SOMAIYA VIDYAVIHAR UNIVERSITY

03/06/2024 (E)

Maximum Marks: 100 Programme code: 01 Programme: UG	Semester: Jan 2024 - April 2024 Examination: ESE Examination (KT)	Duration:3 Hrs.
Name of the Constituent College: K. J. Somaiya College of Engineering	Class: S.Y. B. Tech.	Semester: III (SVU 2020)
		Name of the department: COMPUTER
Course Code: 116U01C305	Name of the Course: Discrete Mathematics	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary		

Que. No.	Question	Max. Marks
Q1	Solve any **Four**	20
i)	Let A = {a, b, {a, b}, {{a, b}}}, Identify following statements are true or false. Justify your answer: i. $a \in A$ ii. $\{a\} \in A$ iii. $\{a, b\} \subseteq A$ iv. $\{a, \{b\}\} \subseteq A$ v. $\{\{a, b\}\} \subseteq A$	5
ii)	In a town with 60 people, 25 people read The Hindu newspaper, 26 read The Times of India, 26 read Indian Express, 9 read both The Hindu and The Indian Express, 11 read both The Hindu and The Times of India, and 8 read The Times of India and The Indian Express. How many people read all three newspapers? Also, draw suitable Venn diagram for the same.	5
iii)	Let S = {red, blue, green, yellow}, Determine which of the following is a partition of S. Justify your answer. i. {{red}, {blue, green}} ii. {{blue}, {red, green, yellow}}	5
iv)	If $(\neg P \vee Q)$ is 'false' then find the values of P and Q respectively? Justify.	5
v)	Show that using laws of logic and using Venn diagram: $A \cup (A^c \cap B) = A \cup B$.	5
vi)	Transcribe the following into logical notation. Let the universe of discourse be the real numbers. i. There are positive values of x and y such that $x \cdot y > 0$. ii. There is a value of x such that if y is positive, then x + y is negative.	5

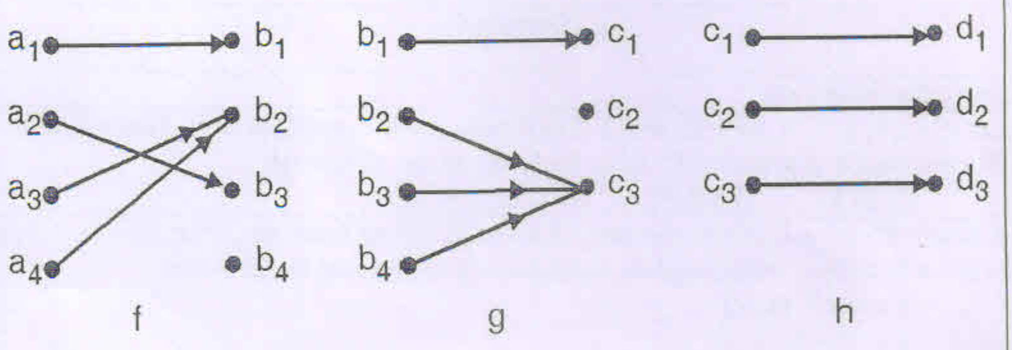
Que. No.	Question	Max. Marks
Q2 A	Solve the following	10
i)	Let A = {1, 2, 3, 4, 6} = B, a R b if and only if a is a multiple of b. Find relation 'R' and obtain digraph of R. Also find each of the following : (i) R(3) (ii) R(6) (iii) R({2, 4, 6})	5
ii)	Assume P(x) = x is Even Number, Q(x) = x is Prime Number , R (x, y) = (x + y) is Even Number, write English sentences corresponding to following: i. $\forall x \exists y R(x, y)$ ii. $\exists x \forall y R(x, y)$ iii. $\forall x (\sim Q(x))$ iv. $\exists x (\sim P(x))$ v. $\forall x (P(x))$	5

OR

Q2 A	Justify which of the following is/are True or False. i. $(p \land (\neg p))$ is Tautology. ii. $(p \lor (\neg p))$ is Contradiction. iii. $(P \land \neg Q) \lor (Q \land \neg P)$ is equivalent to $(P \lor Q) \land (\neg P \lor \neg Q)$ iv. $(P \lor Q) \land (\neg P \lor \neg Q)$ is equivalent to $P \land Q$ v. $(p \lor (q \land r) \equiv (p \lor q) \land (p \lor r)$ shows distribution law.	10
Q 2 B	Solve any **One**	**10**
i)	What is the 'Principle of Mathematical Induction'? Using 'Principle of Mathematical Induction' prove that: $1 + 3 + 5 + \ldots + (2n + 1) = n^2$	10
ii)	Let A ={1, 2, 3, 4, 5} and R be the relation defined by a R b if and only if a < b. i. Determine : R, R^2, R^3. ii. Draw diagraphs for R, R^2, R^3.	10

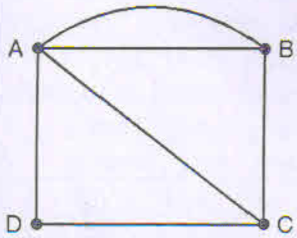
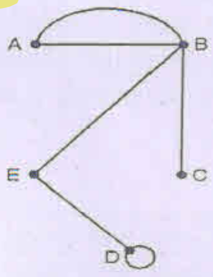
Que. No.	**Question**	**Max. Marks**
Q3	Solve any **Two**	**20**
i)	Let A = {a, b, c, d} and M_R is as follows: $M_R = \begin{bmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ i. Prove that R is 'Partial Order'. ii. Draw 'Hasse Diagram' for R.	10
ii)	Verify that D_{20} is a valid 'Lattice'. Also check whether D_{20} is a 'Complemented Lattice'?	10
iii)	What is the criterion for two lattices to be 'Isomorphic Lattices'? Explain with suitable example with justifications.	10

Que. No.	**Question**	**Max. Marks**
Q4	Solve any **Two**	**20**
i)	What is 'Algebraic System? If, N = Set of all natural numbers, Z = Set of all integers. Prove that: (N, +) and (Z, +, −) are algebraic systems.	10
ii)	$A = \{ a_1, a_2, a_3, a_4 \}$, $B = \{ b_1, b_2, b_3, b_4 \}$, $C = \{c_1, c_2, c_3\}$, $D = \{ d_1, d_2, d_3 \}$.	10



Determine: 'h o (g o f)' and '(h o g) o f'

iii)	Let $H = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ be a parity check matrix. Determine the (2, 5) group code function: $e_H : B_2 \longrightarrow B_5$	10

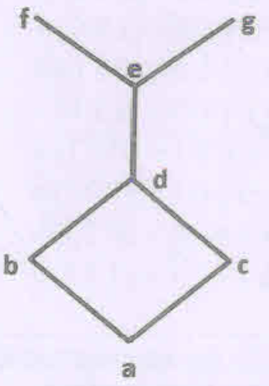
Que. No.	Question	Max. Marks
Q5	(Write notes / Short question type) on any **four**	**20**
i)	Consider the (2, 4) encoding function. How many errors will 'e' detect? e (00) = 0000 e(10)=0110 e (01) = 1011 e (11) = 1100	5
ii)	State the conditions to be satisfied for 'Monoid' and conditions to be satisfied for 'Group'.	5
iii)	Let A = {1, 2, 3} and the relation R = {(1, 1), (1, 2), (2, 3)} determine 'Reflexive Closure'. Let B = {a, b, c, d} and relation R = {(a, b), (b, c), (a, c), (c, d)} determine 'Symmetric Closure'.	5
iv)	How many nodes are necessary to construct a graph with exactly 6 edges in which each node is of degree 2?	5
v)	Obtain Eular Path, Eular Circuit, Hamiltonian Path, and Hamiltonian Circuit for following Fig. (a) and Fig. (b).  Fig. (a)  Fig. (b)	5
vi)	Are the following functions one to one functions? Justify your answer. 1. Function $f : Z \to Z$, where $f(x) = 2x - 1$. 2. Function $g : Z \to Z$ where $g(x) = x^2$.	5

01.02.2023 (E)

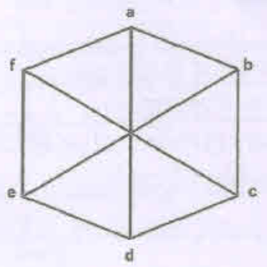
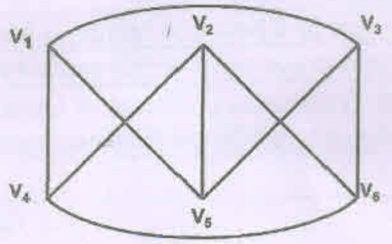
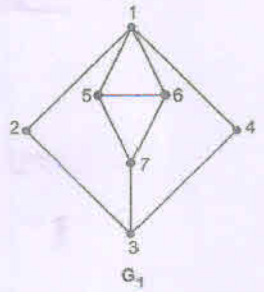
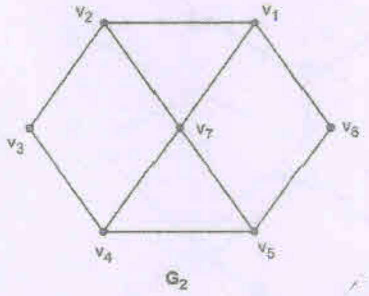
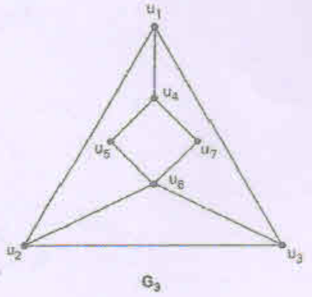
SOMAIYA
VIDYAVIHAR UNIVERSITY

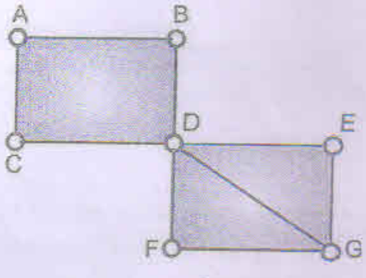
Maximum Marks: 100	Semester: August 2022 – December 2022 – Jan/Feb 2023 Examination: ESE Examination – DSY (Reg+KT) Duration:3 Hrs.		
Programme code: 01 Programme: B. Tech		Class: SY	Semester: III (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering		Name of the department: Computer	
Course Code: 116U01C305	Name of the Course: Discrete Mathematics		
Instructions: 1) Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary			

Que. No.	Question	Max. Marks
Q1	Solve any **Four**	20
i)	Explain equivalence classes with a suitable example	5
ii)	Show that if a relation on a set A is transitive and irreflexive, then it is asymmetric.	5
iii)	State Extended Pigeonhole principle and give an example to justify the statement.	5
iv)	Show that in a bounded lattice, if a complement exists, it is unique.	5
v)	State and prove right or left cancellation property for a group.	5
vi)	Define Predicates, Universe of Discourse, Quantifiers (Universal & Existential) and Negation of Quantified statement. Give an example of each.	5

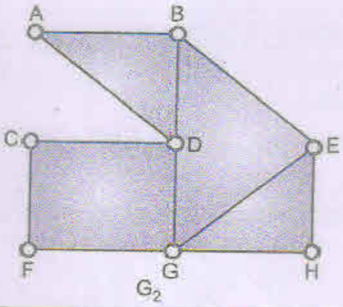
Que. No.	Question	Max. Marks
Q2 A	Solve the following	10
i)	Define Lattice. Determine whether the following Hasse diagram represent lattice or not. 	5
ii)	Show that if a set A has 3 elements, then we can find 8 relations on A that all have the same symmetric closure.	5
	OR	
Q2 A	Find the transitive closure of R by Warshall's algorithm. Where $A = \{1, 2, 3, 4, 5, 6\}$ and $R = \{(x, y) \mid (x - y) = 2\}$.	10

Q 2 B	Solve any One	10
i)	Let A = {1, 2, 3, 4, 5, 6, 7, 8, 9} and let N be the relation on A×A defined by (a, b) ~ (c, d) iff a + d = b + c. a. Prove that ~ is an equivalence relation. b. Find equivalence class of (2, 5).	10
ii)	Let A be set of factors of positive integer m and relation is divisibility on A. i.e., $R = \{x, y\}\|x, y \in A, x \text{ divides } y\}$. For m = 45 show that Poset (A, ≤) is lattice. Draw Hasse diagram and give join and meet for the lattice.	10

Que. No.	Question	Max. Marks
Q3	Solve any Two	20
i)	a. Suppose that a connected planer graph has 20 vertices, each of degree 4. Into how many regions does a representation of this planer graph split the plane? b. Explain which of the following graphs are planer: 	10 (6+4)
ii)	Explain Graph Isomorphism. Determine which of the three graphs G_1, G_2 & G_3 shown below are isomorphic. Justify your answer 	10 (4+6)
iii)	a. Justify following statements with the necessary graph: A. Is every Euclerian graph a Hamiltonian? B. Is every Hamiltonian graph a Euclerian? b. Determine which of the graphs G1 and G2 represent Eulerian circuit, Eulerian path, Hamiltonian circuit, Hamiltonian path. Justify your answer.	10 (4+6)

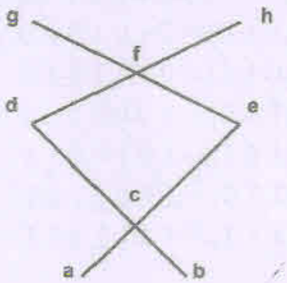


G_1



G_2

Que. No.	Question	Max. Marks
Q4	Solve any Two	20
i)	Prove that the set G = {1, 2, 3, 4, 5, 6} is an abelian group of order 6 with respect to $\times_7$, where '$\times_7$' is multiplication module 7.	10
ii)	Let $H = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ be a parity check matrix. Determine the (2,5) group code function $e_H : B^2 \rightarrow B^5$	10
iii)	Show that the (3,7) encoding function e: $B^3 \rightarrow B^7$ defined by e (0 0 0) = 0 0 0 0 0 0 0 e (0 0 1) = 0 0 1 0 1 1 0 e (0 1 0) = 0 1 0 1 0 0 0 e (0 1 1) = 0 1 1 1 1 1 0 e (1 0 0) = 1 0 0 0 1 0 1 e (1 0 1) = 1 0 1 0 0 1 1 e (1 1 0) = 1 1 0 1 1 0 1 e (1 1 1) = 1 1 1 1 0 1 1 is a group code.	10

Que. No.	Question	Max. Marks
Q5	(Write notes / Short question type) on any **four**	**20**
i)	The converse of a statement is given. Write the Inverse and the contrapositive statements. **"If I come early, then I can get the car"**	5
ii)	Prove the following logical equivalence using Laws of Logic $(p \rightarrow q) \wedge [\sim q \wedge (r \vee \sim q)] \leftrightarrow \sim(q \vee p)$	5
iii)	Prove by mathematical induction that for $n \geq 1$, $1.1! + 2.2! + 3.3! + \cdots. + n.n! = (n+1)! - 1$	5
iv)	Let A = B be the set of real numbers. $f: A \rightarrow B$ given by $f(x) = 2x^3 - 1$ $g: B \rightarrow A$ given by $g(y) = \sqrt[3]{\frac{1}{2}y + \frac{1}{2}}$ show that f is a bijective function and g is also bijective function.	5
v)	Let functions f and g be defined by $f(x) = 2x + 1$, $g(x) = x^2 - 2$, Find a. $gof(4)$ and $fog\ (4)$, b. $gof(a + 2)$ and $fog(a + 2)$, c. $fog(5)$ d. $gof(a + 3)$	5
vi)	Let A = {a, b, c, d, e, f, g, h} be the poset whose Hasse diagram is shown in Fig below.  a. Find GLB and LUB of B = {c, d, e} b. The least upper and greatest lower bound of B	5

07.12.2023(E)

SOMAIYA
VIDYAVIHAR UNIVERSITY

Maximum Marks: 100	Semester: July 2023 –October 2023 Examination: ESE Examination	Duration:3 Hrs.
Programme code: 01 Programme: BTech in Computer Engineering	Class: SY	Semester: III (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering	Name of the department: Computer Engineering	
Course Code: 116U01C305	Name of the Course: Discrete Mathematics	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary		

Que. No.	Question	Max. Marks
Q1	Solve any **Four**	**20**
i)	Show that if every element in a group is its own inverse, then the group must be abelian.	5
ii)	*"If the labour market is perfect then the wages of all persons in a particular employment will be equal. But it is always the case that wages for such persons are not equal therefore the labour market is not perfect".* Test the validity of the argument.	5
iii)	Using the laws of logic, prove that: $$\sim(p \wedge q) \rightarrow (\sim p \vee (\sim p \vee q)) \equiv \sim p \vee q$$	5
iv)	Define following with an example: i. Power Set ii. Partition of a set.	5
v)	If $f : \{R - (2/5)\} \rightarrow \{R - (4/5)\}$ is function defined by $f(x) = \frac{4x+3}{5x-2}$, prove that f is a bijection and find f^{-1}	5
vi)	Define the following terms with example: (i) Eulerian graph (ii) Hamiltonian graph	5

Que. No.	Question	Max. Marks
Q2 A	Solve the following	**10**
i)	Among 50 students in a class, 26 got A in the first examination and 21 got A in second examination. If 17 students did not get an A in either examination, how many students got A in both examinations.	5
ii)	Use Mathematical Induction to prove that $7^n - 1$ is divisible by 6 for n = 1,2, 3,..	5
	OR	
Q2 A	Let $S = \{1, 2, 3\} \times \{1, 2, 3, 4\}$ and let a relation R on S be defined as $(x, y)R(u, v)$ if $\|x - y\| = \|u - v\|$. Compute the partition associated with the equivalence relation R	10
Q 2 B	Solve any **One**	**10**
i)	Let B = $\{b_1, b_2, b_3, b_4, b_5\}$ and let R be the relation given by the following matrix	10

$$R = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Find transitive closure of R.

ii) For the set X = {2, 3, 6, 12, 24, 36}, a relation ≤ is defined by x ≤ y if x divides y. Draw Hasse diagram for (x, ≤). Answer the following: — 10

i. What are maximal and minimal elements?

ii. Give one example of chain and antichain.

iii. Is the Poset a Lattice?

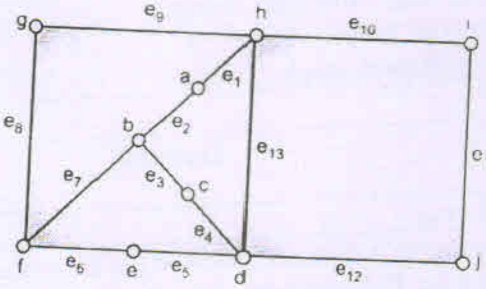
Que. No.	Question	Max. Marks
Q3	Solve any Two	20
i)	Define Graph Isomorphism. Find whether following graphs are isomorphic or not. Justify your answer.	10

G_1 G_2 G_3

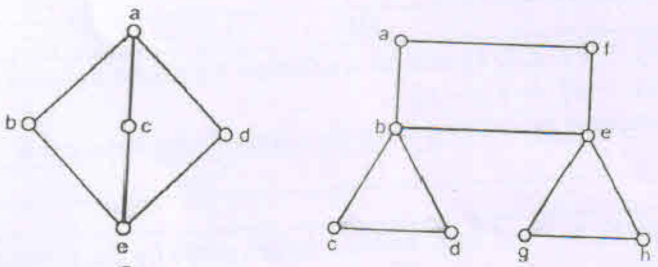
ii)

a) Is there a Hamiltonian circuit in a complete bipartite graph $K_{4,4}$ and $K_{4,6}$? — 10

b) Is there a Hamiltonian circuit in the graph shown in the Fig? What about a Hamiltonian path?



iii) Determine whether Eulerian Path and Eulerian circuit exist in the graphs G_1 and G_2 shown in Fig below: — 10



G_1 G_2

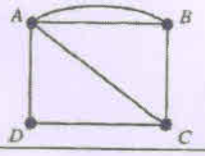
Que. No.	Question	Max. Marks
Q4	Solve any **Two**	**20**
i)	Consider the set **A** = {1, 2, 3, 4, 5, 6} **under multiplication** modulo 7. a. Find **multiplication** table for above. b. Find **the inverse** of 2,3 and 5,6 c. Prove **that it** is a cyclic group. d. Find **the orders** and subgroups **generated by** {3,4} and {2,3}	10
ii)	Show that the **(3,6)** encoding function e: $B^3 \rightarrow B^6$ defined by e (0 0 0) = 0 0 0 0 0 0 e (0 0 1) = 0 0 0 1 1 0 e (0 1 0) = 0 1 0 0 1 0 e (0 1 1) = 0 1 0 1 0 0 e (1 0 0) = 1 0 0 1 0 1 e (1 0 1) = 1 0 0 0 1 1 e (1 1 0) = 1 1 0 1 1 1 e (1 1 1) = 1 1 0 0 0 1 is a group code.	10
iii)	Let $H = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is parity check matrix. Decode following words relative to a maximum likelihood decoding function e_H i. 011001 ii. 101001	10

Que. No.	Question	Max. Marks
Q5	(Write notes / **Short** question type) on any **four**	**20**
i)	Let $f: R \rightarrow R, = f(x) = x^2 - 1,\ g(x) = 4x^2 + 2$ find i. $fo(gof)$ ii. $go(fog)$	5
ii)	Show that there **must** be atleast 90 ways to choose six numbers from 1 to 15. So that all the choices **have** the same sum.	5
iii)	Show that the number of edges in a complete graph K_n is n (n – 1)/2.	5
iv)	Determine the **number** of edges in a graph with 6 nodes, 2 of degree 4 and 4 of degree 2. Draw two such graphs.	5
v)	Let X = {1, 2, ..., 7} and R = {(x, y) | x – y is divisible by 3}. Show that R is equivalence relation. Draw graph of R.	5
vi)	Show that set G = $\{a + \sqrt{2}.b$; a, b ∈Q} is a group with respect to addition. Q is set of all rational numbers.	5

14/6/2023 (E)

SOMAIYA
VIDYAVIHAR UNIVERSITY

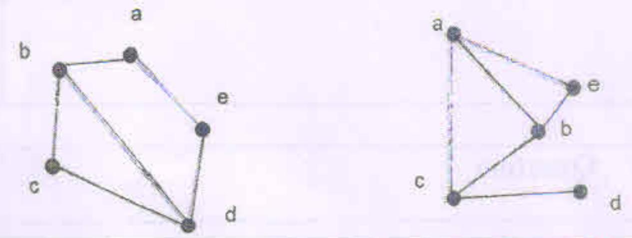
Maximum Marks: 100	Semester: August 2022 – December 2022 Examination: ESE Examination KT May 23	Duration:3 Hrs.
Programme code: 01 Programme: B.TECH Computer Engineering	Class: SY	Semester: III(SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering	Name of the department: COMP	
Course Code: 116U01C305	Name of the Course: Discrete Mathematics	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary		

Que. No.	Question	Max. Marks
Q1	Solve any **Four**	20
i)	What is power set? How many elements are there in any power set in general? Find the power set of the set A{α, β, γ}	5
ii)	Define tautology and contradiction Determine whether $P \vee \neg P$ is a tautology or contradiction.	5
iii)	Define an equivalence relation. Let A={1,2,3,4} and let R={(1,1),(1,2),(2,1),(2,2),(3,4),(4,3),(3,3),(4,4)} Is R an equivalence relation?	5
iv)	Draw Hasse diagram for the following relations on set A={1, 2, 3, 4, 12} R={(1, 1), (2, 2), (3, 3), (4, 4), (12, 12), (1, 2), (4, 12), (1, 3), (1, 4), (1, 12), (2, 4), (2, 12), (3,12)}	5
v)	Consider the above function f (x) = 2x – 3. Find a formula for the composition functions (i) f^2 = f o f and (ii) f^3 = f o f o f.	5
vi)	Define Hamiltonian path and circuit in a graph. Write a Hamiltonian path and a circuit for the graph shown below: 	5

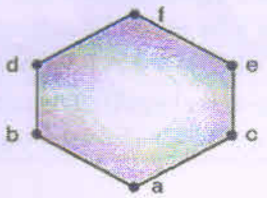
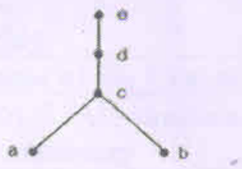
Que. No.	Question	Max. Marks
Q2 A	Solve the following	10
i)	Prove that for any positive integer number n, $n^3 + 2n$ is divisible by 3, for all $n \geq 1$. (use mathematical induction)	5
ii)	Find the DNF of : $(p \vee q) \rightarrow \neg r$ (Using laws of logic **or** using truth table).	5
	OR	
Q2 A	Suppose that 100 of the 120 mathematics students at a college take at least one of the languages French, German and Russian. Also suppose 65 study French, 45 study German, 42 study Russian, 20 study French and German ,25 study French and Russian ,15 study German and Russian . (a) Find the number of students studying all three languages (b) Find correct number of students in each of the 8 regions of Venn diagram. (here F, G, R denotes the sets of the students who study all three languages)	10

	(c) Determine the number k of students who study (i) exactly one language (ii) exactly two languages	
Q 2 B	Solve any **One**	**10**
i)	What is Warshall's algorithm? Let A = {1, 2, 3, 4} and let R = {(1, 2), (2, 3), (3, 4), (2, 1)}. Find transitive closure of R using Warshall's algorithm.	10
ii)	Let A = {a, b, c, d} and R be a relation on A whose matrix is $M_R = \begin{bmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ (i)Prove that R is partial order. (ii)Draw Hasse diagram of R.	10

Que. No.	**Question**	**Max. Marks**
Q3	Solve any **Two**	**20**
i)	State the pigeonhole principle and the extended pigeonhole principle. What is the minimum number of students required in a discrete structures class to be sure that at least six will receive the same grade, if there are five possible grades A, B, C, D, E .	10
ii)	What is a Lattice? Show that the set of all divisors of 70 forms a lattice.	10
iii)	Define an edge with respect to a graph. State Handshaking Lemma with its equation. How many nodes are necessary to construct a graph with exactly 6 edges in which each node is of degree 2.	10

Que. No.	Question	Max. Marks
Q4	Solve any Two	20
i)	Write the definition of a graph. What are isomorphic graphs? Determine whether the below mentioned graphs are isomorphic.  	10
ii)	Obtain the addition modulo 6 group, table of Z6. Let H = {[0]6, [3]6}.Find the left and right cosets in group Z6. Is H normal subgroup of Z6?	10
iii)	Define Hamming distance. How many errors can be detected and corrected in Hamming code if d is the minimum distance between the code words? Consider the (2, 4) encoding function. How many errors will be detect ? e (00) = 0000 e(10)=0110 e (01) = 1011 e (11) = 1100	10

Que. No.	**Question**	**Max. Marks**
Q5	Solve any **four**	**20**
i)	Write the following two propositions in symbols:	5

	Let p(x,y) denote the predicate 'y = x + 1'. (i)'For every number x there is a number y such that y = x + 1.' (ii)'There is a number y such that, for every number x, y= x + 1.'	
ii)	Construct the truth table for the following compound proposition $\sim P \wedge (P \rightarrow Q)$	5
iii)	Identify the greatest and the least element in the following structures:   Figure 1 Figure 2	5
iv)	Let A = { 0, – 1, 1 } and B = { 0, 1} Let f : A → B where f(a) = |a| . Is f onto?	5
v)	What is multigraph, subgraph and spanning subgraph?	5
vi)	Define a group and an abelian group. Is a set of all non zero real numbers a group with respect to multiplication?	5