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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

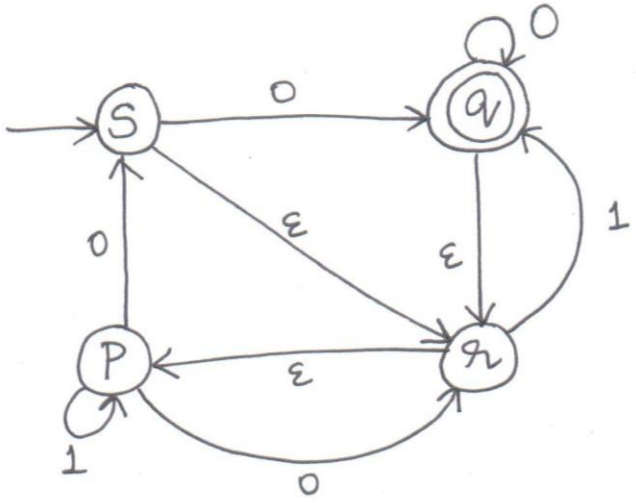
January 2017 Semester End Make Up Examinations

Course: **Theoretical Foundations of Computation** Duration: **3 hrs**
Course Code: **15IS3DCTFC** Max Marks: **100**
Date: 17.01.2017

Instructions: **1. Answer any five full questions choosing one from each unit.**
2. Assume missing data (if any) suitably

UNIT 1

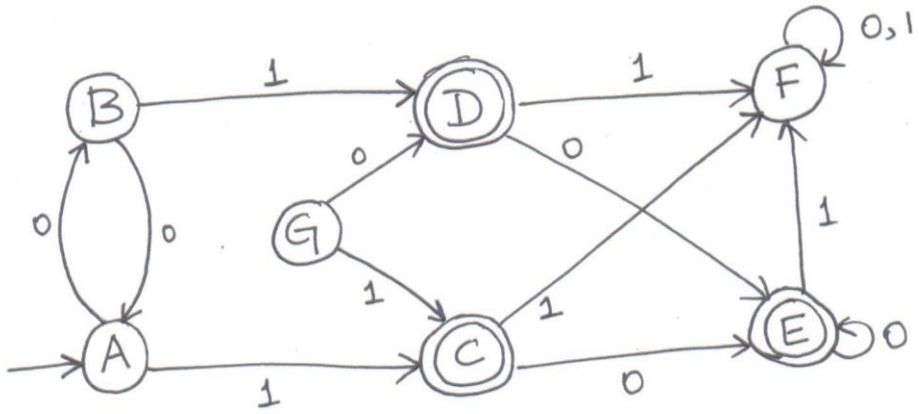
1. a) Define language of a DFA and NFA. **03**
   b) Design DFA's accepting the following strings over $\Sigma = \{0,1\}$ **12**
      i. The set of all strings which either start or end with 10.
      ii. The set of all strings where every 00 is followed immediately by a 1.
      iii. The set of all strings which when interpreted as a binary integer is a multiple of 3
   c) Compute ε-closure for each state in the given ε-NFA. Also convert it to DFA. **05**



UNIT 2

2. a) Compose regular expressions for the following languages. **06**
      i. L= {x Є {a,b}* | x does not contain consecutive a's}
      ii. L= {y Є {a,b}* | length of y is either even or multiple of 3 or both}
   b) Apply pumping lemma for the language L = { ww^r | w Є (a+b)* } and prove that it is not regular. **05**

c) Minimize the following automata using table filling algorithm. **09**

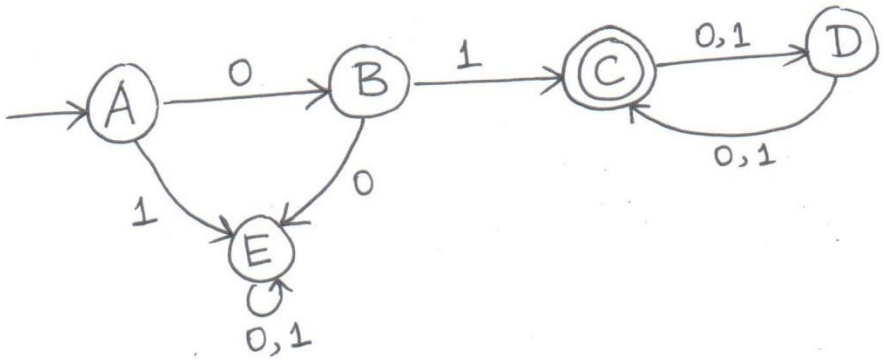


OR

3. a) Transform the following DFA to regular expression by elimination of states. **07**

	0	1
→ * **p**	**s**	**p**
q	**p**	**s**
r	**r**	**q**
s	**q**	**r**

b) Generate regular grammar from the given automata. **06**



c) Demonstrate that if L and M are regular languages, then so is L - M. **07**

UNIT 3

4. a) Design Context free grammars for the following languages **08**
   i. $L = \{w : w \in \{a,b\}^* , n_a(w) = n_b(w) \}$
   ii. $L = \{0^i1^j \mid i \neq j \text{ and } i >= 0, j >= 0\}$
   iii. $L = \{a^{n+2}b^m \mid n >= 0 \text{ and } m > n \}$

   b) Illustrate the relevance of context free grammars in programming languages with two examples. **04**

   c) Show that the following grammars are ambiguous. **08**
   i. $S \rightarrow SS \mid (S) \mid a$
   ii. $S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$

OR

5. a) Define Chomsky Normal Form. Convert the following grammar to Chomsky Normal Form. **10**

$S \rightarrow ASA \mid aB$

$A \rightarrow B \mid S$

$B \rightarrow b \mid \varepsilon$

b) Generate the equivalent unambiguous grammar for the following grammar. **05**

$E \rightarrow I \mid E+E \mid E*E \mid (E)$

$I \rightarrow a \mid b \mid c$

c) Consider the following two languages: **05**

$L_1 = \{ a^n b^n c^m \mid m,n >= 0 \}$

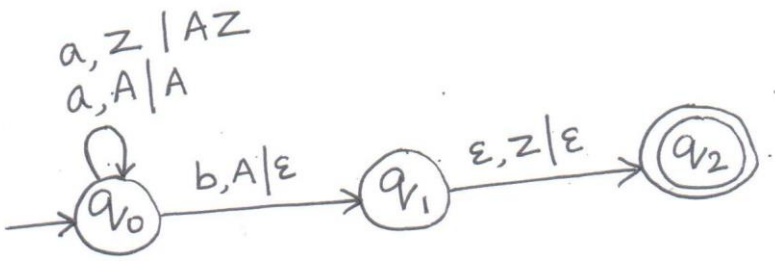
$L_2 = \{ a^n b^m c^m \mid m,n >= 0 \}$

Is $L_1 \cap L_2$ a Context free language? Justify your answer.

UNIT 4

6. a) Construct a PDA that accepts the language $L = \{ x : x \in \{a,b\}^* \mid n_a(x) = n_b(x) \}$ **12**
Justify if the designed PDA is deterministic or not.

b) Convert the following PDA to its equivalent grammar. **08**



UNIT 5

7. a) Design a Turing machine to compute the function which reverses the input strings of a's and b's. **12**

b) Provide a 'high-level' description for Turing machine that multiplies two positive integers in unary notation. **04**

c) Demonstrate that Turing machine with complex storage can be stimulated by a standard Turing machine. **04**

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