PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

Midterm Examination: Semester 1 **Academic Year**: 2008-2009

Date: 3rd August, 2008 **Time**: 13:30 – **15:30 (2 hours)**

Subject Number: 240-340 **Room**: R200

Subject Title: Compiler Structures

Lecturer: Aj. Andrew Davison

Exam Duration: 2 hours

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)

a) Write a regular expression using grep (or egrep) which lists all the words in /usr/share/dict/words that use some or all of the letters a, n, d, r, e, w (e.g. wed, need). (5)

b) Write a regular expression using grep (or egrep) which lists all the words in /usr/share/dict/words that contain at least two i's and no other vowels (e.g. skiing). The vowels are a, e, i, o, and u. (10)

Note: your answers may use multiple calls to grep/egrep piped together.

Question 2 (20 minutes; 20 marks)

Write a **lex** program which finds all the integers in an input file, and prints their sum when the end of file is reached. *Note*: use atoi() to convert a char array into an integer.

Question 3 (45 minutes; 45 marks)

a) Explain the four parts of a grammar. Do **not** include any program code. (10)

b) Write a context-free grammar that generates an even number of *a*'s followed by the same number of *b*'s (e.g. aabb, aaaabbbb).

Draw a parse tree for the string aaaabbbb using your grammar. (10)

c) Write a context-free grammar for expressions involving integers, +, and – (e.g. 14+5-22, 3-12-114).

Draw a parse tree for the string 3-12-114 using your grammar. (15).

d) Explain grammar *ambiguity*, and include an example. (10)

Question 4 (40 minutes; 40 marks)

a) What are FIRST sets? Define FIRST() using FIRST_SEQ(). (10)

b) What are FOLLOW sets? Define FOLLOW() using FIRST_SEQ(). (10)

c) Calculate the FIRST **and** FOLLOW sets for the grammar:

S → (G) | ε

G → P E

P → (G) | r | s | t

E → # P E | ε

The lowercase letters, (,), and # are terminals. The uppercase letters are non-terminals, and S is the start symbol. Show **all** your working. (20)

--- End of Examination ---