Reg. No.										

प्रज्ञानं ब्रह्म

Manipal
INSPIRED BY LIFE

MANIPAL INSTITUTE OF TECHNOLOGY, MANIPAL 576104

(Constituent College of Manipal University)

FIRST SEMESTER M. Tech(S/W Engg.) DEGREE MAKEUP EXAMINATION, JAN– 2016
SUBJECT: THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE(ICT 521)
(REVISED CREDIT SYSTEM)

TIME: 3 HOURS **03/ 01 /2016** **MAX. MARKS: 50**

Instructions to candidates

- Answer any **FIVE FULL** questions.
- Missing data, if any, may be suitably assumed.

1A. Consider the following NPDA and answer the questions below.
PDA P=({q0,q1,q2,q3},{0,1},{X,Y,Z},δ,q0,Z,{q3}) has the rules defining δ :

$\delta(q0,\varepsilon,Z)=\{(q1,XZ)\}$ $\delta(q2,0,Y)=\{(q2,\varepsilon)\}$
$\delta(q1,0,X)=\{(q1,YX)\}$ $\delta(q2,\varepsilon,X)=\{(q2,\varepsilon)\}$
$\delta(q1,0,Y)=\{(q1,YY)\}$ $\delta(q1,\varepsilon,Z)=\{(q3,Z)\}$
$\delta(q1,1,Y)=\{(q2,Y)\}$ $\delta(q2,\varepsilon,Z)=\{(q3,Z)\}$
$\delta(q2,1,Y)=\{(q2,Y)\}$

i) Give an execution trace (ID's) showing that string 0110 is accepted by P
ii) Give stack content after reading the string $0^3 1^5 0^3$ from the input.

1B. Show that context free languages are not closed under intersection.

1C. With proper examples explain Chomsky hierarchy of languages. [5+3+2]

2A. Formally describe a DPDA. Find a DPDA for $L=\{wcw^r: w \text{ is a string of a's and b's}\}$.

2B. Prove that Regular languages are closed under intersection using product construction.

2C. Explain Church's Turing thesis. [5+3+2]

3A. State and prove pumping lemma for Context free languages.

3B. Convert following DFA to regular expression.

	0	1
→ q_1	q_2	q_1
q_2	q_3	q_1
*q_3	q_3	q_2

3C. What are CNF and GNF normal forms? Explain. [5+3+2]

4A. Find NFA's for the following languages over {0,1} alphabet.

i) The set of all strings such that containing 101 or 110 as substring
ii) The set of all strings containing exactly 2 occurrences of 10.

4B. Convert following CFG to Chomsky Normal Form.

S→ABC A→BC|a B→bAC|ε C→cAB|ε

4C. Differentiate between recursive and recursively enumerable languages. [5+3+2]

5A. Design a TM to convert a unary number to binary number.

5B. Discuss how the following can be simulated by standard TM and vice versa.

i) Multi tape TM ii) Nondeterministic TM

5C. Differentiate between NP-Hard and NP-complete problems.

6A. Give an example for a Language that is not recursively enumerable. Prove that it is not recursively enumerable.

6B. With a suitable example discuss Post correspondence problem.

6C. Prove that if L is recursive so is its complement L□. [5+3+2]