

*(KNOWLEDGE FOR DEVELOPMENT)*

**KIBABII UNIVERSITY  
(KIBU)**

**UNIVERSITY EXAMINATIONS  
2020/2021 ACADEMIC YEAR**

**SPECIAL/SUPPLEMENTARY EXAMINATIONS  
THIRD YEAR FIRST SEMESTER  
FOR THE DEGREE IN  
(COMPUTER SCIENCE)**

**COURSE CODE: CSC 312**

**COURSE TITLE: DESIGN AND ANALYSIS OF  
ALGORITHMS**

**DATE: 7/01/2022**

**TIME: 2.00 P.M-4.00 P.M**

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**INSTRUCTIONS**

**ANSWER QUESTIONS ONE AND ANY OTHER TWO.**

**QUESTION ONE [COMPULSORY]****[30 MARKS]**

- a. Define an algorithm and explain different criteria that satisfy the algorithm? [4 marks]
- b. Explain in brief the basic asymptotic efficiency classes. [6 marks]
- c. Determine the best case and worst-case time complexity of the following function:

```
void fun(int n, int arr[ ])
{
  int i = 0, j = 0;
  for(; i < n; ++i)
    while(j < n && arr[i] < arr[j])
      j++;
}
```

**[4 marks]**

- d. What is meant by time complexity? Define different time complexity notations giving example each case? [4 marks]
- e. Differentiate between :
- i. deterministic and non deterministic algorithms [2 marks]
  - ii. polynomial and non deterministic polynomial [2 marks]
- f. Explain the concept of P, NP-hard and NP-Complete problems. [4 marks]
- g. If you have to solve the searching problem for a list of n numbers, how can you take advantage of the fact that the list is known to be sorted? Give separate answers for
- i. lists represented as arrays. [2 marks]
  - ii. lists represented as linked lists. [2 marks]

**QUESTION TWO****[20 MARKS]**

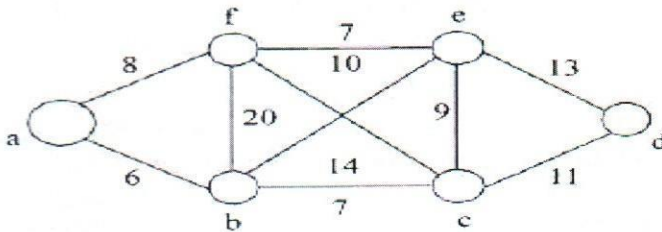
- a. Briefly discuss the various Greedy techniques to problem solving and their respective components [6 marks]
- b. i. Draw undirected graph for the adjacent matrix below. [2 marks]

$$\begin{bmatrix} 0 & \infty & 3 & \infty \\ 2 & 0 & \infty & \infty \\ \infty & 7 & 0 & 1 \\ 6 & \infty & \infty & 0 \end{bmatrix}$$

ii. Write the formula to find the shortest path using Floyd's approach hence or otherwise solve the following all pairs shortest paths problem using the graph drawn in b (i).

[6 marks]

c. Use Kruskal's method to find min cost spanning tree for the following graph [6 marks]



### QUESTION THREE

[20 MARKS]

- Explain steps followed when developing an algorithm. [4 marks]
- Discuss any four advantages of using standard algorithms while developing a system [4 marks]
- Write the Bubble sort algorithm (Ascending order), determine the running time (big O) and illustrate how it will sort the following list of elements: 89, 45, 68, 90, 29, 34 and 17. [6 marks]
- Write a java program to simulate the outputs of part (c) above. [4 marks]

### QUESTION FOUR

[20 MARKS]

- You are working with an array of size 1000 elements, assume that the running time of a searching algorithm is defined by  $f(n)$ . Explain how the algorithm may be considered to have the following types of analysis
  - Best case [2 marks]
  - Worst case [2 marks]
  - Average case [2 marks]
- Describe the asymptotic notation and discuss one advantage of using asymptotic notations to analyze algorithms [4 marks]
- Discuss how a Divide-and-Conquer algorithm works and state the nature of problems that can be solved using this approach [6 marks]



- d. Algorithm analysis is the study of an algorithm's efficiency with respect to resource utilization, discuss these resources **[4 marks]**

**QUESTION FIVE** **[20 MARKS]**

- a. Explain the concept of Backtracking. Explain how 4 Queen Problem can be solved using backtracking. Draw the state space tree corresponding to 4 Queen Problem. **[5 marks]**
- b. Describe Dynamic Programming approach of solving problems and state any two example of algorithms that apply this approach. **[6 marks]**
- c. Explain Greedy Approach and write down the general greedy algorithm. **[3 marks]**
- d. Formulate Fractional Knapsack Problem. Write Greedy Algorithm for fractional Knapsack Problem and find the optimal solution for the following fractional Knapsack problem.  $n=4$ ,  $m = 60$ ,  $W=\{40, 10, 20, 24\}$  and  $P=\{280, 100, 120, 120\}$  **[6 marks]**