Nirma University

Institute of Technology

Semester End Examination (IR/RPR), December - 2018

B. Tech. in Computer Engineering / Information Technology, Semester-V

CE501 Theory of Computation

Roll / Exam No. ______ Supervisor's initial with date ______

Time: 3 Hours Max. Marks : 100

Instructions:
1. Attempt all questions of Section I and II separately in same Answerbook.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume suitable data wherever necessary and mention the same.

SECTION – I

Q-1. Do as directed. **[18]**

(A) Use the principle of mathematical induction to prove that for any positive integer number n, $n^3 + 2n$ is divisible by 3. (6)

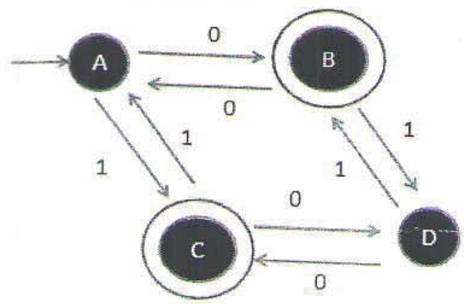
(B) Define equivalence of grammars. Given grammars G1, G2, and G3, which of the two grammars are equivalent and why? (6)

$G1 = (\{S, B, C\}, \{a, b, c\}, S, \{S \rightarrow aSBC, S \rightarrow aBC, CB \rightarrow BC, aB \rightarrow ab, bB \rightarrow bb, bC \rightarrow bc, cC \rightarrow cc\})$

$G2 = (\{S, A, B\}, \{a, b, c\}, S, \{S \rightarrow aSA, S \rightarrow aB, B \rightarrow bBc, cA \rightarrow Ac, B \rightarrow bc\})$

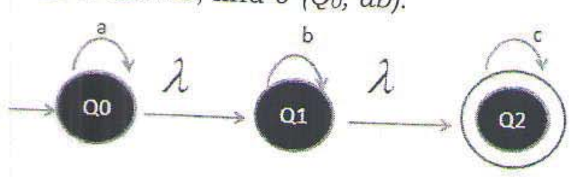
$G3 = (\{S, B, C\}, \{a, b, c\}, S, \{S \rightarrow abc, S \rightarrow aBb, Bb \rightarrow bB, Bc \rightarrow Cbc, bC \rightarrow Cb, aC \rightarrow aaB\})$.

(C) Define regular set. Prove that for any given regular set over the alphabet Σ, we can give a grammar of type-3. Find Type-3 grammar corresponding to the following automaton: (6)



Q-2. Answer the following. **[16]**

(A) Define λ-closure (Null Closure) of a state and a set of states. In the following NFA with λ-moves, find $\delta^*(Q_0, ab)$. (6)



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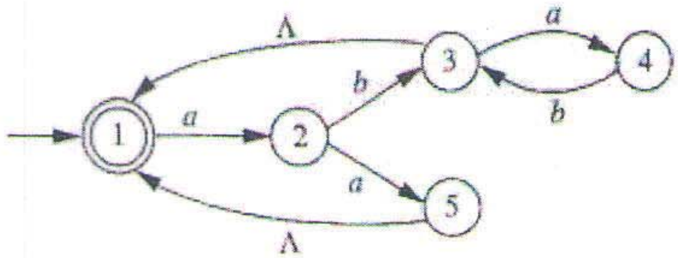
OR

(A) Convert the following null- NFA to DFA: (6)



(B) Explain the Mealy and Moore machine. For the following Mealy machine find an equivalent Moore machine: (6)

	Input Symbol			
Current state	**a**		**b**	
	Next State	Output	Next State	Output
q_0	q_1	1	q_3	1
q_1	q_1	0	q_0	1
q_2	q_0	1	q_2	0
q_3	q_3	0	q_1	1

(C) Explain Chomsky's hierarchy of grammar and languages. (4)

Q-3. Answer the following. **[16]**

(A) Consider Input alphabet as {a, b}*. Write the regular expression and give the automaton for each of the following: (6)

(i) Strings that starts and ends with a.
(ii) Strings that have length greater than or equal to 3.
(iii)Strings that have length greater than or equal to 3 and its third symbol is a.

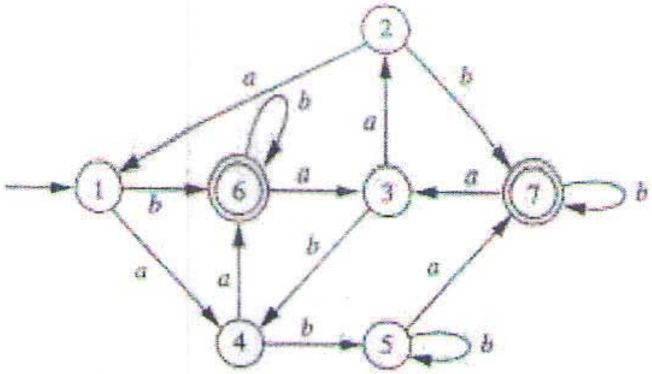
(B) Minimize the DFA shown in the following transition table. Take q_2 as final sate. (6)

$\delta \setminus \Sigma$	***a***	***b***
q_0	q_5	q_1
q_1	q_2	q_6
q_2	q_2	q_0
q_3	q_6	q_2
q_4	q_5	q_7
q_5	q_6	q_2
q_6	q_4	q_6
q_7	q_2	q_6

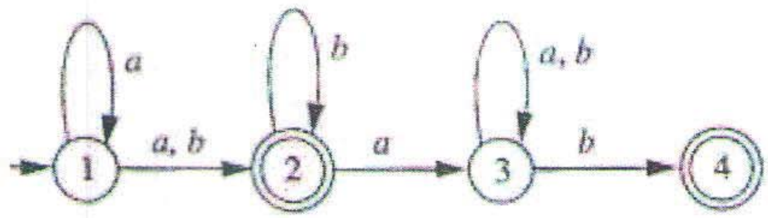
OR

P. T. O.

(B) Minimize the following DFA: (6)



(C) Convert the following NFA to DFA (4)



SECTION – II

Q-4. Do as directed. **[16]**

(A) MCQs with justification: (4)

(1) L={ $a^ib^ic^i$ | i>=1 }
   a. Regular Language
   b. CFL
   c. Both CFL & Regular
   d. Neither CFL nor Regular

(2) L={ $a^ib^jc^j$ | I,j>=1 }
   a. Regular Language
   b. CFL
   c. Both CFL & Regular
   d. Neither CFL nor Regular

(3) L={ $a^nb^nc^md^m$ | n,m>=1 }
   a. Regular Language
   b. CFL
   c. Both CFL & Regular
   d. Neither CFL nor Regular

(4) L={ $0^n1^m2^{m+n}$ | n, m>=1 }
   a. Regular Language
   b. CFL
   c. Both CFL & Regular
   d. Neither CFL nor Regular

(B) Fill in the blanks: (4)

(1) The regular expression corresponding to the CFG S -> aS | bS | a | b is ________

(2) The CFG corresponding to the language $L=\{0^k1^k \mid k>=1\}$ is:

____

(3) The CFL $L=\{a^nb^n \mid n>0\}$ can be generated by the following CFG:

______________ .

(4) A Pumping lemma is used for proving that

__________________ .

(C) Prove that if L_1 and L_2 are context free languages than L_1L_2 and $L_1{}^*$ are also context free languages. (4)

(D) Construct CFG for the following RE: (4)
(1 + 0) * 11

Q-5. Answer the following. **[18]**

(A) Convert the following CFG to CNF: (6)

S -> aAC
A -> aB | bAB
B -> b
C -> c

(B) Design a deterministic PDA for the string of $\Sigma = \{a, b\}$ and having more number of a's than b's. (6)

OR

(B) Write Notes on NP Completeness. (6)

(C) Design a Turing Machine for reversing a string. (6)

OR

(C) Write note on Universal Turing Machine. (6)

Q-6. Answer the following. **[16]**

(A) Design a Turing Machine to accept the language of odd length and even length palindrome. Trace the strings: ababa, abbb, abbbba (8)

(B) Give a CFG for the following PDA (8)

$\delta(q_0, a, Z_0) \vdash (q_0, aZ_0)$
$\delta(q_0, a, a) \vdash (q_0, aa)$
$\delta(q_0, c, a) \vdash (q_1, a)$
$\delta(q_1, a, a) \vdash (q_2, \epsilon)$
$\delta(q_2, a, a) \vdash (q_2, \epsilon)$
$\delta(q_2, \epsilon, Z_0) \vdash (q_2, \epsilon)$