# MTE 2151- DATA STRUCTURES AND ALGORITHMS

## III SEMESTER- MAKE-UP EXAM QUESTION PAPER

Type: DES

**Q1.** What is a Stack? How is it different from a Queue? Discuss the various operations that occur on a stack. (5)

**Q2.** Create an AVL tree with necessary rotations at each step for the following set of nodes: 5, 6, 78, 9, 4, 56, 90 (3)

**Q3.** What would be the output for the following code snippet?

```
def f(y):
        x = 1
        z =y + x
        print ("In function",z)
x = 5
f(x)
print ("Outside function",x)
```
(3)

Solution: **In function 6        (1.5)**

**Out function 5       (1.5)**


**Q4.** Consider the following functions:

$$g(n) = 502n^2 + 3n - 7$$

$$f(n) = 715n^2 + 100n + 10$$

Is $g(n) = O(f(n))$? Give reasons for your answer.(2)

**Q5.** Compare and contrast between the Bubble sort and Insertion sort algorithms. (3)

**Q6.** Elaborate on the steps to find the string 'jumped' in the text 'The quick brown fox jumped over the wall' using the Brute Force algorithm. (3)

**Q7.** What is the need for creation of a shift table in the Horspool's algorithm? Explain using an example. (3)

**Q8.** Find the pattern 'Engine' in the text 'I am an Engineer' using the Rabin-Karp algorithm. Illustrate the creation of the rolling hash function/code function for the same. (3)
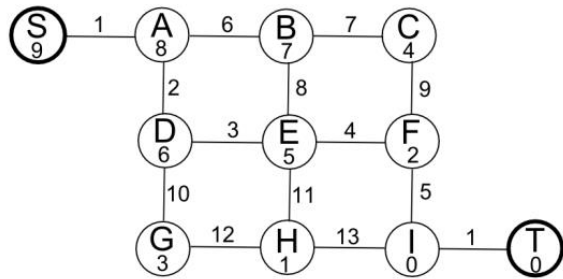
Q9. Draw the tree and give the path with:
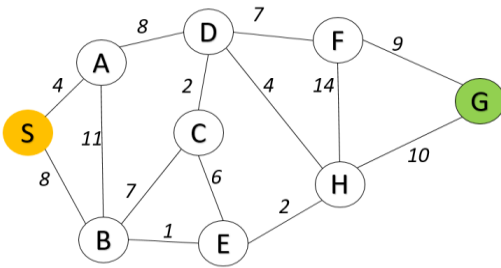


a) Breadth First Search
b) Depth First Search
c) Dijsktra Search Technique(5)

Q10. Illustrate the working of Greedy Algorithms on the following Graph and show why A* is better option. (5)
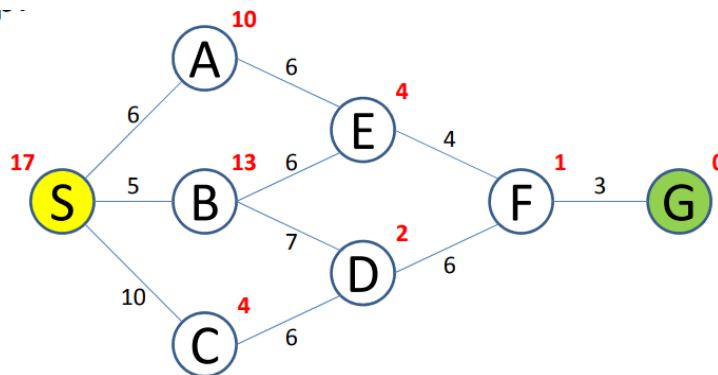


Q11. Explain the need of Heuristics in Search Algorithms. Explain why the total cost function throughout the graph must be non-decreasing. (5)

Q12. Aliens have invaded the MIT campus, thinking that the "S" was their mothership. Despite their realization that it was not, they went ahead with their invasion plan anyway. Advanced alien technology has disabled use of phones and internet, so you and your friends decide to go across and tell everyone what's going on. You decide to use the secret underground network of tunnels underneath the campus to get from your starting location at "S", to the railway station a "T". You have the above graph of the underground tunnels. The edges are labelled with distances, and the nodes are labelled with a heuristic estimate to your destination at T. When performing search, ties are broken by choosing the node that is alphabetically first. (6)

The graph consists of the following nodes with heuristic values and edge weights:

Nodes (with heuristic values):
- S: 9
- A: 8
- B: 7
- C: 4
- D: 6
- E: 5
- F: 2
- G: 3
- H: 1
- I: 0
- T: 0

Edges (with costs):
- S–A: 1
- A–B: 6
- B–C: 7
- A–D: 2
- B–E: 8
- C–F: 9
- D–E: 3
- E–F: 4
- D–G: 10
- E–H: 11
- F–I: 5
- G–H: 12
- H–I: 13
- I–T: 1

a) You first attempt to pick your route using Depth-first search. Draw your search tree and path taken.

b) Next you try to pick your route using A*, draw search tree and path.