B.Tech Odd Semester (CBCS) Exam., December—2016

INFORMATION TECHNOLOGY

(5th Semester)

Course No. : IT–505

(Formal Language and Automata Theory)

Full Marks : 75
Pass Marks : 30

Time : 3 hours

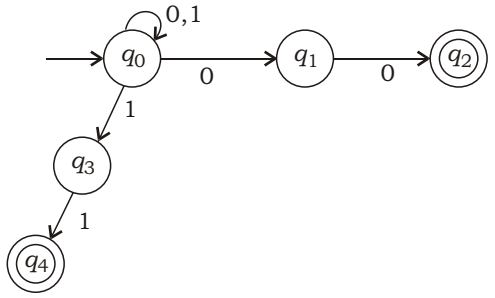
The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* Design DFA and NFA which accepts the language $L = \{W / W \in \{a, b, c\}$ and W contains the pattern *abac* as substring$\}$.

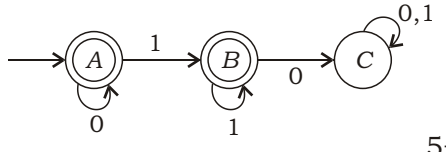
(b) Convert the following NFA to an equivalent DFA :



(c) Prove that the minimal state DFA to accept all strings over $\{0, 1\}$ that end in 00 has three states. 5+6+4=15

2. *(a)* Design the -NFA for the regular expression (11 0) (00 1) by decomposition method. Show all the steps.

(b) State and prove the Arden's theorem. Find the regular expression for the finite automata given below using Arden's theorem.



5+(2+3+5)=15

UNIT—II

3. *(a)* Design a context-free grammar (CFG) for the following languages :

(i) The set of palindromes over $(a, b\}$

(ii) The set of all well-formed parentheses.

(b) Define ambiguous grammar. Show that the grammar $S \quad SbS/a$ is ambiguous for the string $W = abababa$.

(c) Consider the following grammar and eliminate the unit productions :

$$E \quad E \quad T/T$$
$$T \quad T \quad F/F$$
$$F \quad (E)/a$$

5+5+5=15

4. *(a)* State Chomsky Normal Form (CNF). Convert the following grammar with productions to the Chomsky Normal Form :

$$S \quad AD, \ A \quad aB/bAB, \ B \quad b, \ D \quad b$$

(b) Convert the following grammar with productions to the Greibach Normal Form (GNF) :

$$S \quad AA/a, \ A \quad SS/b$$

(c) What is left recursive grammar? Eliminate left recursion from the following grammar :

$$S \quad A, \ A \quad Ad/Ae/\ aB/aC,$$
$$B \quad bBC/f, \ C \quad g$$

(2+3)+5+(1+4)=15

UNIT—III

5. *(a)* Define push-down automata (PDA). Construct the PDA for accepting $L \quad \{WcW^R / W$ is in $(0/1)$ and W^R is reverse of $W\}$. Verify your design using the string $01c10$.

(b) Differentiate between DPDA and NPDA with examples. (2+6+3)+4=15

6. *(a)* Construct a PDA to generate the set of balanced parenthesis of (,) and [,]. Trace the PDA for two strings ([])[] and ([(])].

(b) Show that the context-free languages are closed under concatenation and not closed under complementation. (7+4)+4=15

UNIT—IV

7. *(a)* Explain basic Turing Machine (TM) model. Construct a Turing Machine (TM) accepting $L \quad \{a^n b^n / n \quad 1\}$.

(b) Show that every multitape Turing Machine has an equivalent single-tape TM. (4+6)+5=15

8. *(a)* Construct a TM that computes a function $f(m, n)$ m n, i.e., addition of two integers.

(b) Define non-deterministic TM. Differentiate between recursively enumerable language and recursive language. 7+(3+5)=15

UNIT—V

9. *(a)* Define undecidable problem. What is reduction technique for solving undecidability?

(b) If L_1 and L_2 are two recursively enumerable languages, show that $L_1 U L_2$ is also recursively enumerable language.

(c) Write a short note on universal turing machine. (2+2)+6+5=15

10. *(a)* Explain post's correspondence problem with example.

(b) Show that union of two recursive languages is always recursive.

(c) Write a short note on Church-Turing hypothesis. 5+5+5=15

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