



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya.

Tel: 020-2069349, 061-2309217. 064-30320 Cell phone: +254 712524293, +254 789151411

Fax: 064-30321

Website: www.must.ac.ke Email: info@must.ac.ke

University Examinations 2013/2014

FOURTH YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE IN BACHELOR OF
SCIENCE IN COMPUTER SCIENCE

ICS 2401 – COMPILER CONSTRUCTION

DATE: APRIL 2014

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

QUESTION ONE – 30 MARKS

- (a) What is the difference between a compiler and an interpreter? (4 marks)
- (b) Explain how the lexical analyzer works. (6 marks)
- (c) Briefly explain the meaning of the following terms
- (i) Patterns (2marks)
 - (ii) Tokens (2marks)
 - (iii) Lexemes (2marks)
- (d) The following block of code has some weaknesses. Identify and then improve the block using appropriate transformations. (4 marks)
- ```
a = b * c;
b = d / e;
c = b * c;
z = d / e;
```
- (e) Given the statement “a = a + 1 “, generate its equivalent intermediate code. (4 marks)

- (f) What do you understand by the phrase “algebraic transformations”? Illustrate your answer with a suitable example. (6 marks)

### QUESTION TWO –20 MARKS

- (a) Distinguish between a syntax tree and a parse tree. Draw a syntax tree for the statement “ $a = b+c - d$ ”. (6 marks)
- (b) What are the properties of parse trees? (2 marks)
- (c) Give reasons why you would opt for the following parser design methods
- (i) Recursive descent parser (2 marks)
  - (ii) Predictive parser (2 marks)
- (d) Convert the infix statement “ $e + f - g$ ” into polish postfix notation equivalent and then construct an annotated parse tree for it. (6 marks)

### QUESTION THREE – 20MARKS

- (a) What is semantic analysis and why should it be included in the front-end and not back-end part of a compiler? (4 marks)
- (b) Explain the meaning of dangling references and support your answer with suitable examples. (6 marks)
- (c) You are a compiler designer with a firm that is currently developing a compiler for a java-like language. You are charged with developing the lexical analyzer component for the language. What kind of errors do you expect your lexical analyzer to identify and what corrective actions is it likely to take? (4 marks)
- (d) Explain the use of each of the following functions from a parser implementation perspective.
- (i) `mknode (op, left,right)` (2 marks)
  - (ii) `mkleaf (id, entry)` (2 marks)
  - (iii) `mkleaf (num, val)` (2 marks)

### QUESTION FOUR – 20MARKS

- (a) Distinguish between static checking and dynamic checking. (4 marks)
- (b) What is a code optimizer and what is its importance? (4 marks)
- (c) What criteria would you use for code-improving transformation? (2 marks)

- (d) Given that the expression “**num =22 -7/2**”, show how it is transformed as it passes through the three phases of the front-end part of a compiler. (6 marks)

**QUESTION FIVE – 20MARKS**

- (a) Briefly describe the loop optimization techniques. (6 marks)

- (b) Study the following directed acyclic graph (dag) carefully and then generate a basic block for it. (4 marks)

- (c) Review the basic block of the dag in (b) above and then optimize it. (4 marks)

- (d) Give the equivalent assembly code for the optimized basic block in (c) above. (6 marks)