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AUTOMATA THEORY AND COMPUTABILITY

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2017 -2018)

SEMESTER – V

Subject Code **17CS54** IA Marks **40**

Number of Lecture Hours/Week **04** Exam Marks **60**

These Questions are being framed for helping the students in the "FINAL Exams" Only (Remember for Internals the Question Paper is set by your respective teachers). Questions may be repeated, just to show students how VTU can frame Questions.

- **ADMIN**

Module 2

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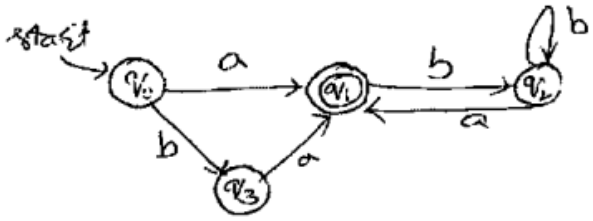
1. Consider the DFA shown below:

States	0	1
$\rightarrow q_1$	q_2	q_1
q_2	q_3	q_1
$*q_3$	q_3	q_2

Obtain the regular expressions $R_{ij}^{(0)}$, $R_{ij}^{(1)}$ and simplify the regular expressions as much as possible. (9-Marks) (3a) (Dec.2017/Jan.2018)

2. Give Regular expressions for the following languages on $\Sigma = \{a, b, c\}$
   i. all strings containing exactly one a
   ii. all strings containing no more than 3 a's.
   iii. all strings that contain at least one occurrence of each symbol in Σ. (3-Marks) (3b) (Dec.2017/Jan.2018)

3. Let L be the language accepted by the following finite state machine.



Indicate for each of the following regular expressions, whether it correctly, describes L: (6-Marks) (3c) (Dec.2017/Jan.2018)

4. Prove that the following language in not regular : L ={0^n1^n | n > 0}. (5-Marks) (4a) (Dec.2017/Jan.2018)

5. If L_1 and L_2 are regular languages then prove that L_1 U L_2, $L_1.L_2$ and L_1* are regular languages. (5-Marks) (4b) (Dec.2017/Jan.2018)

6. Is the following grammar is ambiguous?
   S → iC + S| iC + SeS|a
   C → b (6-Marks) (4c) (Dec.2017/Jan.2018)

7. Define regular expression. Obtain a regular expression for the following languages:
   i. L={a_nb_m|m+n is even}.
   ii. L={a_nb_m|m>=1,n>=1, nm >= 3}
   iii. L={w:|w|mod3=0 where w Є (a,b)*} . (8-Marks) (3a) (June/July 2018)

8. Design an NDFSM that accept the language L(aa*(a+b)). (4-Marks) (3b) (June/July 2018)

9. Convert the regular expression (0+1)*1(0+1) to NDFSM. (4-Marks) (3c) (June/July 2018)

10. If the regular grammars define exactly the regular language, then prove that the class of languages that can be defined with regular grammars is exactly the regular languages. (4-Marks) (4a) (June/July 2018)

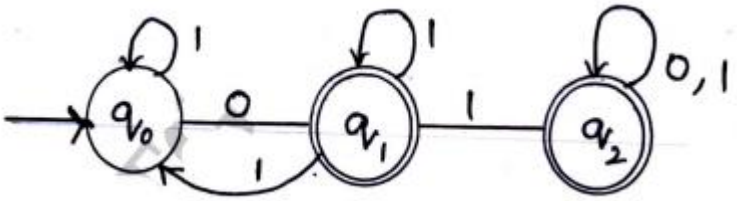
11. Prove that the regular languages are closed under complement, intersection, difference, reverse and letter substitution. (8-Marks) (4b) (June/July 2018)

12. State and prove pumping theorem for regular language. (4-Marks) (4c) (June/July 2018)

13. Define Regular expression and write Regular expression for the following language.

i. $L = \{a^{2n} b^{2m} \mid n \geq 0 , m \geq 0 \}$
ii. $L = \{a^n b^m \mid m \geq 1 , n \geq 1 , nm \geq 3\}$. (8-Marks) (3a) (Dec.2018/Jan.2019)

14. Obtain the Regular expression for the following FSM. (8-Marks) (3b) (Dec.2018/Jan.2019)



15. Define a Regular grammar. Design regular grammars for the following languages.
i. Strings of a's and b's with at least one a.
ii. Strings of a's and b's having strings without ending with ab.
iii. Strings of 0's and 1's with three consecutive 0's. (8-Marks) (4a) (Dec.2018/Jan.2019)

16. State and prove pumping theorem for regular languages. (8-Marks) (4b) (Dec.2018/Jan.2019)

17. State and prove pumping lemma for regular languages. (8-Marks) (3a) (Dec.2018/Jan.2019|10 Scheme)

18. Prove that the following languages are not regular:
i. $\{a^i b^j \mid i>j\}$
ii. $L = \{ w \mid n_a(w) = n_b(w) \}$ (8-Marks) (3b) (Dec.2018/Jan.2019|10 Scheme)

19. Show that if L_1 and L_2 are regular, so is $L_1 \cap L_2$. (4-Marks) (3c) (Dec.2018/Jan.2019|10 Scheme)

20. Define context free grammar. Obtain the CFG for following languages:
i. $L=\{a^n b^m c^k \mid n+2m=k \text{ for } n>=0,m>=0\}$
ii. $L= \{ ww^R / w \in \{a, b\}^*\}$ (8-Marks) (4a) (Dec.2018/Jan.2019|10 Scheme)

21. Construct the left most derivation, right most derivation and parse trees for the grammar.
E→E+E|E-E|E*E]id for input string "id + id * id". (6-Marks) (4b) (Dec.2018/Jan.2019|10 Scheme)

22. Is the following grammar ambiguous?

S→aS|X
X→aX|a (6-Marks) (4c) (Dec.2018/Jan.2019|10 Scheme)

23. State and prove pumping lemma for regular languages. (5-Marks) (3a) (June/July.2017|10 Scheme)

24. Prove that if L is a regular language SO LR. (5-Marks) (3b) (June/July.2017|10 Scheme)

25. Minimize the following DFA using table filling Algorithm. (10-Marks) (3c) (June/July.2017|10 Scheme)

26. Define context free grammar. Write a CFG for palindromes over {0, 1}*. (5-Marks) (4a) (June/July.2017|10 Scheme)

27. What is ambiguous grammar? Show that following grammar is ambiguous for the string "abababa". S→Sbs|a (5-Marks) (4b) (June/July.2017|10 Scheme)

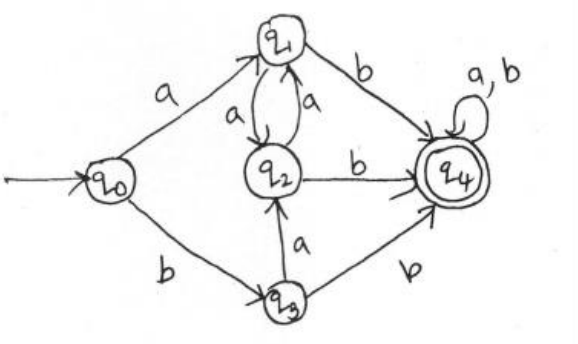
28. What is inherent ambiguity? Explain with an example. (5-Marks) (4d) (June/July.2017|10 Scheme)

29. Explain the application of CFG with respect to parsers. (5-Marks) (4c) (June/July.2017|10 Scheme)

30. If L and M are regular languages prove that L∩M is also regular. (5-Marks) (3a) (Dec.2016/Jan.2017|10 Scheme)

31. Prove that the following language is not regular
L= $\{0^n | n \text{ is prime}\}$ (5-Marks) (3b) (Dec.2016/Jan.2017|10 Scheme)

32. Minimize the following DFA (10-Marks) (3c) (Dec.2016/Jan.2017|10 Scheme)



33. Define CFG. Write CFG for the language.
L=$\{0^n 1^n | n>1\}$ (Dec.2016/Jan.2017|10 Scheme)

34. Consider the grammar
E → +EE| *EE | -EE | x | y
Find leftmost and rightmost derivation for the string +* — xyxy and write parse tree. (8-Marks) (4b) (Dec.2016/Jan.2017|10 Scheme)

35. Write the application of CFG (6-Marks) (4c) (Dec.2016/Jan.2017|10 Scheme)

36. State and prove pumping lemma for regular languages. (7-Marks) (3a) (June/July.2016|10 Scheme)

37. Show that the language L = {an bn| n> 0} is not regular. (6-Marks) (3b) (June/July.2016|10 Scheme)

38. Minimize the following DFA using table filling algorithm. (7-Marks) (3c) (June/July.2016|10 Scheme)

δ	0	1
→q_1	q_2	q_3
q_2	q_3	q_5
*q_3	q_4	q_3
q_4	q_3	q_5
*q_5	q_2	q_5

39. Define CFG. Design CFG's for the following languages:
i. L= {$a^n b^{2n}$ |n>=0}
ii. L= {$\infty\infty^R$ / ∞ Є {a, b}*} (8-Marks) (4a) (June/July.2016|10 Scheme)

40. Write the LMD, RMD and parse tree for the string '+*-xyxy' using the grammar
E → +EE | *EE | -EE |x| y (6-Marks) (4b) (June/July.2016|10 Scheme)

41. What is an ambiguous grammar? Show that the following grammar is ambiguous:
E → E+E | E*E | (E) | id (6-Marks) (4c) (June/July.2016|10 Scheme)

42. State and prove pumping Lemma theorem for regular languages. Show that

L = {a^n b^n | n >= 0} is not regular. (8-Marks) (3a) (Dec.2015/Jan.2016|10 Scheme)

43. What is Homomorphism? Explain with an example. (4-Marks) (3b) (Dec.2015/Jan.2016|10 Scheme)

44. Consider the transition table of DFA given below:

	0	1
→A	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

i. Draw the table of distinguish abilities of states.
ii. Construct the equivalent minimized DFA. (8-Marks) (3c) (Dec.2015/Jan.2016|10 Scheme)

45. Obtain a grammar to generate integers and write derivation for the unsigned integer 1965.(8-Marks) (4a) (Dec.2015/Jan.2016|10 Scheme)

46. Consider the grammar:
S → aS | aSbS | e
Is the above grammar ambiguous? Show that the string aab has two —
i. Parse trees
ii. Left most derivations
iii. Rightmost derivations. (12-Marks) (4b) (Dec.2015/Jan.2016|10 Scheme)

ANSWER SCRIP FOR THESE QUESTIONS WILL BE UPLOADED ASAP

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THANK YOU
