

**CS/EI/IT-405**

**B. E. (Fourth Semester)**  
**EXAMINATION, May/June, 2006**

(Common for CS, EI & IT Engg.)

**DISCRETE STRUCTURES**

*Time : Three Hours*

*Maximum Marks : 100*

*Minimum Pass Marks : 35*

**Note :** Attempt any five questions.

1. (a) Define the following : 10
  - (i) Power set
  - (ii) Cut set
  - (iii) One-to-one function
  - (iv) Relation
  - (v) Graph
- (b) Categorize the following sets as finite, countably infinite or uncountably infinite and also give an alternative representation for them : 10
  - (i)  $\{x \mid x \text{ is a real number and } 2 \leq x \leq 3\}$
  - (ii) All employees of an organization
  - (iii)  $\{x \mid x \text{ is an odd positive integer less than } 100\}$
  - (iv)  $\{1, 2, 3, 5, 7, 11, 13, 17, \dots\}$

**P. T. O.**

2. (a) There are two restaurants next to each other. One has a signboard that says, "Good food is not cheap," and other has a sign that says, "Cheap food is not good." In context of formal logic, do both the signs say the same thing ? 6
- (b) Briefly explain the principle of inclusion and exclusion. 6
- (c) Given that for any positive integer  $n \geq 2$  : 8

$$\frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} - A > 0$$

where A is a constant. How large can A be ?

3. (a) Discuss the properties that a binary relation may have. What is meant by a partial ordering relation ? 10
- (b) Briefly illustrate the application of Pigeon-hole principle using an example. 5
- (c) Show that : 5

$$(P \cap Q) \times (R \cap S) = (P \times R) \cap (Q \times S)$$

for some arbitrary sets P, Q, R and S.
4. (a) Find power set of : 5

$$X = \{\phi, 1, \{b\}\}$$
- (b) What properties a graph should have to be considered as tree ? 5
- (c) What is a semigroup ? Prove that  $(A, +)$  is a semigroup where A be the set of all positive even integers and + be the ordinary addition operation. 10

5. (a) Differentiate between a function and a relation. 5

- (b) Show that for a planar graph : 10

$$v - e + r = 2$$

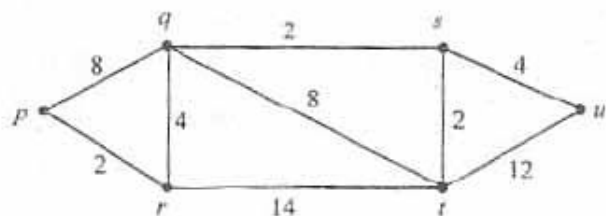
where :

$v$  is number of vertices

$e$  is number of edges

$r$  is number of regions in the graph

- (c) Define Eulerian path and Eulerian circuit. 5
6. (a) Show that a regular binary tree has an odd number of vertices. 5
- (b) Give definition of the following : 5
- Spanning tree
  - Rooted tree
- (c) Using Dijkstra's algorithm find the shortest path from  $p$  to  $u$  in the following weighted graph : 10



7. (a) In context of functions what is meant by bijection ? 5
- (b) Define Well Formed Formula (WFF). 5
- (c) Let  $C$  and  $D$  be sets such that  $(C \cup D) \subseteq D$  and  $D \not\subseteq C$ . Draw a Venn diagram for these sets. 5
- (d) Show that the truth value of the following formula is independent of its components : 5

$$(P \wedge (P \rightarrow Q)) \rightarrow Q$$

8. Write short notes on any four of the following : 20

- Principle of induction
- Groups and Rings
- Russell's paradox
- Transitive relations
- Prefix codes
- Applications of formal logic