NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI-ABUJA
FACULTY OF COMPUTING
DEPARTMENT OF COMPUTER SCIENCE
2025_2 EXAMINATIONS

Course Code: CIT316
Course Title: Principles and Techniques of Compilers (Compiler Construction I)
Course Credit: 3 units
Time Allowed: 3 hours
Instruction: Answer **Question One (1)** and any other **Three (3)** Questions

Question 1: 25 Marks (Compulsory Question)
1 (a)   Define automata theory and its relevance to computer science. (5 marks)
1 (b)   Explain the relationship between automata and formal languages. (3 marks)
1 (c)   Describe the different types of automata associated with each type of formal grammar. (4 marks)
1 (d)   Provide an example of a language recognized by a finite state machine. (3 marks)
1 (e)   Discuss the limitations of finite state machines. (5 marks)
1 (f)   Explain how pushdown automata extend the capabilities of finite state machines. (5 marks)

Questions 2: 15 Marks
2 (a)   Describe the syntax analysis phase and its output. (3 marks)
2 (b)   Outline the process of code generation. (5 marks)
2 (c)   Provide the general algorithm for eliminating left recursion from a CFG and apply it to the following grammar: $S \rightarrow S + T \mid T$. (4 marks)
2 (d)   Describe a derivation in the context of CFGs. (3 marks)

Questions 3: 15 marks
3 (a)   Explain the difference between leftmost and rightmost derivations with examples. (3 marks)
3 (b)   What is a parse tree, and how does it differ from a derivation? (3 marks)
3 (c)   Outline the steps involved in constructing a parse tree for the expression id + id * id using the grammar $E \rightarrow E + T \mid T * F \mid F \mid id$. (6 marks)
3 (d)   Discuss the significance of parse trees in the syntax analysis phase of a compiler. (3 marks)

Question 4: 15 Marks
4 (a)   Discuss the importance of semantic analysis in the compilation process. (4 marks)
4 (b)   Explain the purpose of code optimization and give an example. (5 marks)
4 (c)   Discuss the error recovery strategies employed by parsers during syntax analysis. (3 marks)
4 (d)   Discuss the space-time trade-off in the context of code optimization. (3 marks)

Question 5: 15 Marks
5 (a)   Evaluate the impact of error handling on the performance and reliability of compiled applications. (2 marks)
5 (b)   Discuss the challenges of managing symbol tables in a compiler for a language with dynamic scoping. (3 marks)
5 (c)   Define intermediate code and its importance in the compilation process. (4 marks)
5 (d)   Explain three different forms of intermediate code commonly used in compilers. (6 marks)

Question 6: 15 Marks
6 (a)   Describe the role of peephole optimization in the code generation phase. (4 marks)
6 (b)   Evaluate the trade-offs between generating optimized intermediate code and fast compilation times. (3 marks)
6 (c)   Define code optimization and its objectives in the context of compiler design. (4 marks)
6 (d)   Explain the concept of loop unrolling and its benefits in code optimization. (4 marks)