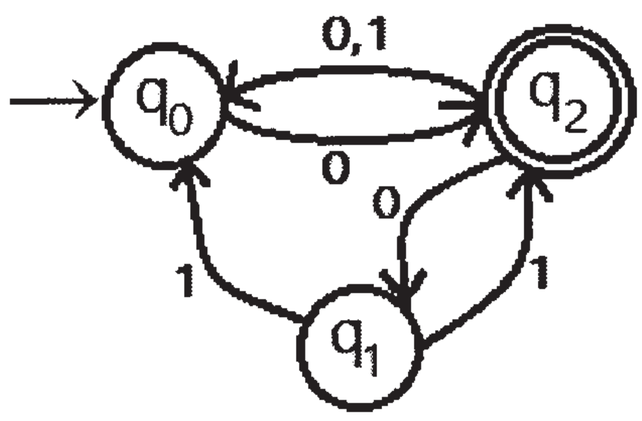
PANDIT DEENDAYAL PETROLEUM UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
END SEMESTER EXAMINATION SEPTEMBER 2018

B. Tech Computer Engineering

Semester V

Course Name : Theory of Computation Course Code : 18CP 302 Max. Marks: 50

1.	a	Design a DFA for the language $L=\{w \mid w \in (a,b)^*, n_a(w) \bmod 3=0$ and $n_b(w) \bmod 3=0\}$	(4)
	b	State Kleene's theorem. Convert the following NFA to a DFA and informally describe the language it accepts. 	(6)
	c	Prove that language $L=\{ww^R \mid w \in (a,b)^*\}$ is not regular using pumping lemma.	(5)
2.	a	(i) Write regular expression for strings not containing 110 as substring. Also draw its NFA and DFA. (ii) For the two regular expressions given below, (a) find two strings corresponding to r_2 but not to r_1 and (b) find three strings corresponding to both r1 and r2. $r_1 = a^* + b^*$ $r_2 = ab^* + ba^* + b^*a + (a^*b)^*$	(10)
	b	Draw a PDA for the following language. $L = \{0^n 1^m \mid n \leq m \leq 2n\}$ Given an example for a language for which PDA is not possible to design.	(5)
	c	Show that the grammar G: $E \rightarrow E+E \mid E*E \mid (E) \mid a$ is ambiguous. Construct an unambiguous grammar equivalent to the grammar G. Also state whether ambiguity of any context free grammar is decidable or not. Justify.	(5)
3.	a	State and prove pumping lemma for context free languages. Whether the language L is a context- free? Justify your answer with counter examples. $L = \{a^i b^j c^k \mid 0 \leq i \leq j \leq k\}$	(12)
	b	Given the following grammar G with production rules S → ASB | ε ; A →aAS | a; B →SbS | A | bb; Can you apply CYK algorithm on G to test the membership of the string w=aabb in L(G)? Justify your answer mentioning the necessary changes that you make in G. Show the complete steps in testing the membership.	(8)

4.	a	Consider the following two languages : $L_1 = \{a^n b^n c^m \mid n, m \leq 0\}$ $L_2 = \{a^{2n} b^m c^m \mid n, m \leq 0\}$ (i) Show that each of these languages is context-free by giving grammars for each. (ii) Is $L_1 \cap L_2$ a CFL? Justify your answer. (iii) Derive a context free grammar for L_1 from the PDA M such that L(M)=L_1.	(10)
	b	Draw the Turing machine that finds 2's complement of a binary number. Also write the instantaneous description of the Turing machine for the input 1100110.	(7)
	c	Choose the appropriate programming technique to design Turing machine for (i) recognizing $L=\{wcw \mid w \in (a,b)^*\}$ **(OR)** (ii) computing 0^{2^n} (0 power 2 power n), i.e., TM will start with 0^n1 on its tape and end with $0^{2^n}1$ on the tape. You need to clearly state the definition of TM using 7 tuple and also the tape movement for an example.	(8)
5.	a	Write a short note on Universal Turing machine and encoding of Turing machines. State whether following problems are decidable or undecidable? Justify your answer (i) *Whether two DFAs M_1 and M_2 accept the same language?* (ii) ATM = {<M,w> | Turing machine M accepts w}	(10)
	b	State PCP and MPCP problems. Whether they are decidable or not? Justify your answer with necessary proof.	(10)