SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES (AUTONOMOUS)
MURUKAMBATTU, CHITTOOR
DEPARTMENT OF SCIENCE AND HUMANITIES
QUESTION BANK

Subject Name: **Discrete Mathematics and Graph Theory** Academic year: **2025-26**
Subject Code: **23BSC232** Year & Sem: **II & III**

UNIT-1: MATHEMATICAL LOGIC		
PART A (2 marks)		
Q. No.	**Questions**	**BTL**
1.	Define statement with example.	L1
2.	Construct a truth table for XOR.	L3
3.	Define well-formed formula with an example.	L1
4.	Define Duality law and give an example.	L1
5.	Define Modus Ponens rule, Rules of Syllogism and Modus Tollens.	L1
6.	Write the following argument using Quantifiers, variables and predicate symbols: "All birds can fly."	L2

PART B (10 marks)		
Q. No.	**Questions**	**BTL**
1.	What are connectives? Explain different types of connectives with truth tables.	L1, L2
2.	a) Construct the truth table for the following formula: $\neg(P \vee (Q \wedge R)) \leftrightarrow ((P \vee Q) \wedge (P \vee R))$.	L3
	b) Define converse, inverse, contra positive with an example.	L1
3.	a) Prove that the following formula is a tautology: $[(P \to R) \wedge (Q \to R)] \to [(P \vee Q) \to R]$.	L2
	b) Show that $(P \vee (Q \wedge R))$ and $(P \vee Q) \wedge (P \vee R)$ are logically equivalent by using truth tables.	L2
4.	a) Define Max terms & Min terms of P & Q and give their truth tables.	L1
	b) Obtain the Principal Conjunctive normal form of the following formula S given by $(\neg P \to R) \wedge (Q \leftrightarrow P)$.	L3
5.	a) What is Principal disjunctive normal form? Obtain the Principal disjunctive normal form of $\neg P \vee Q$.	L1, L3
	b) What is Principal conjunctive normal form? Obtain the Principal conjunctive normal form of $(\neg P \vee \neg Q) \to (P \leftrightarrow \neg Q)$.	L1, L3
6.	a) Explain the concept of functionally complete set of connectives and write an equivalent formula for $P \wedge [(Q \leftrightarrow R) \vee (R \leftrightarrow P)]$ which does	L5

	not contain the biconditional.	
	b) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises $P \vee Q$, $Q \rightarrow R$, $P \rightarrow M$ and $\neg M$.	L2
7.	Show that the following premises are inconsistent. If Jack misses many classes through illness, then he fails high school. If Jack fails high school, then he is uneducated. If Jack reads a lot of books, then he is not uneducated. Jack misses many classes through illness and reads a lot of books.	L2
8.	a) Show that the set of premises $P \rightarrow Q$, $P \rightarrow R$,$Q \rightarrow \neg R$ and P are inconsistent.	L2
	b) Explain the concept of free, bound variables and quantifiers with an example.	L5
9.	a) Show that $(\forall x)\big(P(x) \rightarrow Q(x)\big) \wedge (\forall x)(Q(x) \rightarrow R(x)) \Longrightarrow (\forall x)(P(x) \rightarrow R(x))$.	L2
	b) Show that (∃x) M(x) follows logically from the premises (x) (H(x) → M(x)) and (∃x) H(x).	L2
10.	Verify the validity of the arguments: i) All men are mortal Socrates is a man Therefore, Socrates is mortal ii) All integers are rational numbers Some integers are powers of 3 Therefore, some rational numbers are powers of 3.	L3

UNIT-2: SET THEORY		
PART A (2 marks)		
Q. No.	**Questions**	**BTL**
1.	State Principle of Inclusion-Exclusion for three sets.	L1
2.	State Pigeon hole principle.	L1
3.	Define a) one to one function b) onto function.	L1
4.	Define Composition of Functions.	L1
5.	Write short notes on semi group and monoid.	L1
6.	Define group and abelian group.	L1
7.	Define finite and infinite groups and give one example for each.	L1
8.	Define order of a group and give one example.	L1

PART B (10 marks)		
Q. No.	**Questions**	**BTL**
1.	Find the number of integers between 1 and 1000 inclusive that are divisible by none 5,6 and 8.	L3
2.	a) Find the minimum number of students in the class to be sure that 4 out of them are born on the same month.	L3
	b) Applying pigeon hole principle show that of any 14 integers are selected from the set S = {1, 2, 3… 25} there are at least two whose sum is 26. Also write a statement that generalizes this result.	L3
3.	Verify $f(x) = 2x + 1$ for all $x \in R$ is bijective from $R \to R$.	L4
	If $f: R \to R$ such that $f(x)=2x+1$ *and* $g: R \to R$ *such that* $g(x)=\frac{x}{3}$ then verify that $(gof)^{-1} = f^{-1}og^{-1}$.	L4
4.	Find the inverse of $f(x) = 4e^{6x+2}$.	L3
	A function f(n)=an is defined recursively by a0=4 and an= an-1+n, for n≥1. Find f(n) in explicit form.	L3
5.	Define Lattices and explain the properties of Lattices.	L1, L2
	If A = {1,2,3,5,30} and R is the divisibility relation, prove that (A, R) is a Lattice but not a distributive Lattices.	L3
6.	Define algebraic system and explain its general properties.	L1, L2
7.	Show that the set, $G = \{1, \omega, \omega^2\}$,where $1, \omega, \omega^2$ are cube roots of unity, form an abelian group under the operation of ordinary multiplication.	L2
	Prove that the four roots of unity 1, –1, i, –i, where $i = \sqrt{-1}$, form an abelian multiplicative group.	L2
8.	Prove that the set, Z of integers forms an abelian group with respect to the operation, * defined on it as: $a * b = a + b + 1$.	L2
9.	Define subgroup and explain with suitable example.	L1, L2
	Show that the necessary and sufficient condition for a non – empty subset H of a group (G, *) to be a subgroup is $a \in H, b \in H \Rightarrow a * b^{-1} \in H$	L2
10.	Define homomorphism, monomorphism, epimorphism, isomorphism, endomorphism and automorphism. And explain isomorphism with an example.	L1

UNIT3: ELEMENTARY COMBINATRICS		
PART A (2 marks)		
Q. No.	**Questions**	**BTL**
1.	Define permutation with example.	L1
2.	Define combination with example.	L1

3.	Compute P(8,5) and C(6,3).	L3
4.	How many ways are there to seat 10 boys and 10 girls around a circular table?	L3
5.	State Binomial theorem.	L1
6.	State Multinomial theorem.	L1

PART B (10 marks)		
Q. No.	**Questions**	**BTL**
1.	a) There are 21 consonants and 5 vowels in the English alphabet. Consider only 10-letter words with 4 different vowels and 6 consonants. i) How many such words can be formed? ii) How many contain the letter a? iii) How many begin with b and end with c?	L1, L2, L3
	b) A man has 15 close friends of whom 6 are women. i) In how many ways can he invite 3 or more his friends to a party? ii) In how many ways can he invite 3 or more of his friends if he wants the invite same number men and women?	L1, L2, L3
2.	A student is to answer 12 of 15 questions in an examination. How many choicesdoes the students have i) In all? ii) If he must answer the first two questions? iii) If he must answer the first or the second question but not both? iv) If he must answer exactly 3 of the first 5 questions? v) If he must answer at least 3 of the first 5 questions?	L1, L2, L3
3.	a) Out of 5 men and 2 women, a committee of 3 is to be formed. In how many ways can it be formed if at least one woman is to be included?	L1, L2, L3
	b) Find the number of arrangements of the letters in the word i) ACCOUNTANT ii) MATHEMATICS	L1, L2, L3
4.	a) How many four-digit numbers can be formed using the digits 0,1,2,3,4,5. i) If repetition of digits is allowed. ii) If repetition of digits is not allowed.	L2
	b) How many different license plates are there that involve 1, 2or 3 letters followed by 4 digits?	L2
5.	Consider the word "TALLAHASSEE" How many arrangements are there i) Altogether? ii) Where two letters A appear together? iii) Where the letters S are together and the letters E are together? iv) If 4 letters are taken?	L2

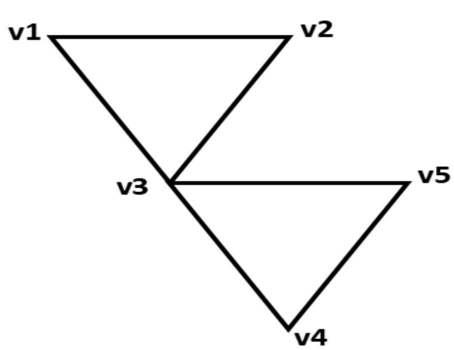
6.	a) A committee of 5 men and 3 women is to be formed out of 7 men and 6 women. If two particular women are not to be together in the committee, then how many such committees can be formed?	L1, L2, L3
	b) How many integers are between 1 and 1000000 having the sum of the digits as 18?	L1, L2, L3
7.	a) How many integral solutions are there to the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 20$ where $x_1 \geq -3, x_2 \geq 0, x_3 \geq 4, x_4 \geq 2$ and $x_5 \geq 2$.	L2
	b) Enumerate the number of non-negative integral solutions to the inequality $x_1 + x_2 + x_3 + x_4 + x_5 \leq 19$.	
8.	How many integral solutions are there to the equation $x_1 + x_2 + x_3 + x_4 + x_5 = 30$ where for each i i) $x_i \geq 1$ ii) $x_1 \geq 2, x_2 \geq 2, x_3 \geq 4, x_4 \geq 2$ and $x_5 \geq 0$ iii) $x_i \geq i + 1$	L2
9.	c) Find the coefficient of i) $x^3y^2z^2\ in\ (2x - y + z)^7$ ii) $x^6y^3\ in\ (x - 3y)^9$	L3
	d) Find the coefficient of i) x^9y^3 in $[2x - 3y]^{12}$ ii) xyz^2 in $[2x - y - z]^4$	L3
10.	a) Find the coefficient of i) $ab^2c^3d^4$ in $[a + 2b - 3c + 2d + 5]^{13}$ ii) x^2yz in $[2x - y + z + 1]^7$	L3
	b) Find the co-efficient of i) x^3y^7in$(x + y)^{10}$ ii) $x^2y^4\ in\ (x - 2y)^6$	L3

UNIT 4: RECURRENCE RELATIONS		
PART A (2 marks)		
Q. No.	**Questions**	**BTL**
1.	Define Generating Function.	L1
2.	Find the sequence for the function $\frac{1}{1-ax}$	L3
3.	Find the generating function for the sequence 1,1,0,1,1,1-----------	L3
4.	Find the coefficient of $x^5 in\ (1 - 2x)^{-7}$	L3
5.	Define recurrence relation.	L1
6.	Find the solution for $a_{n+2} - 6a_{n+1} + 9a_n = 0$.	L3
7.	Find the particular solution $a_n = 3a_{n-1} + 7$.	L3

PART B (10 marks)		
Q. No.	**Questions**	**BTL**
1.	a) Determine the sequence generated by i) $f(x) = 2e^x + 3x^2$ ii) $f(x) = e^{8x} - 4e^{3x}$.	L1, L2, L3
	b) Find the sequence generated by the following generating functions i) $(2x-3)^3$ ii) $\frac{x^4}{1-x}$	L1, L2, L3
2.	a) Determine the coefficient of x^{20} in $(x^3 + x^4 + x^5 + \cdots)^5$.	L1, L2, L3
	b) Determine the coefficient of x^{20} in $(x^2 + x^3 + x^4 + x^5 + x^6)^5$.	L1, L2, L3
3.	a) Solve the linear recurrence relation by using substitution method $a_n = a_{n-1} + 3^n, n \geq 1, a_0 = 1$.	L1, L2, L3
	b) Solve the linear recurrence relation by using substitution method $a_n + 3na_{n-1} = 0, a_0 = 1$.	L1, L2, L3
4.	Using the method of generating function to solve the recurrence relation $a_n - 2a_{n-1} - 3a_{n-2} = 0, n \geq 2\ with\ a_0 = 3, a_1 = 1$.	L1, L2, L3
5.	Suppose that a person deposits Rs. 10,000/- in a saving account at bank yielding12% per year with interest compounded annually. How much will be in the account after 30 years?	L1. L2, L3
6.	Solve the linear recurrence relation $a_n = 8a_{n-1} + 10^{n-1},\ with\ a_0 = 1, a_1 = 9$.	L1, L2, L3
7.	Using an iterative approach find the solutions to each of these recurrence relations with the given initial conditions i) $a_n = a_{n-1} + 2, a_0 = 3$ ii) $a_n = a_{n-1} + 2n + 3, a_0 = 1$	L1, L2, L3
8.	Solve the linear recurrence relation by using method of characteristic roots $a_n - 7a_{n-1} + 12a_{n-2} = 0, n \geq 2\ with\ a_0 = 2, a_1 = 5$.	L1, L2, L3
9.	Solve $a_n = 2a_{n-1} + a_{n-2} - 2a_{n-3}, for\ n \geq 3\ with\ a_0 = 3, a_1 = 1\ and\ a_2 = 0$.	L1, L2, L3
10.	Solve $a_{n+2} + 4a_{n+1} + 4a_n = 7, n \geq 0\ with\ a_0 = 1, a_1 = 2$.	L1, L2, L3

UNIT 5: GRAPH THEORY		
PART A (2 marks)		
Q. No.	**Questions**	**BTL**
1.	Define a graph and a sub graph.	L1
2.	Define Adjacency matrix.	L1
3.	Define Isomorphism.	L1

4.	What is difference between graph and a tree?	L1, L2
5.	Define spanning tree.	L1
6.	Define Eulerian circuit.	L1
7.	Define Hamiltonian circuit and Hamiltonian graph.	L1

PART B (10 marks)		
Q. No.	**Questions**	**BTL**
1.	a) Explain indegree and out degree of a graph. Also explain about the adjacency matrix representation of graphs. Illustrate with an example?	L1, L2
	b) Draw the graph represented by given adjacency matrix (i) $\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$ (ii) $\begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & 1 & 2 \\ 2 & 1 & 1 & 0 \\ 1 & 2 & 0 & 1 \end{bmatrix}$	L1, L2, L3
2.	Define the following with an example each i) Walk ii) Trial iii) Circuit iv) Path v) Cycle	L1
3.	Distinguish between the following terms i) Cycle and Circuits ii) Hamiltonian graphs and Euler graphs	L1, L2
4.	Explain the following: a) Complete Graph b) Simple Graph c) Degree of vertex d) Null Graph e) Self-loop f) Tree g) Euler graph	L1, L2
5.	Define weighted graph and explain i) Matrix representation ii) Incidence matrix	L1
6.	Write short on the following with suitable examples. a) Multi graphs b) Hamiltonian graphs c) Spanning tree	L1, L2
7.	How many vertices the following graphs will have if the conditions are i) 16 edges and all the vertices of degree 2 ii) 21 edges, three vertices of degree 4 and other vertices of degree 3 iii) 24 edges and all the vertices of same degree	L1, L2, L3
8.	a) Determine whether the graph is Euler path or circuit  	L1, L2, L3

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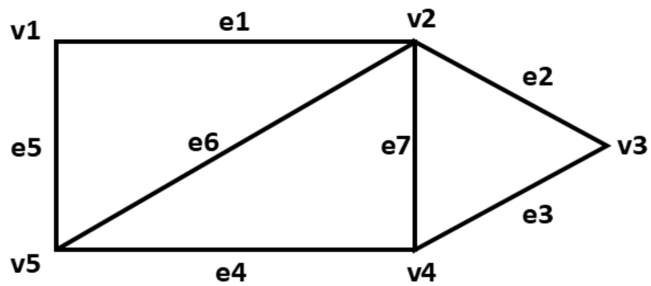
b) Determine whether the graph is Hamiltonian path or circuit



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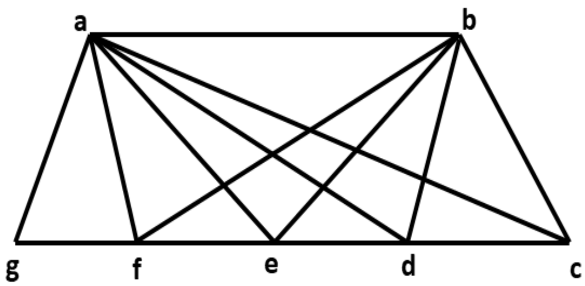
a) What is Planar graph? Determine whether the following is planar graph or not.



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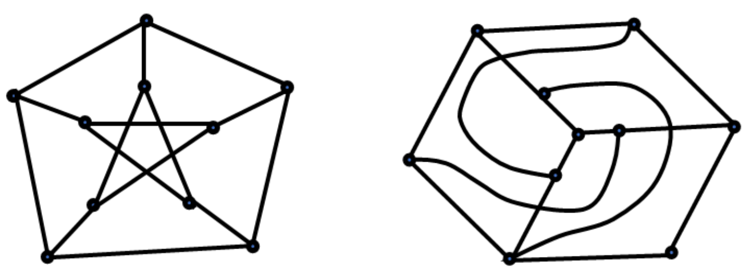
b) Verify whether the following graphs are isomorphic or not



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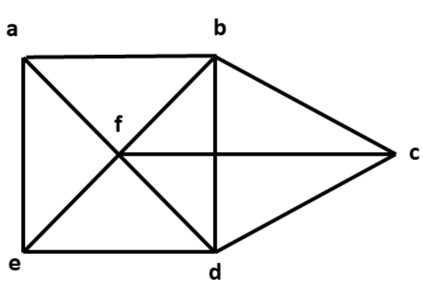
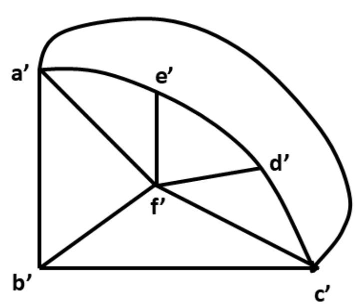
Verify whether the following graphs are isomorphic or not



(a) Graph G



(b) Graph G’

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