CS/B.Tech/CSE/IT/Even/Sem-4th/CS-402/2015

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WEST BENGAL UNIVERSITY OF TECHNOLOGY

CS-402

FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer *all* questions. $10 \times 1 = 10$

(i) Consider the grammar $S \rightarrow aSAb / \in$

$A \rightarrow bA / \in$

The grammar generates the strings of the form $a^i b^j$ for some i, j ≥ 0. What is the conditions of the values of i and j?

(A) i = j   (B) j $\leq$ 2i   (C) j $\geq$ 2i   (D) i $\leq$ j

(ii) Let N be an NFA with n states and let M be the minimized DFA with m states recognizing the same language. Which of the following is NECESSARILY true?

(A) m $\leq 2^n$ (B) n $\leq$ m

(C) M has one accept state   (D) m $= 2^n$

(iii) Compatible pairs are obtained from

(A) Merger Graph   (B) Compatible Graph (C) Testing Table   (D) Testing Graph

(iv) The string 1101 does not belong to the set represented by

(A) $110^*(0 + 1)$ (B) $1(0 + 1)^*101$

(C) $(10)^*(01)^*(00 + 11)^*$ (D) $(00 + (11)^*01)^*$

(v) Regular sets are closed under

(A) Union   (B) Concatenation   (C) Kleene Closure   (D) All of these

(vi) The intersection of CFL & RE is always

(A) CFL   (B) RE   (C) CSL   (D) CFL or CSL

(vii) Which of the following common in both CNF & GNF?

(A) (NT) $\rightarrow$ (Single T) (String of NT)   (B) (NT) $\rightarrow$ (String of exactly two NT)

(C) (NT) $\rightarrow$ (String of NT)   (D) (NT) $\rightarrow$ (Single T)

(viii) Consider the languages:

$L_1 = \{ww^R \mid w \in \{0, 1\}^*\}$

$L_2 = \{w\#w^R \mid w \in \{0, 1\}^*\}$, where # is a special symbol

$L_3 = \{ww \mid w \in \{0, 1\}^*\}$

Which one of the following is true?

(A) L_1 is a deterministic CFL   (B) L_2 is a deterministic CFL

(C) L_1 is a CFL, but not a deterministic CFL   (D) L_3 is a deterministic CFL

(ix) Difference between Turing Machine & Two way FA is in

(A) input tape   (B) read write head   (C) finite control   (D) all of these

(x) Which of the following statements is false?

(A) the halting problem of Turing machine is undecidable

(B) determining whether a context-free grammar is ambiguous is undecidable

(C) given two arbitrary context free grammars G_1 and G_2, it is undecidable whether

$L(G_1) = L(G_2)$

(D) given two regular grammars G_1 and G_2, it is undecidable whether $L(G_1) = L(G_2)$

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. $3 \times 5 = 15$

2. What do you mean by Right Invariant? Let R be an equivalence relation in $\{0\}^*$ with the following equivalence classes: 1+4

$[\ ]_R = \{0\}^0$

$[0]_R = \{0\}^1$

$[00]_R = \{0\}^2 \cup \{0\}^3 \cup \{0\}^4 \ldots\ldots\ldots$

Show that R is right invariant.

3. Define NFA. Construct equivalent DFA from the given NFA.   1+4

Present State	Next State	
	0	1
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_2	q_1
q_2	q_1	q_2

4. Design a two input two output sequence detector which generates an output '1' every time the sequence 1101 is detected. And for all other cases output '0' is generated. Overlapping sequences are also counted. [Denote State Graph, State Table and perform State assignment]   2+1+2

5. Construct a Push Down Automata equivalent to the following Context Free Grammar   5
   $G = (Vn, Vt, P, S)$ with $Vn = \{S, E\}$, $Vt = \{0, 1\}$ and P is define transition
   follows:
   S- > 0S1 / A
   A- > 1A0 / S / ε
   Now check the string 001011 is acceptable by this Push Down Automata or not.

6. (a) What is parse tree?   5
   (b) Consider the CFG
       S- > aaB
       A- > bBb / ε
       B- > Aa
   Find the Parse tree for the string aabbababa.

GROUP C
(Long Answer Type Questions)

Answer any *three* questions.   3×15 = 45

7. (a) A long sequence of pulses enters a synchronous sequential circuit, which is required to   10+5
   produce an output pulse $z = 1$ whenever the sequence 1001 occurs. Overlapping
   sequences are accepted.
   (i) Draw a state diagram
   (ii) Select an assignment and show the excitation and output tables.
   (b) Minimize the machine using equivalent partitioning

Present state	Next state, X = 0	output X = 1
A	E, 0	D, 1
B	F, 0	D, 0
C	E, 0	B, 1
D	F, 0	B, 0
E	C, 0	F, 1
F	B, 0	C, 0

8. (a) Define and compare Moore and Mealy machines.   2+6+7
   (b) Convert the following Mealy machines into Moore machine.
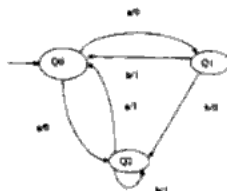
(c) Consider the N.F.A given by the following diagram

Find the equivalent D.F.A without ε-transition.

9. Consider the following state table   3+3+3+t

Present state	Next state, I1	Out Put I2
A	E, 0	B, 0
B	F, 0	A, 0
C	E, -	C, 0
D	F, 1	D, 0
E	C, 1	C, 0
F	D, -	B, 0

(a) Draw the merger graph.
(b) Draw the merger table.
(c) Draw the compatibility graph.
(d) Find the minimal machine which covers that machine.

10. Consider the following state table   8+5+2

Present State	Next State, X = 0	Output X = 1
A	B, 1	H, 1
B	F, 1	D, 1
C	D, 0	E, 1
D	C, 0	F, 1
E	D, 1	C, 1
F	C, 1	C, 1
G	C, 1	D, 1
H	C, 0	A, 1

(a) Find the equivalence partition for the machine.
(b) Show a standard form of the corresponding reduced machine and draw the state
diagram.
(c) Find a minimum length sequence that distinguishes state A from state B.

11.(a) Define Turing machine.   2+5+3+5
   (b) Explain different types of Turing machine.
   (c) What is halting problem in Turing machine?
   (d) Design a Turing machine that accepts the language of all string which contain
   "aba" as a substring.