DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
B.TECH. SEMESTER V [Information Technology]
SUBJECT: (IT 511) Theory of Automata and Formal Languages

Examination	**: Third Session**	**Seat No.**	**:**
Date	**:8/10/2018**	**Day**	**:Monday**
Time	**: 11:45 to 1:00 PM -**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed.

(a) A language L is said to be Turing decidable if: **[01]**
1) It is recursive 2) TM recognizes L 3) TM accepts L

i) both 1 and 2 ii) both 1 and 3 iii) only 2 iv) only 3

(b) From following identify which are the Context free languages (CFL) . **[01]**

(1) $L = a^n c b^n$ (2) $L = \{a^m b^n c^p d^q : n = q, \text{ or } m \leq p \text{ or } m + n = p + q\}$

(3) $L = \{www : w \in \{a, b\}^*\}$ (4) all except (3) are CFL

(c) If L1 and L2 are recursively enumerable languages over S, then the following is/are recursively enumerable. **[01]**
1) L1 U L2 2) L1 ∩ L2 3 **)** Both (1) and (2) 4) None of the mentioned

(d) From the following languages, identify which are the two decidable languages ?Why? **[02]**

1) Determine if PDA can ever enter an accept state with its stack empty

2) Turing machine M accepts "null" in an even number of moves .

3) On input “w”, Turing machine M eventually enters the reject state.

4) For DFA D and strings u; v; determine if there is a string ‘w’ such that D accepts “uw” and rejects “vw”

(e) The complexity class P consist of all the decision problems that can be solved by _____using polynomial amount of computation time.[Detereministic TM/non deterministic TM] **[01]**

(f) Consider three problems P_1, P_2 and P_3. It is known that P_1 has polynomial time solution and P_2 is NP-complete and P_3 is in NP. Which one of the following is true. **[01]**

1) P_3 has polynomial time solution if P_1 is polynomial time reducible to P_3
2) P_3 is NP complete if P_3 is polynomial time reducible to P_2
3) P_3 is NP complete if P_2 is reducible to P_3
4) P_3 has polynomial time complexity and P_3 is reducible to P_2.

(g) Which of the following statements is/are FALSE? **[01]**
(1) For every non-deterministic Turing machine, there exists an equivalent deterministic Turing machine.
(2) Turing recognizable languages are closed under union and complement.
(3) Turing decidable languages are closed under intersection and complement.
(4) Turing recognizable languages are closed under union and intersection.

(h) The Turing machine "M" has two States "q" and "p" with "q" as the start state.

Tape symbols are 0, 1, and B where 0 and 1 are input symbols, and B is the blank.

The following are next-move function:

State	Tape symbol	Move
q	0	(q,0,R)
q	1	(p,0,R)
q	B	(q,B,R)
p	0	(q,0,L)
p	1	None (halt)
p	B	(q,0,L)

Now answer following-

1) Draw the Transition diagram for the given TM. **[02]**

2) Identify from following which input(s) would make 'M' halt. **[02]**

(i) 0110 **(ii)** 100101

Q.2 Attempt Any Two of following questions.

(a) Prove that following language is not context free. **[06]**
$L = \{a^n b^m a^n : n \geq m\}$

(b) For the TM described in figure1 , answer following questions- **[06]**
i) Give the corresponding algorithm for the TM .
ii) Give trace of the Turing machine for the input " abbaa##'.Assume when the TM starts , the tape head is on leftmost "b" (shown with underline in the input string) .
iii) Give the time complexity of the TM.
Note :- "ha" is halt state .

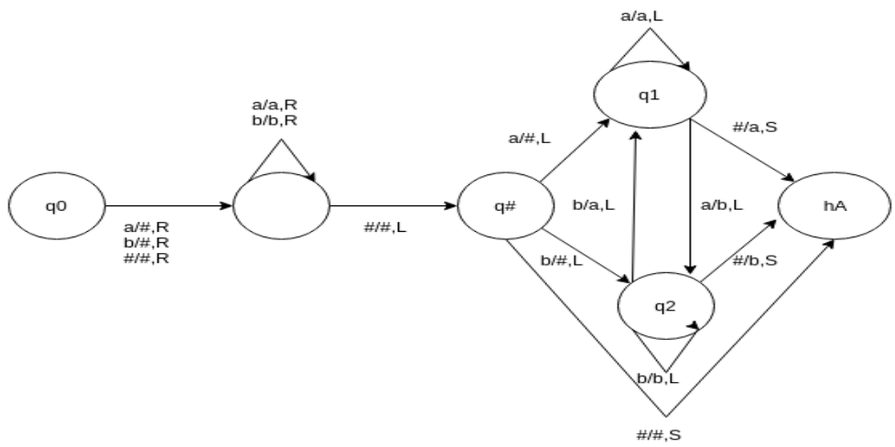

Figure1

(c) Explain following with reference to complexity theory: **[06]**
P,NP,NPC,NPH ,Tractable and Intractable .

Q.3 Attempt following questions

(a) 1) Show the design of a Turing machine that takes as input two integers encoded in binary and determines is the first less than the second. Example: it should accept 0110#1000 but reject 1#0. **[06]**
2) Give the algorithm for above Turing machine. **[03]**

(b) Explain the working of Universal Turing machine in brief. **[03]**

OR

Q.3 Attempt following questions

(a) **[06]**
1) Show the design of a decidable TM for $L=\{ww : w \in \{a, b\}^*\}$. The input alphabet is {a, b, #}. Example:- the machine should accept abab# but reject abaa# .
2)Show the trace of your machine on the strings given in above example. **[02]**

(b) Explain the undecidable Halting problem . **[04]**

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