Total No. of Questions: 25

Enrollment No : _____

MEDICAPS UNIVERSITY

Faculty of Engineering / Science

End Semester Examination May 2025

CS3CO38 / BC3CO64 Theory of Computation

Programme	:	B.Tech. / B.Sc.	**Branch/Specialisation**	:	CSE All / CS
Duration	:	3 hours	**Maximum Marks**	:	60

Note: *All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary. Notations and symbols have their usual meaning.*

Section 1 (Answer all question(s))

Q1. If L = {01,00,100} then which of one is not in L* ? — Marks: 1 | CO: 1 | BL: 2

- ○ 000100100
- ● 10001001
- ○ 1001000101
- ○ 010100100

Q2. A regular language can be described by- — Marks: 1 | CO: 1 | BL: 1

- ○ Finite state automata
- ○ Regular Expression
- ○ Regular Grammar
- ● All of the above

Q3. Which of the following is true? — Marks: 1 | CO: 2 | BL: 1

- ○ Non-deterministic automata is more powerful than deterministic automata.
- ○ Deterministic automata is more powerful than non-deterministic automata.
- ● Every Non-deterministic automata has equivalent deterministic automata
- ○ Every Non-deterministic automata do not have equivalent deterministic automata

Q4. What is acceptance condition of a string **w** by NDFA M=(Q, Σ, δ, q_0, F)? — Marks: 1 | CO: 2 | BL: 2

- ○ $\delta(q_0, w) \cap F = \emptyset$
- ○ $\delta(q_0, w) \cup F = \emptyset$
- ○ $\delta(q_0, w) \cup F \neq \emptyset$
- ● $\delta(q_0, w) \cap F \neq \emptyset$

Q5. What language is generated by CFG G = ({S}, {0,1}, P, S) with productions S -> 0S1 | 01? — Marks: 1 | CO: 3 | BL: 2

- ● $L = \{0^n1^n : n \geq 1\}$
- ○ $L = \{0^n1^n : n \geq 0\}$
- ○ $L = \{(01)^n : n \geq 1\}$
- ○ None of the above

Q6. Which one of the following is not Greibach Normal Form ? — Marks: 1 | CO: 3 | BL: 1
Where {A,B,C,D} are variables and a is terminal symbol of the grammar.

- ○ A ->aBCD
- ○ A -> a
- ○ A -> aA
- ● A -> BC

Q7. A pushdown automata has- — Marks: 1 | CO: 4 | BL: 1

- ○ Read and write head
- ○ Infinite length tape
- ● Stack
- ○ All of the above

Q8. Which of the following is/are correct ? — Marks: 1 | CO: 4 | BL: 2
I. Non-Deterministic PDA is more powerful than deterministic PDA.
II. Every Non-Deterministic PDA can be converted into its equivalent deterministic PDA.

- ● Only I
- ○ Only II
- ○ Both I and II
- ○ None of these

Q9. In transition function δ(q,0) = (p, X, L) of Turing machine X and L are respectively- — Marks: 1 | CO: 5 | BL: 1

- ○ Input symbol and direction of head
- ○ Input Symbol and tape symbol
- ○ Tape symbol and input symbol
- ● Tape symbol and direction of head

Q10. Halting problem of Turing Machine is- **1 5 2**

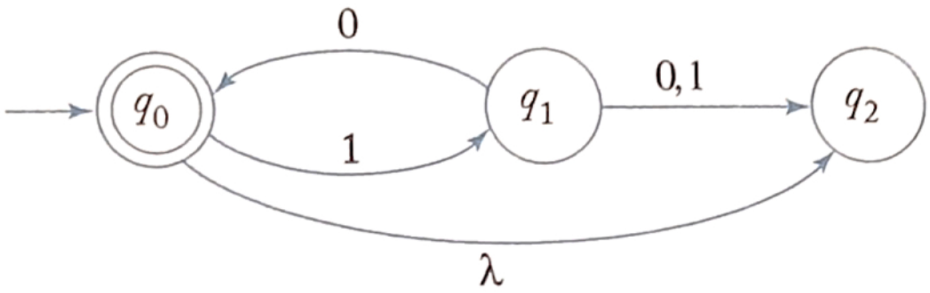
- ○ Always Decidable
- ◉ Always Undecidable
- ○ Decidable in case of recursive languages
- ○ None of these

Section 2 (Answer all question(s))

Q11. Give formal definition of Moore Machine with description of each tuples. **Marks CO BL: 2 1 1**

Rubric	Marks
Formal Definition. - 1 Marks Description of each tuples. 1 Marks	2

Q12. Consider Finite state automata as given below. Find all strings up to length 5 accepted by this automata. **3 1 2**



Rubric	Marks
1 marks for each correct string.	3

Q13. (a) Derive set of strings (Language) denoted by following regular expressions- **5 1 3**
(a) r = a*(a+b)
(b) r = (a+b)*(a+bb)

Rubric	Marks
r = a*(a+b) showing derivation up to set of strings	2.5
r = (a+b)*(a+bb) showing derivation up to set of strings	2.5

(OR)

(b) Construct deterministic finite state automata that accept set of strings as mentioned below from alphabet $\sum = \{a, b\}$
(a) All strings of even length
(b) All strings of even number of a's
Write tuples and draw transition diagram for each.

Rubric	Marks
All strings of even length with tuples and draw transition diagram.	2.5
All strings of even number of ***a's*** with tuples and draw transition diagram.	2.5

Section 3 (Answer all question(s))

Q14. What is non-regular language? Explain. **Marks CO BL: 2 2 1**

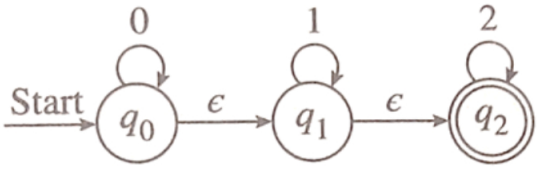
Rubric	Marks
Explanation of non-regular language.	2

Q15. Give statement of Pumping Lemma for Regular Language. Also mention its applications. **3 2 1**

Rubric	Marks
Pumping Lemma statement -2 Marks Application of pumping Lemma. - 1 Mark	3

Q16. (a) Convert NFA with ε-move into its equivalent NFA without ε-move. Also draw transition diagram of equivalent NFA without ε-move **5 2 3**

$M = (\{q_0, q_1, q_2\}, \{0,1,2\}, \delta, q_0, \{q_2\})$



Rubric	Marks
Procedure of conversion - 3 Marks Transition diagram - 2 Marks	5

(OR)

(b) A FSA is given as below. Find its equivalent minimal state automata. Also draw transition diagram and write tuples of minimal state automata.

$M=(\{q_0, q_1, q_2,q_3\},\{a,b\}, \delta, q_0, \{q_2\})$ and transition functions are-

$\delta(q_0, a) = q_2$
$\delta(q_0, b) = q_2$
$\delta(q1, a) = q_2$
$\delta(q_1, b) = q_2$
$\delta(q_2, a) = q_3$
$\delta(q_2, b) = q_3$
$\delta(q_3, a) = q_3$
$\delta(q_3, b) = q_1$

Rubric	Marks
Procedure to finding minimal state automata (Either equivalent class method or table filled method) - 3 marks Transition diagram of Minimal state automata. - 1 Mark Tuples of minimal state automata - 1 Mark	5

Section 4 (Answer all question(s))

Marks CO BL

Q17. Explain Chomsky hierarchy with diagram. **2 3 1**

Rubric	Marks
Explanation about Chomsky hierarchy - 1 Mark Hierarchy diagram - 1 marks	2

Q18. Define followings **3 3 1**

- Inherent ambiguity of Context free Language
- Context free Grammar

Rubric	Marks
Inherent ambiguity of Context free Language. - 1.5 Marks Context free Grammar - 1.5 Marks	3

Q19. (a) Get the following CFG grammar G into Chomsky Normal Form **5 3 3**

G = ({S,A,B}, {a,b},S,P) with productions

S -> ABA

A -> aA | ε

B -> bB | ε

Rubric	Marks
Removing of null productions - 2 Marks Conversion into CNF - 3-Marks	5

(OR)

(b) (i) What is CYK algorithm ?

(ii) Determine whether the string w = aaba is in the language generated by the grammar G.

G = {{S,A},{a,b},S, P})

S -> AS | a

A -> SA | b

Rubric	Marks
About CYK algorithm - 2 Marks Determine whether the string **w = aaba** is in the language generated - 3 Marks	5

Section 5 (Answer any 2 question(s))

Marks CO BL

Q20. Write answer of following- **5 4 2**

- Condition for PDA to be Deterministic
- Condition for PDA accept string by empty stack.

Rubric	Marks
Condition for PDA to be Deterministic - 2.5 Marks Condition for PDA accept string by empty stack. - 2.5 Marks	5

Q21. Design and construct Pushdown automata for the following CFL. Also write its tuples and draw transition diagram. **5 4 3**

L = { $a^n b^n c^m$ | n,m>=1 }

Rubric	Marks
Design and construct Pushdown automata - 3 Marks Transition diagram. - 1 Marks Tuples - 1 Marks	5

Q22. Compute input string ω = abba on given pushdown automata and write comments on acceptability of this string. **5 4 3**

P = ({q0, q1,q2},{a,b},{a,b,Z}, δ,q0,Z,{q2}))
δ (q0, a, a) = {(q0, aa)}
δ (q0, ε, a) = {(q1, a)}
δ (q0, b, a) = {(q0, ba)}
δ (q0, ε, b) = {(q1, b)}
δ (q0, a, b) = {(q0, ab)}
δ (q0, b, b) = {(q0, bb)}
δ (q0, a, Z) = {(q0, aZ)}
δ (q0, b, Z) = {(q0, bZ)}
δ (q1, a, a) = {(q1, ε)}
δ (q1, b, b) = {(q1, ε)}
δ (q1, ε, Z) = {(q2, Z)}

Rubric	Marks
Computational sequence - 3 Marks Comments ie String is accepted by empty stack or final state or string is rejected. - 2 Marks	5

Section 6 (Answer any 2 question(s))

Marks CO BL

Q23. Explain Recursive and Recursively Enumerable Language. **5 5 1**

Rubric	Marks
Recursive Language 2.5 Marks Recursively Enumerable Language - 2.5 Marks	5

Q24. Write short notes on Universal Turing Machine with neat diagram. **5 5 1**

Rubric	Marks
Diagram - 2 Marks notes on UTM -3 Marks	5

Q25. Compare followings- **5 5 1**
(a) Deterministic and Non-deterministic Turing Machine
(b) Standard Turing Machine and Linear Bounded Automata.

Rubric	Marks
Deterministic and Non-deterministic Turing Machine	2.5
Standard Turing Machine and Linear Bounded Automata	2.5

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