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Code No. : 15637 S

**VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD**

*Accredited by NAAC with A++ Grade*

**B.E. (I.T.) V-Semester & III Year I-Semester Supplementary Examinations, July-2022**

**Automata, Languages and Computation**

Time: 3 hours

Max. Marks: 60

*Note: Answer all questions from Part-A and any FIVE from Part-B*

**Part-A (10 × 2 = 20 Marks)**

Q. No.	Stem of the question	M	L	CO	PO												
1.	Differentiate between NFA and DFA.	2	1	1	1												
2.	Define regular expression. Give a regular expression for the language $L = \{a^n b^m \mid n \geq 1, m \geq 0\}$ .	2	2	1	1												
3.	Give a Context free grammar for the language $\{0^n 1^n \mid n \geq 1\}$ .	2	2	2	1												
4.	State pumping lemma for regular languages.	2	1	2	1												
5.	What is an instantaneous description of PDA?	2	1	3	1												
6.	Define Greibach normal form. Give an example.	2	1	3	1												
7.	Define non-deterministic TM.	2	1	4	1												
8.	What is a multi-stack machine?	2	1	4	1												
9.	Distinguish between recursive and recursively enumerable languages.	2	1	5	1												
10.	What is an undecidable problem? Give an example.	2	1	5	1												
<b>Part-B (5 × 8 = 40 Marks)</b>																	
11. a)	Design a DFA for the following languages. i) $L = \{w \mid w \text{ is a binary string and its decimal equivalent is divisible by } 5\}$ ii) $L = \{(01)^i 1^{2j} \mid i, j \geq 1\}$	4	3	1	2												
b)	Explain Arden's theorem. Obtain a regular expression for the following finite automaton.  <table style="margin-left: 20px;"> <tr> <td></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: right;">→ q<sub>1</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>2</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>3</sub></td> </tr> <tr> <td style="text-align: right;">q<sub>2</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>1</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>3</sub></td> </tr> <tr> <td style="text-align: right;">* q<sub>3</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>2</sub></td> <td style="border: 1px solid black; text-align: center;">q<sub>1</sub></td> </tr> </table>		0	1	→ q <sub>1</sub>	q <sub>2</sub>	q <sub>3</sub>	q <sub>2</sub>	q <sub>1</sub>	q <sub>3</sub>	* q <sub>3</sub>	q <sub>2</sub>	q <sub>1</sub>	4	2	1	2
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→ q <sub>1</sub>	q <sub>2</sub>	q <sub>3</sub>															
q <sub>2</sub>	q <sub>1</sub>	q <sub>3</sub>															
* q <sub>3</sub>	q <sub>2</sub>	q <sub>1</sub>															
12. a)	Show that $L = \{ww \mid w \in \{a, b\}^*\}$ is not regular.	3	4	2	2												
b)	Discuss about the closure properties of regular languages.	5	2	2	2												

13. a)	Simplify the following grammar $S \rightarrow ABC \mid BaB$ $A \rightarrow aA \mid BaC \mid aaa$ $B \rightarrow bBb \mid a \mid D$ $C \rightarrow CA \mid AC$ $D \rightarrow \epsilon$	5	4	3	3																		
b)	What is CNF? Convert the following grammar to CNF $S \rightarrow aAbB$ $A \rightarrow aA \mid a$ $B \rightarrow bB \mid b$	3	2	3	2																		
14. a)	Design a TM to accept the language $L = \{wcw \mid w \in (a+b)^*\}$ .	5	3	4	3																		
b)	Show the sequence of moves made by the above TM for $L = \{wcw \mid w \in (a+b)^*\}$ for the string "aabcaab".	3	3	4	3																		
15. a)	What is diagonalization language ( $L_d$ ). Show that $L_d$ is not recursively enumerable.	3	2	5	2																		
b)	Define PCP and MPCP. Given the MPCP instance shown below, construct PCP instance. List A = (10, 011, 101) List B = (101, 11, 011)	5	3	5	3																		
16. a)	Convert the following NFA to DFA. <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;"><math>\rightarrow q_0</math></td> <td style="border: 1px solid black; padding: 5px;">{<math>q_0, q_1</math>}</td> <td style="border: 1px solid black; padding: 5px;">{<math>q_0, q_3</math>}</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;"><math>q_1</math></td> <td style="border: 1px solid black; padding: 5px;">{<math>q_2</math>}</td> <td style="border: 1px solid black; padding: 5px;">{ }</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;"><math>q_2</math></td> <td style="border: 1px solid black; padding: 5px;">{<math>q_2</math>}</td> <td style="border: 1px solid black; padding: 5px;">{<math>q_2</math>}</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;"><math>q_3</math></td> <td style="border: 1px solid black; padding: 5px;">{ }</td> <td style="border: 1px solid black; padding: 5px;">{<math>q_4</math>}</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">*<math>q_4</math></td> <td style="border: 1px solid black; padding: 5px;">{<math>q_4</math>}</td> <td style="border: 1px solid black; padding: 5px;">{<math>q_4</math>}</td> </tr> </table>		0	1	$\rightarrow q_0$	{ $q_0, q_1$ }	{ $q_0, q_3$ }	$q_1$	{ $q_2$ }	{ }	$q_2$	{ $q_2$ }	{ $q_2$ }	$q_3$	{ }	{ $q_4$ }	* $q_4$	{ $q_4$ }	{ $q_4$ }	5	3	1	3
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* $q_4$	{ $q_4$ }	{ $q_4$ }																					
b)	Briefly describe the decision properties of regular languages.	3	2	2	2																		
17.	Answer any <i>two</i> of the following:																						
a)	Design a PDA for the language $L = \{a^n b^n \mid n \geq 1\}$ . Show the sequence of moves made the PDA for the string <i>aaabbb</i> .	4	3	3	3																		
b)	Briefly describe the programming techniques for TM's	4	2	4	2																		
c)	State and prove the properties of recursive and recursively enumerable languages.	4	2	5	2																		

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level - 1	20%
ii)	Blooms Taxonomy Level - 2	37.50%
iii)	Blooms Taxonomy Level - 3 & 4	42.50%