Code No: 114AG **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2018
FORMAL LANGUAGES AND AUTOMATA THEORY
(Computer Science and Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Define DFA. [2]
b) Design FA which accepts set of all strings ending with 00. [3]
c) Define Left linear Grammar. [2]
d) Give the regular expression for the language all string over alphabet **{0,1}** containing at least two 0's. [3]
e) What is ambiguity in CFG? [2]
f) Write the context free grammar for the language **$L=\{a^n b^{2n}/n\geq 1\}$** [3]
g) Give Instantaneous description ID of Turing Machine. [2]
h) Define Type 0 Grammar. [3]
i) List any 2 NP Hard Problems. [2]
j) Define Turing reducibility. [3]

PART-B

(50 Marks)

2.a) Convert the following NFA with € - moves to DFA shown in figure 1.

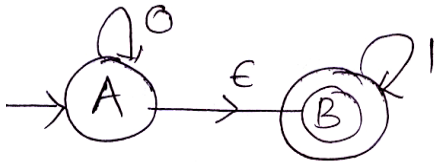

Figure: 1

b) Minimize the following DFA shown in figure 2. [5+5]

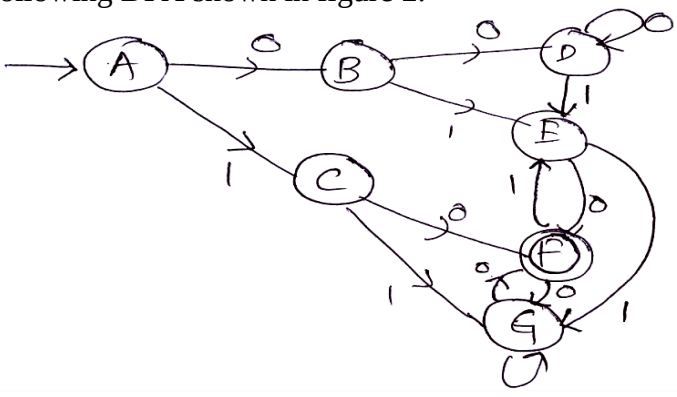

Figure: 2

OR

3.a) Check whether the following two Finite Automaton's are equivalent or not?
Finite Automaton (FA) 1 (figure 3):

Figure: 3

Finite Automaton (FA) 2(figure 4):

Figure: 4

b) Convert the following NFA with € moves to DFA in figure 5. [5+5]

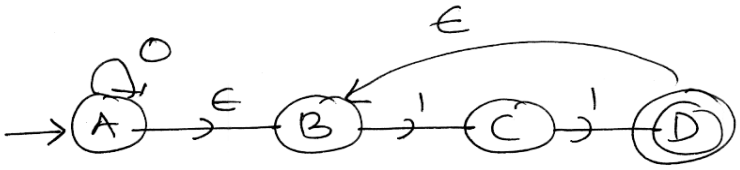

Figure: 5

4. Construct an NFA for the following Regular expression:
a) 01[((10)*+111)*+0]*1
b) ((01+10)*00)* [5+5]

OR

5.a) Find the regular grammar for the following Finite Automate shown in figure 6.

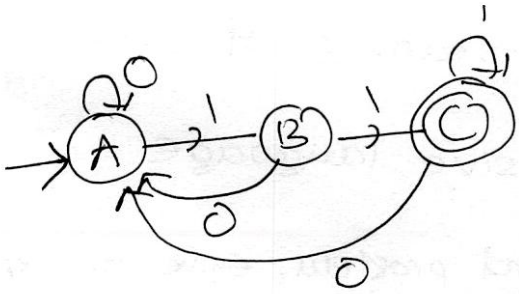

Figure: 6

b) Construct FA for the following regular expressions (0+1)*(1+00)(0+1)*. [5+5]

6.a) Convert the following grammar to Chomsky Normal Form
S→ ABA
A→ aA | Є
B→ bB | Є
and simplify the grammar

b) Write and explain closure properties of Context Free Languages. [5+5]

OR

7.a) State the Pumping Lemma for Context Free Languages.

b) Design Push down Automata for the language **L = {$a^n b^{2n}$ | n≥1}.** [5+5]

8.a) Design Turing Machine for the Language L={ $\mathbf{a^n b^n c^n / n \geq 1}$ }

b) List the Closure properties of recursive Languages. [6+4]

OR

9.a) Design Turing Machine to compute the function n!

b) Design TM for performing proper subtraction of two numbers. [5+5]

10.a) Briefly write about Universal Turning Machine (UTM).

b) What do you mean by NP Complete? List any 6 NP Complete Problems. [4+6]

OR

11.a) Discuss about turing Reducibility.

b) Write about:

i) Post Correspondence Problem

ii) Halting problem of TM. [3+7]

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PART- A

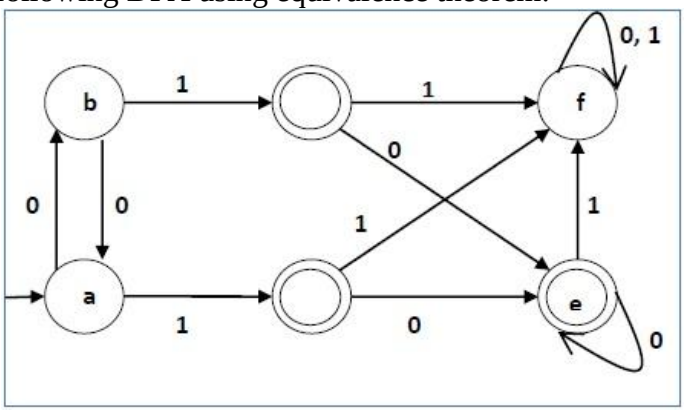
(25 Marks)

1.a) Define the terms: Strings, Finite State Machine. [2]
b) Write down the differences between Moore Machines and Mealy Machines? [3]
c) State the applications of regular languages. [2]
d) Write down the pumping lemma of regular sets. [3]
e) Define Greiback Normal Form. [2]
f) What is the ambiguity in CFG? [3]
g) List out several types of Turing Machines. [2]
h) Discuss about Church's Hypothesis in brief. [3]
i) What are Universal Turing Machines? [2]
j) Briefly write about Turing Machine halting problem. [3]

PART-B

(50 Marks)

2.a) Construct DFA for the following: L={w | w has both an even number of 0's and even number of 1's }.
b) Minimize the following DFA using equivalence theorem. [5+5]



OR

3.a) Construct the equivalent DFA for the NFA which accepts the language (a/b)*abb.
b) Design a Moore Machine to determine the residue mod 5 for each binary string treated as integer. [5+5]

4.a) Prove or disprove the following for regular expressions r, s, and t.
i) (r + s)t = rt + st ii) (rs + r)*r = r(sr + r)*
b) Write a detail note on the closure properties of regular sets. [5+5]

OR

5.a) Construct Regular grammar for the given Finite Automata.(a+b)*ab*.
b) Obtain a CFG to generate unequal number of a's and b's. [5+5]

6.a) Construct a grammar in CNF of the language $L=\{ a^n b^m a^n \mid n\geq 0, m\geq 1\}$.
b) Prove the following grammar is ambiguous: S → aS | aSbS | ε. [5+5]

OR

7.a) Construct the PDA to the following grammar:
S→AB
A→BS/b
B→SA/a
b) List out the properties of PDA. [5+5]

8. Design a T.M for copying of information from one place to the other place. Make all the necessary assumptions and discuss its functioning. [10]

OR

9.a) Design a TM to compute *n mod 2.*
b) Construct a Turing Machine that accepts those strings beginning with a '1'. [5+5]

10.a) Explain briefly about Turing reducibility.
b) Explain about post correspondence problem in detail. [5+5]

OR

11. Discuss briefly about decidability and undecidability problems. [10]

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PART- A

(25 Marks)

1.a) Define Transition Table. [2]
b) Explain the difference between DFA and NFA. [3]
c) Construct CFG to generate strings with any number of 1's. [2]
d) Explain Leftmost Derivation with an example. [3]
e) Construct PDA for the language $L=\{a^m b^m c^n \mid m, n \geq 1\}$ [2]
f) Define Ambiguity in CFG with an example. [3]
g) Explain about Turing Machine. [2]
h) Write a short note on Recursive languages. [3]
i) List the properties of type-3 grammar. [2]
j) Define Context-sensitive grammar. [3]

PART-B

(50 Marks)

2.a) Construct NFA with ε which accepts a language consisting the strings of any number of 0's followed by any number of 1's followed by any number of 2's.
b) Check whether the following two FSM's are equivalent. [5+5]

M1	0	1
→ A	B	D
(B)	A	C
C	D	B
(D)	C	A

M2	0	1
→ P	R	R
Q	R	P
(R)	P	Q

OR

3.a) Define Moore and Mealy machines with examples.
b) Design FA to accept string with 'a' and 'b' such that the number of a's are divisible by 3. [5+5]

4.a) Construct the left linear grammar for the language (0+1)*00(0+1)*.
b) Apply pumping lemma for the language $L=\{a^n/n$ is prime$\}$ and prove that it is not regular. [5+5]

OR

5. Design a FA for the following Languages
   a) (0*1*)*
   b) (0+1)*111*
   c) (0*11*+101). [3+3+4]

6.a) Find the GNF equivalent to the following
   $S \rightarrow AA \mid a$
   $A \rightarrow SS \mid b$

   b) Convert the following grammar to a PDA that accepts the language by empty stack
   $S \rightarrow 0S1|A$
   $A \rightarrow 1A0|S|\varepsilon$. [5+5]

OR

7.a) Eliminate Useless symbols from the following grammar
   $S \rightarrow aA \mid a \mid Bb \mid cC$
   $A \rightarrow aB$
   $B \rightarrow a \mid Aa$
   $C \rightarrow cCD$
   $D \rightarrow ddd$

   b) Construct CFG for the PDA $M = (\{q_0,q_1\}, \{0,1\}, \{R,Z_0\}, \delta, q_0, Z_0, \Phi)$ and δ is given by
   $\delta(q_0,1,Z_0)=(q_0,RZ_0)$
   $\delta(q_0,1,R)=(q_0,RR)$
   $\delta(q_0,0,R)=(q_1,R)$
   $\delta(q_1,0, Z_0)=(q_0, Z_0)$
   $\delta(q_0,\varepsilon, Z_0)=(q_0,\varepsilon)$
   $\delta(q_1,1,R)=(q_1,\varepsilon)$. [5+5]

8.a) Design a Turing Machine to accept $L=\{WW^R \mid W \text{ is in } (a+b)^*\}$.
   b) Design a TM to recognize the language $L= \{1^n2^n3^n \mid n \geq 1\}$. [5+5]

OR

9.a) Design TM which will recognize strings containing equal number of 0's and 1's.
   b) Design TM that accepts the language 00*. [5+5]

10.a) Explain Chomsky hierarchy of Languages.
   b) Write short note on NP- hard and NP-complete problem. [5+5]

OR

11.a) Discuss about universal turing Machine.
   b) Define post's correspondence problem and show that it is undecidable. [5+5]

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