Code No: RR210501 **Set No.1**

II B.Tech. I Semester Regular Examinations, November -2005
DISCRETE STRUCTURES AND GRAPH THEORY
(Common to Computer Science & Engineering, Information Technology, Computer Science & Systems Engineering and Electronics & Computer Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Construct the truth tables for the following formula; [8+8]
   $(P \wedge Q) \vee (\neg P \wedge Q) \vee (P \wedge \neg Q) \wedge (\neg P \wedge \neg Q)$
   (b) Construct the truth tables of the following formula.
   $(P\rightarrow Q) \wedge (Q \rightarrow P)$
2. (a) Given S = {1,2,3,....,10}and a relation R on S where R = {<x,y> / x+y + 10}, what are the properties of the relation R? [8+8]
   (b) Show that if f <x, y> defines the remainder upon the division of y by x, then it is a primitive recursive function.
3. (a) Show that for any fixed k the relation given by $\{< k, y > |y > k\}$ is primitive recursive. [8+8]
   (b) Show that the sets of even numbers and odd numbers are both recursive.
4. Prove that any 2 simple connected graphs with n vertices, all of degree 2, are isomorphic. [16]
5. (a) State the criteria to detect the planarity of a connected graph and given an example also. [8+8]
   (b) A connected graph G is an Euler graph if and only if G can decomposed into edge-disjoint circuits.
6. Prove whether it is always, never, or some times that the nodes are added to the minimum spanning tree by the dijkstra-prim algorithm is the same as the order in which they are encountered in a depth-first traversal. [16]
7. (a) In how many ways can 10 people be seated in a row so that a certain pair of them are not next to each other ? [8+8]
   (b) Define the combinations and permutations.
8. Solve the recurrence relation a_n-9a_{n-1+}26$a_{n-2} - 24a_{n-3}$=0 for n$\geq$ 3. [16]

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Code No: RR210501 **Set No.2**

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Time: 3 hours **Max Marks: 80**

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1. (a) Explain the difference between the principal of disjunctive and conjunctive normal forms. [8+8]
   (b) Obtain the principal conjunctive normal form of the formula S given by
   $(\urcorner P \rightarrow R) \wedge (Q \rightarrow P)$
2. (a) Let $S = \{1, 2, 3, 4, 5\}$ and let $A = S \times S$. Define the following relation R on A such that (a, b) R (a', b') if and only if a b' = a'b. [5+5+6]
   (b) Show that R is an equivalence relation.
   (c) Compute A/R.
3. (a) Show that for any fixed k the relation given by $\{< k, y > |y > k\}$ is primitive recursive. [8+8]
   (b) Show that the sets of even numbers and odd numbers are both recursive.
4. Prove that any 2 simple connected graphs with n vertices, all of degree 2, are isomorphic. [16]
5. (a) Define planar graph and show that the following graphs are planar [8+8]
      i. Graph of order 5 and size 8.
      ii. Graph of order 6 and size 12.
   (b) Explain non-planar graph and prove that the complete graph of 5 varieties K_5 is non-planar (Kurtowskis First graph).
6. Implement a graph so that the lists of header nodes and arc nodes are circular.
7. (a) Compute the number of rows of 6 Americans, 7 Mexicans, and 10 Canadians in which an American invariably stands between a Mexican and a Canadian and in which a Mexican and a Canadian never stand side by side.
   (b) In how many ways can we choose 3 of the numbers from 1 to 100. So that their sum is divisible by 3 ? [8+8]
8. Solve the recurrence relation $a_n - 8a_{n-1} + 21a_{n-2} - 18a_{n-3}$=0 for n$\geq$ 3. [16]

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Code No: RR210501 **Set No.3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. With reference to automatic theorem proving, show that SVR is tautologically implied by (P∨Q) ∧ (P → R)∧(Q→S) [16]

2. (a) Let $S = \{1, 2, 3, 4, 5\}$ and let A = S × S. Define the following relation R on A such that (a, b) R (a', b') if and only if a b' = a'b. [5+5+6]
   (b) Show that R is an equivalence relation.
   (c) Compute A/R.

3. (a) Prove that if the function f : A→B has an inverse if and only if b is bijective.
   (b) Show that the set of positive N is a lattice with respect to the operations a ∨ b = l c m(a,b) and a ∧ b = g c d, (a, b), l c m - least common multiple and g c d - greatest common divisor. [8+8]

4. Let G be a complete directed graph. A non empty subset of the vertices of G is said to be an 'out classed group' if any edge joining a vertex in the subset and a vertex not in the subset is always directed from the latter to the former. Show that G has a directed circuit containing all the vertices, if there is no outclassed group of vertices. [16]

5. (a) Which of the following non planar graphs have the property that the removal of any vertex and all edges incident with that vertex produces a planar graph?
      i. K_5.
      ii. K_6.
      iii. $K_{3,3}$.
      iv. $K_{3,4}$.
   (b) Let n be a positive integer. Show that a sub graph induced by a non empty subset of the vertex set of K_n is a complete graph. [8+8]

6. (a) Write a detailed algorithm for depth-first traversal using an adjacency matrix that just prints the node label as the visit operation. You should trace it using the graphs. [8+8]
   (b) Prove that each edge in a connected graph will be part of the depth-first traversal tree or will be an edge pointing to a predecessor in the tree.

7. (a) In how many ways can 10 people be seated in a row so that a certain pair of them are not next to each other ? [8+8]

(b) Define the combinations and permutations.

8. Solve the recurrence relation
   $S(k) - 10\,S(k-1) + 9S(k-2) = 0$, $S(0) = 3$, $S(1) = 11$. [16]

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Time: 3 hours **Max Marks: 80**

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1. (a) Show that RVS follows logically from premises. [8+8]
   C$\vee D, (C \vee D) \rightarrow_{\urcorner} H,_{\urcorner} H \rightarrow (A \wedge_{\urcorner} B) \quad (A \wedge_{\urcorner} B) \rightarrow R \vee S$
   (b) Show that R → S can be derived from the premises P→(Q→ S), $\urcorner$ R∨P and Q.
2. (a) Let A be a set with cardinality n and let R be a relation on A. Then prove that the transitive closure R^{α} is given by R^{α} = R U R^2 U - - - - - - - - U R^n
   [8+8]
   (b) Let A = $\{1, 2, 3, 4, 5\}$ and R =$\{(1, 1), (1, 2), (2, 1), (2, 2), (3, 3), (3, 4), (4, 3), (4, 4), (5, 5)\}$ and S = $\{(1, 1), (2, 2), (3, 3), (4, 4), (5, 4), (4, 5), (5, 5)\}$. Find the smallest-equivalence relation containing R and S and compute the partition of A that it produces
3. (a) If f : X→Y and g : Y→X the function g is equal to f^{-1} only if g • f = I$_x$ and f •g = I$_y$ .Prove the result . [8+8]
   (b) Let f : R → R and g : R → R where R is the set of real numbers. Find f • g and g • f where f(x) = x^2 - 2, g(x) = x + 4. State whether these functions are injective, subjective or objective.
4. (a) Let G be a simple graph, all of whose vertices have degree 3 and $|R| + |V| + |E| + 2$. What can be said about G ? [8+8]
   (b) Can a simple graph with 7 vertices be isomorphic to its complement ?
5. (a) Define 'Euler path' and 'Euler circuit' of a directed multigraph and give examples.
   (b) Explain De Bruijn sequence and its applications. [8+8]
6. (a) Prove that if there is one edge with a weight smaller than all of the other edges, that edges will be part of every minimum spanning tree. [10]
   (b) Evaluate the value of prefix expression. [6]
   + - * 235 / ↑ 234 ?
   Give the solution steps.
7. (a) Explain about Enumerating permutations with constrained repetitions. [8+8]
   (b) Compute the number of 10-digit numbers which contain only the digits 1,2 and 3 with the digit 2 appearing in each number exactly twice.

8. Solve the recurrence relation [16]
   T(k) + 3 kT(k-1) = 0, T(0) = 1

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