



Final Exam

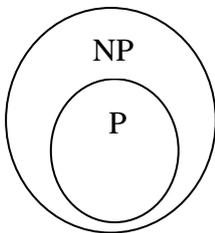
Program: Network Technology  
Course Name: Design and analysis  
of Algorithms  
Course Code: NCS314  
Instructor(s): Sherif Khattab

Date: 20/1/2016  
Duration: 2 hours  
Total Marks: 60

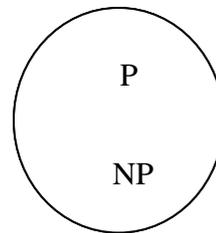
**OPEN BOOK AND NOTES**

**Question 1 [15 marks] NP-completeness**

a. [2 marks] Which (if any) of the following two figures is correct and why?



(1)

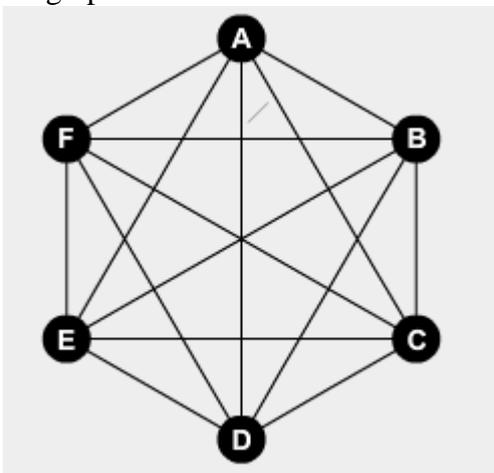


(2)

- b. [3 marks] Sketch briefly how you would prove that problem A is an NP-complete problem
- c. [3 marks] What is the difference between optimization problems and decision problems. Give one example of each. How would you build an algorithm for an optimization problem from an algorithm for an appropriate decision problem?
- d. [2 marks] List four strategies to deal efficiently with NP-complete problems.
- e. [5 marks] Write an efficient algorithm to solve the maximum cut problem on a bipartite graph. Trace your algorithm on a graph of your choice. What is the running-time of your algorithm?

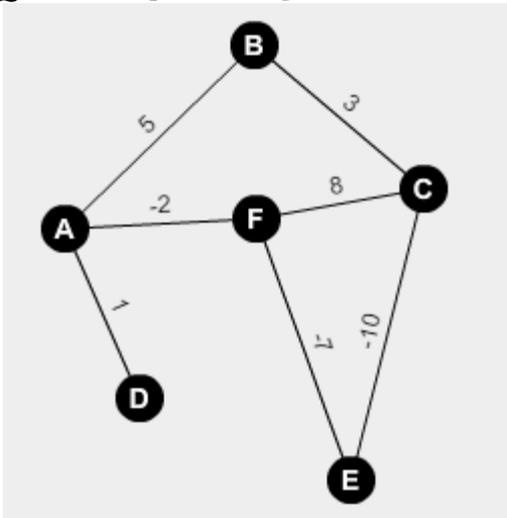
**Question 2 [10 marks]**

a. [5 marks] Define the minimum vertex cover problem. What is the minimum vertex cover of the graph below?



b. [5 marks] Write an algorithm that solves the vertex cover problem as fast as  $O(2^k m)$ , where  $k$  is the size of the minimum vertex cover and  $m$  is the number of edges of the graph.

**Question 3 [20 marks]** Answer the following questions on the below graph.



- [4 mark]** What is the graph type (directed or undirected)? What is the number of vertices and the number of edges?
- [3 marks]** Which algorithm(s) would you choose to compute the shortest paths between all pairs of vertices of the above graph? Why? What is the running time?
- [5 marks]** Trace Johnson's re-weighting algorithm on the above graph.
- [3 marks]** Which algorithm(s) would you choose to compute the shortest paths from vertex F to all other vertices of the above graph? Why? What is the running time?
- [5 marks]** Trace the algorithm(s) you selected in (d) on the above graph.

**Question 4 [15 marks]**

- [2 marks]** Name two algorithms for computing the minimum spanning tree.
- [2 marks]** Would the two algorithms work on the graph of Question 3 above? Why?
- [5 marks]** Trace an appropriate minimum spanning tree algorithm on the graph of Question 3.
- [6 marks]** For each of the following data structures, list one application and indicate why the data structure is the most suitable for this application: bloom filter, heap, and hash table.

Sherif Khattab