

Marks scored:

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
July, 2017

Level : B. Sc.  
Year : III

Course : COMP 316  
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No. :

Date JUL: 18 2017

SECTION "A"  
[20 Q. × 0.5 = 10 marks]

Multiple choice questions.

1. Give a production grammar that specified language  $L = \{a^i b^{2i} \mid i \geq 1\}$   
a.  $\{S \rightarrow aSbb ; S \rightarrow abb\}$       b.  $\{S \rightarrow aSb ; S \rightarrow b\}$   
c.  $\{S \rightarrow aA ; S \rightarrow b ; A \rightarrow b\}$       d. None of the above
2. Which of the following statement is wrong?  
a. A turing machine can not solve halting problem  
b. Set of recursively enumerable languages is closed under union  
c. A Finite State Machine with 3 stacks is more powerful than Finite State Machine with 2 stacks  
d. Context Sensitive Grammar can be recognized by a linearly bounded memory machine
3. The regular expression have all strings in which any number of 0's is followed by any number of 1's followed by any number of 2's is:  
a.  $(0 + 1 + 2)^*$       b.  $0^*1^*2^*$       c.  $0^* + 1 + 2$       d.  $(0 + 1)^*2^*$
4. The regular expression with all strings of 0's and 1's with at least two consecutive 0's is :  
a.  $1 + (10)^*$       b.  $(0 + 1)^*00(0+1)^*$       c.  $(0 + 1)^*011$       d.  $0^*1^*2^*$
5. The regular sets are closed under  
a. Union      b. Concatenation      c. Kleene's closure      d. All of the above
6. The Grammar  $G = \langle \{S\}, \{0,1\}, P, S \rangle$  where P is  $S \rightarrow 0S1 ; S \rightarrow 0S ; S \rightarrow S1 ; S \rightarrow 0$  is:  
a. Recursively enumerable language      b. Regular language  
c. Context sensitive language      d. Context free language
7. Consider a NFA shown in figure below. The automation accepts:  

$\delta$	a	b
1	{1,2}	A
2	$\varnothing$	$\varnothing$

  
a. All words that contain the substring ab and end with a  
b. All words that contain the substring ba and end with a  
c. All words that end with a, but not the null string  $\epsilon$   
d. All words that end with a, and also the null string
8. The language constructs which are most useful in describing nested structures such as balanced parenthesis  
a. Regular expression      b. Context free grammar  
c. Non context free grammars      d. None of these

9. In the given DFA, it has start state A and accepting state D. Which of the following regular expression denoted the set of all words accepted by DFA?

$\Delta$	0	1
A	B	A
B	B	C
C	B	D
D	B	A

- a. 001                      b.  $10^*1^*0$                       c.  $(0+1)^*011$                       d.  $1^*0^*001$
10. Which of the following is not regular?
- Strings of 0's whose length is a perfect square
  - Set of all palindrome made up of 0's and 1's
  - Set of all 0's whose length is prime
  - All of the above
11. The following CFG  $\{ S \rightarrow aB \mid bA ; A \rightarrow b \mid aS \mid bAA ; B \rightarrow a \mid bS \mid aBB \}$  generates strings of terminals that have
- Equal number of a's and b's
  - Odd number of a's and odd number of b's
  - Even number of a's and even number of b's
  - Odd number of a's and even number of a's
12. P, Q and R are three languages, if P and R are regular and if  $PQ = R$  then
- $Q = R$
  - $Q = P$
  - Both (a) and (b)
  - None of the above
13.  $L = \{a^P \mid P \text{ is a prime}\}$  is a
- Regular
  - Not regular
  - Accepted by DFA
  - Accepted by PDA
14. In pumping lemma theorem  $(x y^n z)$  the range of n is
- $n=1, 2, 3, 4, \dots$
  - $n=0, 1, 2, 3, 4, \dots$
  - $n=\dots-3, -2, -1, 0, 1, 2, 3, 4, \dots$
  - $n=\dots-3, -2, -1, 1, 2, 3, 4, \dots$
15. The following problem(s) ----- is/are called decidable problem(s).
- The two regular expressions define the same language
  - The two FAs are equivalent
  - Both a and b
  - None of given
16. The languages ----- are the examples of non regular languages.
- PALINDROME and PRIME
  - PALINDROME and EVEN-EVEN
  - EVEN-EVEN and PRIME
  - FACTORIAL and SQUARE
17. \_\_\_\_\_ states are called the halt states.
- ACCEPT and REJECT
  - ACCEPT and READ
  - ACCEPT AND START
  - ACCEPT AND WRITE

18. Examine the following CFG and select the correct choice:

$S \rightarrow AB$

$A \rightarrow BSB$

$B \rightarrow CC$

$C \rightarrow SS$

$A \rightarrow a|b$

$C \rightarrow b|bb$

- abb is a word in the corresponding CFL.
  - abb is not the word of corresponding CFL.
  - any word can be accept from the corresponding CFL.
  - None of these.
19. Which statement is true?
- The PDA must have one accept state and one reject state
  - The PDA must have one accept state and two reject state
  - The PDA must have two accept state and two reject state
  - There is no reject state in the PDA

20. Consider the following grammar G

G:  $S \rightarrow Ax | By$

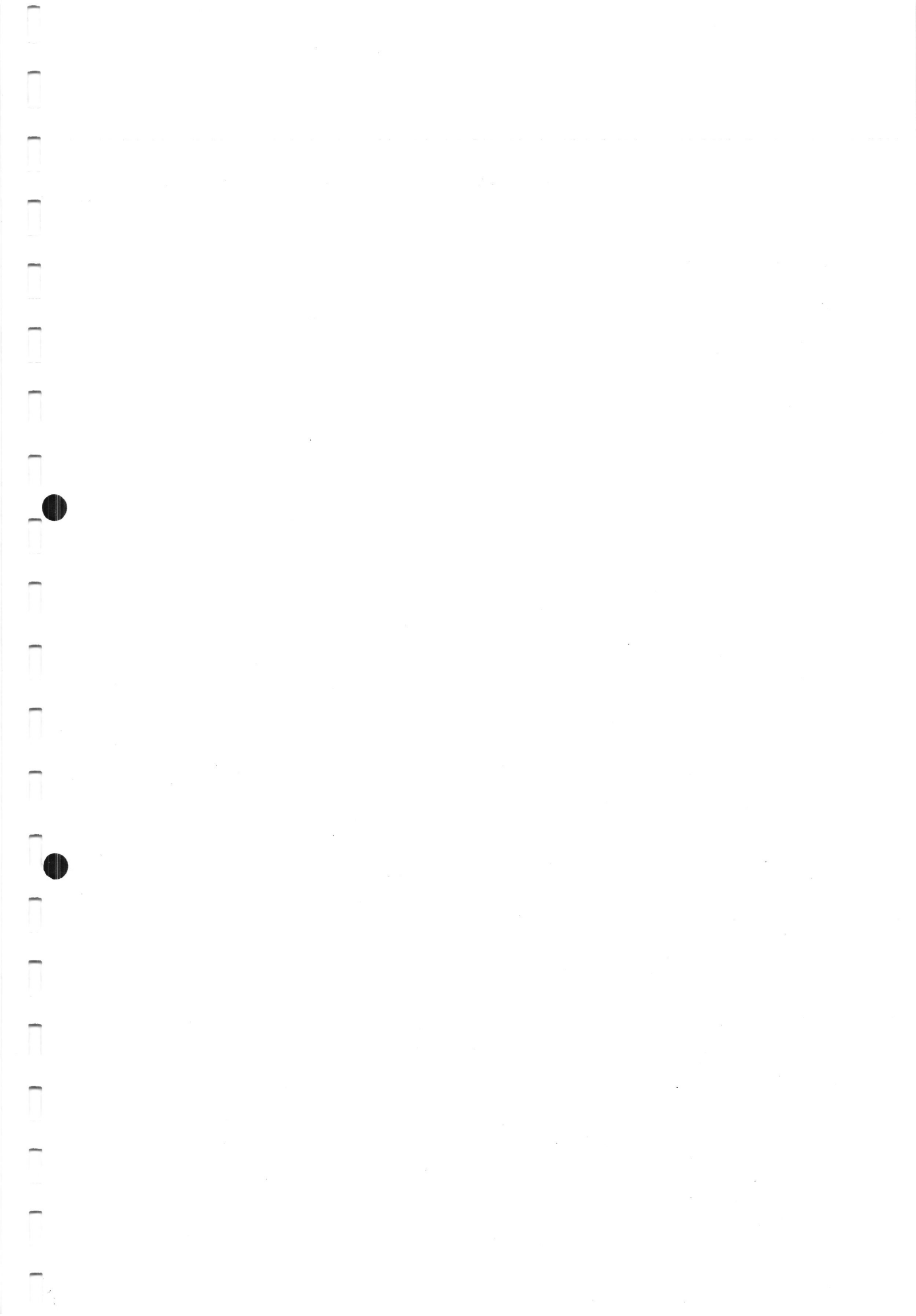
$A \rightarrow By | Cw$

$B \rightarrow x | Bw$

$C \rightarrow y$

Which of the regular expression describes the same set of strings as the grammar?

- $xwy + xw^*xy + ywx$
- $xw^*y + xw^*yx + ywx$
- $xw^*y + xwxyx + ywx$
- $xwxy + xww^*y + ywx$



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SECTION "B"  
(Short answer question)  
[6Q × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Prove the statement: For every NFA, there exists a DFA which simulates the behavior of NFA. Alternatively, if L is the set accepted by NFA then there exists a DFA which also accepts L.

2. Convert the following  $\epsilon$ -NFA into NFA

$\delta$	$\epsilon$	a	b
$\rightarrow A$	{C}	{B}	{C}
B	{E}	{D}	$\phi$
C	$\phi$	{A}	{D}
D	$\phi$	{D,E}	$\phi$
*E	$\phi$	$\phi$	$\phi$

3. Prove that, for any regular expression r, there is a  $\epsilon$ -NFA that accepts the same language represented by r.

4. Construct regular expression corresponding to the give FA

$\delta$	0	1
$\rightarrow *Q1$	Q1	Q2
Q2	Q3	Q2
Q3	Q1	Q2

5. Show that  $L = \{yy \mid y > 0\}$  is not regular using pumping lemma.
6. The following grammar generates prefix expression with operands x and y and binary operators +, -, and \*

$E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$

Find leftmost and rightmost derivations for the string  $+*-xyxy$

7. Write short notes on (*ANY TWO*) :

- (a) Left recursive grammar and its removal
- (b) A homomorphism of a regular language is regular
- (c) Properties of a PDA
- (d) Universal Turing Machine

[2+2]

SECTION "C"

(Long answer question)

[2Q × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. (a) Prove that any context free language without  $\epsilon$  can be generated by a grammar in CNF

(b) Convert the given grammar into CNF

$S \rightarrow CBA \mid A$

$A \rightarrow baB \mid \epsilon$

$B \rightarrow aA \mid bb$

9. Design a PDA for the grammar  $G = (V_n, V_t, P, S)$  where  $V_n = \{S\}$ ,  $V_t = \{a,b,c\}$  and  $P$  is defined as  $\{ S \rightarrow aSa ; S \rightarrow bSb ; S \rightarrow c \}$ . Test whether the string  $w = abbcba$  is valid or not.

10. Design a Turing Machine which computes following function:  $f(w) = ww^R$ , where  $w^R$  is the reverse of string  $w$  and  $w \in \{a,b\}^*$ . Test your TM with the string  $w = abba$