Course Code: 23HS0836 **R23**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR

(AUTONOMOUS)

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QUESTION BANK (DESCRIPTIVE)

Subject with Code: DISCRETE MATHEMATICS & GRAPH THEORY (23HS0836)

Course & Branch: B.Tech – Common to CSIT, CSE and Allied Branches

Year & Sem: II-B.Tech & I-Sem **Regulation:** R23

UNIT –I

MATHEMATICAL LOGIC

1	a) Construct a truth table for $p \wedge (\neg q \wedge q)$.	[L3][CO1]	**[2M]**
	b) Define Duality law.	[L1][CO1]	**[2M]**
	c) Define Tautology.	[L1][CO1]	**[2M]**
	d) Construct a truth table for XOR.	[L3][CO1]	**[2M]**
	e) Translate the statement in symbolic form 'Some rationals are not reals'.	[L2][CO1]	**[2M]**
2	a) Explain the connectives and their truth tables.	[L2][CO1]	**[5M]**
	b) Construct the truth table for the following formula $\neg(p \vee q) \vee (\neg p \wedge \neg q)$	[L3][CO1]	**[5M]**
3	a) Define converse, inverse contra positive with an example.	[L1][CO1]	**[5M]**
	b) Prove that $[(p \to q) \wedge (q \to r)] \to (p \to r)$ is a tautology.	[L3][CO1]	**[5M]**
4	a) Define Well-formed formulas with an example.	[L1][CO1]	**[5M]**
	b) Show that $p \vee (q \wedge r)$ and $(p \vee q) \wedge (p \vee r)$ are logically equivalent by using truth tables.	[L2][CO1]	**[5M]**
5	a) Show that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent without using truth tables.	[L2][CO1]	**[5M]**
	b) What is Principal disjunctive normal form? Obtain the Principal disjunctive normal form of $\neg(p \to (q \wedge r))$.	[L1][CO1]	**[5M]**
6	a) What is Principal conjunctive normal form? Obtain the Principal conjunctive normal form of $(\neg p \to r) \wedge (q \leftrightarrow p)$ without using truth table.	[L1][CO1]	**[5M]**
	b) Obtain Principal conjunctive normal form of $A = (p \wedge q) \vee (\neg p \wedge q) \vee (q \wedge r)$ by constructing Principal disjunctive normal form.	[L3][CO1]	**[5M]**
7	a)Define Maxterms & Minterms of P & Q and give their truth tables.	[L1][CO1]	**[5M]**
	b) Define NAND & NOR and give their truth tables.	[L1][CO1]	**[5M]**
8	a) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises $P \vee Q, Q \to R, P \to M \; and \neg M$.	[L2][CO1]	**[5M]**
	b) Prove by indirect method $\neg q, p \to q \; and \; p \vee t, then t$.	[L3][CO1]	**[5M]**
9	a) Show that $S \vee R$ tautologically implied by $(P \vee Q) \wedge (P \to R) \wedge (Q \to S)$.	[L2][CO1]	**[5M]**
	b) Show that $\neg p$ is logically follows from the premises $\neg(p \wedge \neg q)$, $\neg q \vee r$, $\neg r$.	[L2][CO1]	**[5M]**
10	a) Define quantifiers and types of quantifiers with examples.	[L1][CO1]	**[5M]**
	b) Show that $(\exists x) \; M(x)$ follows logically from the premises $(\forall x)(H(x) \to M(x)) \; and \; (\exists x)H(x)$	[L2][CO1]	**[5M]**
11	a) Verify the validity of the following arguments: Lions are dangerous animals, there are lions. Therefore, there are dangerous animals.	[L4][CO1]	**[5M]**
	b) Prove that $(\forall x)(P(x) \to (Q(y) \wedge R(x))), (\exists x)P(x) \Rightarrow Q(y) \wedge (\exists x)(P(x) \wedge R(x))$.	[L3][CO1]	**[5M]**

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UNIT –II

SET THEORY

1	a) State Principle of Inclusion-Exclusion for three sets	[L1][CO2]	**[2M]**
	b) State Pigeon hole principle	[L1][CO2]	**[2M]**
	c) Define Composition of Functions	[L1][CO2]	**[2M]**
	d) What is the Subgroup of a Group	[L1][CO2]	**[2M]**
	e) Define Monoid with example	[L1][CO2]	**[2M]**
2	a) A Survey among 100 students shows that of the three ice cream flavours vanilla, chocolate, and straw berry.50 students like vanilla,43 like chocolate,28 like straw berry,13 like vanilla and chocolate 11 like chocolate and straw berry,12 like straw berry and vanilla and 5 like all of them. Find the number of students who like 1. Chocolate but not straw berry 2. Chocolate and straw berry but not vanilla 3. Vanilla or chocolate but not straw berry	[L3][CO2]	**[5M]**
	b) Find how many integers between 1 and 60 that are divisible by 2 not by 3 and not by 5. Also determine the number of integers divisible by 5 not by 2, not by 3.	[L3][CO2]	**[5M]**
3	a) 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][CO2]	**[5M]**
	b) Show that if 8 people are in a room, at least two of them have birthdays that occur on the same day of the week.	[L2][CO2]	**[5M]**
4	a) Verify $f(x) = 2x + 1, g(x) = x$ for all $x \in R$ are bijective from $R \to R$	[L4][CO2]	**[5M]**
	b) Let $f: A \to B,\ g: B \to C,\ h: C \to D$ then show that $ho(gof) = (hog)of$	[L2][CO2]	**[5M]**
5	a) If $f: R \to R$ such that $f(x,y) = 2x+1$ *and* $g: R \to R$ *such that* $g(x) = \frac{x}{3}$ then verify that $(\boldsymbol{gof})^{-1} = \boldsymbol{f^{-1}og^{-1}}$	[L4][CO2]	**[5M]**
	b) A function f(n)=a_n is defined recursively by a_0=4 and a_n= a_{n-1}+n, for n≥1. Find f(n) in explicit form.	[L3][CO2]	**[5M]**
6	a) Define Lattices and write the properties of Lattices	[L1][CO2]	**[5M]**
	b) If A={1,2,3,5,30} and R is the divisibility relation, prove that (A,R) is a Lattices but not a distributive Lattices	[L3][CO2]	**[5M]**
7	a) Define and give examples for semi group, Monoid, Group.	[L1][CO2]	**[6M]**
	b) Show that the binary operation * defined on $(R,*)$ where $x * y = x^y$ is not associative.	[L2][CO2]	**[4M]**
8	a) Prove that the set Z of all integers with the binary operation *, defined as $a*b = a+b+1, \forall a,b \in Z$ is an abelian group.	[L3][CO2]	**[5M]**
	b) Show that the set of all positive rational numbers forms an abelian group under the composition defined by a*b = (ab) / 2	[L2][CO2]	**[5M]**
9	a)Show that the set of all roots of the equation $x^4 = 1$ forms a group under multiplication.	[L2][CO2]	**[5M]**
	b) On the set Q of all rational number operation * is defined by $a*b = a+b-ab$, Show that this operation Q forms a commutative monoid.	[L2][CO2]	**[5M]**
10	a) Show that the set{1,2,3,4,5} is not a group under addition and multiplication modulo 6.	[L2][CO2]	**[5M]**
	b) Show that the necessary and sufficient condition for a non – empty subset H of a group (G, *) to be a subgroup is $a \in H, b \in H \Rightarrow a * b^{-1} € H$	[L2][CO2]	**[5M]**

11 a) Let $S = \{a,b,c\}$ and let * denotes a binary operation on 'S' is given below also let $P = \{1,2,3\}$ and addition be a binary operation on 'p' is given below. show that $(S,*)$ & $(P,\oplus)$ are isomorphic. [L2][CO2] **[5M]**

(+)	1	2	3
1	1	2	1
2	1	2	2
3	1	2	3

*	a	b	c
A	a	b	c
B	b	b	c
C	c	b	c

b) Explain the concepts of homomorphism and isomorphism of groups with examples [L2][CO2] **[5M]**

UNIT –III

ELEMENTARY COMBINATORICS

1	a) Define permutation with example.	[L1][CO3]	**[2M]**
	b) Define combination with example.	[L1][CO3]	**[2M]**
	c) Find n, if c(n,7)=c(n,5)	[L3][CO3]	**[2M]**
	d) State Binomial theorem.	[L1][CO3]	**[2M]**
	e) State Multinomial theorem.	[L1][CO3]	**[2M]**
2	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][CO3]	**[5M]**
	b) How many different license plates are there that involve 1,2or 3 letters followed by 4 digits ?	[L2][CO3]	**[5M]**
3	a) How many ways can we get a sum of 8 when two indistinguishable dice are rolled?	[L2][CO3]	**[5M]**
	b) Out of 9 girls and 15 boys how many different committees can be formed each consisting of 6 boys and 4 girls?	[L2][CO3]	**[5M]**
4	a) How many numbers can be formed using the digits 1, 3, 4, 5, 6, 8 and 9 if no repetitions are allowed?	[L2][CO3]	**[5M]**
	b) Find the number of permutations of the letters of the word "MASSASAUGA". In how many of these all four A's are together? How many of them begin with S ?	[L3][CO3]	**[5M]**
5	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?	[L2][CO3]	**[5M]**
	b) Find the number of arrangements of the letters in the word ACCOUNTANT.	[L3][CO3]	**[5M]**
6	a) The question paper of mathematics contains ten questions divided into two groups of 5 questions each. In how many ways can an examinee answer six questions taking atleast two questions from each group.	[L2][CO3]	**[5M]**
	b) How many permutations can be formed out of the letters of word "SUNDAY"? How many of these (i) Begin with S? (ii) End with Y? (iii) Begin with S & end with Y? (iv) S &Y always together?	[L2][CO3]	**[5M]**
7	a) In how many ways can the letters of the word COMPUTER be arranged? How many of them begin with C and end with R? how many of them do not begin with C but end with R?	[L2][CO3]	**[5M]**
	b) How many integral solutions are there to $x_1 + x_2 + x_3 + x_4 + x_5 = 32$ where each (i) $x_i \geq 2$ (ii) $x_i > 2$	[L2][CO3]	**[5M]**
8	a) Enumerate the number of integral solutions for $x_1 + x_2 + x_3 + x_4 + x_5 = 20$ have, subject to constraints, $x_1 \geq -2,\ x_2 \geq 0,\ x_3 \geq 4,\ x_4 \geq 2,\ x_5 \geq 2$.	[L1][CO3]	**[5M]**
	b) Enumerate the number of nonnegative integer solutions of the inequality $x_1 + x_2 + x_3 + \cdots \ldots \ldots \ldots + x_8 < 10$	[L1][CO3]	**[5M]**
9	a) Find how many solutions are there for $x_1 + x_2 + x_3 = 17$, subject to the constraints $x_1 > 1, x_2 > 2, x_3 > 3$.	[L3][CO3]	**[5M]**
	b) Enumerate the number of non negative integral solutions to the inequality $x_1 + x_2 + x_3 + x_4 + x_5 \leq 19$.	[L1][CO3]	**[5M]**

10	a) Find the coefficient of (i) $x^3y^2z^2$ in $(2x-y+z)^7$ (ii) x^6y^3 in $(x-3y)^9$	[L3][CO4]	**[5M]**
	b) Find the coefficient of (i) x^9y^3 in $[2x-3y]^{12}$ (ii) xyz^2 in $[2x-y-z]^4$	[L3][CO4]	**[5M]**
11	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][CO4]	**[5M]**
	b) Find the co-efficient of (i) x^3y^7 in $(x+y)^{10}$ (ii) x^2y^4 in $(x-2y)^6$	[L3][CO4]	**[5M]**

UNIT –IV
RECURRENCE RELATIONS

1	a) Find the sequence for the function $\frac{1}{1-ax}$	[L3][CO5]	**[2M]**
	b) Find the generating function for the sequence 1,1,0,1,1,1-----------	[L3][CO5]	**[2M]**
	c) Find the coefficient of $x^5 in\ (1-2x)^{-7}$	[L3][CO5]	**[2M]**
	d) Find a_1, a_2 for the recurrence relation $a_k = k(a_{k-1})^2, k \geq 1$ $a_0 = 1$	[L3][CO5]	**[2M]**
	e) Solve $a_n - a_{n-1} - 2a_{n-2} = 0$	[L3][CO5]	**[2M]**
2	a) Determine the sequence generated by (i) $f(x) = 2e^x + 3x^2$ (ii) $f(x) = e^{8x} - 4e^{3x}$.	[L3][CO5]	**[5M]**
	b) Find the sequence generated by the following generating functions (i) $(2x-3)^3$ (ii) $\frac{x^4}{1-x}$	[L3][CO5]	**[5M]**
3	a) Determine the coefficient of x^{20} in $(x^3+x^4+x^5+\cdots)^5$	[L3][CO5]	**[5M]**
	b) Solve $a_n = a_{n-1} + f(n)$ for $n \geq 1$ by using substitution method.	[L3][CO5]	**[5M]**
4	a) Solve$a_n = a_{n-1} + 2a_{n-2}, n \geq 2$ with the initial conditions $a_0 = 0, a_1 = 1$	[L3][CO5]	**[5M]**
	b) Solve $a_{n+2} - 5a_{n+1} + 6a_n = 2$ with the initial conditions $a_0 = 1, a_1 = -1$	[L3][CO5]	**[5M]**
5	a) Solve $a_n - 7a_{n-1} + 10a_{n-2} = 4^n$	[L3][CO5]	**[5M]**
	b) Using generating function to solve $a_n = 3a_{n+1} + 2$, $a_0 = 1$	[L3][CO5]	**[5M]**
6	a) **S**olve the following $y_{n+2} - y_{n+1} - 2y_n = n^2$	[L3][CO5]	**[5M]**
	b) Solve $a_n - 5a_{n-1} + 6a_{n-2} = 1$	[L3][CO5]	**[5M]**
7	Solve $a_n - 4a_{n-1} + 4a_{n-2} = (n+1)^2$ given $a_0 = 0, a_1 = 1$	[L3][CO5]	**[5M]**
8	a) Solve $a_n = 2a_{n-1} - a_{n-2}$ with initial conditions $a_1 = 1.5$ & $a_2 = 3$	[L3][CO5]	**[5M]**
	b) Solve $a_n = 3a_{n-1} - a_{n-2}$ with initial conditions $a_1 = -2$ & $a_2 = 4$	[L3][CO5]	**[5M]**
9	Solve the R.R $a_{n+2} - 2a_{n+1} + a_n = 2^n$ with initial conditions $a_0 = 2, a_1 = 1$	[L3][CO5]	**[10M]**
10	Solve the recurrence relation using generating functions $a_n - 9a_{n-1} + 20a_{n-2} = 0$ for $n \geq 2$ and $a_0 = -3, a_1 = -10$	[L3][CO5]	**[10M]**
11	Solve $a_n - 5a_{n-1} + 6a_{n-2} = 2^n$, $n \geq 2$ with the initial conditions $a_0 = 1, a_1 = 1$. Using generating functions.	[L3][CO5]	**[10M]**

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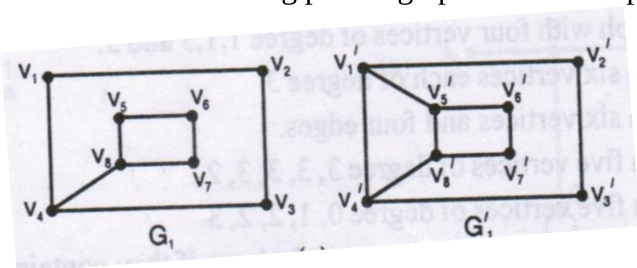
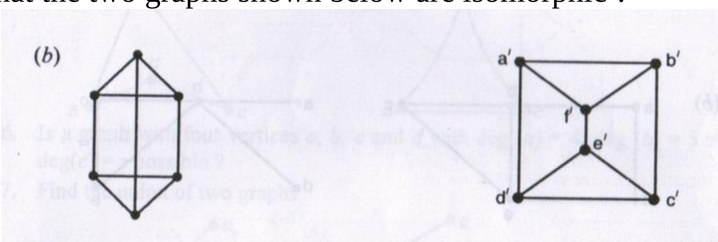
UNIT –V
GRAPHS

1	a) Define directed graph with example.	[L1][CO6]	**[2M]**
	b) Define Bipartite graph with example.	[L1][CO6]	**[2M]**
	c) State Euler formulae for plannar graph.	[L1][CO6]	**[2M]**
	d) Define Binary tree with example.	[L1][CO6]	**[2M]**
	e) Define spanning tree with example.	[L1][CO6]	**[2M]**
2	a) Explain indegree and out degree of a graph. Also explain about the adjacency matrix representation of graphs. Illustrate with an example?	[L2][CO6]	**[5M]**
	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][CO6]	**[5M]**
3	a) Show that the maximum number of edges in a simple graph with n vertices is $\frac{n(n-1)}{2}$	[L2][CO6]	**[5M]**
	b) A graph G has 21 edges, 3 vertices of degree 4 and the other vertices are of degree 3.Find the number of vertices in G?	[L3][CO6]	**[5M]**
4	a) Suppose a graph has vertices of degree 0 , 2, 2, 3 and 9 . How many edges does the graph have ?	[L2][CO6]	**[5M]**
	b) Show that in any graph the number of odd degree vertices is even	[L2][CO6]	**[5M]**
5	a) Define isomorphism. Explain Isomorphism of graphs with a suitable example	[L1][CO6]	**[5M]**
	b) Identify whether the following pair of graphs are isomorphic or not? 	[L2][CO6]	**[5M]**
6	a) Show that the two graphs shown below are isomorphic ? 	[L2][CO6]	**[5M]**
	b) Give an example of a graph which is Hamiltonian but not Eulerian and vice versa	[L2][CO6]	**[5M]**
7	a) Give an example of a graph that has neither an Eulerian circuit nor a Hamiltonian cycle.	[L2][CO6]	**[5M]**
	b) State Euler’s formula and Handshaking theorem	[L1][CO6]	**[5M]**
8	a)Define planar graph and Hamiltonian graph with examples	[L1][CO6]	**[5M]**
	b) Let G be a 4 – Regular connected planar graph having 16 edges. Find the number of regions of G.	[L3][CO6]	**[5M]**
9	a) Define K-regular graph and draw 3-regular and 4-regular graph.	[L1][CO6]	**[5M]**
	b) Define a complete graph and explain with suitable example.	[L1][CO6]	**[5M]**
10	a) Show that a tree with n vertices has n-1 edges.	[L3][CO6]	**[5M]**
	b) Explain about complete bipartite graph and complete binary tree with example.	[L2][CO6]	**[5M]**

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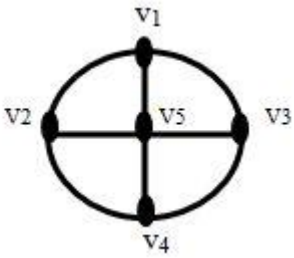
11	a) A connected planar graph has 10 vertices each of degree 3.Find the number of regions; does a representation of this planar graph split the plane?	[L3][CO6]	**[5M]**
	b) Find the number of vertices, number of edges and the number of regions for the following graph and verify the Euler's formula 	[L3][CO6]	**[5M]**

Prepared by: Dept. of Mathematics