# M.Sc. 2nd Semester Examination, 2025

COMPUTER SCIENCE

(Theory of Computer Science & Compiler Design)

PAPER—COS-202

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

Answer the following questions (any **four**) : 2 × 4

1. Write a regular expression equivalent to the following NFA.
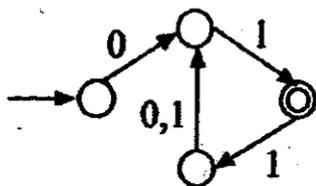
2. Consider the contex-free grammar G over {a, b}, with the start symbol S and the following productions. What is L(G) ?

   S → aaB|Abb
   A → a|aA
   B → b|bB

3. Define CNF and GNF.

4. What are the functions of semantic analysis phase ?

5. Define parse tree.

6. Differentiate between top-down and bottom-up parsing.

GROUP – B

Answer the following questions (any four) : 4 × 4

7. Design the FA for the following regular expressions over $\Sigma = \{a, b\}$:

$$((aa+bb+\varepsilon)(ab+ba)^*+a)^*+b$$

8. Convert the following grammar into Chomsky Normal Form (CNF)

$$S \rightarrow AACD$$
$$A \rightarrow aAb | \varepsilon$$
$$C \rightarrow aC | a$$
$$D \rightarrow aDa | bDb | \varepsilon$$

9. Using the pumping lemma, prove that the language $L = \{a^i b^j \mid i, j \geq 0$, and $|i - j|$ is a prime$\}$ is not regular.

10. Calculate FIRST and FOLLOW for the following grammar ?

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S->xABC
A->a|bbD
B->a|ε
C->b|ε
D->c|ε
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11. Consider the following grammar :

$$E \rightarrow E+T|T$$
$$T \rightarrow TF|F$$
$$F \rightarrow F*|a|b$$

Construct the SLR parsing table.

12. (a) Draw the syntax tree and DAG for the following expression : 2 + 2

$$(a+(b*c)^\wedge d-e/(f+g)$$

(b) Write quadruples and triples for the expression :
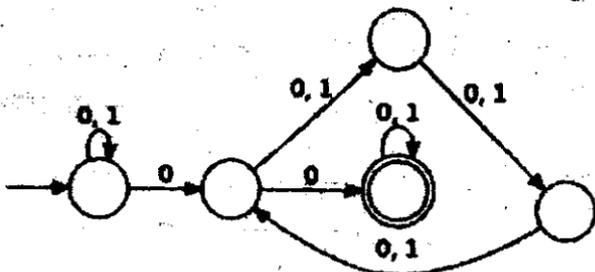
$$-(a*b)+(c+d)-(a+b+c+d)$$

GROUP – C

Answer the following questions (any two) : 8 × 2

13. Consider the following NFA. Draw regular expressions corresponding to the NFA.
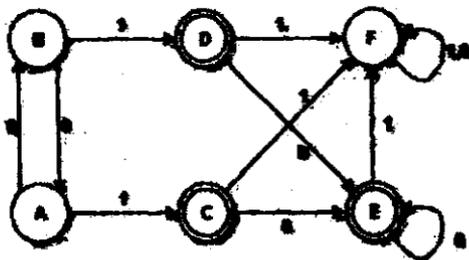
Names of the states are Q_1, Q_2, Q_3, Q_4 and Q_5 accordingly.   8

14. Minimize the following DFA by the Myhill-Nerode theorem, describing the steps in detail.   8

15. (a) Write the three address code sequence for the assignment statement.

$$d:=(a-b)+(a-c)+(a-c)$$

(b) What are basic blocks? Write the algorithm for partitioning into Blocks.

(c) Define dependency graph. Give one example. $3+1+2+2$

16. Show the following grammar

S->Aa|bAc|Bc|bBa

A->d

B->d

Is LR(1) but not LALR(1). 8

[**Internal Assessment — 10 Marks**]