5. (a) What will be the output of the composition of initial function? 2

$$\left(S\left(Z\left(S\left(U_2^4\left(5, 9, 3, 1\right)\right)\right)\right)\right)$$

(b) Show that the following functions are primitive recursive : 7

(i) $f(x, y) = x^y$

(ii) $f(x, y) = x * y$

(c) Write short notes on : 7

   (i) NP-completeness

   (ii) Space & Time complexity

(d) Design a simple turing machine for computing the addition of two numbers. 7

322554(22)

B. E. (Fifth Semester) Examination, Nov.-Dec. 2016

(New Scheme)

(CSE Engg. Branch)

THEORY OF COMPUTATION
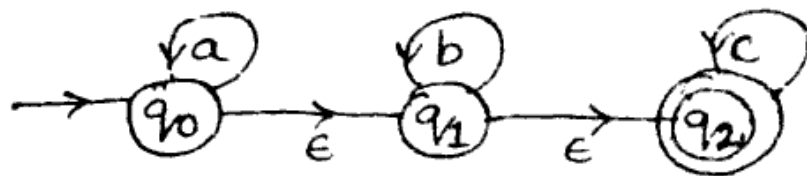
Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Part (a) is compulsory from each unit. Attempt any two parts from (b), (c) and (d) from each unit

Unit-I

1. (a) Define transition graph.

(b) Consider the following NFA with $\in$ transitions. Transform this NFA with $\in$ transitions to an NFA without $\in$ transitions. 7

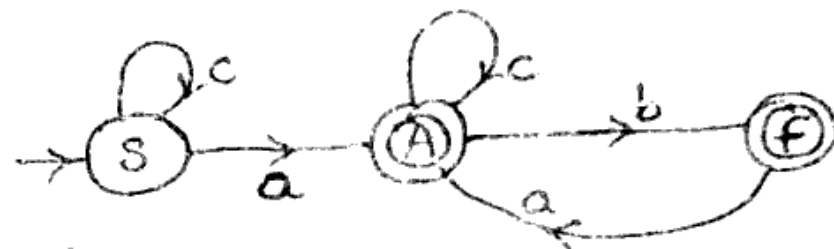(b) Minimize the following DFA, represented using transition diagram. 7

Current State	Input Symbol	
	0	1
q_0	q_1	q_3
q_1	q_0	q_1
q_2	q_1	q_4
*q_3	q_5	q_5
q_4	q_3	q_3
*q_5	q_5	q_5

(d) Write short notes on :

(i) Two way finite automata 3½

(ii) Mealy machines 3½

Unit-II

2. (a) Define pumping lemma for regular sets. 2

(b) Find the regular expression corresponding to the following DFA. 7

(c) Construct the finite automation equivalent to the regular expression.

$$(0+1)^* (00+11)(0+1)^*$$

(d) Define regular expression. Let

$$G = \left(\{A_0, A_1\}, \{a, b\}, P, A_0 \right) \text{ where } P \text{ consists}$$

of $A_0 \to aA_1$, $A_1 \to bA_1$, $A_1 \to a$, $A_1 \to bA_0$.

Construct a transition system M accepting $L(G)$. Also mention the rules for such construct. 7

Unit-III

3. (a) Define context free grammars. 2

(b) Write a CFG which generates the string of balanced parenthesis. Also show that the following group of parenthesis is accepted by this CFG. 7

$$(( )((( )))) $$

(c) What do you mean by ambiguity in context free Grammars. If G is the grammar $S \rightarrow SbS|a$, then show that G is ambigous. 7

(d) Explain how a CFG can be simplified or reduced. Eliminate epsilon productions from the following grammar. 7

$$S \rightarrow ABAC$$

$$A \rightarrow aA|\in$$

$$B \rightarrow bB|C$$

$$C \rightarrow c$$

Unit-IV

4. (a) Define PDA. 2

(b) Write short notes on any **two** : 7

(i) Church's hypothesis

(ii) Post correspondance problem

(iii) Halting problem of Turing machine

(c) Consider the following CFG,

$$S \rightarrow aA$$

$$A \rightarrow aABC|bB|a$$

$$B \rightarrow b$$

$$C \rightarrow c$$

where S is the start symbol.

Design a push down automata corresponding to the above grammar. 7

(d) Design a Turing machine over $\{a, b\}$ to accept the language 7

$$L = \left\{ a^n b^n \mid n \geq 1 \right\}$$

Unit-V