United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam Total Marks: **25** Fall-2020

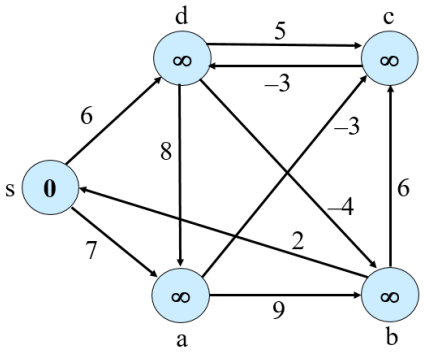
Course Code: CSI 227 Course Title: Data Structure and Algorithms II

Time: *1 hour 15 minutes* for answering. *Another 15 minutes* for download and upload

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

There are **FOUR questions**. **Answer all of them**. Figures in the right-hand margin indicate full marks.

1 **a)** Show the shortest-path tree for the following graph using Dijkstra's algorithm. **[3+2]**



The tree you just obtained using Dijkstra's algorithm is not really the shortest-path tree. Can Bellman-Ford algorithm get the shortest-path tree for you here? Justify your answer with proper reasoning.

b) Consider an open-addressing hash table as shown below. The table already contains three data items, and other empty slots contain '#'. Assume that collisions are handled by the following hash function: **[3]**

$h(k, i)=(h(k) + i^2 * h'(k))$ mod 11, where $h'(k)=(k + 7)$ *mod 11* and $h(k)=k$ *mod 11*.

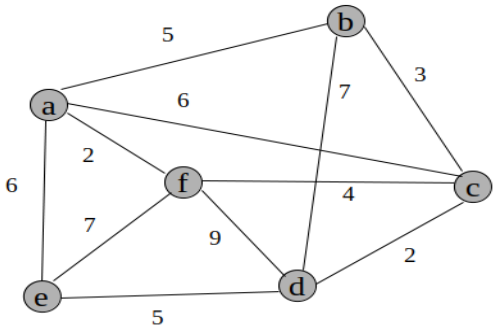
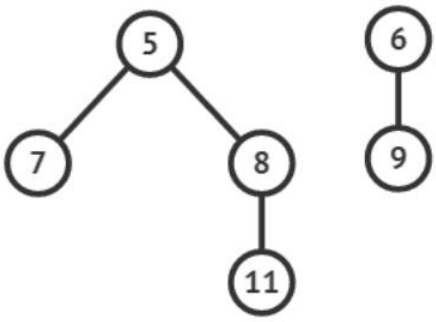
By showing detailed calculations, redraw the table after the operations: (i) *insert* 121; (ii) *insert* 3; (iii) *search* 44

0	1	2	3	4	5	6	7	8	9	10
22	#		**80**	#	#		**62**	#	#	#

2 **(a)** Write an algorithm that prints the out-degree of each vertex for an adjacency matrix **Mat**. Analyse the running time of your algorithm. **[3+1]**

(b) At the Rabin-Karp algorithm, for matching a pattern from a string of digits, why do we use the modulo operation? Show an example in which case the worst-case scenario occurs in the Rabin-Karp algorithm. **[1+2]**

(c) "Sorting is an NP problem"- is the statement correct. Explain briefly. **[2]**

3	**(a)** Find a minimum spanning tree of the following graph using Kruskal's algorithm.  	**[3]**
	(b) Suppose, the edges of the above graph are sorted using bubble sort algorithm (The time complexity of bubble sort is $O(n^2)$). Is this going to affect the time complexity of the Kruskal's algorithm? Explain your answer briefly.	**[2]**
4	Draw the resultant forest after calling UNION(6, 11) and after that, FIND-SET(9) on the disjoint-sets of the following figure. You must use the union-by-rank and the path-compression heuristics.  	**[3]**