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May 2019

M.Tech. (CSE)-1st Semester (Reappear)

MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

(MCSE–17-109)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

(i) It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.

(ii) Answer any four questions from Part-B in detail.

(iii) Different sub-parts of a question are to be attempted adjacent to each other.

PART–A

1. (a) Why do we need of Pumping Lemma? (1.5)

(b) Can we simulate multi-tape turing machine using single tape turing machine? Explain. (1.5)

(c) List various limitations of Finite State Machine. (1.5)

(d) What is right most derivation? Explain with a suitable example. (1.5)

(e) Differentiate between Moore and Mealy Machine. (1.5)

(f) Design a DFA to accept string of a and b having a substring aab. (1.5)

(g) Write a regular expression for the language L = {w: $|w|$ mod 3=0 where w ε (a, b)*}. (1.5)

(h) Discuss Chomsky hierarchy of grammars. (1.5)

(i) List various conditions for a PDA to be deterministic. (1.5)

(j) What are recursively enumerable languages? (1.5)

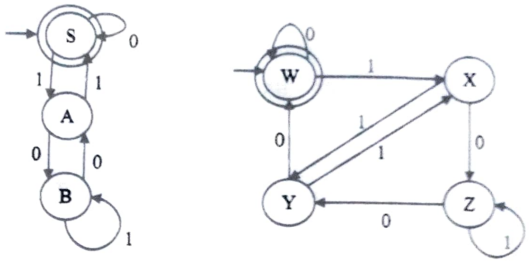
PART–B

2. (a) Construct a DFA for the following ε-NFA.

	ε	a	b	c
p	∅	{p}	{q}	{r}
q	{p}	{q}	{r}	∅
*r	{q}	{r}	∅	{p}

(7.5)

(b) Check the equivalence of the following two DFAs. (7.5)



3. (a) Design a TM to recognize the language L = {$a^n b^n | n >= 1$}. (5)

(b) X and y are two positive integers. Design a turing machine to perform $x + y$. (10)

4. (a) Construct a PDA accepting the language L = {$a^{2n}b^n | n \geq 1$} by null store. (7.5)

(b) Design the CFG G for the PDA M given by the following transitions :

$\partial(q_0, a, Z_0) \vdash (q_0, aZ_0)$
$\partial(q_0, a, a) \vdash (q_0, aa)$
$\partial(q_0, c, a) \vdash (q_1, a)$
$\partial(q_1, a, a) \vdash (q_2, \varepsilon)$
$\partial(q_2, a, a) \vdash (q_2, \varepsilon)$
$\partial(q_2, \varepsilon, Z_0) \vdash (q_2, \varepsilon)$ (7.5)

5. (a) Show that following grammar is ambiguous and make it unambiguous.

$S \rightarrow S + S|S \times S \mid a \mid b$. (5)

(b) State and prove Pumping Lemma for Context Free Languages with a suitable example. (10)

6. (a) Differentiate between DFA, NFA and ε-NFA. (5)

(b) Convert the following CFG to GNF :

$S \rightarrow XY \quad X \rightarrow YSY \quad X \rightarrow YY|1 \quad Y \rightarrow 0X1|1$

(5)

(c) Given an instance of PCP with two pairs (x_1, y_1), (x_2, y_2), ...(xn, yn) and the character set of PCP containing only one alphabet, write an algorithm to find the solution of PCP, if it exists. (5)

7. Write short notes on :

(a) Halting Problem of Turing Machine.

(b) Closure Properties of regular sets.

(c) Context Sensitive Grammars. (15)
