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18CS44

FOURTH Semester B.E. Degree Summer Semester End Examination (SSEE), January 2023

THEORETICAL FOUNDATION OF COMPUTER SCIENCE

[Time: 3 Hours] [Maximum Marks: 100]

Instructions to students:

(i) Answer FIVE FULL Questions as per choice.
(ii) Any Missing Data can be assumed suitably.
(iii) Use BLACK ball point pen for text, figure, table, etc.

			Marks	CO	RBT Level
1.	a)	Define the following with example i) Alphabet ii) Language of DFA iii) Power set iv) Concatenation of strings	[06 Marks]	CO1	L1
	b)	Write DFA's for the following i) to accept strings of a's and b's with substring "abb". ii) to accept strings of a's and b's such that the second symbol from RHS is 'a'.	[08 Marks]	CO1	L3
	c)	Write a note on applications of Finite Automata.	[06 Marks]	CO1	L1

OR

2.	a)	Using subset construction method, convert the following NFA to a DFA.	[06 Marks]	CO1	L2

δ	0	1
→ p	{q,s}	{q}
* q	{r}	{q,r}
r	{s}	{p}
* s	ϕ	{p}

	b)	Construct transition diagram and find the regular expression using state elimination technique for the transition table given below.	[08 Marks]	CO1	L3

δ	0	1
→* p	s	p
q	p	s
r	r	q
s	q	r

	c)	Write a note on applications of regular expressions.	[06 Marks]	CO1	L4
3.	a)	Show that the language L = { a^n / n is prime } is not regular.	[06 Marks]	CO2	L3
	b)	Write Table filling algorithm to find the distinguishable pairs in a DFA 'A'.	[08 Marks]	CO2	L1

c) Using identities prove that the regular languages are closed under intersection. [06 Marks] CO2 L3

OR

4. a) State and prove pumping lemma for regular languages. [06 Marks] CO2 L5

b) Show that the language $L = \{ a^n b^n : n>=0\}$ is not regular using the concept of pumping lemma. [06 Marks] CO2 L2 9.

c) For the transition table of DFA [08 Marks] CO2 L3

i. Draw the table of distinguishibilities for this automata

ii. Construct the Minimum state equivalent DFA

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

5. a) Show that the following grammar is ambiguous and write an equivalent unambiguous grammar for the same using general precedence and associativity. [08 Marks] CO3 L3

$E \rightarrow E+E / E-E / E*E / E/E / (E) / id$

b) Develop context free grammars for the following [12 Marks] CO3 L6

i) $L(G) = \{a^n b^n : n \geq 1\}$

ii) $L(G) = \{ a^n b^{n+1} : n \geq 0 \}$

iii) $L(G) = \{w: n_a(w) = 2\, n_b(w)\}$

iv) $L(G) = \{w\, w^R : w \in \{a,b\}^*\}$

OR

6. a) Define the following [12 Marks] CO3 L1

i) Grammar ii) CFG iii) LMD iv) Sentence v) Ambiguous Grammar vi) Yield of a tree

b) Develop context free grammars for the following [08 Marks] CO3 L6

i) $L(G) = \{a^n b^n c^m d^m : m, n \geq 1\}$

ii) $L(G) = \{w: n_a(w) = n_b(w)+1\}$

7. a) With neat diagram explain the working of PDA and define the language accepted by PDA by both methods. [10 Marks] CO4 L2

b) Design a PDA to accept the language $L = \{ww^R : w \varepsilon \{a,b\}^*\}$ and give the trace for accepting a string. [10 Marks] CO4 L6

OR

8. a) Give the formal definition of PDA. Define Instantaneous Description and Moves of a PDA. [08 Marks] CO4 L2

b) What are the conditions to be met for a PDA to be a DPDA. Design a DPDA to accept the language $L = \{a^n b^{2n} : n \geq 1\}$. [12 Marks] CO4 L6

9. a) Define Useless symbols. Eliminate useless symbols / productions from the following grammar. [08 Marks] CO5 L3

$S \rightarrow aAB / bC$
$A \rightarrow aA / b$
$B \rightarrow bB / a$
$D \rightarrow ab$
$E \rightarrow aD / bC$

b) Convert to GNF [06 Marks] CO5 L3

$S \rightarrow ABb / a$
$A \rightarrow aaA / B$
$B \rightarrow bAb$

c) Convert the following grammar to CNF [06 Marks] CO5 L3

$S \rightarrow aSA$
$A \rightarrow bABc$
$B \rightarrow aB / b$

OR

10. a) With a neat schematic explain the model of Turing machine [08 Marks] CO5 L1

b) Define Turing machine formally. Obtain a Turing machine to accept the language $L(M) = \{ 0^n 1^n 2^n / n>=1\}$ [12 Marks] CO5 L6

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FOURTH Semester B.E. Degree Semester End Examination (SEE), October 2022

THEORETICAL FOUNDATION OF COMPUTER SCIENCE

[Time: 3 Hours] [Maximum Marks: 100]

Instructions to students:

(i) Answer FIVE FULL Questions as per choice.
(ii) Any Missing Data can be assumed suitably.
(iii) Use BLACK ball point pen for text, figure, table, etc.

			Marks	CO	RBT Level
1.	a)	Define the following terms: i) String ii) Language iii) Alphabet iv) Power of an Alphabet	[08 Marks]	CO1	L1
	b)	Design a DFA to accept strings of 0's and 1's ending with the string "000".	[06 Marks]	CO1	L5
	c)	Convert the following NFA to DFA	[06 Marks]	CO1	L2

δ	0	1
→ p	{q,s}	{q}
* q	{r}	{q,r}
r	{s}	{p}
* s	ϕ	{p}

OR

2.	a)	List a few applications of finite automata and regular expressions.	[06 Marks]	CO1	L1
	b)	Write regular expressions for the following i) Strings of a's and b's starting with 'a' and ending with 'b' ii) Strings of a's and b's whose second symbol from the right end is 'a'. iii) Strings of a's and b's that do not end with ab.	[06 Marks]	CO1	L2
	c)	Show that the language defined by a regular expression is also defined by a finite automaton (Thomson Construction).	[08 Marks]	CO1	L3
3.	a)	State and prove pumping lemma for regular languages.	[08 Marks]	CO2	L3

b) Minimize the following DFA using table filling algorithm. [12 Marks] CO2

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

OR

4. a) Show that the language L = { 0^n / n is prime } is not regular. [06 Marks] CO2 L3

b) Write the Table filling algorithm to find the distinguishable pairs in a DFA. [08 Marks] CO2 L1

c) Using identities prove that the regular languages are closed under intersection . [06 Marks] CO2 L3

5. a) Define the following: [12 Marks] CO3 L1
i) Grammar ii) CFG iii) LMD iv) RMD v) Derivation tree
vi) Yield of a tree

b) Show that the following grammar is ambiguous and write an equivalent unambiguous grammar for the same. [08 Marks] CO3 L2
E → E+E / E*E / (E) / id

OR

6. a) Consider the grammar S→ aS / aSbS / ε. For the string "aab", show that there are two [08 Marks] CO3 L3
i) LMD ii) RMD iii) Parse Trees

b) Write context free grammars for the following: [06 Marks] CO3 L1
i) L(G) = {$a^n b^m c^m d^n$: m, n ≥ 1}
ii) L(G) = {w: $n_a(w) = n_b(w)$}

c) Write context free grammars for the following regular expressions: [06 Marks] CO3 L1
i) (011+1)* (01)*
ii) (a+b)* ab (a+b)*

7. a) With a neat diagram explain the working of a pushdown automata. [10 Marks] CO4 L1

b) Design a PDA to accept the language L = {ww^R : w ∈{0,1}*} by empty stack and final state method. [10 Marks] CO4 L5

OR

8. a) Design a PDA to accept the following languages: [12 Marks] CO4 L5

i) $L = \{wcw^R : w \in \{0,1\}^*\}$

ii) $L = \{a^n b^{2n} : n \geq 1\}$

b) Obtain PDA for the following grammar. [08 Marks] CO4 L3

$S \rightarrow aABC$

$A \rightarrow aB / a$

$B \rightarrow bA / b$

$C \rightarrow a$

9. a) Eliminate ϵ-Productions from the following grammar. [06 Marks] CO5 L4

$S \rightarrow aAa / AB$

$A \rightarrow BS / aBa / \epsilon$

$B \rightarrow aB / \epsilon$

b) Eliminate useless symbols / productions from the following grammar. [06 Marks] CO5 L4

$S \rightarrow aAB / bC$

$A \rightarrow aA / b$

$B \rightarrow bB / a$

$D \rightarrow ab$

$E \rightarrow aD / bC$

c) State and prove pumping lemma for context free languages. [08 Marks] CO5 L3

OR

10. a) With a neat diagram explain the model of a Turing machine. [10 Marks] CO5 L1

b) Design a Turing Machine to accept the language $L = \{0^n 1^n 2^n : n \geq 1\}$. [10 Marks] CO5 L5

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