D 12071 (Pages : 3) Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) [14 SCHEME] DEGREE EXAMINATION, NOVEMBER 2016

CS/IT 14 506—THEORY OF COMPUTATION

Time : Three Hours Maximum : 100 Marks

Part A (Short Questions)

Answer any **eight** *questions.*

1. Show that "If n is a positive integer such that n mod (3) = 2 then n is not a perfect square.
2. Find a regular expression for the set of strings containing exactly three 1's.
3. When is a grammar said to be ambiguous ? Give an example for ambiguous grammar.
4. Differentiate between Deterministic Push Down Automata (DPDA) and Non-Deterministic Push Down Automata (NPDA).
5. Define the ways of accepting languages by a PDA.
6. Give the formal definition for a Turing Machine(TM).
7. Why do you need a Universal Turing Machine ?
8. Show that the function Add $(x, y) = x + y$ is primitive recursive.
9. How is θ notation helpful in assigning complexity to functions ?
10. When is a language said to be NP-Complete ?

(8 × 5 = 40 marks)

Part B (Descriptive Questions)

Answer **all** *questions.*

11. (a) Construct a NFA for the regular expression 1(10 + 1)*0 defined over $\Sigma = \{0, 1\}$ and trace the string "011". Use Thompson's construction method to design a NFA-A for the same regular expression and convert it into a DFA. Show the moves of the DFA on reading the string "1100" and "101".

(15 marks)

Or

(b) (i) Using Pumping Lemma show that the language of palindromes is not regular.

(8 marks)

(ii) Prove using mathematical induction that for $n \geq 2$, then $n^3 - n$ is always divisible by 3.

(7 marks)

Turn over

12. (a) Design a Deterministic Push Down Automata (DPDA) with no ε-transition that recognizes the following language $L = \{x\varepsilon \{a, b\}^* n_a(x) > n_b(x)\}$. Check whether the strings *aba* and *baab* is recognized by it.

Or

(b) (i) Write about how Push Down Automata helps in accepting strings in languages.

(4 marks)

(ii) Express the following Context Free Grammar in Chomsky Normal Form :

$S \rightarrow ASB \mid \varepsilon$
$A \rightarrow aAS \mid a$
$B \rightarrow SbS \mid A \mid bb$

(11 marks)

13. (a) (i) Design a Turing Machine that recognizes palindromes. (9 marks)

(ii) Design a Turing Machine to simulate the following grammar.

$S \rightarrow abS \mid \wedge$
$aB \rightarrow Ba$
$Ba \rightarrow aB$
$B \rightarrow b$

(6 marks)

Or

(b) (i) Express the following Context Free Grammar to Chomsky Normal Form (CNF).

$I \rightarrow a \mid b \mid Ia \mid Ib \mid I0 \mid I1$
$F \rightarrow I \mid (E)$
$T \rightarrow F \mid T^*F$
$E \rightarrow T \mid E + T$

(11 marks)

(ii) Write the procedure involved in converting Context Free Grammar(CFG) to Greibach Normal Form(GNF).

(4 marks)

14. (a) (i) Write the procedure involved in halting of a Turing Machine(TM). Design a Turing machine illustrating the halting problem.

(7 marks)

(ii) Prove the fact that 3-Satisfiable is in NP and the vertex cover problem is NP-Complete.

(8 marks)

Or

(b) (i) What is PCP ? Give an example.

(6 marks)

(ii) Explain in detail NP, NP hard, NP complete problems giving suitable examples.

(9 marks)

[4 × 15 = 60 marks]