Reg. No.										

प्रज्ञानं ब्रह्म

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION –MAY 2016

SUBJECT: FORMAL LANGUAGES AND AUTOMATA THEORY (CS 233)

(BRANCH: COMPUTER SCIENCE)

24TH MAY, 2016

Time: 3 Hours Max. Marks: 100

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed.**

1A. Define finite automata. Explain deterministic and non-deterministic finite automata. with the help of an example for each . **6**

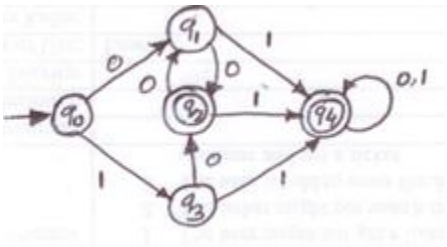
1B. Design a DFA which contains exactly one ‘a’ and exactly two b`s. **4**

1C. Prove that for any transition function δ and for any two input strings x and y,

$$\delta^*(q,xy) = \delta(\delta^*(q, x), y)$$ **6**

1D. Obtain grammar for regular expression representing strings of a`s and b`s, having a substring’ab’.What language does this grammar represent? **4**

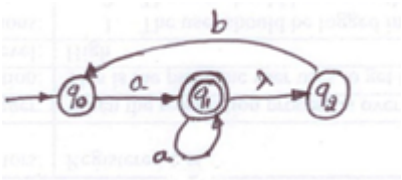
2A. Minimize the following DFA Fig-2A. Clearly show all the steps.



8

(Fig-2A)

2B. Convert following NFA to DFA Fig-2. Show all the steps.



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(Fig-2B)

2C. Obtain regular expression for the following sets

a) $L_1 = \{ a^n b^m : (n+m) \text{ is even}\}$

b) $L_2 = \{$ Strings of a’s and ‘b’s ending with ‘ab’ or ‘ba ‘$\}$ **6**

3A. State pumping lemma for regular languages with rules and use it to check whether the language

$L = \{1^p \mid \text{where p is prime}\}$ is regular or not. **8**

3B. Define right linear and left linear grammar with example for each .Construct a left linear grammar by designing respective non deterministic automata for the given languages.
(i) L {(aab)*ab} **(ii)** L(abb*) **12**

4A. Find context free grammar for the language L= { $a^n b^m c^k$: m = n or m ≤ k} **4**
4B. Given the set of production
S→S *A |A A→A+ B | B B→(S)| a | b
Find the left most derivation and draw the corresponding derivation tree for the string a*(b+a). **6**
4C. Find S grammar for the language L = { $a^n b^{n+1}$ | n ≥ 2} **5**
4D. Test whether the following grammar is ambiguous or not
S→AB |aaB A→aA | a B→ b
If it is ambiguous construct an equivalent unambiguous grammar. **5**

5A. Eliminate useless,λ and unit productions from the following
S→abAB |A A→bAB | λ B→BAa | A| λ **6**
5B. Convert the following into CNF:
S→ASB |λ A→aAS | a B→SbS | A| bb **6**
5C. Convert the following into GNF:
S→AA | 0 A→ SS | 1 **4**
5D. Show the following two grammar are equivalent
(i) S→abAB |ba (ii) S→abAaA |abAbb | ba
A→aaa A→aaa
B→aA|bb **4**

6A. With neat figure explain the language families in the Chomsky Hierarchy **8**
6B. Construct NPDA for the language L = {ww^R |w ∈{a,b}$^+$} **6**
6C. Convert the following CFG to PDA
S→0A
A→0AB | 1
B→1 **6**

7A. Design nondeterministic pushdown automata with its transition graph for the following grammar. Trace it for the string w= aaabc.
S→aA
A→aABC |bB | a
B→ b
C→ c **10**
7B. Design Turing machine which accepts the language L = {$1^n 2^n$ | n ≥ 1}.Draw transition graph and also trace it for w =1122. **10**

8A. Define recursively enumerable and recursive languages .Is the family of recursive languages closed under concatenation? **6**
8B. Discuss the concept of context sensitive grammar and language and also give one example for the same. **4**
8C. Give formal definition of Off- line turing machine with the help of figure. **4**
8D. Suppose we make a restriction that a turing machine must always write different from the one it reads, that is if **$\delta(q_i,a) = (q_j, b , L \text{ or } R)$,** then a and b must be different. Does this limitation reduce the power of automaton? Justify. **4**