UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

SPECIAL AND SUPPLEMENTARY EXAMINATIONS
YEAR 1 SEMESTER II

FOR THE DEGREE OF
MASTER OF SCIENCE IN COMPUTER SCIENCE

COURSE CODE: **MCS 822**

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

DATE: 15/08/2023   TIME: 2.00 P.M -4.00 P.M

INSTRUCTIONS

SECTION A IS COMPULSORY.

ANSWER ANY 2 QUESTIONS FROM SECTION B. EACH QUESTION IN

THIS SECTION CONTAINS 20 MARKS.

SECTION A [COMPULSORY QUESTION]

QUESTION ONE [20 MARKS]

a. i. What do you understand by the terms: [2 Marks]

    I.   Algorithm [2 Marks]

    II. pseudo code [3 Marks]

  ii. Outline the characteristics of an algorithm.

b. i. Write an algorithm for *insertion sort* which can sort a sequence of numbers. [4 Marks]

c. i. When running a search algorithm, when does: [2 Marks]

    I.   Best case occur [2 Marks]

    II.   Worst case occur [5 Marks]

  ii. Using diagrams show how the array below will be sorted

Sort by insertion

5	2	4	6	1	3

SECTION B

ANSWER ANY TWO (2) QUESTIONS FROM THIS SECTION

QUESTION TWO [20 MARKS]

a Outline the basis for choosing the greedy approach in solving a computational problem? [2 Marks]

b Discuss the steps of Dynamic Programming technique. [6 Marks]

c Distinguish between dynamic programming and greedy strategy. [2 Marks]

d Explain any FIVE techniques of designing algorithms. [10 Marks]

QUESTION THREE [20 MARKS]

a. Describe the '*Merge sort algorithm*'. [5 Marks]

b. Quicksort is based on the three-step process. Outline these steps. [3 Marks]

c. Outline the determinants of quick sort algorithm. [2 Marks]

d. Discuss the heap algorithm. [10 Marks]

QUESTION FOUR [20 MARKS]

a. Consider a town with n men and n women seeking to get married to one another. Each man has a preference list that ranks all the women, and each woman has a preference list that ranks all the men. The set of all 2n people is divided into two categories: good people and bad people. Suppose that for some number k, $1 \leq k \leq n - 1$, there are k good men and k good women; thus there are n − k bad men and n − k bad women. Everyone would rather marry any good person than any bad person. Formally, each preference list has the property that it ranks each good person of the opposite gender higher than each bad person of the opposite gender: its first k entries are the good people (of the opposite gender) in some order, and its next n − k are the bad people (of the opposite gender) in some order. Show that in every stable matching, every good man is married to a good woman. [10 Marks]

b. Write an algorithm to solve the problem above. [10 Marks]

QUESTION FIVE [20 MARKS]

a. In design and analysis of algorithms, what do you understand by **asymptotic** notation? [4 Marks]

b. i. Briefly describe the concept of "*Recursion* "in algorithms. [3 Marks]

ii. Study the algorithm below.

```
Algorithm D and C (P)

{

if small(P)

then return S(P)

else

{ divide P into smaller instances P1 ,P2 .....Pk

Apply D and C to each sub problem

Return combine (D and C(P1)+ D and C(P2)+.......+D and C(Pk))

}

}
```

Let a recurrence relation is expressed as $T(n) =$

$\Theta (1)$, if n<=C

aT(n/b) + D(n)+ C(n), otherwise

then n=input size a=no. Of sub-problemsn/b= input size of the sub-problems

     I. What type of algorithm is presented above.   **[2 Marks]**

     II. Outline the main components of this algorithm.   **[3 Marks]**

     III.   Explain step by step how the algorithm above functions   **[8 Marks]**