Code No: R09220504

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
## B.Tech II Year II Semester Examinations, May-2013
### Formal Languages and Automata Theory
(Computer Science and Engineering)

Time: 3 hours                                                                          Max. Marks: 75

**Answer any five questions**
**All questions carry equal marks**

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1.a) Design NFA to accept strings with a's and b's such that the string end with 'bb'.

b) Design FA to accept string with 'a' and 'b' such that the number of b's are divisible by 3.                                                                    [15]

2.a) Convert the following NFA with ε to equivalent DFA

|  | a | b | ε |
|---|---|---|---|
| →A | Φ | A | B |
| B | B | Φ | C |
| ©C | B | A | Φ |

b) Construct the minimum state automata for the following.                           [15]

|  | a | b |
|---|---|---|
| →A | B | A |
| B | A | C |
| C | D | B |
| (D) | D | A |
| E | D | F |
| F | G | E |
| G | F | G |
| H | G | D |

3.a) Find the regular expression for the Language L = $\{a^{2n}b^{2m} \mid n \geq 0, m \geq 0\}$.

b) Construct NFA for the R.E. that contains odd number of 0's over Σ = {0}.

c) Write a R.E. for the following DFA.                                              [15]

|  | a | b |
|---|---|---|
| →P | Q | P |
| ⓠQ | Q | P |

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

b) Construct right linear grammar for the following DFA.                            [15]

|  | 0 | 1 |
|---|---|---|
| →A | B | C |
| ⑬B | B | C |
| C | A | C |

5.a) Discuss the languages accepted by a PDA. Design a PDA for the language that accepts the strings with number of a's less than number of b's where w is in (a+b)* and show the instantaneous description of the PDA on input 'abbab'.

b) Convert the given CFG into GNF. [15]

$S \rightarrow CA$

$A \rightarrow a$

$C \rightarrow aB \mid b$

6.a) Using CFL pumping lemma show that the following language is not context free $L=\{a^i b^j c^k \mid i<j<k\}$

b) Obtain the following grammar in CNF. [15]

$S \rightarrow aBa \mid abba$

$A \rightarrow ab \mid AA$

$B \rightarrow aB \mid a$

7.a) Construct TM for the function $f(x) = (x+3)$.

b) Design a Turing Machine to recognize the language $L = \{a^n b^n a^n \mid n \geq 1\}$. [15]

8.a) Is the language $a^n b^n c^n$ Context Sensitive ? Explain.

b) What do you mean by 'decidable' and 'undecidable' problem? Give example.

c) Write short notes on Universal Turing Machine. [15]

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