



UNIVERSITY EXAMINATIONS

**EXAMINATION FOR JANUARY/APRIL 2023/2024 FOR BACHELOR OF SCIENCE IN
COMPUTER SCIENCE**

COURSE CODE RCS 302: COURSE UNIT COMPILER CONSTRUCTION

DATE _____

TIME: 2 HOURS

GENERAL INSTRUCTIONS:

Students are NOT permitted to write on the examination question paper during examination time.

This is a closed book examination. Text book/Reference books/notes are not permitted.

SPECIAL INSTRUCTIONS:

This examination paper consists Questions in Section A followed by section B.

Answer **Question 1 and any Other Two** questions.

QUESTIONS in ALL Sections should be answered in answer booklet(s).

- 1. PLEASE start the answer to EACH question on a NEW PAGE.**
- 2. Keep your phone(s) switched off at the front of the examination room.**
- 3. Keep ALL bags and caps at the front of the examination room and DO NOT refer to ANY unauthorized material during the course of the examination.**
- 4. ALWAYS show your working.**
- 5. Marks indicated in parenthesis i.e. () will be awarded for clear and logical answers.**
- 6. Write your REGISTRATION No. clearly on the answer booklet(s).**
- 7. For the Questions, write the number of the question on the answer booklet cover page in the order you answered them.**
- 8. DO NOT use your PHONE as a CALCULATOR.**
- 9. YOU are ONLY ALLOWED to leave the exam room 1 hour to the end of the Exam.**
- 10. DO NOT write on the QUESTION PAPER. Use the back of your BOOKLET for any calculations or rough work.**

SECTION A (Compulsory)

Question #1 [30 Marks]

- a) The table below is a fragment of the compilation process. Give the respective phase as per the output described. **(4 Marks)**

Phase	Output
i) _____	Token String
ii) _____	Parse Tree or Abstract Syntax Tree
iii) _____	Annotated parse tree or Abstract Syntax Tree
iv) _____	Three address code or Register Transfer Language

- b) Discuss the statement: "Compiler construction is a microcosm of computer science."

(5 Marks)

- c) In the economy of programming languages, the question: "*Why are there so many programming languages?*" can be answered by focusing on application domains and their distinctive needs. Describe **three(3)** distinct application domains and in each a suitable programming language that can meet its needs. **(6 Marks)**

- d) Give a brief meaning of the following special characters as used in Regular Expressions

(6 marks)

i) *

ii) ()

iii) |

- e) List any three types of codes compilers may generate.

(3 Marks)

- f) Discuss any three memory segments allocated by most operating systems when a program is started.

(6 marks)

SECTION B (Answer any two options)

Question #2 [20 Marks]

- a) In the context of lexical analysis, give 3 differences between Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (N DFA). **(6 Marks)**
- b) When observing the features of a compiler, list four important qualities that should be considered. **(4 Marks)**
- c) Using the regular expression $a b^* c$ design its corresponding DFA and Transition table. Show clearly its state transitions-start state and accepting state. **(7 Marks)**
- d) State the difference between syntax and semantics in programming languages. **(3 Marks)**

Question #3 [20 Marks]

- a) Explain three major goals of optimization in compiler construction. **(6 Marks)**
- b) Discuss 2 major differences between a compiler and an interpreter. **(4 Marks)**
- c) List and explain 3 key features that should be prioritized when designing a compiler. **(6 Marks)**
- d) Identify four problems encountered in modern computing platforms due to computer Architecture and Compiler Design. **(4 Marks)**

Question #4 [20 Marks]

- a) Provide 4 examples of different error types that can be encountered during compilation
(4 Marks)
- b) Explain 3 ways in which a compiler should handle errors.
(6 Marks)
- c) Give 3 reasons why it is important to separate Lexical Analysis in the compilation process
(6 Marks)
- d) Identify and describe two distinct types of semantic analysis that can be conducted in the compilation process.
(4 Marks)

Question #5 [20 Marks]

- a) Describe 2 primary operations of a code generator in a compiler. (4 Marks)
- b) Given the following grammar:
- $\langle \text{assignment-stmt} \rangle ::= \langle \text{identifier} \rangle = \langle \text{expr} \rangle ;$
 - $\langle \text{expr} \rangle ::= \langle \text{expr} \rangle + \langle \text{expr} \rangle \mid \langle \text{expr} \rangle - \langle \text{expr} \rangle \mid (\langle \text{expr} \rangle) \mid \langle \text{identifier} \rangle \mid \langle \text{integer} \rangle$
 - $\langle \text{identifier} \rangle = a \mid b \mid c$

Draw a parse tree of the following assignment statement : $c = a + 10;$

(6 Marks)

- c) A major element of context-free grammar in the syntax phase is a non-terminal. List four examples of non-terminals as used in this context.
(4 Marks)
- d) Give three considerations that are involved in the use of register allocation in compiler optimization
(6 Marks)