i. Let A = {a, b, c, d} and let R = {(a, b), (b, d), (a, d), (d, a), (d, b), (b, a), (c, c)}

   ii. Let A = {1,2,3,4,5,6,7,8} and Let $x R y$, wherever y is divisible by x.

   iii. Determine which of the relations (i) and (ii) are reflexive, which are transitive, which are symmetric and which are anti symmetric.

CAT-II Sample Paper for Discrete Mathematics and Graph Theory (BMAT205L)

Ankush Chanda

General Instructions: (Please read carefully)

1. The question paper indicates the difficulty level. This sample paper is **not representing IMPORTANT topics** by any means. It is only a **SAMPLE PAPER.**

Q. No.	Question Text	Marks	Unit/ Module
Answer All		Total Marks: 50	
1	Let $G = (\mathbb{Z}, +)$ and $G' = (\mathbb{Z}_n, +)$ and $\varphi : G \to G'$ be defined by $\varphi(m) = \overline{m}$, $m \in \mathbb{Z}$, where $\overline{m}$ is the remainder of $m \pmod n$. Examine φ is a homomorphism.	10	2
2.	Given the generator matrix $$G = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{pmatrix}$$ corresponding to the encoding function $e : B^4 \to B^7$, find the corresponding parity check matrix and use it to decode the following received words and hence, to find the original message: 1101001, 1101000, 1001000, 1111111.	10	2
3.	A_1, A_2, A_3 and A_4 are subsets of a set U containing 75 elements with the following properties. Each subset contains 28 elements; the intersection of any two of the subsets contains 12 elements; the intersection of any three of the subsets contains 5 elements; the intersection of all four subsets contains 1 element. (a) How many elements belong to none of the four subsets? (b) How many elements belong to exactly one of the four subsets? (c) How many elements belong to exactly two of the four subsets?	10	3
4.	i) How many positive integers less than 1000000 have the sum of their digits equal to 19? ii) Use the method of generating functions to solve the recurrence relation: $$a_{n+2} - a_n = 9n^2, \ n \geq 0.$$	10	3

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Q. No.	Question Text	Marks	Unit/ Module
Answer All		Total Marks: 50	
5.	i) Let $\mathcal{F}$ be a non-empty family of finite sets. A relation R is defined on $\mathcal{F}$ by: $$A \text{ R } B \text{ if and only if } A = B \text{ or } \lvert A\rvert < \lvert B\rvert.$$ Show that R is a partial order on $\mathcal{F}$. ii) Let $$A = \{0,1,2\} \times \{2,5,8\}.$$ A partial order relation R on A is defined by $(a,b)R(c,d)$ if and only if $(a+b)$ divides $(c+d)$. (a) Draw a Hasse diagram for the poset A. (b) What are the maximal and minimal elements of the poset A?	5+5	4

Satyaprakash Swain

Reg. No.:

Name :

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test II – October 2022

Programme	: B.Tech.	Semester	:	FALLSEM 2022-23
Course Title	: Discrete Mathematics and Graph Theory	Code	:	BMAT205L
		Slot	:	D2+TD2+TDD2
Faculty(s)	: Dr. Balamurugan B J, Dr. Kalyan Banerjee, Dr. Uma Maheshwari S, Dr. Berin Greeni, Dr. Nathiya N, Dr. Somnath Bera, Dr. Devi Yamini S, Dr. Durga Nagarajan, Dr. Prasannalakshmi, Dr. Dhivya P, Dr. Pavithra R, Dr. Karan Kumar Pradh, Dr. Kamalesh Acharya, Dr. Amit Kumar Rahul	Class Nos.	:	CH2022231001488; CH2022231001464; CH2022231001466; CH2022231001468; CH2022231001470; CH2022231001477; CH2022231001480; CH2022231001482; CH2022231001484; CH2022231001490 CH2022231001493; CH2022231001495; CH2022231001497; CH2022231001500
Time	: 90 Minutes	Max. Marks	:	50

Answer ALL the Questions (5 X 10 = 50 Marks)

Q.No.	Sub. Sec.	Question Description	Marks
1.	a.	Find the code words generated by the parity check matrix $H = \left(\begin{array}{ccc\|ccc} 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{array}\right)$ corresponding to the encoding function: $B^3 \to B^6$. Can all single errors in transmission be detected? Give justification. Decode the received words (a) 111000 and (b) 001110.	5
	b.	How many numbers must be selected from the set $\{1,3,5,7,9,11,13,15\}$ to guarantee that there is at least one pair of numbers such that the sum of the two numbers is 16?	5
2.	a.	How many integers not exceeding 1000 are there divisible by 11, 13, 17?	5
	b.	Passwords on a certain system have exactly 5 letters that are either lowercase letters or uppercase letters. (a) How many possible passwords are there? (b) How many possible passwords are there that use only lowercase letters? (c) How many possible passwords are there with at least one uppercase letter and at least one lowercase letter?	5
3.	a.	Solve the following recurrence relation using generating function: $a_n = 3a_{n-1} - 4a_{n-2}, a_0 = 2\ a_1 = -1$.	7

$G(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + \cdots$

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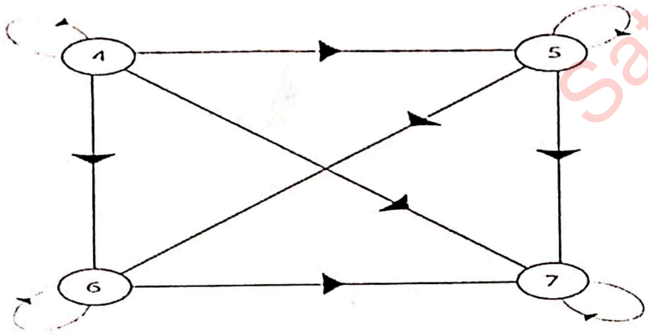
	b.	Find a recurrence relation for the given sequence: $a_n = n + (-1)^n$.	3
4.		Let D_{150} be the set of divisors of 150 and | be the relation defined as $a\|b$ if and only if a divides b. a. Check whether the relation | (divides) is a partially ordered relation. b. Draw the Hasse diagram of the POSET $(D_{150}, \|)$ c. Find the least element and greatest element of the POSET if exists. d. Find the lower bound, upper bound, GLB and LUB of the following sets $\{5,10,25,50\}$ and $\{3,6,15\}$. e. Check whether the POSET is a Lattice or not.	10
5.	a.	i) Give an example of a POSET that is not a lattice along with the justification. (2 Marks) ii) Find the greatest and least elements of the POSET corresponding to the following digraph: (2 Marks) 	4
	b.	Let N denote the set of all natural numbers and R be a relation on $N \times N$ defined by $(a,b)R(c,d)$, if $ad(b+c) = bc(a+d)$. Verify the following properties on the relation R: a) Reflexive b) Symmetric c) Antisymmetric d) Transitive.	6

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Continuous Assessment Test II - OCTOBER 2023

Programme	:	B.Tech.	Semester	:	Fall 2022-23
Course	:	Discrete Mathematics and Graph Theory	Code	:	BMAT205L
			Slot	:	D2+TD2+TDD2
Faculty	:	Dr. Berin Greeni, Dr. Jayagopal R, Dr. Nathiya N, Dr. Somnath Bera Dr. Saurabh Chandra Maury Prof. Aarthy B, Prof. Vignesh R, Prof. Anitha G, Prof. Sumathi S, Prof. Sakthidevi K, Prof. Gnanaprasanna K.	Class ID	:	CH2023240101049, CH2023240101048, CH2023240101050, CH2023240101051, CH2023240101205, CH2023240101199, CH2023240101200, CH2023240101203, CH2023240101206, CH2023240101207, CH2023240101208.
Time	:	90 Minutes	Max.Marks	:	50

Answer ALL the questions $[5 \times 10 = 50]$

1. Suppose the number of bacteria in a colony triples every hour. Also additionally 50 new bacteria is added in each hour.

   a) Set up a recurrence relation for the number of bacteria after n hours have elapsed. **(3 Marks)**

   b) If 100 bacteria are used to begin a new colony, solve the recurrence relation by using generating function. Also, find how many bacteria will be there in the colony in 10 hours? **(7 Marks)**

2. a) Let A be the set of all lines in the plane, and R_1, R_2 be two relations on A defined as follows:
   Definition of R_1 : For all $l_1, l_2 \in A$, $(l_1, l_2) \in R_1$ if and only if l_1 is perpendicular to l_2.
   Definition of R_2 : For all $l_1, l_2 \in A$, $(l_1, l_2) \in R_2$ if and only if l_1 is parallel to l_2.
   Check whether the relations R_1 and R_2 are symmetric, anti-symmetric and transitive.**(5 Marks)**

   b) Examine whether the following degree sequence $\{7,6,6,4,4,3,2,2\}$ is graphical. If yes, construct such a graph. **(3 Marks)**

   c) Is it possible to construct a simple graph with 15 vertices, with each of degree 5? **(2 Marks)**

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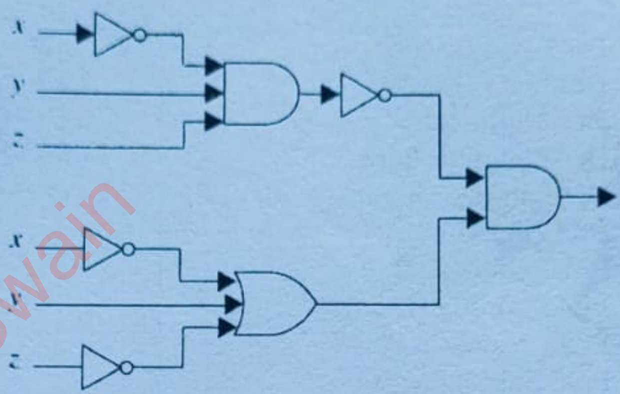
3. Let A be the set of all subgroups of the finite group $(Z_{12}, +_{12})$. Two sets U and V in A are related if and only if $U \subseteq V$. Check this relation is a partially ordered relation or not. If it is, draw the Hasse diagram. Also verify is it a Lattice or not.

4. a) Simplify the following Boolean functions using Karnaugh map? **(7 marks)**

$$f(a,b,c,d) = \prod(0,1,2,5,7,9,10,11,12,15)$$

b) Find the output of the following circuit diagram and also express the output as product of sum. **(3 marks)**



5. a) Consider the adjacency matrix given below. **(5 Marks)**

$$\begin{array}{c} \\ v_1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{array} \begin{array}{c} \begin{array}{cccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array} \\ \begin{pmatrix} 0 & 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \end{pmatrix} \end{array}$$

i) Construct a simple graph corresponding to the given adjacency matrix and label the vertices from v_1 to v_8.

ii) Find the sub-graphs with the vertices $\{v_1, v_8, v_4, v_6\}$ and find its maximum and minimum degree.

b) Construct a simple graph G by considering the factors of 80 as vertices V and the set of edges defined as "two distinct vertices are connected by an edge if and only if the one divides the other or vice versa". **(5 Marks)**

i) Find its incidence matrix and the degree of each vertex.

ii) Is the constructed graph regular.

Satyaprakash Swain

...rsity under section 3 of UGC Act, 1956)

Continuous Assessment Test II - OCTOBER 2023

Programme	:	B.Tech.	Semester	:	Fall 2023-24
Course	:	Discrete Mathematics and Graph Theory	Code	:	BMAT205L
			Slot	:	D1+TD1+TDD1
Faculty	:	Dr. Berin Greeni, Dr. Jayagopal R, Prof. Aarthy B, Prof. Vignesh R, Prof. Anitha G, Prof. Sumathi S, Prof. Sakthidevi K, Prof. Gnanaprasanna K	Class ID	:	CH2023240101195, 1047, 1191, 1192, 1193, 1195, 1196, 1197, 1198
Time	:	90 Minutes	Max.Marks	:	50

Answer ALL the questions [$5 \times 10 = 50$]

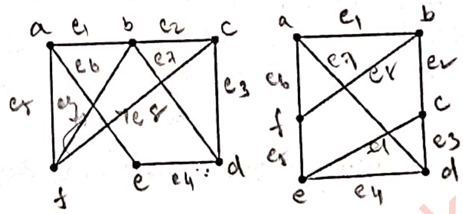
1. Suppose that there are two goats on an island initially. The number of goats on the island doubles every year by natural reproduction and some goats are either added or removed each year.

   a) Construct a recurrence relation for number of goats on the island at the start of the n^{th} year, assuming that during each year an extra 100 goats are put on the island. **(3 Marks)**

   b) Solve the recurrence relation from part (a) to find the number of goats on the island at the start of the n^{th} year. **(7 Marks)**

2. a) Let N be the set all positive integers, and R_1, R_2 be two relations on N defined as follows:
   Definition of R_1: For all $a,b \in N, (a,b) \in R_1$ if and only if $(a+b)$ is even.
   Definition of R_2: For all $a,b \in N, (a,b) \in R_2$ if and only if $\frac{a}{b} = 2^i$ for some integer $i \geq 0$.
   Are relations R_1 and R_2 symmetric, anti-symmetric and transitive. **(5 Marks)**

   b) Consider the two graphs given below. **(5 Marks)**

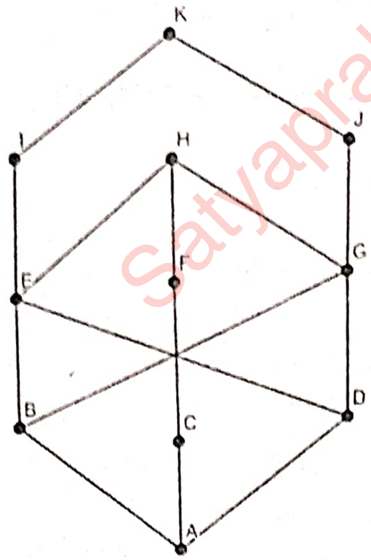


   i) Determine whether the graphs are planar or not, if yes draw the graph.

Satyaprakash Swain

ii) Write the incidence matrix for the above two graphs.

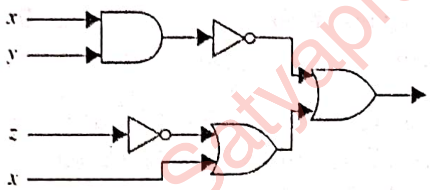
3. a) For the Poset given in the figure below find the maximal, minimal, greatest and least elements if it exists.



b) Determine whether the Poset is a lattice. If not, make minimum changes in the Hasse diagram, so that it becomes a lattice.

c) Find the least upper bound and the greatest lower bound of the subsets $\{B,F,G\}$ and $\{E,C,D\}$.

4. a) Find the output of the following circuit and find it's sum of product. **(3 marks)**



b) Simplify the following Boolean function using Karnaugh map. **(7 marks)**

$$f(a,b,c,d) = \sum(1,2,4,6,10,11,12,13,14,15)$$

5. a) Construct two simple graphs G and H by considering the factors of 12 and 18 as vertices $V(G)$ and $V(H)$, respectively, and the set of edges defined as "two distinct vertices are connected by an edge if and only if the one divides the other or vice versa". **(5 Marks)**

i) Is G isomorphic to H? Justify.

ii) Verify Hand Shaking theorem for these two graphs.

b) Construct a simple graph G by considering the set of numbers starting from 2 to 10 as vertices V and the set of edges defined by the following "two vertices are connected by an edge if and only if the corresponding numbers are co-prime". **(5 Marks)**

i) Find the maximum degree, minimum degree, total number of edges in the graph G.

ii) Is the constructed graph regular? Justify.

Satyaprakash Swain

Reg. Number: 22BCE1351

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Continuous Assessment Test (CAT) – II October 2024

Programme	:	B.Tech.	Semester	:	FALL 2024-2025
Course Code & Course Title	:	BMAT205L Discrete Mathematics and Graph Theory	Slot	:	C2+TC2+TCC2
Faculty	:	Prof. Aarthy B Dr. Amit Kumar Rahul Prof. Anitha G Dr. Ankit Kumar Dr. Padmaja N Dr. Poulomi De Dr. Surath Ghosh	Class Number	:	CH2024250102066 CH2024250102265 CH2024250102267 CH2024250102069 CH2024250102266 CH2024250102068 CH2024250102268
Duration	:	90 Minutes	Max. Mark	:	50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions
(5×10=50)

Q. No	Sub Sec	Description	Marks
1.		How many bit strings of length 8 contain either 3 consecutive 0's or 4 consecutive 1's or both?	[10]
2.		Let R_n represents the number of regions that a plane is divided into by n lines such that no two of the lines are parallel and no three of the lines go through the same point. (i) Form an equation that defines a sequence based on the previous terms with the initial conditions. (ii) Solve the equation by generating function. (iii) Find the number of regions divided by 20 lines under the given condition.	[10]
3.		A set S is defined as $S = \{1,3,5,9,15,25,30,45\}$. A relation R is defined on S such that aRb if and only if "a divides b". (i) Prove that R is a partial order relation [2 marks] (ii) Is R a total order relation [1 mark] (iii) Draw the Hasse diagram of the poset [3 marks] (iv) Hence draw the Hasse diagram of dual of R [1 mark] (v) Find the infimum of $\{3,5,15,30\}$ [1 mark] (vi) Find the supremum of $\{3,5,25,30\}$ [1 mark]	[10]

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		(vii) Find the supremum of {5,9} [1 mark]	
4.	(a)	Consider the poset $X = \{(1,1),(1,2),(1,3),\ldots\} \cup \{(2,1),(3,1),(4,1),\ldots\}$ with the partial order $$f = \bigcup_{\substack{m,n\in N \\ m\le n}} \{((1,m),(1,n))\} \cup \bigcup_{\substack{m,n\in N \\ m\le n}} \{((m,1),(n,1))\},$$ where N is set of natural numbers. (i) Does X have any minimal element(s)? (ii) Does every subset of X have a lower bound? (iii) What type of nonempty subsets of X always have a minimum?	[2+2+1]
	(b)	Find the disjunctive normal form (DNF) and conjunctive normal form (CNF) of the following Boolean expression $$f(x,y,z) = y' + [z' + x + (yz)'](z + x'y)$$	[3+2]
5.	(a)	Draw a picture of the following graph and state whether it is simple or not. Also determine the degree of every vertex of the graph. G1 = (V1, E1), where V1 = {a, b, c, d, e} and E1 = {{a, b}, {b, c}, {a, c} {a, d}, {a, e}}	[2]
	(b)	Is it possible to get a simple graph with the following degree sequence? If yes, then draw the graph and if no, the draw the multigraph. {7, 4, 4, 3, 3, 3}	[2]
	(c)	Consider a graph with 12 vertices and 36 edges. Each vertex has degree 4 or 7. How many vertices of degree 4 and 7 does the graph have?	[3]
	(d)	Suppose that in a group of 5 people: A, B, C, D, and E, the following pairs of people are acquainted with each other. (i) A and C (ii) A and D (iii) B and C (iv) C and D (v) C and E. Write an adjacency and incidence matrix for G	[3]

**********All the best **************

Satyaprakash Swain

$B^2 \to B^5$ $e(00) =$

$e(1) -$

Winter Semester 2018-19

Continuous Assessment Test – II

VIT

Vellore Institute of Technology

Programme Name & Branch: B. Tech.

Course Name & Code: Discrete Mathematics and Graph theory-MAT1014

Slot: A2

Exam Duration: 90 minutes

Maximum Marks: 50

Answer All the Questions ($5 \times 10 = 50$)

1. a. Show that in a group (G,*), if for any a, b in G, $(a*b)^2=a^2*b^2$, then (G,*) must be abelian. (5)

   b. Let a and b be non-identity elements of different orders in a group of order 155. Prove that the only subgroup of G that contains both a and b is G itself. (5)

2. a. Devise a single error correcting group code (2,5) with parity bits $x_3=x_1$, $x_4=x_2$ and $x_5=x_1+x_2$. Find its parity check matrix, generator matrix, group code and decoding table. Correct the single error in the received word 10001 using decoding table. (6)

   b. If $x \le y$ and $z \le w$, then prove that $x \wedge z \le y \wedge w$ and $x \vee z \le y \vee w$. (4)

3. a. Prove that (S_{30}, D), S_{30} the set of divisors of 30, is a Poset. Draw its Hasse diagram. Find LUB and GLB of every pair of elements and hence show that (S_{30}, D) is a lattice. (4)

   b. In any Boolean Algebra, show that (6)

      (i) $a = b \Leftrightarrow ab' + a'b = 0$

      (ii) $(a+b)(a'+c) = ac + a'b = ac + a'b + bc$ $(a+a')$

      abc $a'b$

4. a. Let $S = \{1,2,3\}$. Prove that $(P(S), \cup, \cap, ')$, $P(S)$ *the power set of* S, is a Boolean algebra. List all sub-Boolean algebra of the Boolean algebra. (5)

   b. Expand $f(x,y,z) = x*y + y*z'$ into its sum of products canonical form (5)

5. a. Show that in a lattice with two or more elements, no element is its own complement. (4)

   b. Reduce the Boolean function (6)

   $f(a,b,c,d) = a'b'c'd' + a'b'cd' + ab'c'd' + abcd$ by using Karnaugh map.

Satyaprakash Swain

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Fall Semester – 2019-2020
Continuous Assessment Test – II
Programme Name & Branch : B.Tech./M.Tech.

Course Code & Name : MAT 1014 – Discrete Mathematics and Graph Theory

Slot : A2+TA2+TAA2

Exam Duration : 90 Minutes Maximum Marks : 50

Answer ALL the Questions

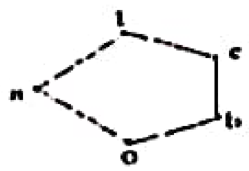
Each question carries equal marks ($5 \times 10 = 50$ Marks)

1. (i) Prove that $\{1, -1\}$ is a normal subgroup of the multiplication group $G = \{1, i, -i, -1\}$.
(ii) Consider the homomorphism f from Z onto Z_n defined by $f(m) = [r]$, where r is the remainder, when m is divided by n. Find $ker(f)$.
[10 M]

2. Consider the group coding function $e : B^2 \to B^4$ defined by $e(00) = 0000$, $e(10) = 1001$, $e(01) = 0111$ and $e(11) = 1111$. Decode the following words (a) 0011 (b) 1011 (c) 1111.
[10 M]

3. (i) Let $X = \{2, 3, 4, 6, 12, 36, 48\}$ and let R be the relation xRy if x divides y. Draw the Hasse diagram of R.
(ii) Let R be a relation on a set A. Then define $R^{-1} = \{(a, b) \in A \times A | (b, a) \in R\}$. Prove that if (A, R) is a poset then (A, R^{-1}) is also a poset.
[10 M]

4. (i) Verify whether the lattice given by the Hasse diagram in the figure below is distributive.



(ii) Consider the lattice $D_{60} = \{1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60\}$, the divisors of 60 ordered by divisibility.
(a) Draw the diagram of D_{60}.
(b) Find the LUB and GLB of 10 and 15?
(c) Find complements of 2 and 10, if they exist.
(d) Express each number x as the join of a minimum number of irredundant join irreducible elements.
[10 M]

5. (i) Show that the following Boolean expressions are equivalent to one another
(a) $(x \oplus y) \bullet (x' \oplus z) \bullet (y \oplus z)$
(b) $(x \bullet z) \oplus (x' \bullet y) \oplus (y \bullet z)$.
(ii) Simply the Boolean expression $((x_1 + x_2) + (x_1 + x_3)).x_1.\overline{x_2}$
[10 M]

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Satyaprakash Swain

Reg. No.:

Name :

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test II – October 2022

Programme	:	B.Tech.	Semester	:	FALLSEM 2022-23
Course Title	:	Discrete Mathematics and Graph Theory	Code	:	BMAT205L
			Slot	:	D1+TD1+TDD1
Faculty(s)	:	Dr.Balamurugan B J, Dr.V.Vidhya, Dr.Kalyan Banerjee, Dr.S.Uma Maheswari, Dr.N.Nathiya, Dr.Somnath Bera, Dr.S.Devi Yamini, Dr.Durga Nagarajan, Dr.Prasannalakshmi, Dr.P.Dhivya, Dr.Saurabh Chandra Maury, Dr.Kamalesh Acharya, Dr.Amit kumar Rahul	Class Nos.		CH2022231001430, CH2022231001431, CH2022231001432, CH2022231001434, CH2022231001436, CH2022231001439, CH2022231001443, CH2022231001444, CH2022231001446, CH2022231001449, CH2022231001452, CH2022231001455, CH2022231001458
Time	:	90 Minutes	Max. Marks	:	50

Answer ALL the Questions (5 X 10 = 50 Marks)

Q.No.	Sub. Sec.	Question Description	Marks
1.	a.	Let $G = \begin{pmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{pmatrix}$ be the generator matrix corresponding to the encoding function $e: B^3 \to B^6$. Decode the following received words and hence find the original message: 111101, 100100, 111100, 010100.	5
	b.	A bowl consists of 10 red balls and 10 blue balls. A man selects balls at random without looking at them. How many balls must he select to be sure of having three balls of the same color? How many balls must he select to be sure of having at least three blue balls?	5

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		1.b There are two boxes corresponding to Red and Blue balls. we have to select balls. Say N s.t. $\lceil \frac{N}{2} \rceil \geq 3$ — 1 So then by strong Pigeonhole principle at least one box has 3 balls, (so they are of the same color). So N must be 5 $\lceil \frac{5}{2} \rceil = \lceil 2.5 \rceil = 3$ — 2 marks. The no. of balls to select to ensure 3 blue balls is $10+3=13$, because 10 Red balls are exhausted and ~~one~~ the box for blue balls has at least 3 balls. — 2 marks	
2.	a.	How many permutations of the letters ABCDEFG contain the string BCD? How many permutations contain the strings BA and GF?	5

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2.(a) How many permutations of the letter ABCDEFG contains BCD? How many contain BA and GF

Ans: BCD is appearing as a block in the letter.

Except BCD there are A~~B~~EFG

so total AEFG BCD

5 letters, no. of permutation

5!. — ② marks

A:= The letters containing BA is arranged like CDEFG BA

the no. is 6!.,

the no. of strings with

B:= Similarly no. 6!, — 2 marks

GF is principle of inclusion

B:= Similarly no. 6!, — 2 marks

GF is principle of inclusion

Then by principle of inclusion exclusion

$|A \cap B| = |A \cup B| - (|A| + |B|)$

$= 7! - 2 \cdot 6!$

1 ← mark

	b.	Of 1000 applicants for a mountain climbing trip in the Himalayas, 450 got altitude sickness, 622 are not in good shape, and 30 having allergies. An applicant is selected if and only if he/she does not have altitude sickness, is in good shape and does not have allergies. If there are 111 applicants who have altitude sickness and are not in good shape, 14 have altitude sickness and allergies, 18 who are not in good shape and allergies, 9 have altitude sickness, not in good shape and have allergies, how many applicants qualify?	5

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		b) Total of 1000 Applicants 450 got altitude sickness $= A$ 622 are not in good shape $= B$ 30 having allergies $= C$ — ② marks $111 = \|A \cap B\|$ $14 = \cancel{\|B \cap A\|} = \|A \cap C\|$ $18 = \cancel{\|B \cap A\|} = \|B \cap C\|$ $\|A \cap B \cap C\| = 9$ — ① marks By principle of inclusion-excl. $\|A \cup B \cup C\| = \|A\|+\|B\|+\|C\| - \|A \cap B\| - \|B \cap C\| - \|C \cap A\| + \|A \cap B \cap C\|$ $\|A \cap B \cap C\| = 9$ — ① marks By principle of inclusion-excl. $\|A \cup B \cup C\| = \|A\|+\|B\|+\|C\| - \|A \cap B\| - \|B \cap C\| - \|C \cap A\| + \|A \cap B \cap C\|$ $= 450 + 622 + 30 - 111 - 18 - 14 + 9$ $= 1102 - 134 = 968$ So the people qualifying is $1000 - 968 = 32$ — ① mark	
3.	a.	Solve the following recurrence relation using generating function: $a_n = a_{n-1} + 3a_{n-2}$, $a_0 = 1$ $a_1 = 2$.	7

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3. a) $a_n = a_{n-1} + 3a_{n-2}$ $a_1 = 2$

~~Substitute~~ multiply by x^n on both sides and take sum

$$\sum_{n=2}^{\infty} a_n x^n = \sum_{n=1}^{\infty} a_{n-1} x^n + 3\sum_{n=2}^{\infty} a_{n-2} x^n$$

$$= x\sum_{n=1}^{\infty} a_{n-1} x^{n-1} + 3x^2 \sum_{n=0}^{\infty} a_{n-2} x^{n-2} \quad \text{— (1) mark}$$

$$A(x) = \sum_{n=0}^{\infty} a_n x^n$$

So we have

$$A(x) - a_0 - a_1 x = x(A(x) - a_0) + 3x^2 A(x).$$

$$A(x)(1 - x - 3x^2) = a_0 - a_0 x + a_1 x$$

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$A(x)(1-x-3x^2) = 1 - x + 2x$

$= 1 + x$

$A(x) = \dfrac{1+x}{1-x-3x^2}$ — (2)

$1 - x - 3x^2 = 0$

$\Rightarrow 3x^2 + x - 1 = 0$

$\Rightarrow x = \dfrac{-1 \pm \sqrt{1+12}}{2 \cdot 3}$

$= \dfrac{-1 \pm \sqrt{13}}{6}$

$A(x) = \dfrac{x-1}{(x-\alpha)(x-\beta)} = \dfrac{A}{x-\alpha} + \dfrac{B}{x-\beta}$

$\Rightarrow A(x-\beta) + B(x-\alpha)$

$= x+1$

$x(A+B) = x \qquad A+B = 1$

$-\beta A - \alpha B = 1$

$-\left(\dfrac{-1 \pm \sqrt{13}}{6}\right)A - \left(\dfrac{-1-\sqrt{13}}{6}\right)B$

$= 1$

$x(A+B) = x \qquad A+B = 1$

$-\beta A - \alpha B = 1$

$-\left(\dfrac{-1 \pm \sqrt{13}}{6}\right)A - \left(\dfrac{-1-\sqrt{13}}{6}\right)B$

$= 1$

Solving this we get A, B and the corresponding series.

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		$\frac{A}{6}+\frac{B}{6}+\frac{\sqrt{13}}{6}(B-A)=1$ $\frac{A+B}{6}+\frac{\sqrt{13}}{6}(B-A)=1$ $A+B+\sqrt{13}(B-A)=6$ $\sqrt{13}(B-A)=5$ $B-A=5/\sqrt{13}$ $B+A=1$ So lving $2B=1+\frac{5}{\sqrt{13}}$ $B=\frac{1}{2}+\frac{5}{2\sqrt{13}}$ $2A=1-5/\sqrt{13}$ $A=\frac{1}{2}-\frac{5}{2\sqrt{13}}$ So the series ~~as~~ is $\frac{\frac{1}{2}-\frac{5}{2\sqrt{13}}}{(x-\alpha)}+\frac{\frac{1}{2}+\frac{5}{2\sqrt{13}}}{(x-\beta)}$ $\left(\frac{1}{2}-\frac{5}{2\sqrt{13}}\right)\left[1+\alpha/x+\frac{\alpha^2}{x^2}+\cdots\right]$ $+\left(\frac{1}{2}+\frac{5}{2\sqrt{13}}\right)\left[1+\beta/x+\beta^2/x^2+\cdots\right]$ from this we derive a_n —— 3 marks.	
	b.	Find a recurrence relation for the given sequence: $a_n = 2n + 3.$ b) $a_n = 2n+3$ $a_{n-1} = 2(n-1)+3$ $= 2n+1$ —— 1 mark $a_n = 2n+1+2$ $= a_{n-1}+2$ $\boxed{a_n = a_{n-1}+2}$ —— 2 marks.	3
4.	a.	Consider the set of students in Discrete Mathematics class. For any two students x, y in the class, we say xRy if the difference in their CAT-I marks is greater than 20. Check whether the relation R is reflexive, symmetric, antisymmetric, and transitive.	5

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a) xRy if the difference in their CAT-1 marks is greater than 20. [ie xRy iff $x-y>20$] — 1

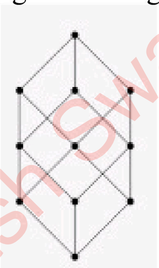
(1) R is not reflexive — 1

(2) R is ~~not~~ symmetric — 1

(3) R is not antisymmetric — 1

(4) R is transitive — 1

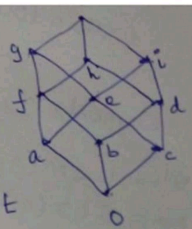
b. Label the elements and check whether the partially ordered set given in the following Hasse diagram is a Lattice or not. **5**



$g \wedge i = e$; $g \vee i = 1$;

$b \wedge e = 0$
$b \vee e =$ doesn't exist

$h \wedge e =$ doesn't exist
$h \vee e = 1$



$a \wedge b = 0$; $b \wedge c = 0$
$a \vee b = f$; $b \vee c = d$
$a \wedge c = 0$; $e \wedge f = a$
$a \vee c = e$; $e \vee f = g$
$e \wedge d = c$; $f \wedge d = b$
$e \vee d = i$; $f \vee d = h$
$g \wedge h = f$; $h \wedge i = d$
$g \vee h = 1$; $h \vee i = 1$

It is not a Lattice.

5. Let D_{200} be the set of divisors of 200 and | be the relation defined as $a|b$ if and only if *a divides b*. **10**

a. Check whether the relation | (divides) is a partially ordered relation.
b. Draw the Hasse diagram of the POSET $(D_{200}, |)$
c. Find the least element and greatest element of the POSET if exists.
d. Find the lower bound, upper bound, GLB and LUB of the following sets $\{8,10,20,40\}$ and $\{50,100\}$.
e. Check whether the POSET is a Lattice or not.

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$D_{200} = \{1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 200\}$

a) Yes it is a Partially ordered relation.

b) Least element 1, greatest element 200.

d) Lower bound of $\{8, 10, 20, 40\} = \{1, 2, 4\}$

GLB = 4

" $\{50, 100\} = \{1, 2, 4, 5, 10, 25, 50\}$

GLB = 50

Upper bounds of $\{8, 10, 20, 40\} = \{40, 200\}$

LUB = 40

" $\{50, 100\} = \{100, 200\}$

LUB = 100

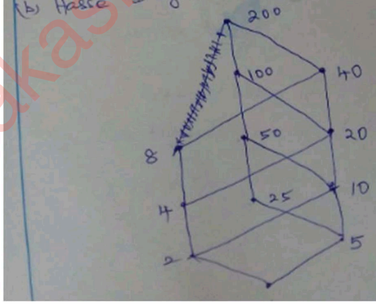
(e) For every pair of elements $(a, b) \in D_{200}$

$a \vee b = LCM(a, b)$ exist

$a \wedge b = GCD(a, b)$

$\therefore (D_{200}, /)$ is a Lattice.

(b) Hasse Diagram.



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Satyaprakash Swain

Reg. No.:

Name :

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test II – October 2022

Programme	:	B.Tech.	Semester	:	FALLSEM 2022-23
Course Title	:	Discrete Mathematics and Graph Theory	Code	:	BMAT205L
			Slot	:	D2+TD2+TDD2
Faculty(s)	:	Dr. Balamurugan B J, Dr. Kalyan Banerjee, Dr. Uma Maheshwari S, Dr. Berin Greeni, Dr. Nathiya N, Dr. Somnath Bera, Dr. Devi Yamini S, Dr. Durga Nagarajan, Dr. Prasannalakshmi, Dr. Dhivya P, Dr. Pavithra R, Dr. Karan Kumar Pradh, Dr. Kamalesh Acharya, Dr. Amit Kumar Rahul	Class Nos.		CH2022231001488; CH2022231001464; CH2022231001466; CH2022231001468; CH2022231001470; CH2022231001477; CH2022231001480; CH2022231001482; CH2022231001484; CH2022231001490 CH2022231001493; CH2022231001495; CH2022231001497; CH2022231001500
Time	:	90 Minutes	Max. Marks	:	50

Answer ALL the Questions (5 X 10 = 50 Marks)

Q.No.	Sub. Sec.	Question Description	Marks
1.	a.	Find the code words generated by the parity check matrix $H = \begin{pmatrix} 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{pmatrix}$ corresponding to the encoding function$e: B^3 \to B^6$. Can all single errors in transmission be detected? Give justification. Decode the received words (a) 111000 and (b) 001110.	5

	b.	How many numbers must be selected from the set {1,3,5,7,9,11,13,15} to guarantee that there is at least one pair of numbers such that the sum of the two numbers is 16? 1. (b) Given set is {1,3,5,7,9,11,13,15} We can group eight numbers into four subsets of two integer each such that sum of two elements is 16. {1,15}, {3,13} {5,11} {7,9}. If we select five integers from this set, then by pigeonhole principle, atleast two of them must come from the same subset. and these two integers have a sum of 16. ∴ 5 numbers must be selected from the given set.	5
2.	a.	How many integers not exceeding 1000 are there divisible by 11, 13, 17? (a) There is no integers not exceeding 1000, which is divisible by 11, 13, 17. [we did not realize that 11, 13, 17 are co-primes. The number, divisible by 11, 13, 17 must be divisible by 11.13.17 = 2431] Ans: is: no integer exists not exceeding 1000.	5
	b.	Passwords on a certain system have exactly 5 letters that are either lowercase letters or uppercase letters. (a) How many possible passwords are there? (b) How many possible passwords are there that use only lowercase letters? (c) How many possible passwords are there with at least one uppercase letter and at least one lowercase letter?	5

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		(b) Passwords have exactly 5 letters. There are 26 lowercase and 26 uppercase le Total 52 letters (a) 52^5 possible passwords are there. (b) 26^5 possible passwords, having only lowerca letters. (c) $52^5 - 26^5 - 26^5 = 52^5 - 2 \cdot 26^5$ Reason Total no of passwords $-$ (no of passwords h only lowercase letters + no of passwords ha uppercase letters) = no of passwords hav atleast one uppercase and at least on lowercase letter.	
3.	a.	Solve the following recurrence relation using generating function: $a_n = 3a_{n-1} - 4a_{n-2}, a_0 = 2\ a_1 = -1.$ $a_n = 3a_{n-1} - 4a_{n-2}, \quad a_0 = 2, a_1 = -1$ $\Rightarrow a_n x^n = 3a_{n-1}x^n - 4a_{n-2}x^n$ $\Rightarrow \sum_{n=2}^{\infty} a_n x^n = 3x\sum_{n=2}^{\infty} a_{n-1}x^{n-1} - 4x^2\sum_{n=2}^{\infty} a_{n-2}x^{n-2}$ $\Rightarrow \sum_{n=0}^{\infty} a_n x^n - a_0 - a_1 x = 3x\left[\sum_{n=1}^{\infty} a_{n-1}x^{n-1} - a_0\right] - 4x^2\sum_{n=0}^{\infty} a_n x^n$ $\Rightarrow G(x) - 2 + x = 3x(G(x) - 2) - 4x^2 G(x)$ $\left[\because G(x) = \sum_{n=0}^{\infty} a_n x^n\right]$ $\Rightarrow G(x)(1 - 3x + 4x^2) = 2 - x - 6x = 2 - 7x$ $\Rightarrow G(x) = \dfrac{2-7x}{1-3x+4x^2}$ (6 Marks)	7

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		$\Rightarrow G(x) = \dfrac{2-7x}{1-3x+4x^2}$. (6 Marks) After this any further steps to find a_n, (1 Mark) [This step is complicated as denominator can't be factorized]	
	b.	Find a recurrence relation for the given sequence: $a_n = n + (-1)^n$. 3 (b). $a_n = n + (-1)^n$ $a_{n-1} = n-1 + (-1)^{n-1}$ If n is even, $a_n - a_{n-1} = 1+1+1 = 3$. If n is odd, $a_n - a_{n-1} = 1-1-1 = -1$ $\therefore a_n - a_{n-1} = \begin{cases} 3, & \text{if } n \text{ is even.} \\ -1, & \text{if } n \text{ is odd} \end{cases}$ is the required recurrence relation for the given sequence.	3
4.		Let D_{150} be the set of divisors of 150 and | be the relation defined as $a\|b$ if and only if *a divides b*. a. Check whether the relation | (divides) is a partially ordered relation. b. Draw the Hasse diagram of the POSET $(D_{150}, \|)$ c. Find the least element and greatest element of the POSET if exists. d. Find the lower bound, upper bound, GLB and LUB of the following sets $\{5,10,25,50\}$ and $\{3,6,15\}$. e. Check whether the POSET is a Lattice or not.	10

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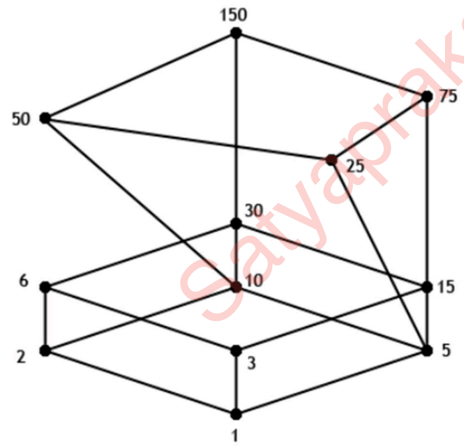
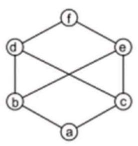
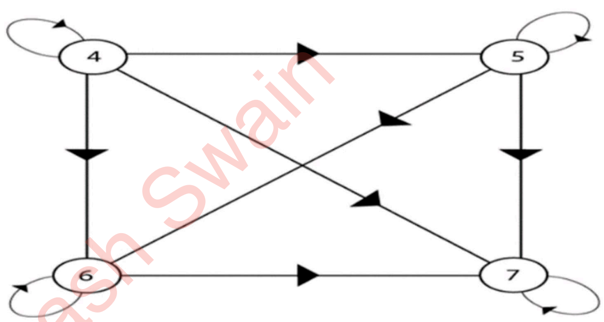
		4) $(D_{150}, \|)$  For {5,10,25,50} Upper Bound = {50,150} Lower bound = {1,5}. LUB = 50 GLB = 5 For {3,6,15} Upper Bound = {30,150} Lower bound = {1,3}. LUB = 30 GLB = 3	
5.	a.	i) Give an example of a POSET that is not a lattice along with the justification. (2 Marks) a) i) Example of a POSET but not a lattice LUB of {d, e} does not exists.  ii) Find the greatest and least elements of the POSET corresponding to the following digraph: (2 Marks)  	4

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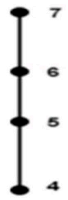
ii) The Hasse diagram is as shown in fig:



Greatest element is 7

Least element is 4

b. Let N denote the set of all natural numbers and R be a relation on $N \times N$ defined by $(a,b)R(c,d), if\ ad(b+c) = bc(a+d)$. Verify the following properties on the relation R: a) Reflexive b) Symmetric c) Antisymmetric d) Transitive. 6

$(a, b)R(c, d) \Leftrightarrow ad(b + c) = bc(a + d)$

$ab(b + a) = ba(a + b) \Rightarrow (a, b)R(a, b)$

Thus, the given relation is reflexive

$(a, b)R(c, d) \Rightarrow ad(b + c) = bc(a + d)$

$ad(b + c) = bc(a + d) \Rightarrow cb(d + a) = da(c + b) \Rightarrow (c, d)R(a, b)$

$\therefore (a, b)R(c, d) \Rightarrow (c, d)R(a, b)$

Thus, the given relation is symmetric

$(a, b)R(c, d) \Leftrightarrow ad(b + c) = bc(a + d) \Rightarrow \frac{1}{b} + \frac{1}{c} = \frac{1}{a} + \frac{1}{d}$.....(1)

$(c, d)R(e, f) \Leftrightarrow cf(d + e) = de(c + f) \Rightarrow \frac{1}{f} + \frac{1}{c} = \frac{1}{e} + \frac{1}{d}$....(2)

$(2) - (1) \Rightarrow \frac{1}{f} - \frac{1}{b} = \frac{1}{e} - \frac{1}{a} \Rightarrow \frac{1}{f} + \frac{1}{a} = \frac{1}{e} + \frac{1}{b} \Rightarrow af(b + e) = be(a + f) \Rightarrow (a, b)R(e, f)$

$\therefore (a, b)R(c, d) \& (c, d)R(e, f) \Rightarrow (a, b)R(e, f)$

Thus, the given relation is transitive.

b) It is Reflexive, Symmetric, not antisymmetric, transitive.

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Reg. Number: 22BCE1335

VIT
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CHENNAI

Continuous Assessment Test (CAT) – II October 2024

Programme	:	B.Tech.	Semester	:	FALL 2024-2025
Course Code & Course Title	:	BMAT205L Discrete Mathematics and Graph Theory	Slot	:	C2+TC2+TCC2
Faculty	:	Prof. Aarthy B Dr. Amit Kumar Rahul Prof. Anitha G Dr. Ankit Kumar Dr. Padmaja N Dr. Poulomi De Dr. Surath Ghosh	Class Number	:	CH2024250102066 CH2024250102265 CH2024250102267 CH2024250102069 CH2024250102266 CH2024250102068 CH2024250102268
Duration	:	90 Minutes	Max. Mark	:	50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions
(5×10=50)

Q. No	Sub Sec	Description	Marks
1.		How many bit strings of length 8 contain either 3 consecutive 0's or 4 consecutive 1's or both?	[10]
2.		Let R_n represents the number of regions that a plane is divided into by n lines such that no two of the lines are parallel and no three of the lines go through the same point. (i) Form an equation that defines a sequence based on the previous terms with the initial conditions. (ii) Solve the equation by generating function. (iii) Find the number of regions divided by 20 lines under the given condition.	[10]
3.		A set S is defined as $S = \{1,3,5,9,15,25,30,45\}$. A relation R is defined on S such that aRb if and only if "a divides b". (i) Prove that R is a partial order relation [2 marks] (ii) Is R a total order relation [1 mark] (iii)Draw the Hasse diagram of the poset [3 marks] (iv)Hence draw the Hasse diagram of dual of R [1 mark] (v) Find the infimum of $\{3,5,15,30\}$ [1 mark] (vi)Find the supremum of $\{3,5,25,30\}$ [1 mark]	[10]

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		(vii) Find the supremum of $\{5,9\}$ [1 mark]	
4.	(a)	Consider the poset $X=\{(1,1),(1,2),(1,3),\ldots\}\cup\{(2,1),(3,1),(4,1),\ldots\}$ with the partial order $$f=\bigcup_{\substack{m,n\in N\\ m\le n}}\{((1,m),(1,n))\}\cup\bigcup_{\substack{m,n\in N\\ m\le n}}\{((m,1),(n,1))\},$$ where N is set of natural numbers. (i) Does X have any minimal element(s)? (ii) Does every subset of X have a lower bound? (iii) What type of nonempty subsets of X always have a minimum?	[2+2 +1]
	(b)	Find the disjunctive normal form (DNF) and conjunctive normal form (CNF) of the following Boolean expression $$f(x,y,z)=y'+[z'+x+(yz)'](z+x'y)$$	[3+2]
5	(a)	Draw a picture of the following graph and state whether it is simple or not. Also determine the degree of every vertex of the graph. G1 = (V1, E1), where V1 = {a, b, c, d, e} and E1 = { {a, b}, {b, c}, {a, c} {a, d}, {a, e} }	[2]
	(b)	Is it possible to get a simple graph with the following degree sequence? If yes, then draw the graph and if no, the draw the multigraph. {7, 4, 4, 3, 3, 3}	[2]
	(c)	Consider a graph with 12 vertices and 36 edges. Each vertex has degree 4 or 7. How many vertices of degree 4 and 7 does the graph have?	[3]
	(d)	Suppose that in a group of 5 people: A, B, C, D, and E, the following pairs of people are acquainted with each other. (i) A and C (ii) A and D (iii) B and C (iv) C and D (v) C and E. Write an adjacency and incidence matrix for G.	[3]

**********All the best *************

Satyaprakash Swain

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