DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY

B.TECH. SEMESTER V [Information Technology]

SUBJECT: (IT 511) Theory of Automata and Formal Language

Examination	**: Third Sessional**	**Seat No.**	**:**
Date	**: 10/10/2016**	**Day**	**:Monday**
Time	**: 12:45 to 2:00**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed. **[12]**

(a) If Turing machine accepts all the words of the languages L and rejects or loops for other words, which are not in L, then L is said to be **[01]**
(A) Recursive enumerable (B) Recursive (C) Context Free Language (CFL)
(D) None of the given

(b) Which of the following problem is undecidable? **[01]**
(A) membership problem for CFL (B) membership problem for regular sets
(C) membership problem for CSL (D) membership problem for type 0 languages

(c) "Let L be any infinite regular language, defined over an alphabet Σ then there exist three strings x, y and z belonging to Σ such that all the strings of the form xy^nz for n=1,2,3, … are the words in L". The given statement represents _____ **[01]**
[Complement of L / pumping lemma / Kleene's theorem / None from given]

(d) Which of the following statements is false? **[01]**
A) The halting problem for Turing machines is undecidable
B) determining whether a context-free grammar is ambiguous is un-decidable
C) Given two arbitrary context-free grammar, G_1 and G_2, it is undecidable with $L(G_1) = L(G_2)$
D) given two regular grammars G_1 and G_2, it is undecidable whether $L(G_1) = L(G_2)$

(e) Computational complexity theory aims to **[01]**
(A) Introduce classes of problems that have similar complexity (require a similar quantity of computational resources)
(B) Study the intrinsic properties of complexity classes
(C) Identify algorithmic feasibility and efficiency
(D) All of above

(f) Church's Thesis supports **[02]**
(A) A Turing machine as a general-purpose computer system
(B) A Turing machine an algorithm and an algorithm as a Turing machine
(C) Both (A) and (B) are correct
(D) None of above is correct

(g) Let L_1 be a regular language and L_2 a deterministic CFL. $L_3$is recursively enumerable but not recursive. Which one of the following statement is FALSE? **[02]**
(A) $L_1 \cap L_2$ is a DCFL (B) $L_3 \cap L_1$ is recursive
(C) $L_1 \cup L_2$ is context-free (D) $L_1 \cap L_2 \cap L_3$ is recursively enumerable

(h) The language $L = \{0^i21^i / i \geq 0\}$ over the alphabet {0, 1, 2} is **[02]**
A. not recursive
B. is recursive and is a deterministic CFL
C. is a regular language
D. is not a deterministic CFL but a CFL

(i) $L_1 = \{a^{n+m} b^n c^m | n, m \geq 0\}$
$L_2 = \{a^{n+m} b^{n+m} c^m | n, m \geq 0\}$
$L_3 = \{a^{n+m} b^{n+m} c^{m+n} | n, m \geq 0\}$
Which of these languages are not CF.
(A) L_1 only (B) L_3 only (C) L_1 and L_2 (D) L_2 and L_3

Q.2 **Attempt any two from following** **[12]**

(a) Draw a transition diagram for a computable TM with input alphabet {0, 1} that interprets the input string as the binary representation of a nonnegative integer and adds 1 to it. Example :- then tape input = "1011" output: "1100" **[06]**

(b) Design a computable Turing machine to reverse the input string. **[06]**

(c) Give the Chomsky hierarchy .Explain the grammar formation rules clearly for all grammars used in the hierarchy. **[06]**

Q.3 **[12]**

(a) Construct a Turing machine with one tape, that accepts the language $\{0^{2n}1^n : n \geq 0\}$. Also derive the time complexity of the TM designed. **[08]**

(b) Given two CFLs L_1 and L_2, Prove that $L_1 \cap L_2$ and L'_1 and L'_2 are not CFLs **[04]**

OR **[12]**

Q.3

(a) Prove that the language $L=\{ss \mid s \in \{a,b\}^*\}$ is not context free language. **[04]**

(b) Construct a Turing machine with one tape, that accepts the language $\{a^n b^m : n<m\}$. Also derive the time complexity of the TM designed. **[08]**