AUTUMN END SEMESTER EXAMINATION-2013

5th Semester B.Tech/B.Tech Dual

THEORY OF COMPUTATION CS-504/505

(Regular-2011 Batch & Back of Previous Batches)

Full Marks: 60 Time: 3 Hours

Answer any SIX questions including Question No.1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. a) What is a undecidable problem? Give two examples of undecidable problems. [2 × 10

   b) Arrange the following in ascending order of their power of acceptance:

   NPDA, DFA, NFA, DPDA, TM where the abbreviations have their usual meanings.

   c) Distinguish between DFA and NFA with examples.

   d) Design an NFA with no more than five states for the set $\{abab^n \mid n \geq 0\} \cup \{aba^n \mid n \geq 0\}$.

   e) What is the importance of *stack as an external memory* in Push-Down Automata?

   f) Write a context free grammar for the language $L = \{a^n b^m c^k \mid k = n + m\}$.

g) *If L is a context free language then its complement L' is also context free.* Is it true or false? Justify.

h) Is the language $L=\{wabaw \mid w \in \{a+b\}^*, |w|=100\}$ regular? Justify.

i) Write a regular expression for the set

$\{a^n b^n \mid n \geq 3 \text{ and } m \text{ is even}\}$

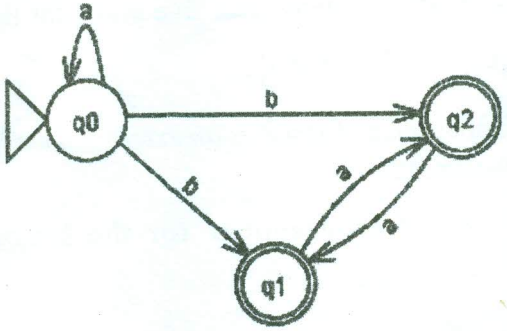
j) Is the family of regular languages closed under complementation? Justify.

2 (a) Find a minimum state DFA equivalent to the following DFA. [6

$M=(Q,\Sigma,\delta,q_0,F)$, Where: Q={$q_0$, q_1, q_2, q_3, q_4, q_5}, Σ={0, 1}, F={q_3, q_5}

δ =	0	1
q_0	q_1	q_3
q_1	q_0	q_3
q_2	q_1	q_4
q_3	q_5	q_5
q_4	q_3	q_3
q_5	q_5	q_5

b) Find a regular expression for the language of the following automaton. [2



3 a) Design a DFA that accepts a binary string if and only if every *00* in it is followed immediately by a *1*. Note that the strings in the language can't have *000* as substring. [4

b) Design a NFA for following regular expression: [4

L= (aa + bb) (a+b)* and convert the NFA into a DFA.

4. a) Convert the following Context free grammar into Chomsky Normal Form (CNF). [6

$S \rightarrow abAB$

$A \rightarrow bAB \mid \lambda$

$B \rightarrow Baa \mid A \mid \lambda$

b) Prove that the family of context free languages is closed under union. [2

5. a) Design a PDA for the language [4

$$L = \{0^n 1^m \mid n \geq 1 \text{ and } m = 2n\}$$

b) Construct an NPDA corresponding to the grammar: [4

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid A$

6. a) State Pumping Lemma for regular languages. Show that the language $L = \{a^n b^{2n} \mid n \geq 1\}$ is not regular. [4

b) State Pumping Lemma for context free languages. Is the language $L = \{a^n 1^n 2^n \mid n \geq 1\}$ context free? Justify. [4

7. Give a formal definition of Turing machine. Construct a Turing machine for the language $L = \left\{ ww^R \mid w \in (a+b)^+ \right\}$. Show the Instantaneous Descriptions (IDs) of the Turing machine for the string *abaaba*. [8

8. a) Is the following grammar in Greibach Normal Form (GNF)? Justify your answer. If it is not in GNF, then convert it into GNF. [4

$S \rightarrow ABb \mid a$

$A \rightarrow aaA \mid B$

$B \rightarrow bAb$

b) Show that the following grammar is ambiguous. [4

$S \rightarrow AB \mid aaB$

$A \rightarrow a \mid Aa$

$B \rightarrow b$

Write an equivalent unambiguous grammar.