INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	DISCRETE MATHEMATICAL STRUCTURES
Course Code	:	ACSB04
Program	:	B.Tech
Semester	:	III
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Section	:	A, B, C & D
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Course Faculty	:	Ms. K Mayuri, Assistant Professor Mr. N V Krishna Rao, Assistant Professor Ms. N M Deepika, Assistant Professor Ms. G Nishwitha, Assistant Professor Ms. B Dhanalaxmi, Assistant Professor Ms. B Pravallika, Assistant Professor

COURSE OBJECTIVES:

The course should enable the students to:	
I	Describe the logical and mathematical foundations, and study abstract models of computation.
II	Illustrate the limitations of predicate logic.
III	Define modern algebra for constructing and writing mathematical proofs.
IV	Solve the practical examples of sets, functions, relations and recurrence relations.
V	Recognize the patterns that arise in graph problems and use this knowledge for constructing the trees and spanning trees.

DEFINITIONS AND TERMINOLOGYQUESTION BANK

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
MODULE-I						
1	Define Proposition?	A proposition is a statement that is either true or false.	Remember	CO 1	CLO 2	ACSB04.02
2	Define connectives?	Any word or expression used to connect two or more statements is called as connectives	Remember	CO 1	CLO 1	ACSB04.01
3	What is implication?	Logical implication is a type of relationship between two statements or sentences. The relation translates verbally into "logically implies" or "if/then" and is symbolized by a double-lined arrow pointing toward the right ($\Longrightarrow$). If A and B represent statements, then A $\Longrightarrow$B means "A implies B"	Remember	CO 1	CLO 1	ACSB04.01

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		or "If A, then B."				
4	DefineTautology ?	A Tautology is a formula which is always true for every value of its propositional variables.	Remember	CO 1	CLO 2	ACSB04.02
5	Define contradiction?	A Contradiction is a formula which is always false for every value of its propositional variables.	Remember	CO 1	CLO 2	ACSB04.02
6	What is Contigency?	A proposition that is neither a tautology nor a contradiction is called a contingency.	Remember	CO 1	CLO 2	ACSB04.02
7	What are Connectives in Propositional Logic?	Propositional logic provides five different types of connectives - • OR (∨) • AND (∧) • Negation/ NOT (¬) • Implication / if-then (→) • If and only if (⇔).	Remember	CO 1	CLO 1	ACSB04.01
8	What is negation?	The negation of a proposition A (written as ¬A) is false when A is true and is true when A is false.	Remember	CO 1	CLO 1	ACSB04.01
9	What is conjunction?	The conjunction of two statements (or propositions) p and q is the statement p ∧ q which is read as p and q. The statement p ∧ q has the truth value T whenever both p and q have the truth value T. Otherwise it has truth value F.	Remember	CO 1	CLO 1	ACSB04.01
10	What is disjunction?	The disjunction of two statements p and q is the statement p ∨ q which is read as p or q. The statement p ∨ q has the truth value F only when both p and q have the truth value F. Otherwise it has truth value T.	Remember	CO 1	CLO 1	ACSB04.01
11	Define quantifers?	Quantifiers are words that are refer to quantities such as ‘some‘ or ‘all‘.	Remember	CO 1	CLO 3	ACSB04.03
12	What is Universal quantifer?	Universal quantifier states that the statements within its scope are true for every value of the specific variable. It is denoted by the symbol ∀.	Remember	CO 1	CLO 3	ACSB04.03
13	What is Existential quantifer?	Existential quantifier states that the statements within its scope are true for some values of the specific variable. It is denoted by the symbol ∃.	Remember	CO 1	CLO 3	ACSB04.03
14	What are nested quantifers?	If we use a quantifier that appears within the scope of another quantifier, it is called nested quantifier.	Understand	CO 1	CLO 3	ACSB04.03

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
15	What is elementary product?	A product of the variables and their negations in a formula is called elementary product?	Understand	CO 1	CLO 4	ACSB04.04
16	What is elementary sum?	A sum of the variables and their negations in a formula is called a elementary sum.	Understand	CO 1	CLO 4	ACSB04.04
17	What is disjunctive normal form?	Sum of elementary products is called as disjunctive normal form of the given formula.	Remember	CO 1	CLO 4	ACSB04.04
18	What is conjunctive normal form?	Product of elementary sum is called as conjunctive normal form of the given formula.	Remember	CO 1	CLO 2	ACSB04.02
19	What is quantified statement?	A proposition involving the universal or the existential quantifier is called as quantified statement.	Remember	CO 1	CLO 2	ACSB04.02
20	What is Duality principle?	Duality principle states that for any true statement, the dual statement obtained by interchanging unions into intersections (and vice versa) and interchanging Universal set into Null set (and vice versa) is also true. If dual of any statement is the statement itself, it is said **self-dual** statement.	Understand	CO 1	CLO 3	ACSB04.03
21	Define Predicate?	A common part or factor in a statement is called as predicate.	Remember	CO 1	CLO 2	ACSB04.02
22	What is conditional statement?	A compound proposition obtained by combining two given propositions by using the words 'if 'and 'then' at appropriate places is called a conditional statement.	Understand	CO 1	CLO 2	ACSB04.02
23	What is biconditional statement?	A biconditional statement is a combination of a conditional statement and its converse written in the *if and only if* form. A biconditional is true if and only if both the conditionals are true. Bi-conditionals are represented by the symbol ↔or ⇔ . p↔q means that p→q and q→p .	Understand	CO 1	CLO 3	ACSB04.03
24	List the types of Normal Forms?	Types of Normal form 1. Disjunctive Normal form 2. Conjunctive normal form	Remember	CO 1	CLO 3	ACSB04.03
25	What is Principle Disjunctive normal form?	For a given formula an equivalent formula consisting of a disjunction of minterms only is known as its principle disjunction normal form. Such a normal form is also said to be the sum-product canonical form.	Remember	CO 1	CLO 3	ACSB04.03
26	What is Principle Conjunctive	The principle of conjunctive normal form or the product-sum canonical form, the equivalent	Remember	CO 1	CLO 3	ACSB04.03

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	normal form?	formula consists of only the conjunction of the maxterms only.				
MODULE-II						
1	Define a set?	Collection of elements is called set	Remember	CO 2	CLO 5	ACSB04 .05
2	Define a subset?	Give two set A and B if B contains some elements of A then B is called subset of A	Remember	CO 2	CLO 5	ACSB04 .05
3	Define null set?	A set with no elements is called null set.	Remember	CO 2	CLO 5	ACSB04 .05
4	Define equal sets?	Two sets A and B are said to equal if they have same elements	Remember	CO 2	CLO 9	ACSB04 .09
5	Define universal set?	A set which contains all sets as subsets is called universal set and it is denoted by U	Remember	CO 2	CLO 5	ACSB04 .05
6	Define power set?	For a given set A we construct a set consisting of all subsets of A that set is called power set of A.	Remember	CO 2	CLO 5	ACSB04 .05
7	What are the operation on sets?	The operation on sets are 1. Union 2. Intersection 3. Complement 4. Difference	Understand	CO 2	CLO 5	ACSB04 .05
8	Define Commutative laws?	Commutative laws are (1) $A \cup B = B \cup A$ (2) $A \cap B = B \cap A$	Remember	CO 2	CLO 5	ACSB04 .05
9	Define associative law?	Associative laws are (1) $A \cup (B \cup C) = (A \cup B) \cup C$ (2) $A \cap (B \cap C) = (A \cap B) \cap C$	Remember	CO 2	CLO 5	ACSB04 .05
10	Define distributive laws?	Distributive laws are (1) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ (3) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$	Remember	CO 2	CLO 5	ACSB04 .05
11	Define idempotent laws?	Idempotent Laws are (1) $A \cup A = A$ (2) $A \cap A = A$	Remember	CO 2	CLO 5	ACSB04 .05
12	Define identity laws?	Identity laws are (1) $A \cup \emptyset = A$ (2) $A \cap U = A$	Remember	CO 2	CLO 5	ACSB04 .05
13	Define law of double complement law?	Double Complement law is $\bar{\bar{A}} = A$	Remember	CO 2	CLO 5	ACSB04 .05
14	Define inverse law?	Inverse law are (1) $A \cup \bar{A} = U$ (2) $A \cap \bar{A} = \emptyset$	Remember	CO 2	CLO 5	ACSB04 .05
15	Define DeMorgan law?	DeMorgan laws are (1) $(A \cup B)^c = A^c \cap B^c$ (2) $(A \cap B)^c = A^c \cup B^c$	Remember	CO 2	CLO 5	ACSB04 .05
16	Define domination law?	Domination laws are (1) $A \cup U = U$ (2) $A \cap \emptyset = \emptyset$	Remember	CO 2	CLO 5	ACSB04 .05

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17	Define absorption law?	Absorption Laws (1) A ᴗ (A ᴖ B) = A (2) A ᴖ (A ᴗ B) = A	Remember	CO 2	CLO 5	ACSB04 .05
18	Define relation?	Let A and B are two sets. Thus if R is a relation from A to B ,then R contains set of ordered pairs(a,b) where a€A and b€B.then R is said to be a relation from A to B.	Remember	CO 2	CLO 5	ACSB04 .05
19	What is matrix of relation?	Consider the sets A={a_1,a_2…..,a_m} and B={b_1,b_2,.....b_n}of orders m and n respectively.let R be a relation from A to B.them$_{ij}$=(a_i,b_j) and assign the values 1 if (a_i,b_j)€R and 0 if (a_i,b_j)₡R	Understand	CO 2	CLO 5	ACSB04 .05
20	Define diagraph of a relation?	Let r be a relation on finite set R.there are vertices and nodes,draw an arrow called edge,from vertex x to vertex y if and only if(x,y) € R,theresuling pictorial representation of R is called a digraph of R.	Remember	CO 2	CLO 6	ACSB04 .06
21	What are the operations of relation?	Operations of relations are 1. Union and intersection of relations 2. Complement of a relation 3. Converse of a relation	Understand	CO 2	CLO 7	ACSB04 .07
22	What are the properties of relation?	Properties of relations defined on a set 1. Reflexive relation 2. Irreflexive relation 3. Symmetric relation 4. Compatibility relation 5. Antisymmetric relation 6. Transitive relation	Understand	CO 2	CLO 7	ACSB04 .07
23	Define reflexive relation?	A relation R on set A is reflexive whenever every element a of A is related to itself by R(i.e., aRa,for all a€A)	Remember	CO 2	CLO 7	ACSB04 .07
24	Define irreflexive relation?	A relation on a set A is said to be irreflexive if (a,a)€R for a€A.thatis,a relation R is irreflexive if no element of A is related to itself by R.	Remember	CO 2	CLO 7	ACSB04 .07
25	Define symmetric relation?	A relation R on a set is said to be symmetric if(b,a)€R whenever(a,b)€R for all a,b€A.	Remember	CO 2	CLO 7	ACSB04 .07
26	Define compatibility relation?	A relation R on a set A which is both reflexive and symmetric is called a compatibility relation on A.	Remember	CO 2	CLO 7	ACSB04 .07
27	Define anti symmetric relation?	A relation R on a set A is said to be antisymmetric if whenever (a,b) €R and (b,a)€R then a=b.	Remember	CO 2	CLO 7	ACSB04 .07
28	Define transitive relation?	A relation R on a set A is said to be transitive if whenever(a,b) €Rand(b,c)€Rthen(a,c)€R,for all	Remember	CO 2	CLO 7	ACSB04 .07

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		a,b,c €A.				
29	Define equivalence relation?	A relation between elements of a set which is reflexive, symmetric, and transitive and which defines exclusive classes whose members bear the relation to each other and not to those in other classes	Remember	CO 2	CLO 7	ACSB04 .07
30	Define partial order relation?	A **relation** that is reflexive, antisymmetric, and transitive is called a **partial order**. Two fundamental **partial order relations** are the "less than or equal" **relation** on a set of real numbers and the "subset" **relation** on a set of sets.	Remember	CO 2	CLO 7	ACSB04 .07
31	Define maximal element?	An element a € A is called minimal element of A if there exists no element x!=a in A such that aRx.in other words,a€A is a minimal element of A if whenever there is x € A such that aRx then x=a.	Remember	CO 2	CLO 8	ACSB04 .08
32	Define minimal element?	An element a € A is minimal element of A if there exists no element x!=a in A such that xRa.in other words,a is a minimal element of A if whenever there is x € A such that xRa,then x=a.	Remember	CO 2	CLO 8	ACSB04 .08
33	Define greatest element?	An element a € A is called a greatest element of A if xRa for all x € A.	Remember	CO 2	CLO 8	ACSB04 .08
34	Define least element?	An element a € A is called a leat element of A if aRx for all x € A.	Remember	CO 2	CLO 8	ACSB04 .08
35	Define least upper bound(LUB)?	The **least upper bound** of A is also called the supremum of A. It can be written sup(A) or **lub**(A). Sets with no **upper bound** have no **least upper bound**, of course. The set of all numbers is an example. The empty set has no **least upper bound**, because every number is an **upper bound** for the empty set.	Remember	CO 2	CLO 11	ACSB04 .11
36	Define greatest lower bound (GLB)?	The infimum of a subset S of a partially ordered set T is the **greatest** element in T that is less than or equal to all elements of S, if such an element exists.Consequently, the term **greatest lower bound**(abbreviated as **GLB**) is also commonly used	Remember	CO 2	CLO 11	ACSB04 .11
37	Define lattice?	Let(A,R) be a poset.thisposet is called lattice if every two-element subset of A has a least	Remember	CO 2	CLO 11	ACSB04 .11

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		upper bound and a Greatest lowe bound in A.				
38	Define sub lattice?	Let (l,r)be a lattice and M be a subset of L.then M is called a sublattice of L if a V b € M and a ^ b € M whenever a € M and b € M.	Remember	CO 2	CLO 11	ACSB04 .11
39	Define properties of lattices?	Properties of lattices are 1. Idempotent properties 2. Commutative properties 3. Associative properties 4. Absorption properties.	Remember	CO 2	CLO 12	ACSB04 .12
40	Define bounded lattice?	A lattice (L,R) is said to be bounded if it has a greatest element and a least element .in bounded lattice, a greatest element is denoted by I and least element by 0.	Remember	CO 2	CLO 12	ACSB04 .12
41	Define distributive lattice?	A lattice(L,R) is said to be distributive if,for any a,b,c € L. 1. a^(bVc)=(a^b)v(a^c) 2. aV(b^c)=(aVb)^(aVc)	Remember	CO 2	CLO 12	ACSB04 .12
42	Define complemented lattice?	Let L be a bounded lattice with greatest element I and least element 0.for a choosen element of a of L, if there exists an element a' € L such that a V a' =I and a ^ a'= 0,then a' is called complement of a in L.	Remember	CO 2	CLO 12	ACSB04 .12
43	Define function?	Let A and B be two non-empty sets. then a function f from A to B is a relation from A to B such that for each a in A there is a unique b in B such that(a,b)€f. A function from A to B is denoted by f:A—>B.	Remember	CO 2	CLO 9	ACSB04 .09
44	Define identify function?	A function f:A—>A such that f(a) = a for every a € Ais called identity function on A.	Remember	CO 2	CLO 9	ACSB04 .09
45	Define constant function?	A function f:A—>B such that f(a)=c for every a€A,where c is a fixed element of B,is called constant function.	Remember	CO 2	CLO 9	ACSB04 .09
46	Define onto function?	A function f:A—>B is said to be onto function if every element of B has a preimage in A,under f.	Remember	CO 2	CLO 9	ACSB04 .09
47	Define one to one function?	If f:A—>B is a one –to-one function,then every element of A has a unique image in B and every element of f(A) has a unique preimage in A.	Remember	CO 2	CLO 9	ACSB04 .09
48	Define bijective function?	A function which is both one –to-one and onto is called bijective.	Remember	CO 2	CLO 9	ACSB04 .09
49	Define recursive function?	We can also **define functions recursively**: in terms of the same **function** of a smaller variable. In this way,	Remember	CO 2	CLO 10	ACSB04 .10

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		a **recursive function** "builds" on itself. A **recursive definition** has two parts: **Definition** of the smallest argument (usually f (0) or f (1)).**Definition** of f (n), given f (n - 1), f (n - 2)				
50	Define Invertible function?	There is a symmetry between a **function** and its inverse. Specifically, if f is an **invertible function** with domain X and range Y, then its inverse f^{-1} has domain Y and range X, and the inverse of f^{-1} is the original **function** f. In symbols, for **functions** f:X → Y and f^{-1}:Y → X, and.	Remember	CO 2	CLO 9	ACSB04 .09
		MODULE-III				
1	Define Algebraic Structure? .	A non empty set S is called an algebraic structure w.r.t binary operation (*) if it follows following axioms: Closure:(a*b) belongs to S for all a,b ∈ S.	Understand	CO 3	CLO13	ACSBO4.13
2	DefineSemi Group	A non-empty set S, (S,*) is called a semigroup if it follows the following axiom: Closure:(a*b) belongs to S for all a,b ∈ S. Associativity: a*(b*c) = (a*b)*c ∀ a,b,c belongs to S.	Remember	CO 3	CLO13	ACSBO4.13
3	Define closure property of semi group	Closure:(a*b) belongs to S for all a,b ∈ S.	Remember	CO 3	CLO13	ACSBO4.13
4	Define Associativity property of semi group	Associativity: a*(b*c) = (a*b)*c ∀ a,b,c belongs to S.	Remember	CO 3	CLO13	ACSBO4.13
5	Define monoid	A non-empty set S, (S,*) is called a monoid if it follows the following axiom: Closure:(a*b) belongs to S for all a,b∈ S. Associativity: a*(b*c) = (a*b)*c ∀a,b,c belongs to S. Identity Element:There exists e ∈ S suchthat a*e = e*a = a ∀ a ∈ S	Remember	CO 3	CLO14	ACSBO4.14
6	Define group	A non-empty set G, (G,*) is called a group if it follows the following axiom: Closure:(a*b) belongs to G for all a,b ∈ G. Associativity: a*(b*c) = (a*b)*c ∀ a,b,c belongs to G. Identity Element:There exists e ∈ G such that a*e = e*a = a ∀ a	Remember	CO 3	CLO14	ACSBO4.14

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		∈ G Inverses : ∀ a ∈ G there exists a-1 ∈ G such that a*a-1 = a-1*a = e				
7	Define Abelian Group or Commutative group	A non-empty set S, (S,*) is called a Abelian group if it follows the following axiom: Closure:(a*b) belongs to S for all a,b ∈ S. Associativity: a*(b*c) = (a*b)*c ∀ a,b,c belongs to S. Identity Element:There exists e ∈ S such that a*e = e*a = a ∀ a ∈ S Inverses:∀ a ∈ S there exists a-1 ∈ S such that a*a-1 = a-1*a = e Commutative: a*b = b*a for all a,b ∈ S	Remember	CO 3	CLO13	ACSBO4.13
8	define Commutative group	A non-empty set S, (S,*) is called a Abelian group if it follows the following axiom: Closure:(a*b) belongs to S for all a,b ∈ S. Associativity: a*(b*c) = (a*b)*c ∀ a,b,c belongs to S. Identity Element:There exists e ∈ S such that a*e = e*a = a ∀ a ∈ S Inverses:∀ a ∈ S there exists a-1 ∈ S such that a*a-1 = a-1*a = e Commutative: a*b = b*a for all a,b ∈ S	Remember	CO 3	CLO13	ACSBO4.13
9	Define Associative law	An operation * on a set is said to be associative or to satisfy the associative law if, for any elements a, b , c in S we have (a * b) * c = a * (b * c)	Remember	CO 3	CLO14	ACSBO4.14
10	Define commutative law	An operation * on a set S is said to be commutative or satisfy the commutative law if, a * b = b * a for any element a, b in S.	Remember	CO 3	CLO13	ACSBO4.13
11	define Identity element and inverse	Consider an operation * on a set S. An element e in S is called an identity elements for * if for any elements a in S - a * e = e * a = a Generally, an element e is called a left identity or a right identity according to as e *a or a * e = awhere a is any elements in S. Suppose an operation * on a set S does have an identity element e. The inverse of an element in S is an element b such that: a * b = b * a = e	Remember	CO 3	CLO14	ACSBO4.14

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
12	What is a ring isomorphism?	A ring homomorphism which is a bijection (one-one and onto) is called aring isomorphism. If f : R → S is such an isomorphism, we call the rings R and Sisomorphic and write R S. Remarks. Isomorphic rings have all their ring-theoretic properties identical.	Remember	CO 3	CLO13	ACSBO4.13
13	What does it mean for two groups to be isomorphic?	In abstract algebra, a group isomorphism is a function between two groups that sets up a one-to-one correspondence between the elements of the groups in a way that respects the given group operations. If there exists an isomorphism between two groups, then the groups are called isomorphic.	Understand	CO 3	CLO14	ACSBO4.14
14	What is ideal algebra?	In ring theory, a branch of abstract algebra, an ideal is a special subset of a ring. Ideals generalize certain subsets of the integers, such as the even numbers or the multiples of 3. ... The concept of an order ideal in order theory is derived from the notion of ideal in ring theory	Remember	CO 3	CLO15	ACSBO4.15
15	What is a zero divisor of a ring?	Zero divisor. In a ring , a nonzero element is said to be a zero divisor if there exists a nonzero such that . For example, in the ring of integers taken modulo 6, 2 is a zero divisor because a ring with no zero divisors is called an integral domain.	Remember	CO 3	CLO15	ACSBO4.15
16	What makes a graph isomorphic?	Two graphs which contain the same number of graph vertices connected in the same way are said to be isomorphic. Formally, two graphs and with graph vertices are said to be isomorphic if there is a permutation of such that is in the set of graph edges if f is in the set of graph edges.	Remember	CO 3	CLO13	ACSBO4.13
17	What is the zero element of a ring?	In mathematics, the zero ideal in a ring is the ideal consisting of only the additiveidentity (or zero element).	Remember	CO 3	CLO13	ACSBO4.13
18	What is a ring isomorphism?	A ring homomorphism which is a bijection (one-one and onto) is called aring isomorphism. If f : R → S is such an isomorphism, we call the rings R and S isomorphic and write R S. Remarks. Isomorphic rings have	Understand	CO 3	CLO13	ACSBO4.13

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		all their ring-theoretic properties identical.				
19	What is Homomorphism in discrete mathematics?	In algebra, a homomorphism is a structure-preserving map between two algebraic structures of the same type (such as two groups, two rings, or two vector spaces).	Understand	CO 3	CLO13	ACSBO4.13
20	What is Homomorphism in discrete mathematics?	In algebra, a homomorphism is a structure	Understand	CO 3	CLO14	ACSBO4.14
21	define the Fundamental Counting Principle	The Fundamental Counting Principle (also called the counting rule) is a way to figure out the number of outcomes in a probability problem. Basically, you multiply the events together to get the total number of outcomes.	Remember	CO 3	CLO16	ACSBO4.16
22	What is combination discrete mathematics?	A combination is a selection of all or part of a set of objects, without regard to the order in which objects are selected. For example, suppose we have a set of three letters: A, B, and C. ... Each possible selection would be an example of a combination.	Remember	CO 3	CLO 17	ACSBO4.17
23	What is pigeonhole principle in discrete mathematics?	The pigeonhole principle states that if items are put into containers, with , then at least one container must contain more than one item.	Remember	CO 3	CLO17	ACSBO4.17
24	What is sum and product rule of combinatorics?	In combinatorics, the rule of sum or addition principle is a basic counting principle. Stated simply, it is the idea that if we have A ways of doing something and B ways of doing another thing and we can not do both at the same time, then there are A + B ways to choose one of the actions	Remember	CO 3	CLO18	ACSBO4.18
MODULE-IV						
1	Define recurrence relation?	A recurrence relation is an equation that defines a sequence based on a rule that gives the next term as a function of the previous term(s).	Remember	CO 4	CLO 19	ACSB04 .019
2	What is generating function?	A **generating function** is a (possibly infinite) polynomial whose coefficients correspond to terms in a sequence of numbers a_n.	Understand	CO 4	CLO 19	ACSB04 .019
3	What is First order Recurrence	A recurrence relation of the form :	Understand	CO 4	CLO 20	ACSB04 .20

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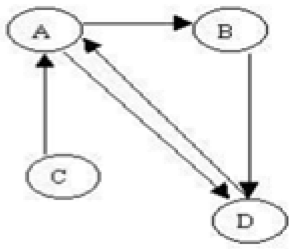
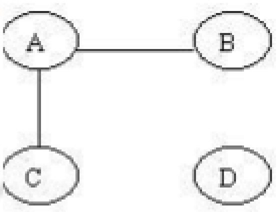
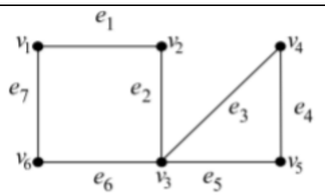
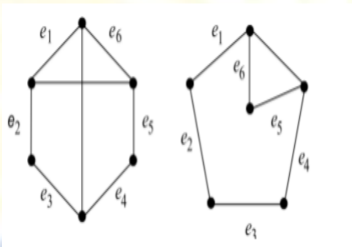
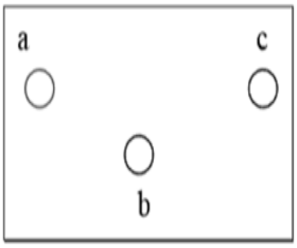
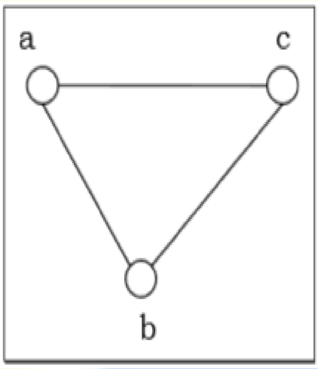
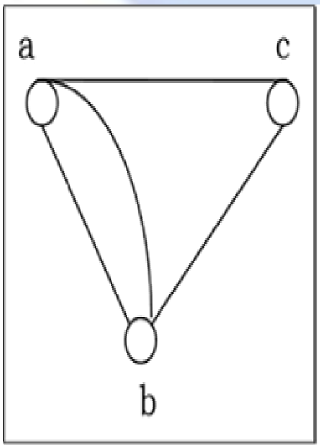
	relation?	$a_n = ca_{n-1} + f(n)$ for n>=1 where c is a constant and f(n) is a known function is called linear recurrence relation of first order with constant coefficient. If f(n) = 0, the relation is homogeneous otherwise non-homogeneous.				
4	What is Second orderlinear homogeneous Recurrence relation?	A recurrence relation of the form $c_n a_n + c_{n-1} a_{n-1} + c_{n-2} a_{n-2} = 0$ for n>=2 where c_n, c_{n-1} and c_{n-2} are real constants with c_n != 0 is called a second order linear homogeneous recurrence relation with constant coefficients.	Understand	CO 4	CLO 20	ACSB04 .20
5	What is characteristic equation?	The characteristic equation (or auxiliary equation) is an algebraic equation of degree *n* upon which depends the solution of a given *n*th-order differential equation.	Understand	CO 4	CLO 21	ACSB04 .21
6	What is third and higher order linear homogeneous recurrence relations?	A recurrence relation of the form $c_n a_n + c_{n-1} a_{n-1} + c_{n-2} a_{n-2} + \ldots + c_{n-k} a_{n-k} = 0$, for $n \geq k \geq 3$, Where cn, cn-1,…..cn-k are real constants with cn $\neq 0$. A relation of this type is called recurrence relation of third and higher order linear homogeneous relation with constant coefficients.	Understand	CO 4	CLO 20	ACSB04 .20
7	What is the form of Second and higher order linear nonhomogeneous recurrence relations?	A recurrence relation of the form $c_n a_n + c_{n-1} a_{n-1} + c_{n-2} a_{n-2} + \ldots + c_{n-k} a_{n-k} = f(n)$, for $n \geq k \geq 2$, Where c_n, c_{n-1}, ….c_{n-k} are real constants with $c_n \neq 0$ and f(n) is a real valued function of n.	Understand	CO 4	CLO 21	ACSB04 .21
MODULE-V						
1	Define Graph	Graph is a collection (nonempty set) of vertices and edges	Remember	CO 5	CLO 22	ACSB04 .22
2	Define Vertices	A **vertex** (plural: **vertices**) is a point where two or more line segments meet. It can have names and properties	Remember	CO 5	CLO 22	ACSB04 .22
3	Define Edges	It connects two vertices, can be labeled, can be directed.	Remember	CO 5	CLO 22	ACSB04 .22
4	Define Adjacent vertices	If there is an edge between the vertices then that vertices can be called as adjacent vertices.	Remember	CO 5	CLO 22	ACSB04 .22
5	Define undirected graphs	In undirected graphs the edges are symmetrical, e.g. if A and B are vertices, A B and B A are one and the same edge.	Remember	CO 5	CLO 22	ACSB04 .22

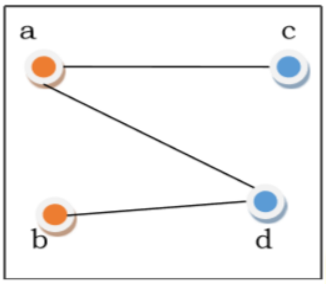
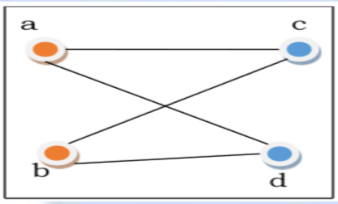
S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
6	Define directed graphs	In directed graphs the edges are oriented; they have a beginning and an end. Thus A B and B A are different edges. Sometimes the edges of a directed graph are called arcs.	Remember	CO 5	CLO 22	ACSB04 .22
7	Define Cycles.	A cycle is a simple path with distinct edges, where the first vertex is equal to the last	Remember	CO 5	CLO 22	ACSB04 .22
8	Define Loop	An edge that connects the vertex with itself	Remember	CO 5	CLO 22	ACSB04 .22
9	Define Connected graph	There is a path between each two vertices in a graph are called connected graphs. 	Remember	CO 5	CLO 22	ACSB04 .22
10	Define Disconnected graph	There are at least two vertices not connected by a path Vertices: A,B,C,D Edges: AB, AC 	Remember	CO 5	CLO 22	ACSB04 .22
11	Define Isomorphic graphs	Two graphs which contain the same number of graph vertices connected in the same way are said to be isomorphic.	Remember	CO 5	CLO 22	ACSB04 .22
12	Define Euler graph	A closed walk in a graph G containing all the edges of G is called an Euler line in G. A graph containing an Euler line is called an Euler graph.	Remember	CO 5	CLO 22	ACSB04 .22

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		 Eulerian graph				
13	Define Hamiltonian graphs	A cycle passing through all the vertices of a graph is called a Hamiltonian cycle. A graph containing a Hamiltonian cycle is called a Hamiltonian graph. A path passing through all the vertices of a graph is called a Hamiltonian path and a graph containing a Hamiltonian path is said to be traceable. Examples of Hamiltonian graphs are given in Figure 	Remember	CO 5	CLO 23	ACSB04 .23
14	Define Planar graph	A planar graph is an undirected graph that can be drawn on a plane without any edges crossing. Such a drawing is called a planar representation of the graph in the plane	Remember	CO 5	CLO 22	ACSB04 .22
15	Define Euler's Planar Formula	A planar representation of a graph splits the plane into regions, where one of them has infinite area and is called the infinite region.	Remember	CO 5	CLO 23	ACSB04 .23
16	Define Graph Coloring	Graph coloring is the procedure of assignment of colors to each vertex of a graph G such that no adjacent vertices get same color. The objective is to minimize the number of colors while coloring a graph. The smallest number of colors required to color a graph G is called its chromatic number of that graph. Graph coloring problem is a NP Complete problem.	Remember	CO 5	CLO 22	ACSB04 .22
17	Define Graph	Graph traversal is the problem	Remember	CO 5	CLO 22	ACSB04 .22

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
	Traversal	of visiting all the vertices of a graph in some systematic order. There are mainly two ways to traverse a graph. **Breadth First Search** **Depth First Search**				
18	Define Digraphs	A graph in which each graph edge is replaced by a directed graph edge, also called a digraph. A directed graph having no multiple edges or loops (corresponding to a binary adjacency matrix with 0s on the diagonal) is called a simple directed graph.	Remember	CO 5	CLO 22	ACSB04 .22
19	Define complete bidirected	A complete graph in which each edge is bidirected is called a complete directed graph.	Remember	CO 5	CLO 22	ACSB04 .22
20	Define oriented graph	A directed graph having no symmetric pair of directed edges (i.e., no bidirected edges) is called an oriented graph.	Remember	CO 5	CLO 22	ACSB04 .22
21	Define tournament	A complete oriented graph (i.e., a directed graph in which each pair of nodes is joined by a single edge having a unique direction) is called a tournament.	Remember	CO 5	CLO 22	ACSB04 .22
22	Define Directed acyclic graphs	Directed acyclic graphs (DAGs) are used to model probabilities, connectivity, and causality. A "graph" in this sense means a structure made from nodes and edges.	Remember	CO 5	CLO 23	ACSB04 .23
23	Define Weighted digraphs	We can assign numbers to the edges or vertices of a graph in order to enable them to be used in physical problems. Such an assignment is called the weight of the edges or vertices.	Remember	CO 5	CLO 23	ACSB04 .23
24	Define Planarity	"A graph is said to be planar if it can be drawn on a plane without any edges crossing. Such a drawing is called a planar representation of the graph."	Remember	CO 5	CLO 22	ACSB04 .22
25	Define Trees	A tree is an undirected graph with no cycles and a vertex chosen to be the root of the tree.	Remember	CO 5	CLO 24	ACSB04 .24
26	Define spanning tree	**A spanning tree** of a graph A spanning tree of an undirected graph is a subgraph that contains all the vertices, and no cycles. If	Remember	CO 5	CLO 24	ACSB04 .24

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		we add any edge to the spanning tree, it forms a cycle, and the tree becomes a graph.				
27	Define Complete graphs	Graphs with all edges present – each vertex is connected to all other vertices, are called complete graphs.	Remember	CO 5	CLO 24	ACSB04 .24
28	Define Dense graphs	relatively few of the possible edges are missing	Remember	CO 5	CLO 24	ACSB04 .24
29	Define Sparse graphs	relatively few of the possible edges are present	Remember	CO 5	CLO 24	ACSB04 .24
30	Define spanning forest	**A spanning forest** is a type of subgraph that generalises the concept of a spanning tree. However, there are two definitions in common use. One is that a spanning forest is a subgraph that consists of a spanning tree in each connected component of a graph.	Remember	CO 5	CLO 25	ACSB04 .25
31	Define Minimum Spanning Tree	A spanning tree with assigned weight less than or equal to the weight of every possible spanning tree of a weighted, connected and undirected graph GG, it is called minimum spanning tree (MST). The weight of a spanning tree is the sum of all the weights assigned to each edge of the spanning tree.	Remember	CO 5	CLO 25	ACSB04 .25
32	Define Kruskal's Algorithm	Kruskal's algorithm is a greedy algorithm that finds a minimum spanning tree for a connected weighted graph. It finds a tree of that graph which includes every vertex and the total weight of all the edges in the tree is less than or equal to every possible spanning tree.	Remember	CO 5	CLO 25	ACSB04 .25
33	Define Degree of a Vertex	The degree of a vertex V of a graph G (denoted by deg (V)) is the number of edges incident with the vertex V.	Remember	CO 5	CLO 22	ACSB04 .22
34	Define Degree of a Graph	The degree of a graph is the largest vertex degree of that graph.	Remember	CO 5	CLO 22	ACSB04 .22
35	Define null graph	A null graph has no edges.	Remember	CO 5	CLO 22	ACSB04 .22

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
						
36	Define Simple Graph	A graph is called simple graph/strict graph if the graph is undirected and does not contain any loops or multiple edges. 	Remember	CO 5	CLO 22	ACSB04 .22
37	Define Multi-Graph	If in a graph multiple edges between the same set of vertices are allowed, it is called Multigraph. In other words, it is a graph having at least one loop or multiple edges. 	Remember	CO 5	CLO 23	ACSB04 .23
38	Define Bipartite Graph	If the vertex-set of a graph G can be split into two disjoint sets, V1 and V2, in such a way	Remember	CO 5	CLO 23	ACSB04 .23

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		that each edge in the graph joins a vertex in V1 to a vertex in V2, and there are no edges in G that connect two vertices in V1 or two vertices in V2, then the graph G is called a bipartite graph. 				
39	Define Complete Bipartite Graph	A complete bipartite graph is a bipartite graph in which each vertex in the first set is joined to every single vertex in the second set. The complete bipartite graph is denoted by Kx,y where the graph G contains x vertices in the first set and y vertices in the second set. 	Remember	CO 5	CLO 23	ACSB04 .23
40	Define Non-planar graph	A graph is non-planar if it cannot be drawn in a plane without graph edges crossing.	Remember	CO 5	CLO 23	ACSB04 .23
41	Define Planar graph	G is called a planar graph if it can be drawn in a plane without any edges crossed. If we draw graph in the plane without edge crossing, it is called embedding the graph in the plane.	Remember	CO 5	CLO 23	ACSB04 .23
42	Define Isomorphism	If two graphs G and H contain the same number of vertices connected in the same way, they are called isomorphic graphs (denoted by G≅H). It is easier to check non-isomorphism than isomorphism. If any of these following conditions occurs, then two	Remember	CO 5	CLO 24	ACSB04 .24

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		graphs are non-isomorphic − 1. The number of connected components are different 2. Vertex-set cardinalities are different 3. Edge-set cardinalities are different 4. Degree sequences are different				
43	Define Homomorphism	A homomorphism from a graph G to a graph H is a mapping (May not be a bijective mapping) h:G→H h:G→H such that − (x,y)∈E(G)→(h(x),h(y))∈E(H) (x,y)∈E(G)→(h(x),h(y))∈E(H). It maps adjacent vertices of graph Gto the adjacent vertices of the graph H.	Remember	CO 5	CLO 24	ACSB04 .24
44	State properties of Homomorphism	A homomorphism is an isomorphism if it is a bijective mapping. Homomorphism always preserves edges and connectedness of a graph. The compositions of homomorphisms are also homomorphisms. To find out if there exists any homomorphic graph of another graph is a NP complete problem.	Understand	CO 5	CLO 24	ACSB04 .24
45	Define HamiltonianGraphs	A connected graph G is called Hamiltonian graph if there is a cycle which includes every vertex of G and the cycle is called Hamiltonian cycle. Hamiltonian walk in graphG is a walk that passes through each vertex exactly once.	Remember	CO 5	CLO 23	ACSB04 .23

Signature of the Faculty **HOD, CSE**