**Code: 13A05404** **R13**

B.Tech III Year I Semester (R13) Supplementary Examinations November/December 2017

**FORMAL LANGUAGES & AUTOMATA THEORY**

(Information Technology)

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 a binary relation on a set. Give an example.

(b) Draw the transition graph of a DFA which recognizes strings over the alphabet {1, 0} that end with 10.

(c) Write any two applications of Regular Expressions.

(d) What are the two minimum length strings that are generated by the Regular expression $(11+10)^*10(11+10)^+$? Give justification to your answer.

(e) Show the leftmost derivation of the string abab by the following CFG:

$S \rightarrow AB/A$ $A \rightarrow ab$ $B \rightarrow AB/\epsilon$

(f) What is meant by left factoring in a CFG? Give an example of CFG which contains left factoring.

(g) What do you mean by Instantaneous Description (ID) of a PDA? Give an example.

(h) Show the following PDA in graphical notation:

$\delta(A, a, Z_0) = (B, aZ_0)$ $\delta(A, b, Z_0) = (B, b Z_0)$

$\delta(B, a, a) = (B, aa)$ $\delta(B, b, b) = (B, bb)$

(Note: A is initial state and B is final state.)

(i) Define Post's Correspondence problem and Modified Post's Correspondence problem.

(j) List any two properties of recursive languages and any two properties of recursively enumerable languages.

**PART – B**

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

**UNIT – I**

2 (a) What is mathematical induction? Prove the following statement using mathematical induction. P(n) = Sum of the interior angles of an n sided convex polygon is $(2n-4)\pi/2$. (Note: $\pi = 180^0$)

(b) Convert the following NFA into equivalent DFA. Show the acceptance of the string 'abaa' on both the FAs.

| Input → / Present State | a | b |
|---|---|---|
| A | {A,B} | A |
| B | C | $\phi$ |
| C | $\phi$ | $\phi$ |

(Note: A is initial state and C is final state).

**OR**

3 (a) Explain the Chomsky Hierarchy of Grammars.

(b) Convert the following Mealy Machine into equivalent Moore Machine.

| Input → | a | | b | |
|---|---|---|---|---|
| Present State | Next State | Output | Next State | Output |
| A | B | b | C | a |
| B | B | a | D | b |
| C | B | a | D | b |
| D | D | b | D | b |

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**UNIT – II**

4 (a) State the Arden's theorem. Find the Regular Expression for the strings recognized by the following FA using Arden's theorem.

| Input → / Present State | 0 | 1 |
|---|---|---|
| A | A | B |
| B | C | B |
| C | A | B |

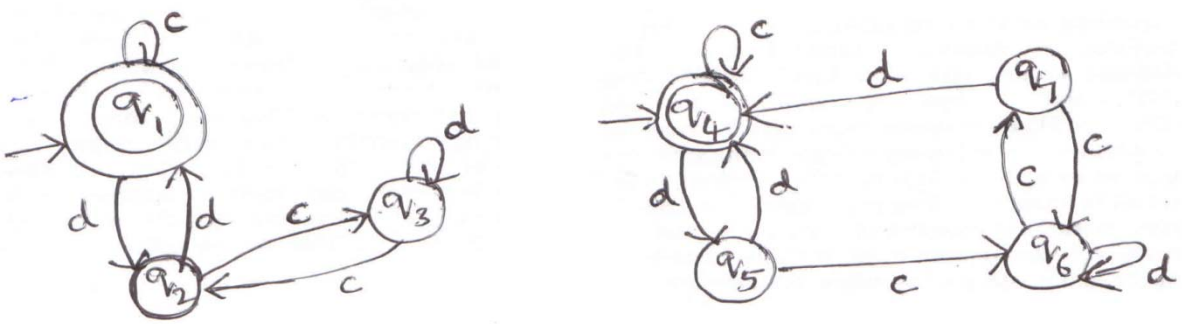
Note: A is initial state and also final state.

(b) State any five decision problems of Regular Languages and a brief solution to each.

**OR**

5 (a) State Pumping Lemma for Regular Languages. Using pumping lemma, prove that the language of palindromes over the alphabet {a, b} is not a Regular Language.

(b) Write the procedure for checking the equality of two FAs. Check whether the following two FAs are equal or not.




**UNIT – III**

6 (a) Define CFG, derivation tree, leftmost derivation and rightmost derivations. Consider the CFG with the following productions:

S → 0B/1A A → 0/0S/1AA B → 1/1S/0BB

For the string 00110101, show the leftmost derivation, rightmost derivation and draw the derivation tree.

(b) Write the procedure for finding a CFG equivalent to a given CFG and contains no null productions. By applying the procedure, find the CFG equivalent to CFG with the following productions and containing no null productions.

S → AB/ABC A → BA/BC/ϵ/a

B → AC/CB/ϵ/b C → BC/c

( Note: ϵ indicates null symbol or string)

**OR**

7 Define GNF for a CFG. Write procedure for finding a CFG in GNF equivalent to a given CFG. Find a CFG in GNF equivalent to the CFG with the following productions.

E → E+T/T T → T*F/F F → (E)/a

**UNIT – IV**

8 Define a PDA. Construct a PDA for recognizing the language of palindromes over the alphabet {0, 1} by specifying the moves of the PDA using: (i) Transition Function Notation (δ notation). (ii) Graphical Notation. Show the moves of the PDA for the string 00100.

**OR**

9 Write the procedure for constructing a PDA which recognizes the language generated by a given CFG. Construct a PDA that recognizes the language generated by the CFG with the following productions.

S → 0BB B → 0S/1S/0

For the string 010000, (i) Show the leftmost derivation using the grammar. (ii) The moves of the PDA.

**UNIT – V**

10 Design a single tape and single tape head TM for multiplication of two given integers x and y. Show the moves of the TM for input values x = 2 and y = 3.

(Note: x and y values are represented on tape as unary numbers. If x = 3 and y = 2, initially the tape contains Δ111Δ11Δ, and the final contents of the tape should be Δ111111Δ).

**OR**

11 (a) Explain about Universal Turing Machine with a suitable example.

(b) Explain about Linear Bounded Automata with a suitable example.

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