PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

Final Examination: Semester 1 **Academic Year**: 2006-2007

Date: Wednesday, 4th October, 2006 **Time**: 13:30 – 16:30 (**3 hours**)

Subject Number: 240-304 **Room**: Hua Hun (Robot)

Subject Title: Mathematics for Computer Engineering

Lecturer: Aj. Andrew Davison

Exam Duration: 3 hours

This paper has 4 pages.

Authorized Materials:

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

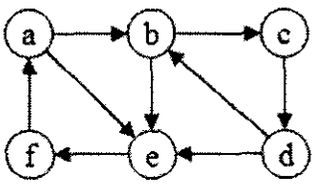
Instructions to Students:

- *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

(25 marks; 25 minutes)

For the following graph:



a) Draw an adjacency list for the graph. (5)

b) Draw an adjacency matrix for the graph. (5)

c) Give the C (or C++) data types for the adjacency list **and** the adjacency matrix. (10)

d) If the adjacency matrix is called A, what does an entry in row i and column j mean in A^3 ? (5)

Question 2

(30 marks; 30 minutes)

The table below shows the network links between the computers in the "Land of Oz" LAN, together with average times in milliseconds to send a message from the machine in the first column to the machine in the second column. For example, the first row says that it takes 5 ms to send a message from "dorothy" to "tinman".

From Machine	To Machine	Message Time
dorothy	tinman	5
dorothy	scarecrow	9
tinman	lion	9
tinman	glinda	8
tinman	wizard	11
scarecrow	glinda	8
scarecrow	wizard	7
glinda	toto	9
lion	toto	4

a) Draw a directed graph representing the table. The nodes must be the machines, and the arcs are the message communication links from one machine to another. Label each arc with its message sending time. (10)

b) Use Dijkstra's shortest path algorithm on the graph from part (a). Use "dorothy" as the start node. Find the shortest time to send a message from "dorothy" to "toto". **Show all your working;** do not only write down the time. (20)

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Question 3 (35 marks; 35 minutes)

The *Towers* game for two players. The start position consists of two towers of bricks, one made from two bricks, the other from three. A turn consists of taking 1 or 2 bricks from a *single* tower. The player who takes the last brick (leaving no towers) is the **loser**.

a) Draw the game tree for the *Towers* game down to level 3.
The start position for the first player is level 1, all the possible game positions for the second player are at level 2, and the possible positions when the first player is about to take their turn again are at level 3. (10)

b) Assign values to all the possible positions at level 3 using the evaluation function:

eval(position) = 1, if there are exactly two different possible turns from this position for the player;
= 0, otherwise (10)

c) Starting from level 3, work up the game tree assigning values to all the vertices. (5)

d) Can the first player win? Explain your answer in words. (5)

e) Discuss whether the evaluation function in part (b) is a good way of deciding if a position is a winning one. (5)

Question 4 (30 marks; 30 minutes)

a) Draw an automaton which accepts input strings that any mix of a's and b's, but the number of b's must be a multiple of 3.

For example, the automaton will accept "aabaabba", "bbaabbabab", and "aa" (no b's), but not "abab" or "aabbbb". (15)

b) Translate the automaton into C code. (15)

Question 5 (40 marks; 40 minutes)

Consider the grammar:

S → c A B A → {b} (a | d) B → A a c

The nonterminals are {S,A,B}, the terminals are {a,b,c,d}, and the start symbol is S.

a) Draw a parse tree for the string "cbbbdaac". (5)

b) Translate the grammar into syntax graphs. Show all your working. (10)

c) Translate the syntax graphs into a parser. The parser should print "yes" if the input string matches the grammar; "no" otherwise. The parser should **not** build a parse tree. (25)

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Question 6 (20 marks; 20 minutes)

A boolean function `foobar(p,q,r,s)` takes 4 inputs and returns 1 or 0. It returns 1 when one, two, or three of p, q, r, and s are 1. If all the inputs are 0, it returns 0. If all the inputs are 1, it returns **0**.

a) Draw a *Karnaugh map* for the `foobar()` function. (10)

b) Use the Karnaugh map to write down the simplest logical expression which does the same as the `foobar()` function. (10)

--- End of Examination ---