Fifth Semester B.E. Degree Examination, Dec.09/Jan.10
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following terms :
i) Alphabets ii) Strings iii) Power of an alphabet iv) Language. **(06 Marks)**

b. Define DFA. Design a DFA to accept the binary numbers which are divisible by 5. **(06 Marks)**

c. Convert the following NFA to its equivalent DFA using subset construction :

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

(08 Marks)

2 a. Design an NFA that accepts the language L(aa*(a+b)). **(04 Marks)**

b. Consider the following $\in$-NFA :

	$\in$	a	b	c
→ p	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
*r	{q}	{r}	ϕ	{p}

i) Compute the $\in$-closure of each state.
ii) Give all the strings of length 3 or less accepted by the automation
iii) Convert the automation to a DFA. **(10 Marks)**

c. Write the regular expressions for the following languages :
i) The set of all strings over Σ : {a, b, c} containing atleast one a and atleast one b.
ii) L={w : |w| mod 3 = 0} Assume Σ :{a, b}
iii) The set of strings of 0's and 1's whose 10^{th} symbol from the right end is 1. **(06 Marks)**

3 a. Convert the regular expression $(0 + 1)^*1(0 + 1)$ to an $\in$-NFA. **(04 Marks)**

b. State and prove the pumping lemma for regular languages. **(06 Marks)**

c. Consider the transition table Q3(c), 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 distinguishabilities of this automaton
ii) Construct the minimum-state equivalent DFA using table filling algorithm. **(10 Marks)**

4 a. Define CFG. Write CFG for the language $L = \{0^n1^n \mid n \geq 1\}$, i.e. the set of all strings of one or more 0's followed by an equal number of 1's. **(08 Marks)**

b. Consider the grammar –

$S \rightarrow aS \mid aSbS \mid \in$

Is the above grammar ambiguous? Show in particular that the strings aab has two :

i) Parse trees
ii) Leftmost derivation
iii) Rightmost derivations. **(12 Marks)**

PART – B

5 a. Define a PDA. Discuss about the languages accepted by a PDA. Design a nondeterministic PDA for the language $L = \{0^n1^n \mid n \geq 1\}$. **(12 Marks)**

b. Convert the following grammar

$S \rightarrow 0S1 \mid A$

$A \rightarrow \mid A0 \mid S \mid \in$

to a PDA that accepts the same language by empty stack. **(08 Marks)**

6 a. State and prove pumping lemma for context free languages. **(08 Marks)**

b. What are CNF and GNF of context free grammar? Give examples. **(06 Marks)**

c. Using the CFL pumping lemma, show that the following language is not context free.

$L = \{a^i b^j c^k \mid i < j < k\}$. **(06 Marks)**

7 a. With a neat diagram, explain the working of a basic turing machine. Design a turing machine to accept $L = \{ww^R \mid w \in (a + b)^*\}$ **(12 Marks)**

b. Explain the general structure of multi-tape and non deterministic turing machines and show that these are equivalent to basic turing machine. **(08 Marks)**

8 Write short notes on :

a. Recursive languages and holting problem
b. Post's correspondence problem
c. Chomsky hierarchy
d. Applications of CFG's **(20 Marks)**

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