

UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

MAIN EXAMINATION 2009

Title of paper: **PROGRAMMING LANGUAGES**

Course code: **CS343**

Time allowed: **3 hours**

Instructions to candidates:

This question paper consists of **FIVE (5)** Questions. Answer any **FOUR (4)** questions.

Marks are indicated in the square brackets.

All questions carry equal marks.

THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

QUESTION 1

a) Explain what the following terms mean:

i. pass-by-value [3]

ii. pass-by-reference [3]

iii. pass-by-need [3]

In all cases state one example of a programming language that uses the parameter passing method.

b) State 2 uses of parameters. With the aid of appropriate examples explain the difference between actual parameters and formal parameters. [6]

c) Judging from the history of programming languages what do you think is most important to make a language successful? [5]

d) State any 5 qualities of a good programming language. [5]

QUESTION 2

a) i) Briefly explain the purpose of parse trees. Construct the parse tree for the number: 2347. [5]

ii) BNF is said to be a metalanguage. What is a metalanguage? Use BNF to describe the structure of a number. [5]

b) Part of syntax analysis involves lexical analysis. Briefly describe Lexical analysis. State and describe briefly the three types of tokens. Use examples. [7]

c) Some Programming Languages are said to rely on compilers, others rely on interpreters, while others are said to rely on both. What are the differences between compiled and interpreted languages? [8]

QUESTION 3

- a) With the aid of appropriate examples, explain the following terms:
- i. Polymorphism [3]
 - ii. Inheritance [2]
 - iii. Lazy evaluation [2]
 - iv. Higher order function [3]
 - v. Type checking [2]
- b) Distinguish between: Axiomatic and denotational semantics. [6]
- c) Consider the following Prolog program:

```
border(sussex, kent).
border(sussex, surrey).
border(surrey, kent).
border(hampshire, sussex).
border(hampshire, surrey).
border(hampshire, berkshire).
border(berkshire, surrey).
border(wiltshire, hampshire).
border(wiltshire, berkshire).
```

```
adjacent(X, Y) :- border(X, Y).
valid(X, Y) :- adjacent(X, Z), adjacent(Z, Y).
```

What will be the result of posing the following queries?

- i. ?-adjacent(sussex,Y).
- ii. ?- valid(wiltshire, sussex).
- iii. ?- valid(X, kent). [6]

QUESTION 4

- a) Give 2 examples of statically typed languages and 2 examples of dynamically typed languages. [4]
- b) Explain why the λ calculus is of interest to computer scientists. Evaluate the following expression: $((\lambda x. x+3) 5)$ [6]
- c) Briefly describe the following language implementation strategies:
- i) Preprocessing [4]
 - ii) Library of routines and Linking [3]
- d) With the aid of appropriate examples, describe briefly the following terms, as they are understood by a Prolog programmer:
- i. fact;
 - ii. rule;
 - iii. query. [8]

QUESTION 5

- a) With the aid of examples, describe the following types of programming languages:
- i. Machine code
 - ii. High level programming languages [3 each]
- b) Having been introduced to the following paradigms
Imperative programming, Functional programming, Object oriented programming, and Logic programming
Someone says it is possible to combine elements of many paradigms in a single program. Do you think this is a good or a bad idea in general? Give reasons for your answer. [4]
- c) Briefly describe the characteristic features of the following:
- i. Functional programming languages
 - ii. Logic programming languages [4 each]
- State 2 applications of functional programming languages and 2 applications of logic programming languages. [4]
- d) Rewrite $15/(2-5)+18*6$ by converting all 4 operators to prefix, i.e. using (+) (-) (*) and (/) instead of + - * /. Your rewritten expression should evaluate to the same value as the given expression. [3]