Course Code: **20HS0836** **R20**

SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

Subject with Code: DISCRETE MATHEMATICS(20HS0836) **Course &Branch**:MCA

Year & Sem: I-MCA & I-Sem. **Regulation:** R20

UNIT -I
MATHEMATICAL LOGIC

1. a) b)	Explain the connectives and their truth tables. Construct the truth table for the following formula $(P \wedge \neg Q) \to R$.	[L2][CO1] [L1][CO1]	**[6M]** **[6M]**
2. a) b)	Define converse, inverse contra positive with an example. Prove that $(P \wedge Q) \Leftrightarrow (\neg P \vee \neg Q)$ is a contradiction.	[L3][CO1] [L3][CO1]	**[6M]** **[6M]**
3. a) b)	Define NAND, NOR & XOR and give their truth tables. Show that the value of $(P \to Q) \wedge (P \to R)$ is logically equivalent to $P \to (Q \wedge R)$.	[L1][CO1] [L4][CO1]	**[6M]** **[6M]**
4. a) b)	Show that $S \vee R$ is a tautologically implied by $(P \vee Q) \wedge (P \to R) \wedge (Q \to S)$ Show that $P \to Q, P \to R, Q \to \neg R, P$ are inconsistent.	[L4][CO1] [L4][CO1]	**[6M]** **[6M]**
5. a) b)	Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises $P \vee Q, Q \to R, P \to M, and\ \neg M$. Prove by indirect method $\neg q, p \to q\ and\ p \vee t, then t$.	[L1][CO1] [L1][CO1]	**[6M]** **[6M]**
6. a) b)	Define Maxterms &Minterms of P & Q and give their truth tables. Obtain the disjunctive normal form of $\neg(P \vee Q) \Leftrightarrow (P \wedge Q)$.	[L4][CO1] [L4][CO1]	**[6M]** **[6M]**
7. a) b)	What is principal disjunctive normal form? Obtain the PDNF of $\neg P \vee Q$. What is principal conjunctive normal form? Obtain the PCNF of $(\neg P \to R) \wedge (Q \leftrightarrow P)$	[L1][CO1] [L4][CO1]	**[6M]** **[6M]**
8. a) b)	Obtain PCNF of $A = (p \wedge q) \vee (\neg p \wedge q) \vee (q \wedge r)$ by constructing PDNF. Define Quantifiers and types of Quantifiers with examples.	[L4][CO1] [L1][CO1]	**[6M]** **[6M]**
9. a) b)	Verify the validity of the following arguments: Lions are dangerous animals, There are lions. Therefore, there are dangerous animals. Show that $(\exists x)\ M(x)$ follows logically from the premises $(\forall x)(H(x) \to M(x))\ and\ (\exists x) H(x)$	[L4][CO1] [L1][CO1]	**[6M]** **[6M]**
10. a) b)	Prove that $(\exists x)(P(x) \wedge Q(x)) \Rightarrow (\exists x)P(x) \wedge (\exists x)Q(x)$ Explain the procedure for Automatic theorem proving.	[L4][CO1] [L2][CO1]	**[4M]** **[8M]**

UNIT –II
RELATIONS, FUNCTIONS & ALGEBRAIC STRUCTURES

1. a) b)	Define Relation? Write the properties of relations. Let A={0,1,2,3,4}.Show that the relation $R=\{(0,0),(0,4),(1,1),(1,3),(2,2),(3,1),(3,3),(4,0),(4,4)\}$ is an equivalence relation.	[L1][CO2] [L4][CO2]	**[6M]** **[6M]**
2. a) b)	Define an equivalence relation? 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 prove that R is an equivalence relation. Draw the Hasse diagram representing the positive divisors of 36.	[L1][CO2] [L1][CO2]	**[6M]** **[6M]**
3. a) b)	Let A = { 1,2,3,4} and let R be the relation on A defined by xRy if and only if "x divides y",written x/y. i.)Write down R as a set of ordered pairs. ii) Draw the diagraph of R. Let A={1,2,3,4,6,12}.On A, define the relation R by aRb if and only if a divides b. Prove that Ris a partial order on A. Draw the Hasse diagram for this relation.	[L1][CO2] [L1][CO2]	**[6M]** **[6M]**
4.	Define transitive closures. Let A = { 1,2,3}and R= {(1,2),(2,3),(3,1)}.Find the reflexive, symmetric and transitive closures of R, using composition of matrix relation of R.	[L3][CO2]	**[12M]**
5. a) b)	Define a function and write the types of functions Find the inverse of the following functions: $(i) f(x)=\frac{10}{\sqrt[5]{7-3x}}$ $(ii) f(x)=4e^{(6x+2)}$	[L1][CO2] [L1][CO2]	**[6M]** **[6M]**
6. a) b)	Let $f(x)=x+3, g(x)=x-4\ and\ h(x)=5x$ are functions from $R\to R$ where R is the set of real numbers. Find $f\circ(g\circ h)\ and\ (f\circ g)\circ h$. Let f and g be functions from R to R defined by $f(x)=ax+b\ and\ g(x)=1-x+x^2$. $If\ (g\circ f)(x)=9x^2-9x+3$, determine a, b.	[L1][CO2] [L1][CO2]	**[6M]** **[6M]**
7. a) b)	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 $(gof)^{-1} = f^{-1}og^{-1}$. Prove that a group G is abelian if and only if $(ab)^{-1}=a^{-1}b^{-1}\ for\ all\ a,b\in G$.	[L4][CO2] [L3][CO2]	**[6M]** **[6M]**
8. a) b)	Show that the set of all positive rational numbers forms an abelian group under the composition defined by $a*b=(ab)/2$. Show that G={1,2,3,4,5} is not a group under addition & multiplication modulo 6.	[L4][CO2] [L4][CO2]	**[6M]** **[6M]**
9. a) b)	Prove that the set Z of all integers with binary operation $a*b=a+b+1, \forall a,b\in Z$. is an abelian group. The necessary and sufficient condition for a non-empty subset H of a group (G,*) to be a subgroup is $a\in H, b\in H \Rightarrow a*b^{-1}\in H$.	[L4][CO2] [L4][CO2]	**[6M]** **[6M]**
10. a) b)	Define abelian group, homomorphism and isomorphism. For a group G, prove that the function $f:G\to G\ defined\ by\ f(a)=a^{-1}$ is an isomorphism if and only if G is abelian .	[L1][CO2] [L4][CO2]	**[6M]** **[6M]**

UNIT –III

ELEMENTARY COMBINATORICS

1.a) b)	In how many ways 4 white balls and 6 black balls be arranged in a row so that no two white balls are together. i. How many 3-digits numbers can be formed using the digits 1, 3, 4, 5, 6, 8 and 9? ii.How many can be formed if no repetitions are allowed?	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
2. a) b)	Find the number of ways in which the letters of the word ARRANGEMENT can be arranged so that two R's and two A's do not occur together. (i)How many ways are there to sit 10 boys and 10 girls around a circular table? (ii)If boys and girls sit alternate how many ways are there.	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
3. a) b)	A group of 8 scientists is composed of 5 psychologists and 3 sociologists. i) In how many ways can a committee of 5 be formed? ii) In how many ways can a committee of 5 be formed that has 3 psychologists and 2 sociologists? The question paper of mathematics contains two questions divided into two groups of 5 questions each. In how many ways can an examine answer six questions taking atleast two questions from each group.	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
4. a) b)	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? 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?	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
5. a) b)	Find the number of arrangements of the letters in the word i) ACCOUNTANT ii) CALCULUS iii) DIFFERENTIATION. Find the number of arrangements of the letters in TALLAHASSEE which have no adjacent A's.	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
6. a) b)	Find the co-efficient of x^9y^3 in the expansion $(2x-3y)^{12}$ Find the coefficient of $(i) xyz^2 \; in \; (2x-y-z)^4 (ii) xyz^5 \; in \; (x+y+z)^7$	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
7. a) b)	Find the number of non-negative integer solutions of the equality $x_1+x_2+x_3+x_4+...+x_6<10$ Find the number of integer solutions of $x_1+x_2+x_3+x_4+x_5=30$ where $x_1\ge 2, x_2\ge 3, x_3\ge 4, x_4\ge 2, x_5\ge 0.$	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
8. a) b)	If $x>2, y>0, z>0$, then find the number of solutions of $x+y+z+w=21.$ Show that there must be at least 90 ways to choose 6 numbers from 1 to 15 so that all the choices have the same sum.	[L1][CO3] [L1][CO3]	**[6M]** **[6M]**
9. a) b)	Find the number of positive integers less than or equal to 2076 and divisible by 3or 4. 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.	[L1][CO3] [L4][CO3]	**[6M]** **[6M]**
10.a b)	Find the minimum number of students in a class to be sure that 4 out of them are born on the same month. In a sample of 100 logic chips, 23 have a defect D_1,26 have a defect D_2 , 30 have a defect D_3 ,7 have defects D_1 and D_2 , 8 have defects D_1 and D_3 ,10 have defects D_2 and D_3 and 3 have all the three defects. Find the number of chips having (i) at least one defect,(ii) no defect.	[L3][CO3] [L1][CO3]	**[6M]** **[6M]**

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UNIT –IV
RECURRENCE RELATION

1. a)	Find the generating function for the sequence 1,1,1,3,1,1,…	[L1][CO4]	**[6M]**
b)	Find the generating function for the sequence 0, 2, 6, 12, 20, 30, 42…	[L5][CO4]	**[6M]**
2. a)	Find the sequence generated by the following generating functions (i) $(2x-3)^3$ (ii) $\frac{x^4}{1-x}$	[L1][CO4]	**[6M]**
b)	Determine the sequence generated by (i) $f(x) = 2e^x + 3x^2$ (ii) $\frac{1}{1-x}+2x^3$.	[L1][CO4]	**[6M]**
3. a)	Find the sequence generated by the function $f(x)=(3+x)^3$.	[L6][CO4]	**[6M]**
b)	Find the generating function of $(n-1)^2$.	[L6][CO4]	**[6M]**
4. a)	Find the generating function of n^2-2.	[L6][CO4]	**[6M]**
b)	Find the coefficient of x^n in the function $(x^2+x^3+x^4+\ldots)^4$.	[L6][CO4]	**[6M]**
5. a)	Find the coefficient of x^{18} in the expansion of $(x+x^2+x^3+x^4+x^5)(x^2+x^3+x^4+\ldots)^5$.	[L6][CO4]	**[6M]**
b)	Find the coefficient of x^{20} in the expansion of $(x^3+x^4+x^5+\ldots)^5$.	[L6][CO4]	**[6M]**
6.a)	Show that $\{a_n\}$ is a solution of recurrence relation $a_n=-3a_{n-1}+4a_{n-2}, if\ a_n=1$	[L6][CO4]	**[6M]**
b)	Solve $a_n=a_{n-1}+2a_{n-2}$ with initial conditions $a_0=2, a_1=7$	[L6][CO4]	**[6M]**
7.	Solve the recurrence relation $a_n+4a_{n-1}+4a_{n-2}=8\ for\ n\geq 2, and\ a_0=1, a_1=2.$	[L6][CO4]	**[12M]**
8. a)	Solve the recurrence relation $a_{n+2}+3a_{n+1}+2a_n=3^n\ for\ n\geq 0\ given\ a_0=0, a_1=1.$	[L6][CO4]	**[8M]**
b)	Solve the recurrence relation $a_n+a_{n-1}-6a_{n-2}=0$, $for\ n\geq 2$, given that $a_0=-1$ and $a_1=8$.	[L6][CO4]	**[4M]**
9.	Find a generating function for the recurrence relation $a_{n+2}-3a_{n+1}+2a_n=0,\quad n\geq 0$ $and\ a_0=1, a_1=6$. Hence solve the relation.	[L6][CO4]	**[12M]**
10.	Find a generating function for the recurrence relation $a_{n+2}-5a_{n+1}+6a_n=2,\quad n\geq 0$ $and\ a_0=3, a_1=7$. Hence solve the relation.	[L6][CO4]	**[12M]**

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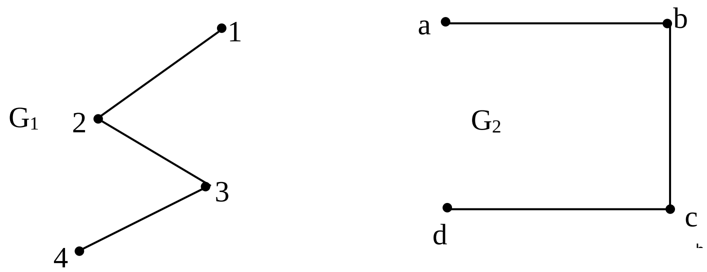
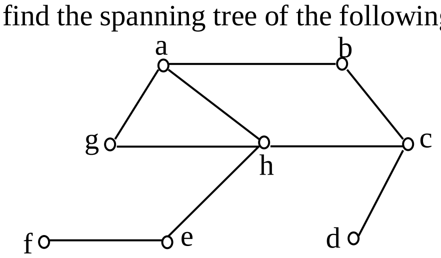
UNIT –V
GRAPH THEORY

1. a)	Show that the maximum number of edges in a simple graph with n vertices is $\frac{n(n-1)}{2}$.	[L5][CO5]	**[6M]**
b)	How many vertices will the graph contains 6 edges and all vertices of degree 3.	[L4][CO5]	**[6M]**
2. a)	How many edges does a graph have if it has vertices of degree 4, 3, 3, 2, 2? Draw such a graph.	[L1][CO5]	**[6M]**
b)	If G is non-directed graph with 12 edges, Suppose that G has 6 vertices of degree 3 and the rest have degree less than 3.Determine the minimum number of vertices.	[L2][CO5]	**[6M]**
3. a)	Determine the number of edges in (i) Complete graph K_n (ii) Complete bipartite graph $K_{m,n}$ (iii) Cycle graph C_n (iv) Path graph P_n.	[L2][CO5]	**[6M]**
b)	Explain about complete graph and Bipartite graph with an example.	[L1][CO5]	**[6M]**
4. a)	Define (i) Planar and non-planar graph (ii) Regular graph (iii)Rooted tree.	[L2][CO5]	**[6M]**
b)	Define the following graph with one suitable example for each graphs (i) sub graph (ii) induced sub graph (iii) spanning sub graph	[L1][CO5]	**[6M]**
5. a)	Explain graph coloring and chromatic number give an example.	[L1][CO5]	**[6M]**
b)	Define (i)Isomorphic graph (ii) Multiple graph (iii)spanning tree.	[L1][CO5]	**[6M]**
6.a)	Show that the two graphs shown in figure are isomorphic? 	[L1][CO5]	**[6M]**
b)	Define Euler circuit, Hamilton cycle, Wheel graph ?	[L1][CO5]	**[6M]**
7. a)	Let G be a 4 – Regular connected planar graph having 16 edges. Find the number of regions of G.	[L1][CO5]	**[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) $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$	[L1][CO5]	**[6M]**
8. a)	Show that in any graph the number of odd degree vertices is even .	[L4][CO5]	**[6M]**
b)	Write difference between Hamiltonian graphs and Euler graphs.	[L1][CO5]	**[6M]**
9.	Apply DFS and find the spanning tree of the following graph 	[L2][CO5]	**[12M]**
10.a)	Explain the algorithm for Breadth- First Search (BFS) for finding a spanning tree for the graph.	[L1][CO5]	**[6M]**
b)	Explain the algorithm for Depth- First Search (DFS) for finding a spanning tree for the graph.	[L1][CO5]	**[6M]**

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