# **Theory of Automata (I)**

**NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES**

## Final Examination, Fall 2012

## Section A,B,C,D,E

**Objective Part: 20 marks**

**Time: 30 min**

Encircle the right option:

**(i)** Which of the following languages over the alphabet ∑ = {0, 1} is regular?

1. {w ∑\* : w contains equal numbers of 1’s and 0’s}
2. {w ∑\* : w contains a prime number of 1’s}
3. {w ∑\* : u ∑\* such that w = uu}
4. {w ∑\* : w does not contain any 1’s in even positions, where the leftmost is position 1}
5. {w ∑\* : w contains a 1 in every position that is a power of 2}

ANS: d

**(ii)** Consider a language L that is recognized by a machine M. Which of the following statements is false?

1. If M is a deterministic finite automaton, then L can be represented by a regular expression.
2. If M is a non-deterministic finite automaton, then L can be represented by a context-free grammar.
3. If M is a deterministic pushdown automaton, then L can be represented by a context-free grammar.
4. Both a and b
5. None of the above

ANS: e

**(iii)** Which of the following statements is not true?

1. The class of regular languages is closed under union, intersection, concatenation, and Kleene star.
2. The class of context-free languages is closed under union, intersection, concatenation, and Kleene star.
3. The class of languages Turing-decidable in polynomial time (P) is closed under union, intersection, concatenation, and Kleene star.
4. Both a , b and c
5. None of above

ANS: b

**(iv)**  Consider the following grammars:

|  |  |
| --- | --- |
| Grammar G1:  S -> 0 T | $  T -> 1 S | Grammar G2  S -> T S  S ->$  T-> X Y  X -> 0  Y-> 1 |

Which of the following statements is not true?

1. Grammar G1 can generate any string that G2 can.
2. Grammar G2 is ambiguous.
3. Grammar G1 corresponds to a regular language.
4. Grammar G2 corresponds to a context free language.
5. Grammar G2 is in Chomsky normal form.

ANS: b

**(v)** Consider the regular expression R= 10\*1\*0 and finite automata M with start state A given below



1

0, 1

0, 1

1

1

1

0

0

0

0

In order for M to accept exactly the strings in the language defined by R, the set of accepting states of M must be

* + 1. C
    2. E
    3. D and E
    4. C and E
    5. C, D and E

ANS: d

**(vi)** What is the number of terminal strings of length 5 generated by the context-free grammar given below?

S-> A0B

A-> BB|0

B-> AA|1

1. 4
2. 5
3. 6
4. 7
5. 8

ANS: b

**(vii)** Consider the following two languages.

L1= {x {a, b}\*| x has equally many a’s and b’s}

L2= {x {a, b, c}\*| x has equally many a’s, b’s, and c’s}

Which of the following is true about L1 and L2 ?

1. L1 and L2 are both regular.
2. L1 is regular, and L2 is context-free but not regular.
3. Neither L1 nor L2 is regular, but both are context-free.
4. L1 is context-free but not regular, and L2 is not context-free.
5. Neither L1 nor L2 is context-free.

ANS: d

**(viii)** Consider the following grammar G:

S → 1 S 1 | T

T → 1 X 1 | X

X → 0 X 0 | 1

Which of the following string is not generated by G?

1. 010
2. 111
3. 00100
4. 001010
5. Both a and c

ANS: d

**(ix)** Which of the following grammars is ambiguous for the given languages over ∑= {a, b}?

1. S → bS|Sb| a ; for L= b\*ab\*
2. S → aSb| ; for L= {an bn | n ≥ 0}
3. S->bS| a; for L= b\*a
4. Both a and b
5. None

ANS: a

**(x)** What is the language described by the grammar with the following production rules:

a)

b)

c)

d)

e) None of the above

ANS: e

**(xi)** Let L1 and L2 be context-free languages. Let L3 be a regular language. Then the following is a context-free language:

1. L3 U L1
2. L2L1
3. L3\*
4. All of the above
5. None of the above

ANS: d

**(xii)** The number of steps in the derivation of a string of length n from a context-free grammar in Chomsky normal form is:

1. 2n -1
2. 2n-1
3. 2(n -1)
4. 2 n–1
5. None of the above

ANS: 2n-1(wali option)

**(xiii)** Which of the following statements is true?

* 1. Multi-tape TM is more powerful than single tape TM
  2. Multi-track TM is more powerful than multi-tape
  3. Power of all TMs (single tape, multitape, multitrack) is same
  4. Both a and b
  5. None of the above

ANS: c

**(xiv)** If L1 = { an bn cm, where n,m≥0 } and L2 ={ am bn cn, where n,m≥0} then L1 L2 =

1. a){ an bn cn, where n,m≥0 }
2. b){ am bn cn, where n,m≥0 }
3. c){ an bn cn, where n≥0 }
4. d){ am bn cm, where n,m≥0 }
5. e){ an bm cm, where n,m≥0 }

ANS: c

**(xv)** Consider the following grammar G

S-> AB

A->BaB | a

B->bbA

1. The length of every string produced by G is even
2. No string produce by G has odd number of consecutive b’s
3. No string produced by G has four consecutive b’s
4. No string produced by G has three consecutive a’s
5. Every string produced by G has at least as many b’s as a’s

ANS: b, c, d

**(xvi)**

0

0

0

1

1

Each of the following is a regular expression that denotes a subset of the language recognized by the automata above except

1. 0\*(11)\*0\*
2. 0\*1(10\*1)\*1
3. 0\*1(10\*1)\*10\*
4. 0\*1(10\*1)0(100)\*
5. (0\*1(10\*1)\*10\*+0\*)\*

ANS: d

**(xvii)** It is known that the language L that contains equal number of a’s and b’s is context free. Let M be the regular language a\*b\*. Which of the following is(are) true?

L M is a context-free language

L M is a regular language

LM={ an bm | n is a positive integer less than integer m}

a) I only

b) III only

c) I and III

d) II and III

e) None

ANS: a

**(xviii)** Which of the following is FALSE?

1. For any language L, if L can be recognized by a DFA, then can be recognized by DFA
2. For any language L, if L can be recognized by a NDFA, then can be recognized by NDFA
3. For any language L, if L is context free, then is context free
4. For any language L, if L is decidable, then is decidable
5. None of the above

ANS: c

**(xix)** Every non-regular language must be recognized by

1. a finite automata.
2. a non-deterministic pushdown automata.
3. a deterministic pushdown automata.
4. Both b and c
5. None of the above.

ANS: e

**(xx)** The set of final states for L1 will be

1. A = {(p,q) / p ε A1& q ε A2}
2. A = {(p,q) / p ε A1 or q ε A2}
3. A = {(p,q) / p ε A1& q  A2}
4. A = {(p,q) / p  A1& q  A2}
5. None of the above

Where A1 and A2 are the sets of final states for automata of L1 and L2 respectively.

ANS: c