Course Code: 20HS0836 **R20**

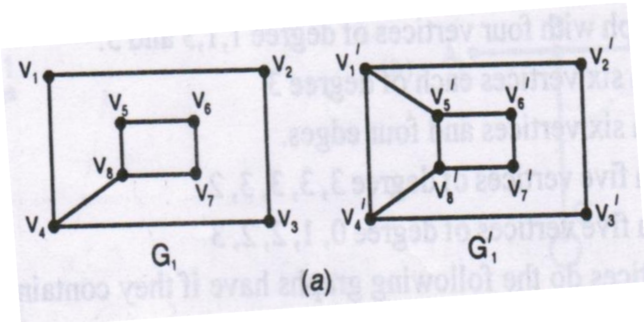
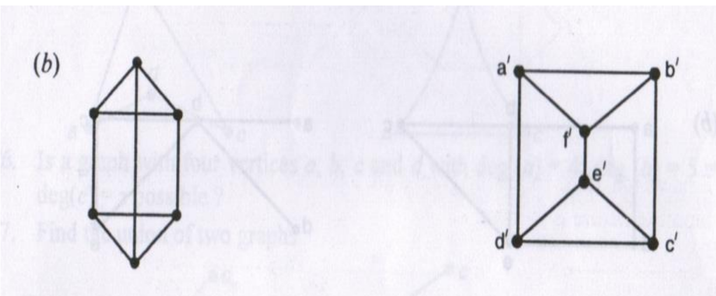
SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Discrete Mathematics (20HS0836) **Course & Branch**: CSE , CSIT,CIC,AI&ML

Year & Sem: II - B.TECH & II-Sem

UNIT-I
Graph Theory

1	a) Explain indegree and out degree of a graph. Also explain about the adjacency matrix representation of graphs. Illustrate with an example?	[L2][CO1]	**[6M]**
	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) $\begin{bmatrix} 1 & 0 & 2 & 1 \\ 0 & 1 & 1 & 2 \\ 2 & 1 & 1 & 0 \\ 1 & 2 & 0 & 1 \end{bmatrix}$	[L2][CO1]	**[6M]**
2	a) Show that the maximum number of edges in a simple graph with n vertices is $\frac{n(n-1)}{2}$	[L2][CO1]	**[6M]**
	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][CO1]	**[6M]**
3	a) Suppose a graph has vertices of degree 0 , 2, 2, 3 and 9 . How many edges does the graph have ?	[L3][CO1]	**[6M]**
	b) Show that in any graph the number of odd degree vertices is even	[L2][CO1]	**[6M]**
4	a) Define isomorphism. Explain Isomorphism of graphs with a suitable example	[L2][CO1]	**[6M]**
	b)Identify whether the following pair of graphs are isomorphic or not? 	[L2][CO1]	**[6M]**
5	a) Show that the two graphs shown below are isomorphic ? 	[L2][CO1]	**[6M]**
	b) Give an example of a graph which is Hamiltonian but not Eulerian and vice versa	[L2][CO1]	**[6M]**

6	a) Give an example of a graph that has neither an Eulerian circuit nor a Hamiltonian cycle.	[L2][CO1]	**[6M]**
	b) State Euler's formula and Handshaking theorem	[L1][CO1]	**[6M]**
7	a)Define planar graph and Hamiltonian graph with examples	[L1][CO1]	**[6M]**
	b)Let G be a 4 – Regular connected planar graph having 16 edges. Find the number of regions of G.	[L3][CO1]	**[6M]**
8	a) Explain about complete graph & complete bipartite graph with example.	[L2][CO1]	**[6M]**
	b) Explain the Rooted tree and Spanning tree with an example .	[L2][CO1]	**[6M]**
9	a)Find the chromatic polynomial & chromatic number for $K_{3,3}$	[L3][CO1]	**[6M]**
	b)Explain graph coloring and chromatic number. Give an example	[L2][CO1]	**[6M]**
10	Explain Depth- First-Search, Breadth-First-Search Algorithm	[L2][CO1]	**[12M]**

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UNIT –II
Mathematical Logic

1	a) Explain the Connectives & their truth tables . b) Define Converse ,Inverse & Contrapositive with examples.	[L2][CO2] [L1][CO2]	**[6M]** **[6M]**
2	a) Construct the truth table for the following formula $\neg(\neg P \vee \neg Q)$ v (R→Q) b) Construct the truth table to Show that $\neg P \wedge (Q \wedge P)$ is a contradiction.	[L3][CO2] [L3][CO2]	**[6M]** **[6M]**
3	a) Define NAND,NOR & XOR and give their truth tables. b)Show that $(P \to Q) \to Q) \Rightarrow P \vee Q$ without constructing truth table	[L1][CO2] [L2][CO2]	**[6M]** **[6M]**
4	a) Show that $S \vee R$ is a tautologically implied by $(P \vee Q) \wedge (P \to R) \wedge (Q \to S)$ b) 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][CO2] [L2][CO2]	**[6M]** **[6M]**
5	a) Show that the following set of premises are inconsistent. $\boldsymbol{P \to Q, P \to R, Q \to \sim R, P}$. b) Show that $(P \vee Q) \to R \equiv (P \to R) \wedge (Q \to R)$	[L2][CO2] [L2][CO2]	**[6M]** **[6M]**
6	a) What is principle disjunctive normal form?Obtain the PDNF of $P \to ((P \to Q) \wedge \neg(\neg Q \vee \neg P))$ **b)** What is principle conjunctive normal form? Obtain the PCNF of $(\neg P \to R) \wedge (Q \leftrightarrow P)$	[L5][CO2] [L5][CO2]	**[6M]** **[6M]**
7	a) Obtain PCNF of $A = (p \wedge q) \vee (\neg p \wedge q) \vee (q \wedge r)$ by constructing PDNF b) Define Maxterms &Minterms of P & Q & give their truth tables	[L5][CO2] [L2][CO2]	**[6M]** **[6M]**
8	a) Show that $\sim P$ is a valid conclusion from the premises $\sim(P \wedge \sim Q)$, $\sim Q \vee R$, $\sim R$ b) Define Quantifiers and types of Quantifiers with examples.	[L2][CO2] [L1][CO2]	**[6M]** **[6M]**
9	a) Use indirect method of proof to show that $(\forall x)(P(x) \vee Q(x)) \Rightarrow (\forall x)P(x) \vee (\exists x)Q(x)$ 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][CO2] [L2][CO2]	**[6M]** **[6M]**
10	a) Show that $(\exists x)(P(x) \wedge Q(x)) \Rightarrow (\exists x)P(x) \wedge (\exists x)Q(x)$ b) Show that $(\forall x)(P(x) \to Q(x)) \wedge (\forall x)(Q(x) \to R(x)) \Rightarrow (\forall x)(P(x) \to R(x))$	[L2][CO2] [L2][CO2]	**[6M]** **[6M]**

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UNIT –III

Relations , Functions & Algebraic Structures

1	a) Define a binary relation. Give an example.Let R be the relation from the set A = {1, 3, 4} on itself and defined by R = { (1, 1), (1, 3), (3, 3), (4, 4)} then Find the matrix of R ,draw the graph of R . b) If R be a relation in the set of integers Z defined by $R = \{(x, y): x \in Z, y \in Z, (x-y)\ is\ divisible\ by\ 6\}$ then show that R is an equivalence relation.	[L3][CO3] [L2][CO3]	**[6M]** **[6M]**
2	a) Let A = { 1,2,3,4} and R ={ (1,1),(1,2) ,(2,1),(2,2), (3,4), (4,3), (3,3) , (4,4)} . Show that R be an equivalence relation & Determine A/R. b) Let A={1,2,3,4,,5,6,7},determine a relation R on A by $aRb \Leftrightarrow 3\ divides(a-b)$,show that R is an equivalence relation.	[L2][CO3] [L2][CO3]	**[6M]** **[6M]**
3	Let A be a given finite set and P(A) its power set . let $\subseteq$ be the inclusion relation on the elements of P(A).Draw the Hasse diagram of (P(A) , $\subseteq$) for i) A = { a } ii) A ={ a ,b} iii) A = { a,b,c } iv) A = { a,b,c,d }.	[L2][CO3]	**[12M]**
4	a) What is a compatability relation? Explain the procedure to find the maximal compatibility blocks. b) Verify $f(x) = 2x + 1, g(x) = x$ for all $x \in R$ are bijective from $R \to R$	[L2][CO3] [L4][CO3]	**[6M]** **[6M]**
5	a) Let $f: A \to B,\ g: B \to C,\ h: C \to D$ then show that $ho(gof) = (hog)of$ b) 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 $(\boldsymbol{gof})^{-1} = \boldsymbol{f^{-1}og^{-1}}$	[L2][CO4] [L4][CO4]	**[6M]** **[6M]**
6	a) Define and give an examples for group, semigroup, & abelian group. b) Show that the necessary and sufficient condition for a non – empty subset H of a group (G, *) to be a subgroup is $a \in H, b \in H \Rightarrow a * b^{-1} €H$	[L1][CO3] [L2][CO3]	**[6M]** **[6M]**
7	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. **b)** Show that the set of all positive rational numbers forms an abelian group under the composition defined by a*b = (ab) / 2	[L2][CO4] [L2][CO4]	**[6M]** **[6M]**
8	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][CO4]	**[6M]**

(+)	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) 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][CO4]	**[6M]**
9	a) Show that the set{1,2,3,4,5} is not a group under addition and multiplication modulo 6.	[L2][CO4]	**[6M]**
	b) Show that the binary operation * defined on $(R,*)$ where $x*y=x^y$ is not associative.	[L2][CO4]	**[6M]**
10	a)Show that the set of all roots of the equation $x^4=1$ forms a group under multiplication.	[L2][CO4]	**[6M]**
	b) Explain the concepts of homomorphism and isomorphism of groups with examples	[L3][CO4]	**[6M]**

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UNIT-IV
Elementary Combinatorics

1	a) How many ways can we get a sum of 8 when two indistinguishable dice are rolled? b) How many different license plates are there that involve 1,2or 3 letters followed by 4 digits ?	[L2][CO5] [L3][CO5]	**[6M]** **[6M]**
2	a) Enumerate the number of non negative integral solutions to the inequality $x_1 + x_2 + x_3 + x_4 + x_5 \le 19$. b) How many integral solutions are there to $x_1 + x_2 + x_3 + x_4 + x_5 = 20$ where each (i) $x_i \ge 2$ (ii) $x_i > 2$	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
3	a) How many numbers can be formed using the digits 1, 3, 4, 5, 6, 8 and 9 if no repetitions are allowed? b) Find the co-efficient of **(i)** $x^3 y^7$ in $(x+y)^{10}$ **(ii)** $x^2 y^4$ *in* $(x-2y)^6$	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
4	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? b) Find the number of arrangements of the letters in the word ACCOUNTANT .	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
5	a) The question paper of mathematics contains two 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. 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?	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
6	**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? **b)** Out of 9 girls and 15 boys how many different committees can be formed each consisting of 6 boys and 4 girls?	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
7	**a)** Find the coefficient of (i) $x^3y^2z^2$ *in* $(2x-y+z)^9$ (ii) x^6y^3 *in* $(x-3y)^9$ x^6y^3 **b)** Find how many integers between 1 and 60 that are divisible by 2 nor by 3 and nor by 5.Also determine the number of integers divisible by 5 not by 2, not by 3.	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**
8	**a)** Out of 80 students in a class, 60 play foot ball, 53 play hockey and 35 play both the games. How many students (i) do not play of these games? (ii) Play only hockey but not foot ball. **b)** 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 following. 1. Chocolate but not straw berry 2. Chocolate and straw berry but not vanilla 3. Vanilla or chocolate but not straw berry	[L3][CO5] [L3][CO5	**[6M]** **[6M]**
9	**a)** Explain Pigeon hole principle and give an example **b)** Find the minimum number of students in a class to be sure that 4 out of them are born on the same month.?	[L3][CO5] [L3][CO5]	**[6M]** **[6M]**

10	**a)** Applying pigeon hole principle show that of any 14 integers are selected from the set S = {1, 2, 3… 25 } there are atleast two whose sum is 26. Also write a statement that generalizes this result.	[L2][CO5]	**[6M]**
	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][CO5]	**[6M]**

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UNIT-V
Recurrence Relation

1	a) Solve $a_n = a_{n-1} + f(n)\ for\ n \geq 1$ by using substitution method. b) Determine the coefficient of $x^{20}\ in\ (x^3 + x^4 + x^5 + \cdots)^5$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
2	a) Determine the sequence generated by (i) $f(x) = 2e^x + 3x^2$ (ii) $f(x) = e^{8x} - 4e^{3x}$. b) Find the sequence generated by the following generating functions (i) $(2x-3)^3$ (ii) $\frac{x^4}{1-x}$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
3	a) Solve $a_n = a_{n-1} + 2a_{n-2}, n \geq 2$ with the initial conditions $a_0 = 0, a_1 = 1$ b) Solve $a_{n+2} - 5a_{n+1} + 6a_n = 2$ with the initial conditions $a_0 = 1, a_1 = -1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
4	a)Solve the R.R $a_{n+2} - 2a_{n+1} + a_n = 2^n$ with initial conditions $a_0 = 2, a_1 = 1$ b) Using generating function to solve $a_n = 3a_{n+1} + 2$, $a_0 = 1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
5	a) **S**olve the following $y_{n+2} - y_{n+1} - 2y_n = n^2$ b) Solve $a_n - 5a_{n-1} + 6a_{n-2} = 1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
6	a) Solve the recurrence relation $a_r = a_{r-1} + a_{r-2}$ using generating function. b) 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][CO6] [L3][CO6]	**[6M]** **[6M]**
7	a) Solve the recurrence relation $a_n = a_{n-1} + \frac{n(n+1)}{2}$ b) Solve $a_k = k(a_{k-1})^2$, $k \geq 1, a_0 = 1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
8	a) Solve $a_n = 2a_{n-1} - a_{n-2}$ with initial conditions $a_1 = 1.5\ \&\ a_2 = 3$ b) Solve $a_n = 3a_{n-1} - a_{n-2}$ with initial conditions $a_1 = -2\ \&\ a_2 = 4$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
9	a) Solve $a_n - 7a_{n-1} + 10a_{n-2} = 4^n$ b) Solve $\boldsymbol{a_n = a_{n-1} + 2a_{n-2}\ n \geq 2}$ with the initial condition $a_0 = 2, a_1 = 1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**
10	a) Solve $a_n - 5a_{n-1} + 6a_{n-2} = 2^n, \quad n \geq 2$ with the initial conditions $a_0 = 1, a_1 = 1$. Using generating functions. b) Solve $a_n - 4a_{n-1} + 4a_{n-2} = (n+1)^2$ given $a_0 = 0, a_1 = 1$	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**

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