



**BRAINWARE UNIVERSITY**

**Term End Examination 2018 – 19**

**Programme – Bachelor of Technology in Computer Science & Engineering**

**Course Name – Formal Language and Automata**

**Course Code – BCSE404**

**(Semester - 4)**

**Time allotted: 3 Hours**

**Full Marks: 70**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

**Group –A**

(Multiple Choice Type Questions)

10 x 1 = 10

1. *Choose the correct alternative from the following*
  - (i) Deterministic Finite State Automaton (DFA) is a simple
    - a. function recognition device
    - b. language recognition device
    - c. routine recognition device
    - d. None of the above
  - (ii) Which of the following regular expression represents the language  $L = \{a^{2n} \mid n \geq 0\}$  ?
    - a.  $(aa)^*$
    - b.  $(aa)^*$
    - c.  $aa^*a$
    - d.  $aa^*a$
  - (iii) All notation in Mealy machine are equal to Moore machine with only the difference of
    - a. Output function
    - b. Initial state
    - c. Output alphabet
    - d. Input alphabet
  - (iv) A pumping lemma is used for proving that
    - a. a language is natural
    - b. two regular sets are equivalent
    - c. a language is not regular
    - d. a language is recursively enumerable

- (v) Which of the following statements is true?
- |   |  |
|---|--|
| a. If a language is context free it can always be accepted by a deterministic push-down automaton | b. The union of two context free languages is context free   |
| c. The intersection of two context free languages is context free                                 | d. The complement of a context free language is context free |
- (vi) The set of all strings over  $\{0,1\}$  starting with 00 and ending in 11 is
- |                   |                  |
|-------------------|------------------|
| a. 0011           | b. $00(0+1)^*11$ |
| c. $(00)^*(11)^*$ | d. $0^*1^*$      |
- (vii) The major limitation of finite automata is
- |  |  |
|--|--|
| a. They are devoid of memory           | b. They are devoid of memory           |
| c. Their behavior is non deterministic | d. Their behavior is non deterministic |
- (viii) Which of the following is not a regular language over  $\{0,1\}$ ?
- |   |   |
|---|---|
| a. Set of all strings containing 1110011 as substring | b. Set of all strings containing 1110011 as substring |
| c. Set of all strings beginning with 0110             | d. Set of all strings beginning with 0110             |
- (ix) A PDA M simulates left most derivation of a context - free grammar G, if
- |                             |                               |
|-----------------------------|-------------------------------|
| a. the grammar is ambiguous | b. the grammar is unambiguous |
| c. the grammar in CNF       | d. the grammar in GNF         |
- (x) The language generated by the grammar  $S \rightarrow AB, A \rightarrow BC \mid a, B \rightarrow CC \mid b, C \rightarrow a$  is
- |                     |                  |
|---------------------|------------------|
| a. infinite         | b. empty         |
| c. Both (a) and (b) | d. None of these |

**Group – B**

(Short Answer Type Questions)

3 x 5 = 15

Answer any *three* from the following

2. Critically comment on – “Complement of a regular language L is context free” with an example. [5]

3. Verify whether the grammar generates the following string or not. [3+2]
  - a)  $S \rightarrow 0B \mid 1A, A \rightarrow 0 \mid 0S \mid 1AA \mid \square, B \rightarrow 1 \mid 1S \mid 0BB$   
String – ‘00110101’
  - b)  $S \rightarrow aAb, A \rightarrow aAb \mid \square$   
String – ‘aabbb’
4. Write a brief note on Chomsky classification of grammars. [5]
5. Remove left recursion from the following grammars - [2+3]
  - (a)  $A \rightarrow ABa \mid Aa \mid a$
  - (b)  $A \rightarrow AC \mid Aad \mid bd \mid c$
6. What do you mean by Ambiguous Grammar? Why the grammar with productions  $S \rightarrow SS \mid aSb \mid \lambda$  is an ambiguous grammar? [2+3]

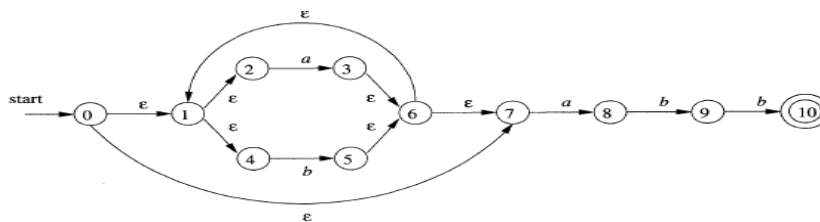
**Group – C**

(Long Answer Type Questions)

3 x 15 = 45

Answer any *three* from the following

7. Find the minimum DFA for the following diagram [15]



8. a) What do you mean by Context Free Languages? [5]
  - b) Construct a context free grammar G generating all integers with sign. Use the grammar to obtain -35 [5]
  - c) Let  $G = \{V, T, P, S\}$  be given by the productions [5]
 
$$S \rightarrow AB, A \rightarrow a, B \rightarrow b, B \rightarrow C, E \rightarrow c$$
 Find  $G'$  such that every variable in  $G'$  derives some terminal string.
9. (a) Explain the different types of methods of acceptance by Push Down Automata. [5]
  - (b) Construct a Push Down Automata accepting  $\{a^{m+n}b^m c^n \mid m, n \geq 1\}$  by Final state. [10]
10. (a) Define Greibach Normal Form and write the steps to convert a given CFG to GNF [1+4]

(b) Convert the following CFG to GNF [10]

$$S \rightarrow CA \mid BB, B \rightarrow b \mid SB, C \rightarrow b, A \rightarrow a$$

11. (a) Construct a Moore Machine from the given Mealy machine. [5]

Present State	Next State, Output			
	a=0		a=1	
	State	Output	State	Output
$\rightarrow q_1$	$q_3$	0	$q_2$	0
$q_2$	$q_1$	1	$q_4$	0
$q_3$	$q_2$	1	$q_1$	1
$q_4$	$q_4$	1	$q_3$	0

(b) Construct a Mealy Machine from the given Moore machine [3]

Present State	Next State		Output
	a=0	a=1	
$\rightarrow q_0$	$q_1$	$q_2$	1
$q_1$	$q_3$	$q_2$	0
$q_2$	$q_2$	$q_1$	1
$q_3$	$q_0$	$q_3$	1

(c) Design a Turing machine to recognize  $\{0^n 1^n 2^n \mid n \geq 1\}$  [7]

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