Kirinyaga University

UNIVERSITY EXAMINATION 2023/2024

YEAR II SEMESTER I EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE/B.Ed SCIENCE/BSc. INFORMATION TECHNOLOGY

SPC 2302: DESIGN AND ANALYSIS OF ALGORITHMS

Date: Wednesday, 15th December 2023 Time: 8.30am – 10.30am

Instructions

Answer Question ONE (compulsory) and Any Other Two.

Question one

a) Using a flowchart highlight the process of algorithm design and analysis [6 marks]

b) (i) describe what it entails to prove the correctness of an algorithm [2 marks]

(ii) Explain what would constitute a correctness proof for an approximation problem [3 marks]

c) Distinguish between best and worst case efficiency of algorithms [5 marks]

d) State 4 reasons why it is important to analyze algorithms [4 marks]

e) State here limitations of experimental analysis of algorithms (6 marks)

f) Develop a computational problem and an instance for sorting an array of numbers in descending order. [4 marks]

Question Two (20 Marks)

a) State FIVE reasons why pseudo odes are more preferred in the analysis of algorithms as compared to other forms of algorithms (5 marks)

b) Write he pseudo ode for a program to find and return the maximum elements in an array (5 marks)

c) Analyze and state he asymptotic running time of the pseudo code in (b) above [4 marks]

d) Illustrate the process of sorting the following data using merge sort

8 3 2 9 7 1 5 4 (6 marks)

i. Consistency
ii. Completeness
iii. Decidability

Question Three (20 Marks)

a) (i) Outline the strategy for analyzing recursive algorithms [5 marks]

(ii) Develop a recursive procedure to find the factorial of a given number N [4 marks]

(iii) Determine the recurrence relation for the algorithm in a (ii) above [2 marks]

(iv) Apply the back substitution technique to solve the recurrence obtained in a (iii) above [6 marks]

(b) Express the following recurrence using the Big Oh notation [3 marks]

$2n^3 + 3n^2 + n$

Question Four (20 Marks)

a) Discuss the similarity between dynamic programming and divide and conqu algorithm design paradigms [2 marks]

b) Describe the following terms as used in graph algorithms [2 marks]

i) The *indegree*
ii) The *outdegree*

c) Use a flowchart to outline the procedure followed by divide and conquer algo design method [6 mark

d) Outline the divide and conquer procedure for the merge sort algorithm [7 marks]

e) Discuss the relationship between tractable and polynomially bound algorithms [3 marks]

Question Five (20 Marks)

a) Describe the Kruskal's algorithm for solving the minimum spanning tree problem [6 marks]

b) Use mathematical induction to prove the correctness of the following sequence [5 marks]

Prove $1 + 2 + 3 + \ldots + n = n(n+1) / 2$

c) Briefly discuss the following properties as they apply to greedy algorithms [4 marks]

i. Greedy-Choice Property

ii. The Principle of Optimality

d) Illustrate, step by step how bubble sort would sort the following input data [5 marks]

5 1 3 6 4