B. E. Fifth Semester (Computer Technology)/ SoE – 2014-15 Examination

Course Code : CT 1301 / CT 301 **Course Name : Theoretical Foundation of Computer Science**

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) All questions carry marks as indicated.
(3) Due credit will be given to neatness.
(4) Assume suitable data wherever necessary.

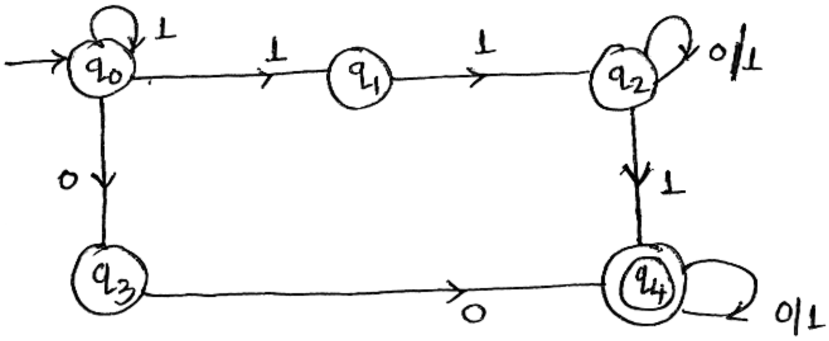
1. (A1) Design an equivalent optimized DFA corresponding to the following NFA. NFA M = < $\{q_0, q_1, q_2, q_3, q_4\}$, {0, 1}, δ, $\{q_0\}$, $\{q_2, q_4\}$> where δ is as follows :

ϕ	0	1
q_0	$\{q_0, q_3\}$	$\{q_0, q_1\}$
q_1	ϕ	q_2
q_2	q_2	q_2
q_3	q_4	ϕ
q_4	q_4	q_4

7 (CO 1)

OR

(A2) Construct an optimized DFA equivalent to the following NDFA given in the following figure.



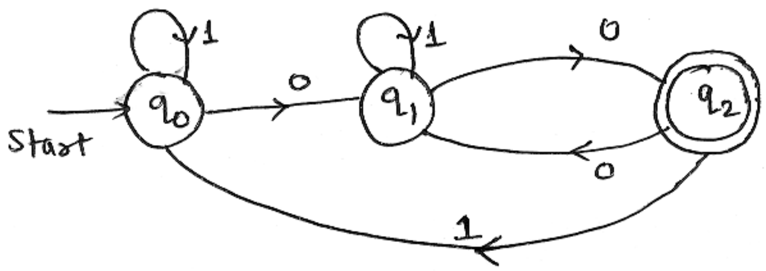
7 (CO 1)

(B1) Design a DFA for the language $L = \{o^m 1^n \mid m \geq 0, \ n \geq 1\}$ 3 (CO 1)

OR

(B2) Construct a finite state machine with minimum number of states, accepting all strings over (a, b) such that the number of a's is divisible by 2 and the number of b's is divisible by 3. 3 (CO 1)

2. (A1) Construct an Regular Expression from the given Finite Automata.



7 (CO 1)

OR

(A2) Construct right linear grammar equivalent to following Left linear grammar:

$S \rightarrow S\,ab \mid Aa$

$A \rightarrow A\,b\,b \mid b\,b$ 7 (CO 1)

(B1) Prove that the following Regular Expressions are equivalent :

(i) $(a + b)^*$

(ii) $a^* \ (b^* \cdot a)^*$ 3 (CO 1)

OR

(B2) Construct a regular grammar for the following Regular Expressions :

$a^* \ (a + b) \ b^*$ 3 (CO 1)

3. (A1) Construct CNF from the following grammar :

$S \rightarrow abAB$

$A \rightarrow bAB \mid \epsilon$

$B \rightarrow BAa \mid \epsilon$ 7 (CO 2)

OR

(A2) Construct GNF from the following grammar

$E \rightarrow E + T \mid T$

$T \rightarrow (E) \mid a$ 7 (CO 2)

(B1) Check whether the following grammar is ambiguous

$S \rightarrow i\ C\ t\ S \mid i\ C\ t\ S\ e\ S \mid a$

$C \rightarrow b$ 3 (CO 2)

OR

(B2) Simplify the following CFG by removing null production, unit production and useless grammar symbol :

$S \rightarrow A\ a\ B \mid a\ a\ B$

$A \rightarrow D$

$B \rightarrow b\ b\ A \mid \epsilon$

$D \rightarrow E$

$E \rightarrow F$

$F \rightarrow a\ S.$ 3 (CO 2)

4. (A1) Construct a PDA to accept the language $L = \{a^n\ b^n\ c^m\ d^m \mid m, n \geq 1\}$ by the empty stack and by the final state. 7 (CO 3)

OR

(A2) Design a PDA that accepts the language generated by the following grammar:

$S \rightarrow a \quad B$

$B \rightarrow b \quad A \mid b$

$A \rightarrow a \quad B$

Show an Instantanous Descriptor (ID) for the string w = ab ab for the PDA generated. 7 (CO 3)

4. (B1) Design a PDA to accept the language of balanced parentheses (where the number of opening and closing parentheses is greater than 0). 3 (CO 3)

OR

(B2) Design a PDA for the language $L = \{(ab)^n\} \cup \{(ba)^n\}, \ n \geqslant 1$ 3 (CO 3)

5. (A1) Design a T. M. to accept the language $L = \{a^n \ b^{2n} \mid n > 0\}$ 7 (CO 4)

OR

(A2) Design a T. M. to accept the string $L = \{a, b)^*$, where $N(a) = N(b) = \text{even}\}$ 7 (CO 4)

(B1) Design a TM to perform the function $f(x) = x + 1$, where $x \geqslant 1$ 3 (CO 4)

OR

(B2) Design a TM to perform addition of two integers $f(x, y) = x + y$. 3 (CO 4)

6. (A1) Evaluate the Ackermann's function for A (2, 1) and A (1, 3). 6 (CO 4)

OR

(A2) Does the PCD with two list

$X = 1, \quad 10, \quad 10111$

and $Y = 111, \quad 0, \quad 10$

have a solution. 6 (CO 4)

(B1) Prove that the function $f(x, y) = x * y$, where x, y are positive integers, is primitive recursive. 4 (CO 4)

OR

(B2) Prove the following function is Recursive function.

$f(x; y) = x^y$, where x, y are positive integers. 4 (CO 4)