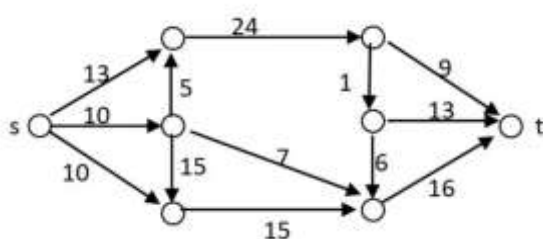


(3 Hours)

[Total Marks: 80]

- N.B. (1) Question No. 1 is compulsory  
(2) Attempt any three out of the remaining five questions  
(3) Assumptions made should be clearly stated

1. (a) Differentiate between P, NP, NP Complete and NP-Hard classes of Complexity. 05  
(b) Define Red-Black tree. 05  
(c) Write short note on bipartite matching. 05  
(d) Explain recurrences with example. 05
2. (a) Define Maximum flow and Minimum-Cut. Apply Ford Fulkerson algorithm on following. 10



- (b) What is convex hull? Explain Jarvis March in detail. 10
3. (a) Prove that Vertex Cover is NP-Complete. 10  
(b) Explain Master theorem, and apply on the following examples. 10
  - i)  $T(n) = 2T(n/2) + n$
  - ii)  $T(n) = 4T(n/2) + n^2$
4. (a) Explain steps to prove any problem as NP Complete problem. 10  
(b) Define Binomial Heap, Explain its operations with example. 10
5. (a) Explain DELETE operation in Red-Black Tree. Discuss its time complexity. 10  
(b) Prove that TSP is NP-Complete. 10
6. Write a short note on following (any 4) 20
  - (a) Amortized Analysis
  - (b) Randomized Algorithm
  - (c) Relabel to Front algorithm
  - (d) Line segment properties
  - (e) NP-Completeness

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