QP Code: SN23BTECH220 | Reg. No | | | | | | | | | | | AY 23

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fifth Semester - Regular) Examinations, November 2025

23BCDPC35003 – Language Theory and Compiler Design

(CSE-DS))

Time: 3 hrs | Maximum: 60 Marks

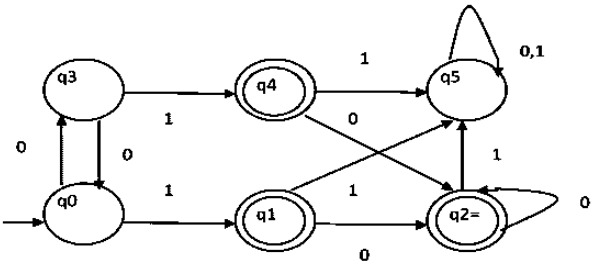
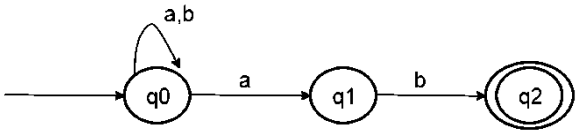
Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

	Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a.	Given Σ = {a, b}. List all possible strings of length 2 and 3.	CO1	K1
b.	Construct a CFG that generates the language **L = { $a^n b^n$ | n ≥ 1 }.**	C02	K2
c.	Define and eliminate left recursion from the following grammar: **S → Sα | β**.	CO3	K1
d.	Differentiate between syntax-directed definitions and translation schemes with examples.	CO4	K2
e.	Construct a DAG (Directed Acyclic Graph) for the expression: **e*(b-c)+(b-c)*d**.	CO5	K2

PART – B **(10 x 5 = 50 Marks)**

	Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a.	Design a DFA to accept all binary strings that represent multiples of 5. Draw the DFA. Give the transition table and transition function.	5	CO1	K2
b.	Minimize the given DFA 	5	CO1	K1
	(OR)			
c.	Explain the difference between a Nondeterministic Finite Automaton (NFA) and a Deterministic Finite Automaton (DFA). Convert the following NFA to an equivalent DFA and provide the transition table and state diagram: 	5	CO1	K1
d.	Explain the Pumping Lemma for regular languages. Use the Pumping Lemma to prove that the language L = {a^n b^n | n ≥ 0} is not regular.	5	CO1	K1
3.a.	Define a Context-Free Grammar (CFG). Construct a CFG for the language L = {a^n b^n | n ≥ 0}. Show both leftmost and rightmost derivations for the string "aabb". Draw the corresponding parse tree.	5	CO2	K2
b.	Construct a PDA for the language L = { w c w' | w ∈ (0,1)^+, w' is the reverse of w }, where c is a special middle symbol.	5	CO2	K2
	(OR)			

c.	What are the simplification techniques for CFGs? Apply the procedures for removing useless symbols, ε-productions, and unit productions from the following CFG: S → AB | a , A → aA | ε , B → bB | b	5	CO2	K1
d.	Construct the parse tree (both leftmost and right most)for the string "id + id * id" using the following grammar: E → E + T | T , T → T * F | F , F → id	5	CO2	K2
4.a.	Explain the various phases of a compiler. Illustrate each phase with a suitable example.	5	CO3	K2
b.	For the given grammar E → E + E | E * E | (E) | id i) Identify the operators and their precedence. ii) Construct the operator precedence table**.** iii) Demonstrate how the parser processes the string **(id + id) * id.** Using operator precedence parser	5	CO3	K1
	(OR)			
c.	X → A B C A → a | ε , B → b | ε , C → c | d Calculate the first and follow function.	5	CO3	K1
d.	Using the grammar below, **show the step-by-step shift and reduce moves** for the input string **id + id * id** E → E + T | T , T → T * F | F , F → id	5	CO3	K1
5.a.	Define Syntax-Directed Definitions (SDD) and explain the types of SDD with an example.	5	CO4	K1
b.	Explain Three-Address Code (TAC).Write the quadruples and triples for the expression: **a = b * -c + b * -c**	5	CO4	K2
	(OR)			
c.	Consider the following SDD and construct the annotated parse tree for the expression 4 * 5 + 6 S → E , E → E + T | T , T → T * F | F , F → num	5	CO4	K1
d.	Consider the Syntax-Directed Translation (SDT) and construct annotated parse tree to convert the expression **a + b * c** from infix expressions to postfix expressions using the following grammar: E → E + T | T , T → T * F | F , F → id	5	CO4	K1
6.a.	What is code optimization? Explain the various code optimization techniques used in compiler design.	5	CO5	K1
b.	Given the arithmetic expression: t=(a+b)∗(a+b+c) (i) Construct the Directed Acyclic Graph (DAG) for the above expression. (ii) Define what a DAG is in the context of Compiler Design.	5	CO5	K2
	(OR)			
c.	Explain the concepts of **Basic Flow of Control Optimization** and **Loop Optimization** in compiler design.	5	CO5	K1
d.	What is Peephole Optimization in compiler design? Explain its purpose and methods to achieve it.	5	CO5	K1

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