ROLL NO. _____

# ALCCS – NEW SCHEME

**Code: CT22** **Subject: DISCRETE MATHEMATICAL STRUCTURES**
**Time: 3 Hours** **Max. Marks: 100**

**AUGUST 2011**

**NOTE:**

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **Question 1 is compulsory and carries 28 marks. Answer any FOUR questions from the rest. Marks are indicated against each question.**
- **Parts of a question should be answered at the same place.**

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**Q.1** a. State one procedure to obtain the principal disjunctive and principal conjunctive normal forms of any predicate formula using an example.

b. What is a bipartite graph? What type of graph a tree and star are?

c. Prove that ${}^{n+1}C_r = {}^{n}C_{r-1} + {}^{n}C_r$

d. Show how many different words can be formed out of the letters of the word VARANASI?

e. Simplify the logical expression $\overline{X}\,\overline{Y} + \overline{X}Z + YZ + \overline{Y}Z\overline{W}$

f. State and prove the Euler formula to detect the planarity of a graph.

g. What are the possible ways to combine two automatons? **(7 × 4)**

**Q.2** a. If P, Q and R are three atomic variables, obtain the principal disjunctive normal form for $(P \rightarrow (Q \wedge R)) \vee (\sim P \rightarrow (Q \vee R))$ **(9)**

b. State and prove the condition to find out if a given graph is an Euler graph. **(9)**

**Q.3** a. On a set S = {1,2,3,4,5}, find the equivalence relation on S, which generate the partition { {1,2}, {3}, {4,5} }. Draw the graph of the relation. **(9)**

b. Show that the maximum number of vertices in a binary tree of height h is $2^{h+1} - 1$. **(9)**

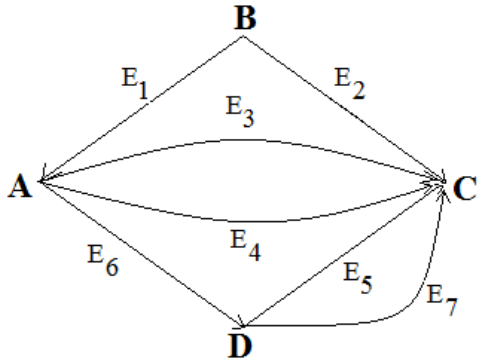
**Q.4** a. Solve the recurrence relation $a_n = 4\,a_{n-1} - 4\,a_{n-2}$ , $n \geq 2$ with initial conditions, $a_0 = 6$ and $a_1 = 8$. **(9)**

b. Define Boolean algebra. Prove that the power set of any set form a Boolean algebra. **(9)**

**Q.5** a. What is a spanning tree of a graph? How to obtain fundamental circuits, given a spanning tree? **(9)**

b. What is a Hasse diagram? Draw the Hasse diagrams of the following sets under the partial ordering relation "divides" and indicate those which are totally ordered.
(i) {2, 6, 24}
(ii) {1,2,3,6,12}
(iii) {3,9,27,54} **(9)**

**Q.6** a. Obtain the incidence and the adjacency matrix of the directed graph given below. Also, from the adjacency matrix, show that the graph is strongly connected or not?**(9)**




b. Prove that if (A, ≤) has a least element, then (A, ≤) has a unique least element. **(9)**

**Q.7** a. Define a Deterministic and Nondeterministic Finite automaton and explain. **(9)**

b. Construct the finite automaton for the state transition table given below **(9)**

| | a | b |
|---|---|---|
| start $s_0$ | $s_0$ | $s_2$ |
| $s_1$ | $s_0$ | $s_1$ |
| $s_2$* | $s_2$ | $s_1$ |