

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

22AI551

Fifth Semester B.E. Degree Examinations, February 2025

AUTOMATA THEORY AND COMPILER DESIGN

(Artificial Intelligence & Machine Learning)

Duration: 3 hrs

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
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Module-1

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|----|--|-----------|------------------------|
| 1. | a. Compare DFA and NFA. | 04 | (3 : 1 : 1.2.1) |
| | b. Design DFA accepting the following languages:
(i) set of all strings of 0's and 1's which end with 01
(ii) set of all strings of a's and b's which contain substring abb
(iii) set of all strings of a's and b's whose length is multiple of three | 09 | (4 : 1 : 1.6.1) |
| | c. Convert the following epsilon NFA to its equivalent DFA. Also draw transition diagram of equivalent DFA. | 07 | (3:1 : 2.5.1) |

δ	ϵ	a	b	c
$\rightarrow p$	$\{q, r\}$	ϕ	$\{q\}$	$\{r\}$
q	ϕ	$\{p\}$	$\{r\}$	$\{p, q\}$
$\star r$	ϕ	ϕ	ϕ	ϕ

(OR)

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|----|--|-----------|------------------------|
| 2. | a. Illustrate with a diagram the use of language processing system to compile a source program | 04 | (3 : 1 : 1.2.1) |
| | b. Explain structure of compiler with a diagram | 08 | (2 : 1 : 1.6.1) |
| | c. Translate the following assignment statement.
position = initial + rate * 60 | 08 | (3 : 1 : 2.5.1) |

Module-2

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|----|--|-----------|------------------------|
| 3. | a. Design regular expression for the following languages:
(i) Set of all strings of 0's and 1's which end with 011
(ii) $L = \{a^n b^m : n \leq 4, m \geq 3\}$
(iii) set of all strings with odd number of a's followed by even number of b's | 06 | (4 : 2 : 2.5.1) |
| | b. Convert the following regular expressions to equivalent epsilon NFA
(i) $a^* + (a + b)$ (ii) $(a + b) \cdot a^* \cdot b$ | 07 | (3 : 2 : 2.5.1) |
| | c. State and prove pumping theorem for regular languages. | 07 | (3 : 2 : 2.5.1) |

(OR)

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| 4. | a. Write regular definition for the following tokens:
(i) identifiers (ii) number | 06 | (3 : 2 : 1.6.1) |
| | b. Explain two buffer scheme with diagram. What are its drawbacks? Explain the use of sentinel character. | 08 | (2 : 2 : 2.5.1) |
| | c. Write an algorithm to advance 'forward' pointer. | 06 | (3 : 2 : 2.5.1) |

Module-3

5. a. Define (i) Leftmost Derivation(LMD) (ii) Rightmost Derivation(RMD) **06** (1 :3 : 1.7.1)
(iii) Parse tree (iv) Ambiguous Grammar
- b. Show that the following grammar is ambiguous **08** (3 :3 : 1.7.1)
 $E \rightarrow E + E \quad E \rightarrow E * E \quad E \rightarrow id$ for the string $id + id * id$.
 Write un-ambiguous grammar
- c. Define left recursive grammar. Eliminate left recursion from the following **06** (3 :3 : 1.2.1)
 Grammar:
 $A \rightarrow A a B \mid B \quad B \rightarrow B b C \mid C \quad C \rightarrow c A d \mid e$
(OR)
6. a. Define FIRST() and FOLLOW() set. Compute FIRST() and FOLLOW() **07** (3 :3 : 1.2.1)
 set for the following Grammar:
 $S \rightarrow AaAb \mid BbBa \quad A \rightarrow \epsilon \quad B \rightarrow \epsilon$
- b. With a diagram explain the structure and working of predictive LL(1)parser **06** (2 :3 : 1.6.1)
- c. Write an algorithm to construct predictive LL(1) parsing table. **07** (4 :3 : 1.7.1)

Module-4

7. a. Design PDA for the following language: **10** (4 :4 :2.5.1)
 Set of all strings of with n number of a's followed by n number of b's.
 where $n \geq 1$. Draw the transition diagram.
- b. Design non-deterministic PDA(NPDA) for the following language: **10** (4 :4 : 2.5.1)
 $L = \{w w^R \mid w \in (0,1)^*\}$ where w^R is the reverse of string w
(OR)
8. a. Construct step by step bottom up parse trees for the input string $id*id$ using **06** (3 :4 : 1.6.1)
 the Grammar:
 $E \rightarrow E + T \mid T \quad T \rightarrow T * F \mid F \quad F \rightarrow (E) \mid id$
- b. Explain the structure and working of shift-reduce parser with a diagram. **07** (2 :4 : 1.2.1)
- c. Write algorithm to construct SLR parsing table. **07** (3 :4 : 2.5.1)

Module-5

9. a. Define Turing machine. With a diagram, explain the structure and working **08** (2 :5 : 1.2.1)
 of Turing machine.
- b. Design TM for the following language: **12** (4 :5 : 2.5.1)
 $L = \{a^n b^n c^n : n \geq 0\}$. Draw transition diagram.
(OR)
- 10 a. Write (i) DAG (ii) three address code (iii) Quadruple (iv) Triple for the **10** (3 :5 : 2.5.1)
 following expression:
 $a + a * (b - c) + (b - c) * d$
- b. Explain various issues in the design of code generator. **10** (2 :5 : 1.2.1)

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