PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

Final Examination: Semester 1

Date: Thursday, 1st October, 2009

Subject Number: 241-303 , 240-304

Subject Title: Discrete Mathematics

Lecturer: Aj. Andrew Davison

Academic Year: 2009-2010

Time: 9:00 – 12:00 (**3 hours**)

Room: R201 , R300

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.

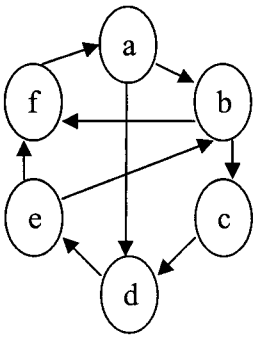
Instructions to Students:

- *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

(30 marks; 30 minutes)

For the following graph:



a) Draw an adjacency list for the graph. (10)

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

c) Give the ANSI 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)

For the table below:

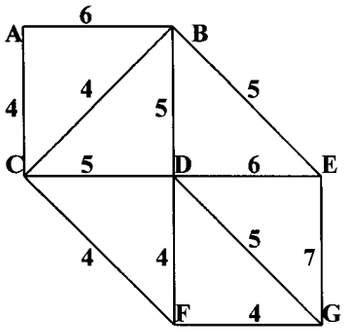
a) Draw a graph. The cities should be nodes, the distances edges. (10)

b) Using Dijkstra's algorithm, find the shortest distances from Detroit to **all** the other cities. If a city cannot be reached from Detroit, then its minimum distance should be "infinity". Show **all** your working. (20)

City 1	City 2	Distance
Marquette	Sault Ste. Marie	153
Saginaw	Flint	31
Grand Rapids	Lansing	60
Detroit	Lansing	78
Escanba	Sault Ste. Marie	175
Ann Arbor	Detroit	28
Ann Arbor	Battle Creek	89
Battle Creek	Kalamazoo	21
Menominee	Escanba	56
Kalamazoo	Grand Rapids	45
Escanba	Marquette	78
Battle Creek	Lansing	40
Flint	Detroit	58

Question 3 (30 marks; 30 minutes)

Consider the following graph:



a) Use Prim's algorithm to find the minimum spanning tree. Show your working. (15)

b) Use Kruskal's algorithm to find the minimum spanning tree. Show your working. (15)

Question 4 (30 marks; 30 minutes)

The *Pile* game for two players. The start position consists of one pile of six stones. A turn consists of taking 1, 2, or 3 stones from the pile. The player who takes the last stone is the loser.

a) Draw the complete game tree for the *Pile* game. Assign values to all the vertices of the game tree. (20)

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

c) Describe a winning sequence of turns for the winning player. (5)

Question 5 (30 marks; 30 minutes)

Consider the regular expression:

$$(0 \mid 1 \mid 1^*)^*$$

a) Draw an automaton with ε-transitions for the regular expression. (15)

b) Draw an equivalent automaton to the one in (a) *without* using ε-transitions. (10)

c) Is the automaton of (b) deterministic? If it is not deterministic, draw an equivalent automaton which is deterministic. (5)

Question 6 on next page.

Question 6

(30 marks; 30 minutes)

Consider the grammar:

S → c D A A → a A A → b D → A a c

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

a) Draw a parse tree for the string "cbacab". (4)

b) Translate the grammar into syntax graphs. Show your working. (6)

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. (20)

--- End of Examination ---