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Fifth Semester B.E/B.Tech. Degree Examination, June/July 2025

Theory of Computation

Max. Marks:100

Note: 4. Answer any FIVE full questions, choosing ONE full question from each module.
 M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			M	L	C
1	a.	With a neat diagram, explain a hierarchy of language in automata theory.	5	L2	CO1
	b.	Draw a DFA to accept string of a's and b's ending with ab or ba. Write a transition table for the same.	5	L3	CO1
	c.	Convert the following ϵ -NFA to it's equivalent DFA.	10	L3	CO1
Fig.Q1(c)					
OR					
2	a.	Draw a DFA to accept the languages : i) $L = \{w : n_a(w) \geq 1, n_b(w) = 2\}, \Sigma = \{a, b\}$ ii) $L = \{w : w \bmod 5 \neq 0\}$ on $\Sigma = \{a, b\}$ iii) $L = \{a^p b^q c^r / p \geq 0, q > 0, r \geq 0\}$ on $\Sigma = \{a, b, c\}$.	12	L3	CO1
	b.	Write differences between DFA, NFA and ϵ -NFA.	4	L2	CO1
	c.	Compute ϵ -CLOSURE of each state for the following transition diagram.	4	L1	CO1
Fig.Q2(c)					

Module – 2

3	a.	Write regular expression for the following languages : i) $L = \{a^n b^m / n \geq 0, m \geq 0, m+n \text{ is even}\}$ ii) $L = \{a^n b^m / n \geq 1, m > 0, nm \geq 3\}$ iii) $L = \{a^n b^m / n \geq 4, m \leq 3\}$.	9	L3	CO1
	b.	Convert the following automata to a regular expression. Fig.Q3(b)	3	L2	CO2
	c.	Show that $L = \{a^n b^n / n \geq 0\}$ is not regular.	8	L2	CO2

OR

4	a.	Show that regular languages are closed under complementation and intersection.	6	L2	CO2																											
	b.	Minimize the following DFA and draw the transition diagram of minimized DFA. <table><tr><td>δ</td><td>a</td><td>b</td></tr><tr><td>$\rightarrow A$</td><td>B</td><td>F</td></tr><tr><td>B</td><td>G</td><td>C</td></tr><tr><td>* C</td><td>A</td><td>C</td></tr><tr><td>D</td><td>C</td><td>G</td></tr><tr><td>E</td><td>H</td><td>F</td></tr><tr><td>F</td><td>C</td><td>G</td></tr><tr><td>G</td><td>G</td><td>E</td></tr><tr><td>H</td><td>G</td><td>C</td></tr></table>	δ	a	b	$\rightarrow A$	B	F	B	G	C	* C	A	C	D	C	G	E	H	F	F	C	G	G	G	E	H	G	C	8	L3	CO1
δ	a	b																														
$\rightarrow A$	B	F																														
B	G	C																														
* C	A	C																														
D	C	G																														
E	H	F																														
F	C	G																														
G	G	E																														
H	G	C																														
	c.	Define Regular Expressions. What are it's applications?	6	L2	CO2																											

Module – 3

5	a.	Write a grammar for the following languages. i) $L = \{w / n_a(w) = n_b(w)\}$ ii) $L = \{0^i 1^j / i \neq j, i \geq 0, j \geq 0\}$ iii) $L = \{a^{n+2} b^m / n \geq 0, m > n\}$ iv) $L = \{0^m 1^n 2^n / m \geq 1, n \geq 0\}$.	12	L2	CO2
	b.	What is ambiguous grammar? Show that the following grammar is ambiguous. $E \rightarrow E + E / E * E / id$	8	L1	CO2

OR

6	a.	Explain the following terms : i) Pushdown automata (PDA) ii) Languages of PDA iii) Instantaneous description of a PDA.	6	L1	CO2
	b.	Obtain a PDA to accept $L = \{a^n b^n / n \geq 0\}$, Draw the transition diagram for the constructed PDA.	8	L3	CO3
	c.	What is the difference between deterministic and non-deterministic pushdown automata? Explain with an example.	6	L1	CO3

Module – 4

7	a.	Consider the grammar $S \rightarrow OA / 1B$ $A \rightarrow OAA / 1S / 1$ $B \rightarrow 1BB / OS / O$ Obtain the grammar in CNF.	10	L3	CO3
	b.	Show that $L = \{a^n b^n c^n / n \geq 0\}$ is not context free.	10	L2	CO3

OR

8	a.	State and prove pumping lemma for context free languages.	10	L2	CO3
	b.	Prove that CFL are not closed under complementation and intersection.	10	L2	CO3

Module – 5

9	a.	Design a Turing Machine to accept the following languages. $L = \{0^n 1^n 2^n / n \geq 1\}$.	10	L3	CO3
	b.	Write a short notes on i) Multi – tape Turing Machine ii) Non- deterministic TM.	10	L1	CO4

OR

10		Write a short notes on i) Post correspondence Problem ii) Halting Problem of TM iii) Recursively enumerable language iv) Linear Bounded Automata.	20	L1	CO4
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