The Hong Kong Polytechnic University

COMP2012 Discrete Mathematics

Assignment 2

(Due: 23:59, 5th December, 2023)

Guideline:

- This is an individual assignment.
- You only need to put the answer on an answer sheet; there is no need to replicate the questions. You may use your own answer sheet/book format.
- You may either type the solution using clear equation expressions with Word/Latex, or write your answer on paper and scan them to a file.
- You must write your answer clearly and neatly, including all necessary steps.
- Finally, digitalise your answer sheet into PDF format and submit it to Blackboard (as a doc/docx/pdf file). You can resubmit new versions by the deadline.

Questions:

Question 1   **[20 marks]**

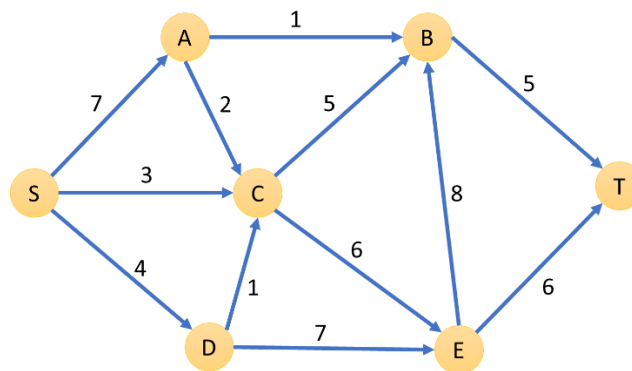Determine the maximum flow of the network G in Figure 1-1,

Figure 1-1

1(a)   Using the *max-flow min-cut* theorem. (3 marks)

1(b)   Using the *Folk-Fulkerson* algorithm. (5 marks)

1(c)   Using the *Edmonds-Karp* algorithm. (5 marks)

1(d)   Discuss whether the 1(c)'s algorithm outperforms 1(b)'s algorithm. (2 marks)

1(e)   Suppose a network G' is an undirected graph with the same vertices and edges (without directions) as in G. Find the minimum spanning tree (MST) from the network G' with any method you have learned in the lesson. (5 marks)

Question 2 [20 marks]

2(a) Simplify the logic of $(A + \bar{A})(AB + AB\bar{C})$ using Boolean Rules and Laws. (5 marks)

2(b) Express $F(A, B, C) = A\bar{B}C + \bar{A}BC + \bar{A}\bar{B}C$ using a combinational circuit (you can only use two-input logic gates). (5 marks)

Hint: in this question type, you are required to draw a logic circuit diagram

2(c) Simplify $F(A, B, C) = A\bar{B}C + \bar{A}BC + \bar{A}\bar{B}C$ using Karnaugh map. (5 marks) And then, express $F(A, B, C)$ using combinational circuit. (5 marks)

Question 3 [10 marks]

Computing students are enrolling for different class sessions of a course. Given:

Paul: available for Tuesday morning & Tuesday afternoon

Mary: available for Thursday morning & Friday afternoon

Peter: available for Tuesday morning & Thursday morning

Susie: available for Tuesday morning & Friday afternoon

Use maximum flow method to solve this class assignment problem. (10 marks)

Question 4. [30 marks]

4(a) Given the array of integers below, draw a Binary Search Tree (BST). (5 marks)

70 11 47 81 20 61 10 12 13 62

4(b) Is this BST a balanced tree? (1 mark) Give your justification (2 marks)

4(c) List nodes in a *pre-order traversal.* (5 marks)

4(d) List nodes in a *post-order traversal*. (5 marks)

4(e) List nodes in an *in-order traversal*. (5 marks)

6(f) On the BST, show the steps to delete node 11 followed by deleting node 47? (7 marks)

Question 5. [20 marks]

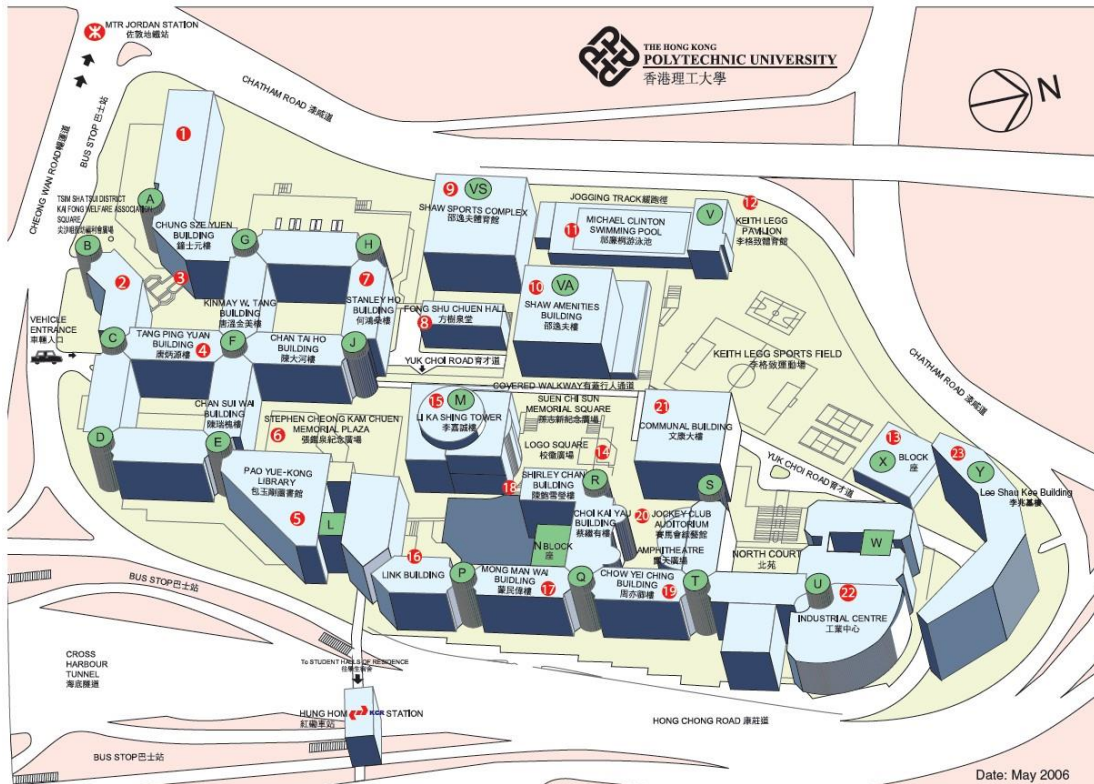Figure 5-1 shows the campus map of the Hong Kong Polytechnic University:

Figure 5-1

We define the distances between Cores/Blocks/Towers:

M to R: 150 metres, Q to R: 100 metres, Q to M: 185 metres, Q to T: 100 metres
R to S: 100 metres, S to T: 100 metres, T to W: 115 metres, S to W: 122 metres

T to U: 100 metres,   U to W: 55 metres,   W to Y: 61 metres.   U to Y: 83 metres
M to VA: 112 metres, R to VA: 171 metres, S to VA: 202 metres

5(a)   Start from Core Q, find the lowest cost distances to the building/tower of the
following landmarks:
  (i)   Tower M (5 marks)
  (ii)   Classroom Y302 (5 marks)
  (iii)   7-Eleven (5 marks)

5(b)   Write down the shortest path from Core Q to Classroom Y302 in order to attend
the COMP2012 lecture. (5 marks)

End of Assignment 2