**Code: 15A05404** **R15**

B.Tech II Year II Semester (R15) Supplementary Examinations December 2017

# FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science & Engineering)

Time: 3 hours Max. Marks: 70

## PART - A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Define symbol, string and language.

(b) Differentiate between DFA and NFA.

(c) Draw DFA that accepts strings which has a substring of 101 over an alphabet {0, 1}.

(d) Differentiate between left and right linear grammars.

(e) Justify the statement CFLs are note closed under intersection with an example.

(f) Draw derivation tree for the string id+id* id from the grammar $E \rightarrow E + E|E * E|$ id.

(g) Formally define a push down automata.

(h) Briefly explain when we call a CFG is in Chomsky's normal form.

(i) List the closure properties of recursive languages.

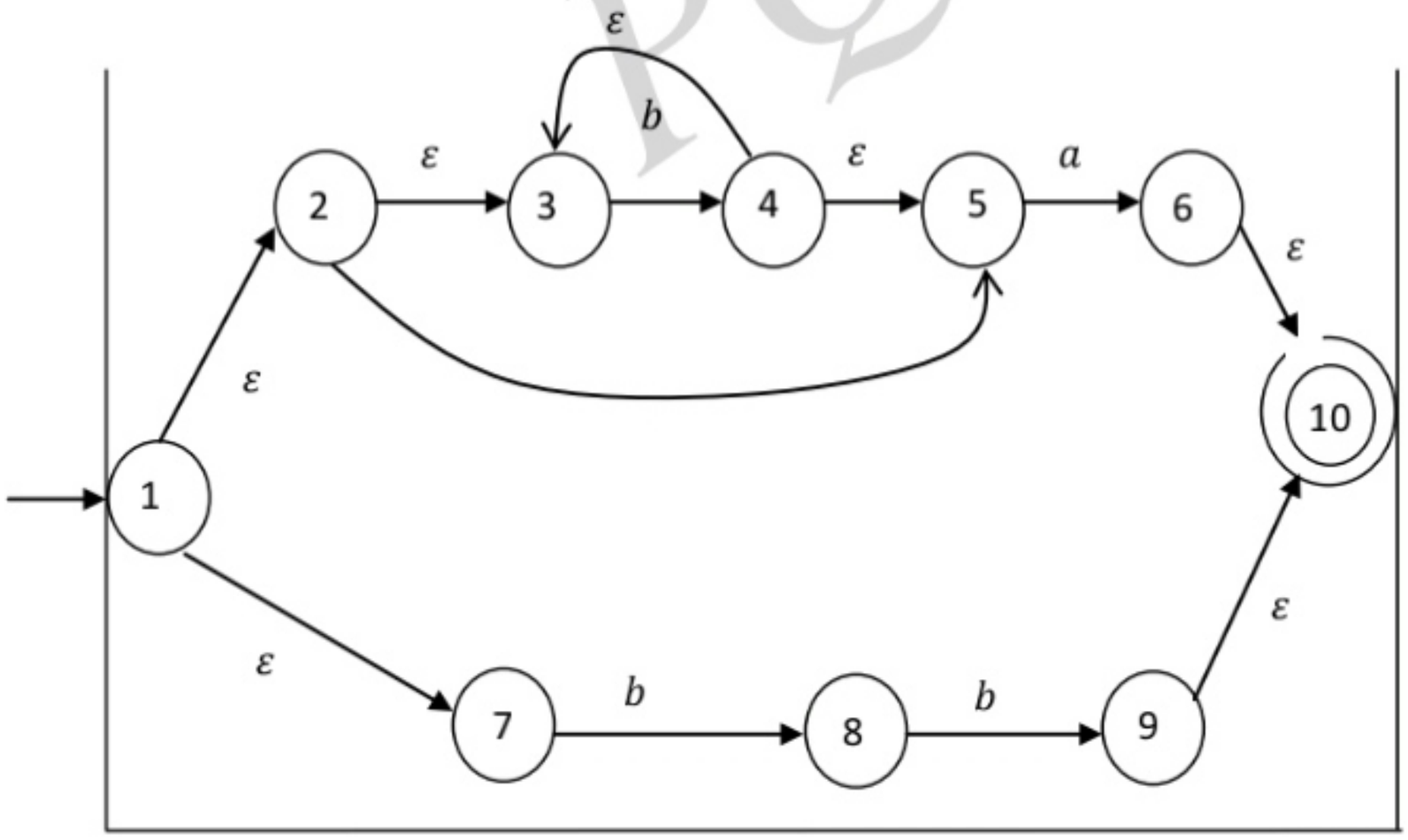
(j) Briefly explain the functioning of a counter machine.

## PART - B

(Answer all five units, 5 X 10 = 50 Marks)

### UNIT - I

2 Convert the following NFA with $\varepsilon$ moves to NFA without $\varepsilon$ moves.




**OR**

3 Construct a DFA for the regular expressions 10 + (0 + 11) 0*1 and optimize the states.

### UNIT - II

4 Prove that $0^n|$ $n$ is a perfect square is not a regular language using pumping lemma.

**OR**

5 List and explain the closure properties of regular languages.

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**UNIT - III**

6 (a) Simplify the following grammar.
$S \rightarrow AB|C\ D; \rightarrow 0\ A|1\ B; B \rightarrow 2|3; D \rightarrow A\ C\ |B\ D\ E; E \rightarrow 4\ E\ |D|\ 5$.

(b) Remove left recursion from the grammar $A \rightarrow AX; A \rightarrow Y$.

**OR**

7 (a) Define Ambiguous grammar.

(b) Remove ambiguity from the grammar $E \rightarrow E + E\ |E * E|\ id$.

**UNIT - IV**

8 Construct a pushdown automaton that recognizes even length palindromes over an alphabet {0, 1}.

**OR**

9 Construct a PDA that recognizes strings which contain equal number of 0's and 1's.

**UNIT - V**

10 Construct a Turing machine which multiplies two unary numbers.

**OR**

11 (a) Define the Turing machine Halting problem.

(b) Define the post correspondence problem.
Let $\Sigma = \{0, 1\}$ and take A and B as $\{w1 = 11,\ w2 = 100,\ w3 = 111\}$ $\{v1 = 111,\ v2 = 001,\ v3 = 11\}$. Give a PCP solution for this problem. If we take $\{w1 = 00,\ w2 = 001,\ w3 = 1000\}$ $\{v1 = 0, v2 = 11,\ v3 = 011\}$. Then, is there PC solution exist. Justify your answer.

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**PART – A**

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) Define inductive proof.

(b) Differentiate NFA and DFA.

(c) Write the regular expression to denote a language L which accepts all the strings which begin or end with either 00 or 11.

(d) State the pumping lemma for regular language.

(e) If $\delta \rightarrow a\delta b/aAb, A \rightarrow bAa, A \rightarrow bAa, A \rightarrow ba$. Find the language generated by the grammar.

(f) Generate context free grammar L={w/w contain at least three a's}.

(g) What do you mean by instantaneous description for push down automata?

(h) Mention the normal forms of context free grammar. Justify the need of normal forms.

(i) Draw transition diagram of the tuning machine to recognize all strings consisting of an even number of 1's over $\sum$={1}.

(j) Distinguish between regular languages and recursively enumerable languages.

**PART – B**

(Answer all five units, 5 X 10 = 50 Marks)

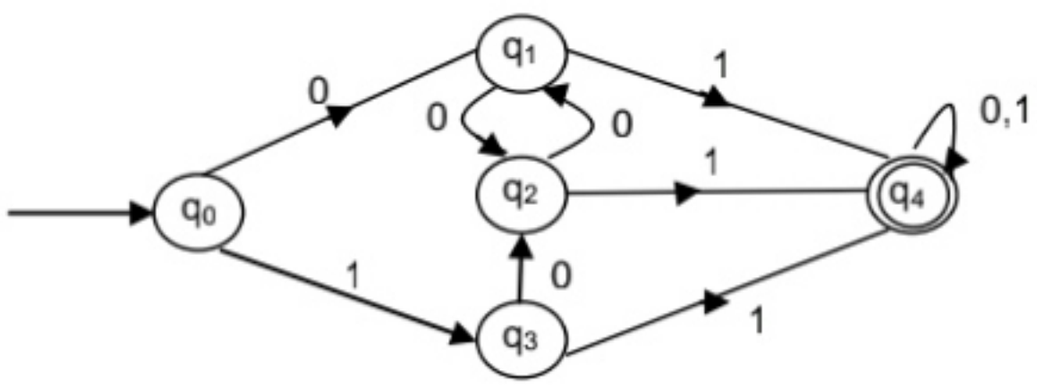
**UNIT – I**

2 Convert the following NFA to DFA.

| | 0 | 1 |
|---|---|---|
| →p | p, r | q |
| q | r, s | p |
| *r | p, s | r |
| *s | q, r | ¢ |

**OR**

3 Minimize the finite automaton shown in figure below.




**UNIT – II**

4 Convert the following NFA into regular expression.


**OR**

5 Summarize the closure properties of regular language.

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**UNIT – III**

6 Find the CNF of the following grammar:

$S \rightarrow OAO||B||BB$

A→C

B→S/A

C→S/∈

**OR**

7 Show that the following grammars are ambiguous:

$S \rightarrow asbs/bsas/\epsilon$

$S \rightarrow AB/aaB, A \rightarrow a/Aa, B \rightarrow b.$

**UNIT – IV**

8 Let M=({$q_0$,$q_1$}, {0,1}, {x,$z_0$}, δ, $q_0$, $z_0$,¢) where δ is given by:

$\delta(q_0,0,z_0)=(q_0,xz_0)$

$\delta(q_1,1,x)=(q_1,\in)$

$\delta(q_0,0,x)=(q_0,xx)$

$\delta(q_1,\in,x)=(q_1,\in)$

$\delta(q_0,1,x)=(q_1,\in)$

$\delta(q_1,\in,z_0)=(q_1,\in)$

Construct a CFG for the PDAM.

**OR**

9 Show that the language L={$a^ib^ic^i$ / i≥1} is not context free language.

**UNIT – V**

10 Define post correspondence problem. Let Σ = {0, 1}. Let A and B be the lists of three strings each, defined as:

| | List A | List B |
|---|---|---|
| i | $w_i$ | $x_i$ |
| 1 | 1 | 111 |
| 2 | 10111 | 10 |
| 3 | 10 | 0 |

Does this PCP have a solution?

**OR**

11 Design a Turing machine for multiplying two numbers using subroutine.

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**Code: 15A05404** **R15**

B.Tech II Year II Semester (R15) Regular Examinations May/June 2017

# FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science and Engineering)

Time: 3 hours Max. Marks: 70

## PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) Define a DFA formally.
(b) Differentiate between a Moore machine and a mealy machine.
(c) What are various forms in which we can represent regular languages?
(d) Construct a DFA that accepts strings which does not contain a substring of 110.
(e) State and prove ARDEN's theorem.
(f) When do we say a CFG is in Greibach Normal Form?
(g) Compare and contrast DPDA and NPDA.
(h) State the properties of LR grammars.
(i) Write short notes on Linear Bounded Automata.
(j) List the closure properties of Recursively Enumerable Languages.

## PART – B

(Answer all five units, 5 X 10 = 50 Marks)

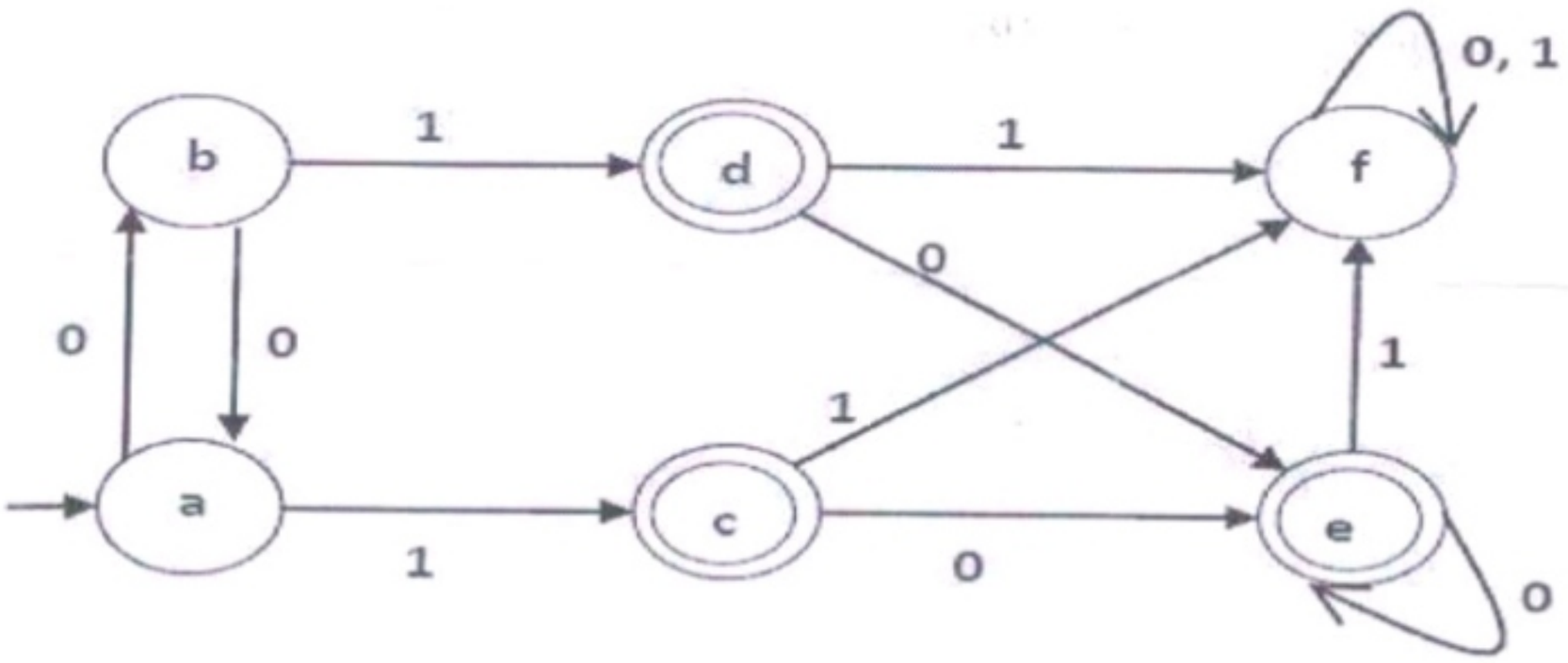
### UNIT – I

2 Convert the following mealy machine into its equivalent Moore machine.

| From state | i/p | To state | o/p | i/p | To state | o/p |
|---|---|---|---|---|---|---|
| $Q_0$ | 0 | $Q_1$ | N | 1 | $Q_3$ | N |
| $Q_1$ | 0 | $Q_2$ | N | 1 | $Q_3$ | N |
| $Q_2$ | 0 | $Q_2$ | Y | 1 | $Q_3$ | N |
| $Q_3$ | 0 | $Q_1$ | N | 1 | $Q_4$ | N |
| $Q_4$ | 0 | $Q_1$ | N | 1 | $Q_4$ | Y |

**OR**

3 Minimize the following automata.




### UNIT – II

4 Prove that the language $0^p$| p is a prime number is not regular.

**OR**

5 (a) Explain how equivalence between two FA is verified with an example.
(b) What are the applications of regular expressions and finite automaton?

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**UNIT – III**

6 Convert the following grammar into Greibach Normal form:
$A_1 \rightarrow A_2A_3;\ A_2 \rightarrow A_3A_1 \mid b;\ A_3 \rightarrow A_1A_2 \mid a;$

**OR**

7 Explain the closure properties of Context Free languages.

**UNIT – IV**

8 Construct a PDA that recognizes balanced parentheses.

**OR**

9 Construct a PDA that recognizes strings of type $a^ib^jc^{i+j}$.

**UNIT – V**

10 Construct a Turing machine which carries out proper subtraction (a-b=0, if a<b).

**OR**

11 (a) Explain Chomsky Hierarchy of languages.
(b) Explain any four variations of Turing machines.

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B.Tech II Year II Semester (R15) Regular & Supplementary Examinations May/June 2018

# FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science & Engineering)

Time: 3 hours Max. Marks: 70

## PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) What is induction principle? Give an example.
(b) Draw finite automata that accept a string start with '1' and ends with '0', $\Sigma = \{0, 1\}$.
(c) Construct a regular expression that accepts 3rd symbol from right end as 'a'.
(d) Define Arden's theorem.
(e) Construct the language L for $S \rightarrow aCa$, $C \rightarrow aCa/b$.
(f) Give the general forms of CNF.
(g) What is instantaneous description of PDA?
(h) Draw push down automata that accept the language $L = \{a^n b^n / n \geq 1\}$.
(i) Differentiate multi tape and multi track turing machine.
(j) List the properties of recursively enumerable language.

## PART – B

(Answer all five units, 5 X 10 = 50 Marks)

### UNIT – I

2 Determine minimal deterministic finite automata (DFA) for the given transition table over $\Sigma = \{0,1\}$, where A is the initial state and C is the final state

| Symbol state | 0 | 1 |
|---|---|---|
| → A | F | B |
| B | C | G |
| C * | C | A |
| D | G | C |
| E | F | H |
| F | G | C |
| G | E | G |
| H | C | G |

**OR**

3 Construct DFA equivalent to NFA

$\mu = (\{p,q,r\}, \{0,1), \delta, p, \{q,s\})$

Where $\delta$ is defined in the following table:

| $\delta$ | 0 | 1 |
|---|---|---|
| p | {q,s} | {q} |
| q* | {r} | {q,r} |
| r | {s} | {p} |
| S* | - | {p} |

### UNIT – II

4 Find whether the languages {ww/w is in (1+0)*} and $\{1^k / k = n^2, n>=1\}$ are regular or not.

**OR**

5 Construct an NFA for the regular expression (a+b)*aab(a+b)*

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**UNIT – III**

6 For the given context free grammar (CFG) G, find Chomsky normal form (CNF). G has productions

S → AaA / CA / BaB

A → aaBa / CDA / aa / DC

B → bB / bAB/ bb / aS

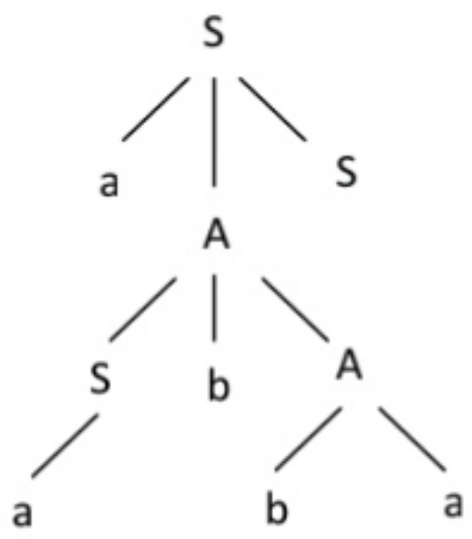
C → Ca / bC / D

D → bD / b

**OR**

7 (a) Explain the closure properties of Context Free languages.

(b) Find the left most derivation and right most derivation to the following parse tree.




**UNIT – IV**

8 Convert the grammar S→oAA, A→OS/1S/o to a PDA that accepts the same language by empty stack.

**OR**

9 Construct pushdown automata (PDA) for the following language:

$L = \{a^{n+1} b^n : n \geq 0\}$

Draw the transition diagram trace the string 'aaaabbb'.

**UNIT – V**

10 Design a Turing machine for the given language $L = \{0^n 1^{3n} : n \geq 1\}$. Write the transition table for the turning machine and show the tracing of string 00111111.

**OR**

11 Prove that Ld is not recursively enumerable.

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