PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

**Midterm Examination**: Semester 1 **Academic Year**: 2016-2017

**Date**: 11th October 2016 **Time**: 9:00 – **11:00 (2 hours)**

**Subject Number**: 242-535 **Room**: R201

**Subject Title**: Algorithm Design and Analysis (ADA)

**Lecturer**: Aj. Andrew Davison

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**Exam Duration**: 2 hours **Total:** 120 points

**This paper has 2 pages.**

**Authorized Materials**:

- Writing instruments (e.g. pens, pencils).
- Books (e.g. dictionaries) and calculators are **not** permitted.

**Instructions to Students:**

- *Answer questions in English.* Perfect English is **not** required.
- Attempt all questions.
- Write your answers in an answer book.
- Start your answer to each question on a new page
- Clearly number your answers.
- Any unreadable parts will be considered wrong.
- When writing programs, use good layout, and short comments; marks will not be deducted for minor syntax errors.
- The marks for each part of a question are given in brackets (…).

## Question 1

(15 minutes; 15 marks)

Give the Big-Oh running time (as a function of N ) for the following code fragment:

```
int sum = 0;
for (int i = 1 i < N; i *= 2)
  for (int j = 0; j < i; j++)
    sum++;
```

## Question 2

(30 minutes; 30 marks)

Use recursion trees to determine the Big-Oh expressions for:

a) $T(n) = 3T(n-1) + n - 1$

b) $T(n) = 4T(n/3) + 2n - 1$

Assume that $T(1) = 1$ for both functions.

## Question 3

(30 minutes; 30 marks)

a) Draw a diagram showing how the **quicksort** algorithm described in the notes sorts an array containing { E, A, S, Y, Q, U } into increasing alphabetical order. (5)

b) Explain the **quicksort** algorithm using the diagram from part (a). (15)

c) Informally explain the running time of the **quicksort** algorithm when given: (10)

- sorted input
- reverse-order sorted input

## Question 4

(25 minutes; 25 marks)

Write a program that prints all permutations of a given string. For example, the input string "abc" causes the printing of "abc", "acb", "bac", "bca", "cab", and "cba".

## Question 5

(20 minutes; 20 marks)

Suppose you have an array of N elements, containing three strings, "true", "false", and "unknown". Give an O(N) algorithm to rearrange the array so that all "false" elements come first, then "unknown" elements, and "true" elements are last. You may use only constant extra space.

*--- End of Examination ---*