

**B.CSE 4<sup>th</sup> YEAR 1<sup>st</sup> SEMESTER SUPPLEMENTARY EXAMINATION 2017**  
**Formal Languages and Automata Theory**

Time: 3 hours

Full Marks: 100

Answer any *five* questions

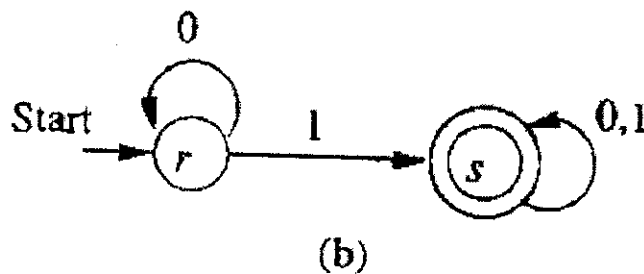
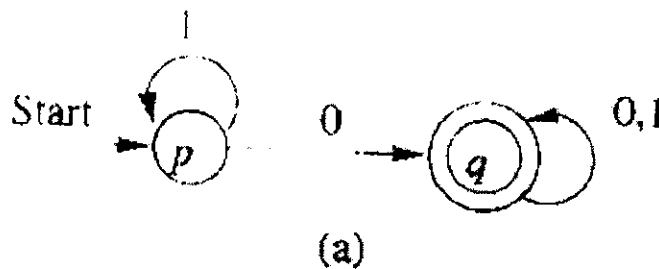
1.(a) Give a DFA that accepts  $\{ w \mid w \text{ in } \{0,1\}^* \text{ and } w, \text{ viewed as a binary integer, is divisible by } 3\}$ . Also show the moves the DFA will make for an input string 1010.

(b) Design an  $\epsilon$ -NFA that accepts the set of strings that consists of either 01 repeated one or more times or 010 repeated one or more times. Convert it into an equivalent NFA. Finally convert it into an equivalent DFA.

7+(3+4+6)

2.(a) State the pumping lemma for regular languages. Explain its significance. Show that  $\{0^n 1^n \mid n > 0\}$  is not regular.

(b) The following DFA shown first accepts all those strings of 0's and 1's that have at least one 0. The next DFA accepts all those strings of 0's and 1's that have at least one 1. With this two DFA's, construct a third DFA accepting all strings of 0's and 1's that has at least one 0 and at least one 1 i.e. the intersection of first two languages.



10+10

3. a) State and prove the pumping lemma for Context-Free languages.

b) Using the pumping lemma, show that the language

$$\{0^i 1^j 2^k 3^l \mid i \geq 1 \text{ and } j \geq 1\}$$

is not a context free.

12+8

4.(a) Construct an NPDA that accepts

$$\{0^i 1^j \mid i \leq j \leq 2i\}$$

Give the transition diagram.

(b) Show that Context-Free Languages are not closed under complement. That is, if  $L$  is a CFL then  $\bar{L}$  is not necessarily a CFL.

(c) Eliminate  $\epsilon$ -productions from the following:

$$S \rightarrow ABC$$

$$A \rightarrow aA \mid \epsilon$$

$$B \rightarrow bB \mid \epsilon$$

$$C \rightarrow \epsilon$$

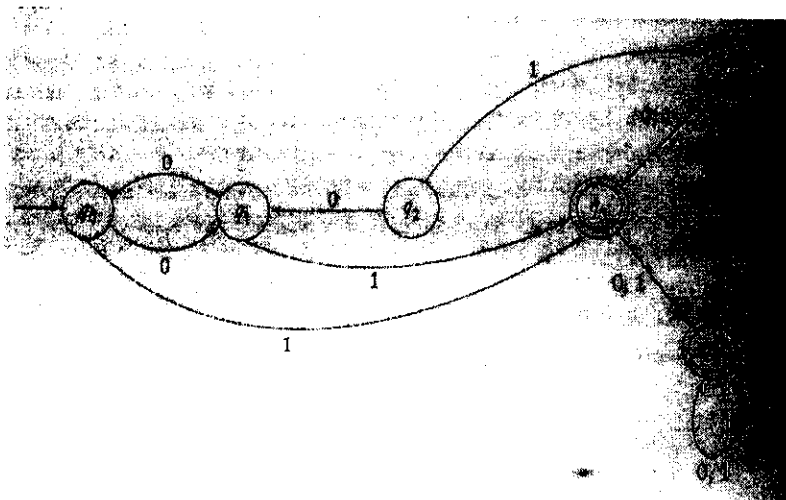
6+8+6

5.(a) State the Halting Problem for TM's. Prove that Halting Problem is undecidable.

(b) Design a Turing Machine that accepts the language  $\{ww^R \mid w \text{ is any string of } 0\text{'s and } 1\text{'s}\}$ . Give the transition diagram and explain the construction of the machine.

10+10

6.(a) Minimize the states in the DFA depicted below:



(b) Discuss about Recursive and Recursively Enumerable languages, Chomsky hierarchy of languages, P and NP class of problems.

10+10