SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR

Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code : Discrete Mathematics (19HS0836) **Branch**: MCA
Year &Sem: I-MCA& I-Sem **Regulation: R19**

Unit1: Mathematical logic

1. **a)** Explain conjuction and disjuction with suitable Examples. [5M]
   b) Define tautology and contradiction with examples. [5M]

2. **a)**Show that $(\neg P \wedge \neg Q \wedge R) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ [5M]
   b) $(P \to Q) \to Q) \Rightarrow P \vee Q$ without constructing truth table [5M]
3. **a)**Show that $P \to Q, P \to R, Q \to \neg R, P$ are inconsistent [5M]
   b) Show that $(P \to Q) \wedge ((Q \to R) \Rightarrow (P \to Q)$ [5M]

4. **a)** What is principle disjunctive normal form? Obtain the PDNF of $P \to ((P \to Q) \wedge \neg(\neg Q \vee \neg P))$ [5M]
   b) What is principle conjunctive normal form? Obtain the PCNF of $(\neg P \to R) \wedge (Q \leftrightarrow P)$ [5M]
5. **a)** Show that S is a valid conclusion from the premises $p \to q, p \to r, \neg(q \wedge r) and (S \vee p)$ [5M]
   b) Obtain PCNF of A= (p∧ q) ∨ (~ p ∧ q) ∨ (q ∧ r) by constructing PDNF. [5M]
6. **a)** Show that $S \vee R$ is a tautologically implied by $(P \vee Q) \wedge (P \to R) \wedge (Q \to S)$ [5M]
   b) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises $P \vee Q, Q \to R, P \to M and \neg M$ [5M]
7. Using indirect method of proof, derive $p \to \neg s$ from the premises $p \to (q \vee r), q \to \neg p, s \to \neg r$ and p. [10M]
8. Show that the following hypothesis is inconsistent.
   (i) If Jack misses many classes through illness, then he fails high school.
   (ii) If Jack fails high school, then he is uneducated
   (iii) If Jack reads a lot of books, then he is not uneducated.
   (iv) Jack misses many classes through illness and reads a lot of books [10M]

9. Given the premises “ A student of this class has not read the Discrete mathematics text book” and “Everyone in this class passed the first unit test” show that “someone who passed the first unit test has not read the discrete mathematics book”. [10M]

10. **a)** Show that $\forall x(P(x) \to Q(x)) \wedge \forall x(Q(x) \to R(x)) \Rightarrow \forall x(P(x) \to R(x))$. [5M]
    b) By indirect method, prove that $\forall x(P(x) \to Q(x)), \exists x P(x) \Rightarrow \exists x Q(x)$. [5M]

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Unit 2: RECURRRENCE RELATION

1. Solve the recurrence relation for the Fibonacci sequence 1,1,2,3,5,8,13…. [10M]

2. Suppose that the white tiger population of Orissa forest is 30 at time n=0 and 32 at time n=1 the increase from time (n-1) to time n is twice the increase from time (n-2) to time (n-1), find the tiger population at time n. hence find the tiger population when n=6. [10M]

3. **a)** Solve $a_n = a_{n-1} + 2a_{n-2}$,$n > 2$ with condition the initial $a_0 = 0$, $a_1 = 1$. [5M]

b) Solve $a_{n+2} - 5 a_{n+1} + 6 a_n = 2$, with condition the initial $a_0 = 1$, $a_1 = - 1$. [5 M]

4. **a)** Solve the RR $a_{n+2} - 2a_{n+1} + a_n = 2^n$ with initial condition $a_0=2$ & $a_1=1$. [5M]

b) Using generating function solve $a_n = 3 a_{n-1} +2$, $a_0= 1$. [5M]

5. **a) S**olve the following $y_{n+2} - y_{n+1} - 2 y_n = n^2$. [5M]

b) Solve $a_n - 5 a_{n-1} + 6 a_{n-2} = 1$. [5M]

6. **a)** Solve the recurrence relation $a_r = a_{r-1} + a_{r-2}$ Using generating function. [5M]

b) Solve the recurrence relation using generating functions $a_n - 9a_{n-1} + 20a_{n-2} = 0$ for $n \geq 2$ and $a_0 = -3, a_1 = -10$ [5M]

7. a) Solve the recurrence relation $a_n = a_{n-1} + \frac{n(n+1)}{2}$ [5M]

b) solve $a_k = k(a_{k-1})^2$, $k \geq 1$, $a_0 = 1$ [5M]

8. Solve the recurrence relations

a) $d_n=2d_{n-1}-d_{n-2}$ with initial conditions $d_1=1.5$ and $d_2=3$. [5M]

b) $b_n=3b_{n-1}-b_{n-2}$ with initial conditions $b_1=-2$ and $b_2=4$. [5M]

9 a) Solve $a_n - 7 a_{n-1} + 10 a_{n-2} = 4^n$. [5M]

b) Solve $a_n = a_{n-1} + 2a_{n-2}$,$n > 2$ with condition the initial $a_0 = 2$, $a_1 = 1$ [5M]

10. a) Solve $a_n - 5 a_{n-1} + 6 a_{n-2} = 2^n$,$n > 2$ with condition the initial $a_0 = 1$, $a_1 = 1$. Using generating function. [5M]

b) Solve $a_n - 4 a_{n-1} + 4a_{n-2} = (n+ 1)^2$ given $a_0 = 0$, $a_1 = 1$. [5M]

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Unit 3: Group theory

1. a) Define semi group, monoid and group. [5M]

   b) Let $*$ on R defined by $a*b=a+b+2ab \quad \forall\ a,b\in R.$
   (i) Find $(R,*)$ is semi group.
   (ii) Find the identity element.
   (iii) Which elements have inverse and what are they? [5M]
2. a) Let $S=N\times N$ be a set of ordered pair positive integer with operation $*$ is defined by $(a,b)*(c,d)=(ad+bc,\ bd)$ if $f:(S,*)\to(Q,+)$ is defined by $f(a,b)=\frac{a}{b}$. then show that f is semigroup homomorphism. [10M]
3. a) Every cyclic monoid (semigroup) is commutative. [5M]
   b) Define abelian group, cyclic group' [5M]
4. Show that M_2, the set of all 2×2 non-singular matrices over R is a group under usual matrix multiplication, is it abelian. [10M]
5. a) If $(G,*)$ is an abelian group iff $(a*b)^2=a^2*b^2 \quad \forall\ a,b\in G$. [5M]
   b) Every cyclic group is an abelian group. [5M]
6. a) The necessary and sufficient condition that a non-empty subset H of a group G to be a sub group is $a,b\in H \Rightarrow a*b^{-1}\in H, \quad \forall\ a,b\in H.$ [5M]
   b) The intersection of two subgroups of a group is also a subgroup of the group. [5M]
7. a) The union of two subgroups of a group G is a subgroup iff one is contained in the other. [5M]
   b) The union of two subgroups of a group need not be subgroup. [5M]
8. State and prove the Lagrange's theorem. [10M]
9. State and prove the fundamental theorem on homomorphism of groups. [10M]
10. a) The intersection of two normal subgroups of a group is also a normal subgroup of the group. [5M]
    b) Every subgroup of an abelian group is normal. [5M]

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Unit4: Graph theory

1.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 **(v)** Null graph N_n [5M]

b) Show that the maximum number of edges in a simple graph with n vertices is n (n-1) / 2 [5M]

2.a) Define isomorphism. Explain Isomorphism of graphs with a suitable example. [5M]

b) Explain graph coloring and chromatic number give an example. [5M]

3. a) Explain about complete graph and planar graph with an example [5M]

b) Define the following graph with one suitable example for each graph

(i) Complement graph (ii) subgraph (iii) induced subgraph (iv) spanning subgraph [5M]

4 .a) Explain In degree and out degree of graph. Also explain about the adjacency matrix representation of graphs. Illustrate with an example? [5M]

b) Give an example of a graph that has neither an Eulerian circuit nor a Hamiltonian circuit [5M]

5.a)A connected graph has an Euler path but not an Euler circuit iff it has exactly two vertices of odd degree [5M]

b) A graph G has 21 edges, 3 vertices of degree4 and the other vertices are of degree 3. Find the number of vertices in G? [5M]

6 .a) Suppose a graph has vertices of degree 0 , 2, 2, 3 and 9 . How many edges does the graph have ? [5M]

b) Give an example of a graph which is Hamiltonian but not Eulerian and vice versa [5M]

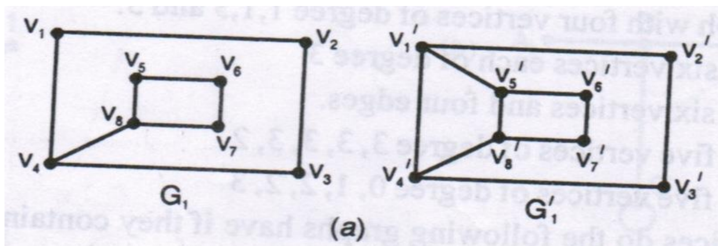
7. a) Let G be a 4 – Regular connected planar graph having 16 edges. Find the number of regions of G . [5M]

b) Draw the graph represented by given Adjacency matrix [5M]

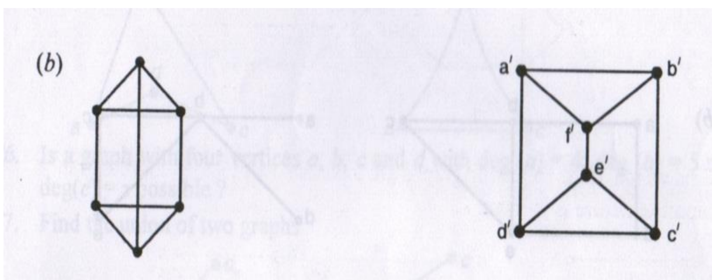
(i) $\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$ (ii) $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$

8. a) Show that in any graph the number of odd degree vertices is even. [5M]

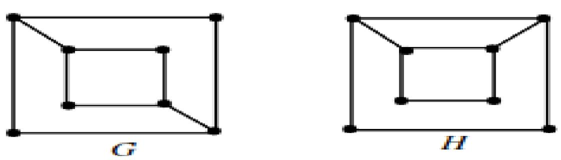
b) Is the following pairs of graphs are isomorphic or not? [5M]



9. a) Show that the two graphs shown below are isomorphic ? [5M]



(b) Determine whether the graphs G and H given below are isomorphic. [5M]



10. a) A connected graph has an Euler path but not an Euler circuit iff it has exactly two vertices of odd degree [5M]

(b) Prove that the maximum number of edges in a simple disconnected graph G with n vertices and k components is $\frac{(n-k)(n-k+1)}{2}$ edges. [5M]

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Unit5: TREES

1. a) Define Spanning tree and explain the algorithm for Depth First Search (DFS) traversal of a graph with suitable example [5M]

   b) Explain about the rooted tree with an example? [5M]

2. a) Write the Properties of Trees [5M]

   b) Define Branch and chord with example. [5M]

3. a) Prove that there is one and only one path between every pair of vertices in a tree, *T*. [5M]

   b) Define eccentricity and center. [5M]

4. a) Prove that if in a graph G there is one and only one path between every pair of vertices, *G* is a tree. [5M]

   b) Define Complement of Tree. [5M]

5. a) Prove that a tree with *n* vertices has $n - 1$ edges. [5M]

   b) Give all the spanning trees of $\mathbf{k_4}$ [5M]

6. The edge set F of the connected graph G is a cut set of G if and only if

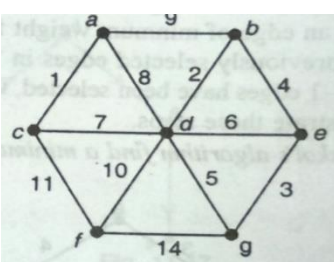
   (i) F includes at least one branch from every spanning tree of G, and

   (ii) if H ⊂F, then there is a spanning tree none of whose branches is in H. [10M]

7. a) Define Rank and Nullity [5M]

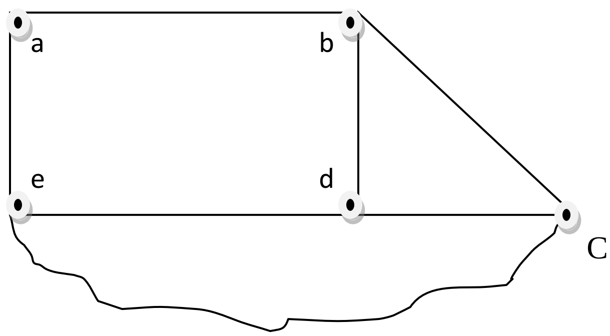
   b) Define Spanning trees in a weighted graph [5M]

8. Show how Kruskal's algorithm find a minimal spanning tree for the following graph

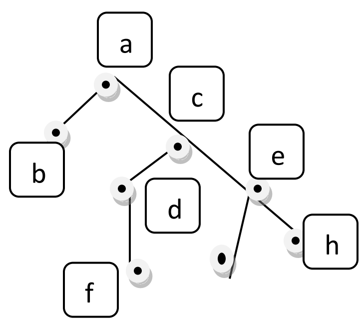


9. a) Prove that for any positive integer n, if G is a connected graph with n vertices and n-1 edges, then G is a tree. [5M]

b) Find six Spanning trees of the graph given below [5M]



10. a) Consider the rooted tree



(i) What is the root of T?

(ii) Find the leaves and the internal vertices of T.

(iii) What are the levels of c and e.

(iv) Find the children of c and e.

(v) Find the descendants of the vertices a and c. [5M]

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b) Suppose a tree has n_1 vertices of degree 1, 2 vertices of degree 2, 4 vertices of degree 3, and three vertices of degree 4, find n_1. [5M]