(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 110404 **Roll No.** | | | | | | | | | | |

B.Tech.

(SEM. IV) THEORY EXAMINATION 2013-14

THEORY OF COMPUTATION

Time : 3 Hours *Total Marks : 100*

Note :– Attempt **all** questions.

SECTION–A

1. Attempt **all** question parts : **(10×2=20)**

(a) Design a FA to accept the string that always ends with 00.

(b) Differentiate L^* and L^+.

(c) Design a Moore m/c which will increment the given binary number by 1.

(d) Describe the instantaneous description of a PDA.

(e) Let G = ({S, A_1, A_2}, {a, b}, P, S), where P consists of $S \rightarrow a A_1A_2a$, $A_1 \rightarrow baA_1A_2b$, $A_2 \rightarrow A_1ab$, $aA_1 \rightarrow baa$, $bA_2b \rightarrow abab$. Test whether w = baabbabaaabbaba is in L(G).

(f) What are the features of universal Turing machine ?

(g) What is Church's Hypothesis ?

(h) Construct the CFG for the regular expression $(0 + 1)^*$.

(i) State Halting problem of Turing machine.

(j) What is the difference between DFA and NDFA ?

SECTION–B

2. Attempt any **three** question parts : **(10×3=30)**

(a) Construct a NFA for the language L which accepts all the strings in which the third symbol from right end is always 'a' over $\Sigma = \{a, b\}$.

(b) State and prove that Regular Languages are closed under Union, Concatenation, Kleen and Complementation.

(c) Convert the following NFA to a DFA and informally describe the language it accepts :

	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
q	$\{r, s\}$	$\{t\}$
r	$\{p, r\}$	$\{t\}$
$*s$	Φ	Φ
$*t$	Φ	Φ

(d) The following grammar generates the language consisting of all strings of even length :

$$S \rightarrow AS \mid \Lambda,\ A \rightarrow aa \mid ab \mid ba \mid bb.$$

Give left-most and right-most derivations for the following strings :

(i) bbbbbbba

(ii) baabab

(iii) aaabbb

(e) Convert the grammar $S \rightarrow aAA,\ A \rightarrow aS \mid bS \mid a$ to a PDA that accepts the same language by empty stack.

SECTION–C

Note :– Attempt **all** questions. **(5×10=50)**

3. Attempt any **two** parts :

(a) Describe the programming technique of Turing machine.

(b) Give the DFA's accepting the following languages over the alphabet $\Sigma = \{a, b\}$:

(i) $L = \{w \in \{a, b\}^* \mid w = a^m b^n \text{ for } m, n > 0\}$

(ii) $L = \{w \in \{a, b\}^* \mid w$ is the string representation of a floating point numbers$\}$

(iii) $L = \{w \in \{a, b\}^* \mid w$ contains an odd number of a's$\}$

(c) Prove that the recursive languages are closed under Union, Intersection and Complement.

4. Attempt any **two** parts :

(a) Check whether the given grammar is ambiguous or not :

$$S \rightarrow |C \tau S||C \tau S e S| a, C \rightarrow b$$

(b) For the two regular expressions :

$$r1 = a^* + b^* \quad r2 = ab^* + ba^* + b^*a + (a^*b)^*$$

(i) Find a string corresponding to r2 but not to r1 and

(ii) Find a string corresponds to both r1 and r2.

(c) Consider the following $\in$– NDFA :

	$\in$	a	b	c
$\rightarrow p$	$\{q, r\}$	Φ	$\{q\}$	$\{r\}$
q	Φ	$\{p\}$	$\{r\}$	$\{p, q\}$
*r	ϕ	ϕ	ϕ	Φ

(i) Compute the $\in$-closure of each state.

(ii) Give the set of strings of length 3 or less accepted by the automata.

(iii) Convert the automata to a DFA.

5. Attempt any **two** parts :

(a) Construct PDA for the language $L = \{a^{2n}b^n \mid n \geq 1\}$

(b) Show that $L = \{a^i b^j c^k \mid k > i + j\}$ is not regular.

(c) Give the state transition diagram for a FA for accepting :

(i) $L1 = \{x \in \{a, b\}^* \mid |x|_a = 3\,k$ for some $k \geq 0$ and also x ends with "ab"$\}$

(ii) $L2 = \{x \in \{a, b\}^* \mid |x|_a = 3\,k$ for some $k \geq 0$ or x ends with "ab"$\}$.

6. Attempt any **two** parts :

(a) Construct deterministic pushdown automata to accept binary strings that start and end with the same symbol and have the same number of 0s as 1s.

(b) Convert the given grammar G into CNF. G is $S \rightarrow ABA$, $A \rightarrow aA \mid \Lambda$, $B \rightarrow bB \mid \Lambda$.

(c) Prove that for every regular language there is a finite automaton.

7. Attempt any **two** parts :

(a) Construct a TM for language consisting of strings having any number of 0's and only even number of 1's over the input set $\Sigma = \{0, 1\}$.

(b) State PCP problem. A correspondence system P = {(01, 1, 10, 010), (1, 01, 0, 1)}. Is there any solution for P ?

(c) Use the CFL pumping lemma to show that following language is not context free :

i) $\{0^i 1^j \mid j = i^2\}$.