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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH./M.TECH.]- DECEMBER 2010

Paper Code: IT301 **Subject: Theory of Computation**
Paper ID: 15301

Time : 3 Hours **Maximum Marks : 60**

Note: Attempt all questions. Internal choice is indicated.

Q1 Attempt **any three** parts of the following:-

(a) Define deterministic and nondeterministic finite automata mathematically. Consider the following DFA over the alphabet $\sum = \{0,1\}$. Construct a minimal equivalent DFA. **(4)**

	0	1
A (start)	B	A
B	C	D
C (final)	F	E
D	E	A
E	F	D
F (final)	F	B

(b) Define Pumping Lemma for regular languages and show the language $L = \{a^n b^n | n >= 1\}$ is Nonregular. **(4)**

(c) Draw a Deterministic Finite Automaton to accept the following regular expression and succinctly describe the set in English $[00+11+(01+10)(00+11)^*(01+10)]^*$ **(4)**

(d) Define pushdown automata mathematically. Construct a PDA A accepting $L = \{wcw^T | we\{a,b\}^*\}$ by final state. **(4)**

Q2 Attempts **any three** parts of the following:-

(a) Consider the following grammar G:

$S \rightarrow 0A0|1B1|BB$

$A \rightarrow C$

$B \rightarrow S|A$

$C \rightarrow S|\varepsilon$

Simplify the above grammar. What is L(G)? What is correct order of the steps: (1) eliminate useless symbols (2) eliminate ε-productions (3) eliminate unit productions, in simplification of a context free grammar in general? **(4)**

(b) Let M1 and M2 be the two Finite automata's accepting the language L1 and L2 respectively. Design an automata recognize the language (i) $L1 \cap L2$ (ii) $L1 - L2$. Where L1=(No. of a's in the string defined over a, b is even) and L2={no. of b's in the string defined over a,b is odd}. **(4)**

(c) Show that two CFL's L1 and L2 are closed under Union but they are not closed under intersection. **(4)**

(d) Design a Turing machine to delete a symbol under the R/w head. **(4)**

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Q3 Attempt **any two** parts of the following:-

(a) What is Parsing? Consider the following grammar $S \rightarrow 0S0|1S1|10$. Construct the SLR Parsing Table for this grammar and show all moves for the parsing of input string 0100 using this table. **(6)**

(b) Define Pumping Lemma for Context Free Languages. **(6)**

(c) Consider the language: $L = \{(k,w) | \textit{Turing machine } T_k \textit{ will halt on input } w.\}$. Prove that L is Undecidable. **(6)**

Q4 Attempt **any two** parts of the following:-

(a) Prove that NSPACE(f(N)) is equivalent to SPACE(f^2(N)). **(6)**

(b) Prove that Multi-tape Turing machine is computationally equivalent to standard Turing Machine. Consider L as recursive enumerable and complement of L is also recursive enumerable then show that L is a recursive language. **(6)**

(c) Write short comments on the following:-
(i) L and NL (ii) PSPACE AND NPSPACE (iii) Churche-Turing thesis **(6)**

Q5 Attempt **any one** part of the following:-

(a) Prove that CNF satisfiability is NP-complete. **(12)**

(b) Prove that True quantifier Boolean formula satisfiability is PSPACE complete. **(12)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH./M.TECH.] DECEMBER 2013

Paper Code: IT301 **Subject: Theory of Computation**

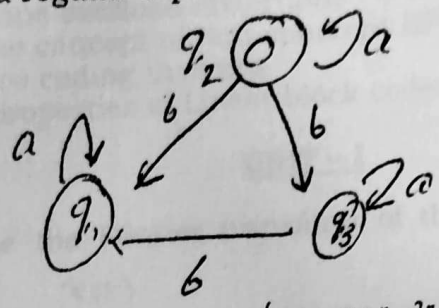
Time : 3 Hours **Maximum Marks :60**

Note: Attempt any five questions including Q.no.1 which is compulsory.

Q1 Explain briefly the following:- (3x4=12)

(a) Differentiate between NFA and DFA.
(b) Differentiate between context free grammar and regular grammar.
(c) Differentiate between P and NP problem.
(d) Explain the structure of a Turing machine.

Q2 (a) Construct a regular expression for the language accepted by DFA- (6)



(b) Show that the language $L = \{\omega \in a^n b^n c^{2n}\}$ is not context free. (6)

Q3 (a) Discuss the closure properties of CFLs. (6)
(b) State Pumping Lemma. Illustrate the pumping Lemma using an example. (6)

Q4 Consider the following grammar $E \rightarrow E+T/T$, $T \rightarrow a/b$. Determine- (12)

(a) SLR parsing table.
(b) LL(I) grammar/parsing table.

Q5 (a) Design a Turing machine, that accepts all the language of all palindrome over the alphabet {a,b}. (8)
(b) Justify the 5(a) turing machine on the string (i) babb (ii) bab. (4)

Q6 Construct a PDA to accept all strings generated by the language $\{a^n b^m a^n | m,n \geq 1\}$. (12)

Q7 (a) Differentiate NP complete and NP Hard problems. Explain NP complete and NP hard problems with some example. (6)
(b) Discuss and explain Hierarchy Theorem. (6)

Q8 Write short notes on **any two** of the following:- (6x2=12)

(a) Halting problem
(b) Decidability
(c) Chomsky Classification

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH./M.TECH.] DECEMBER 2014-JANUARY-2015

Paper Code: IT301 **Subject: Theory of Computation**

Time : 3 Hours **Maximum Marks :60**

Note: Attempt any five questions including Q.no.1 which is compulsory.

Q1 (a) Discuss the applications of regular expressions.

(b) With the help of examples define Pumping lemma.

(c) Explain the disadvantages of ambiguous grammar.

(d) Define halting problem.

(e) Differentiate between NP complete and NP hard problem. **(4x5=20)**

Q2 (a) Explain Chomsky classification using example for each classification. **(5)**

(b) Discuss the steps to convert a NFA to DFA. Provide example to support the steps. **(5)**

Q3 (a) Discuss the closure properties of CFL. **(5)**

(b) Differentiate between LL(1) and LL(2) grammar. Provide example for both LL(1) and LL(2) grammar. **(5)**

Q4 (a) Differentiate between Push down automata and Turing machine. **(5)**

(b) Verify that the language $L = \{\omega \in a^n b^n c^{2n}\}$ is context free or not. **(5)**

Q5 Define Decidability. What are the factors to determine the decidability? How does turing machine helpful for decidability? Explain using an example. **(10)**

Q6 (a) Define hierarchy theorem. Explain using an example. **(5)**

(b) Discuss and explain the various complexity classes. **(5)**

Q7 Construct the regular expression for the following languages:- **(5x2=10)**

(a) Language that accepts exactly one combination of 0 and 1.

(b) Language that accepts any number of 1s at the starting of the language.

Q8 Write short notes on **any two** of the following:- **(5x2=10)**

(a) Recursion Theorem

(b) Non-deterministic turing machine

(c) Interactive proof systems

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] DECEMBER 2016 – JANUARY 2017

Paper Code: IT-301 **Subject: Theory of Computation**

Time: 3 Hours **Maximum Marks: 60**

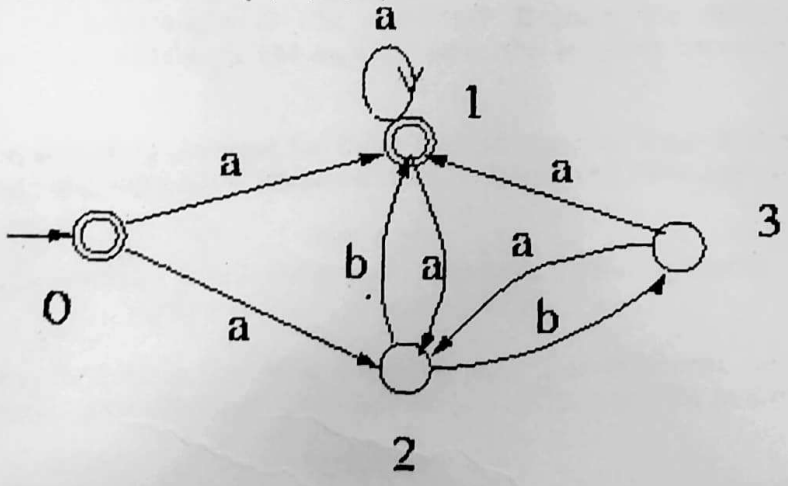
Note: Attempt any five questions including Q.no.1 which is compulsory. Select one question from each Unit.

Q1 (a) Write formal statement of kleen's theorem. **(2.5x8=20)**
(b) Define pumping lemma for context free language?
(c) Define Chomsky normal form of a CFG?
(d) What is LL(2) grammar? How is it different from LL(1).
(e) What is halting problem?
(f) Define Oracle turing Machine.
(g) What is time hierarchy theorem?
(h) Define probabilistic computation and BPP complexity class.

Unit-I

Q2 (a) State Pumping property followed by a regular language and prove that $L = \{a^n b^{2n} \mid n>=1\}$ is non-regular. **(5)**
(b) Prove by construction that regular languages are closed under intersection. **(5)**

Q3 (a) Prove or Disprove the validity of the following statement "Every NDFA (Non-deterministic Finite Automata) can be converted into DFA (deterministic Finite Automata) by increasing the number of states". **(5)**
(b) Find the equivalent regular expression of following Finite Automata with set of states as {0, 1, 2, 3}: **(5)**



Unit-II

Q4 (a) Show that context free languages are closed under union and concatenation. **(5)**
(b) Prove that intersection of regular and context free language will always be context free. **(5)**

Q5 (a) Design a Pushdown Automata to recognize language $L = \{a^n b^{2n} \mid n>=1\}$. **(5)**
(b) Describe the mechanism to find equivalent CFG of a given PDA. **(5)**

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Unit-III

Q6 How can we combine different Turing machines. Design a Turing Machine to recognize a language L = {SS | S $\in$ {a, b} * }. **(10)**

Q7 Discuss any two variant of the standard Turing machine. Design a Turing Machine to Compute F(n) = 1 + 2 + ... + n (represent n in unary) i.e F(3) = 6. **(10)**

Unit-IV

Q8 Write your comment on the implications of knowing an exact relationship that is "equality" or "Non-equality" in between P and NP complexity classes. Briefly outline the proof of Cook's Theorem. **(10)**

Q9 Define SPCAE and NSPCAE Complexity classes. Prove that PSPCAE is equivalent to NPSPACE. **(10)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER 2017

Paper Code: IT-301 **Subject: Theory of Computation**

Time: 3 Hours **Maximum Marks: 60**

Note: Attempt any five questions including Q.No 1 which is compulsory. Select one question from each unit.

Q1 Answer the following questions: **(2x10=20)**

(a) State kleen's theorem. what is a regular expression.
(b) Define top down parsing and LL(1) grammar.
(c) Write your comment on "Can a machine produce itself?
(d) Define PSPACE and NSPACE complexity claases.
(e) Prove that langiage $L=\{a^nb^n|n>0\}$ is not regular.
(f) State Punping lemma for context free language.
(g) What is a parse tree
(h) Differentiate between polynomial time reduction and Logarithmic space reduction
(i) Define Pushdown automata. Give example.

UNIT-I

Q2 Prove that regular languages are closed under union and intersection. Let M1 and M2 be the two Finite automata's accepting the language L1 and L2 respectively. Design automaton to recognize the language. **(10)**

(a) $L_1 \cup L_2$
(b) $L_1 - L_2$
(c) $L_1 \cap L_2$

Where L1=(No. of a's in the string defined over a, b is even}
And L2={ no of b's in the string defined over over a,b is odd}

Q3 Define Nondeterministic automata. Explain the mechanism to convert NDFA into DFA. **(10)**

UNIT-II

Q4 Define Pushdown automata. What is instantaneous descriptor. Design a pushdown automata to recognize the language $L=\{a^nb2^n|n>1\}$ **(10)**

Q5 Prove that context free languages are closed under union and concatenation. Also prove that intersection of a Context free language and regular language will be a context free language. **(10)**

UNIT-III

Q6 What is Un-decidability problem? Prove that Halting Problem is Un-decidable. **(10)**

Q7 Prove that Multitape Mutlihead Turing is computationally equivalent to a Standard Turning Machine. Design a turning Machine to accept the language $L=\{a^nb^n|n>0\}$. **(10)**

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UNIT-IV

Q8 Write your views on the following "Every P-class problem is an NP-class problem". Also Prove that clique problem is NP complete. (10)

Q9 Prove that a problem solvable in the space of O(f(n)) requires worst case time of the order of $O(2^{f(n)})$ [Make necessary assumptions]. State and Prove Savich theorem. (10)

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH.] DECEMBER 2017

Paper Code: IT-301 **Subject: Theory of Computation**

Time: 3 Hours **Maximum Marks: 75**

Note: Attempt any five questions including Q.No 1 which is compulsory. Select one question from each unit.

Q1 Answer the following questions: **(2.5x10=25)**

(a) State kleen's theorem. what is a regular expression.
(b) Define top down parsing and LL(1) grammar.
(c) Write your comment on "Can a machine produce itself?
(d) Define PSPACE and NSPACE complexity claases.
(e) Prove that langiage $L=\{a^n b^n | n>0\}$ is not regular.
(f) State Punping lemma for context free language.
(g) What is a parse tree
(h) Differentiate between polynomial time reduction and Logarithmic space reduction
(i) Define Pushdown automata. Give example.

UNIT-I

Q2 Prove that regular languages are closed under union and intersection. Let M1 and M2 be the two Finite automata's accepting the language L1 and L2 respectively. Design automaton to recognize the language. **(12.5)**

(a) $L_1 \cup L_2$
(b) $L_1 - L_2$
(c) $L_1 \cap L_2$

Where L1=(No. of a's in the string defined over a, b is even}
And L2={ no of b's in the string defined over over a,b is odd}

Q3 Define Nondeterministic automata. Explain the mechanism to convert NDFA into DFA. **(12.5)**

UNIT-II

Q4 Define Pushdown automata. What is instantaneous descriptor. Design a pushdown automata to recognize the language $L=\{a^n b 2^n | n>1\}$ **(12.5)**

Q5 Prove that context free languages are closed under union and concatenation. Also prove that intersection of a Context free language and regular language will be a context free language. **(12.5)**

UNIT-III

Q6 What is Un-decidability problem? Prove that Halting Problem is Un-decidable. **(12.5)**

Q7 Prove that Multitape Mutlihead Turing is computationally equivalent to a Standard Turning Machine. Design a turning Machine to accept the language $L=\{a^n b^n | n>0\}$. **(12.5)**

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UNIT-IV

Q8 Write your views on the following "Every P-class problem is an NP-class problem". Also Prove that clique problem is NP complete. **(12.5)**

Q9 Prove that a problem solvable in the space of O(f(n)) requires worst case time of the order of $O(2^{f(n)})$ [Make necessary assumptions]. State and Prove Savich theorem. **(12.5)**

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END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] NOVEMBER-DECEMBER 2018

Paper Code: IT-301 **Subject: Theory of Computation**

Time: 3 Hours **Maximum Marks: 75**

Note: Attempt any five questions including Q no.1 which is compulsory.

Q1 (a) Explain Chomsky's Hierarchy. (2.5)

(b) Explain Halting Problem. (2.5)

(c) What are the differences between DFA and NFA? (2.5)

(d) What is an ambiguous grammar? Give an example of such a grammar. (2.5)

(e) Is Non deterministic push down automata more powerful that non deterministic push down automata? Justify. (2.5)

(f) What is the full form of Class P and class NP? What is the relation between these two? (2.5)

(g) What do you mean by LL(k) grammar? Give example of such a grammar. (2.5)

(h) What do you understand by the statement," Problem P is reducible to problem Q". Explain the term Reducibility. (2.5)

(i) What is an alphabet? Give an example of an alphabet and also an example of a set which is not an alphabet. (2.5)

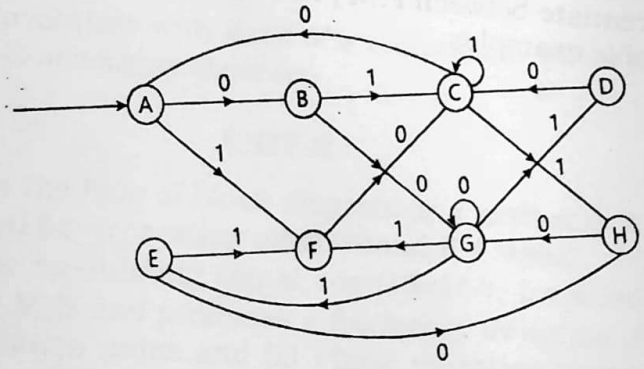
(j) Define Kleen closure. What is Kleen closure of an empty set? 2.5)

Q2 (a) Define a regular expression. Also write the regular expressions for the following languages. (6)

(i) The set of all strings ending in the substring '00' on $\Sigma=\{0, 1\}$.

(ii) $L = \{a^n b^m \mid n\geq 4, m\leq 3\}$.

(b) Consider the DFA given by the transition diagram: (6.5)



Draw the table of distinguishbilities for this automation. Construct the minimum sate equivalent DFA.

Q3 (a) State and prove pumping lemma for regular languages. Show that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular (6)

(b) Prove that every language defined by a regular expression is also defined by a finite automaion. (6.5)

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Q4 (a) Design a PDA for the language $= \{\omega\omega^{\wedge R} | \omega \in \{a, b\}\}$. Draw the transition diagram and also write the sequence of ID's for the string 'abba'. **(6)**

(b) What is an unit production? Begin with the grammar: $S \rightarrow ABC|BaB$

$A \rightarrow aA|BaC|aaa$

$B \rightarrow bBb|a|D$

$D \rightarrow \varepsilon$

Eliminate $\varepsilon-$ productions
Eliminate any unit production in the resulting grammar
Eliminate any useless symbol in the resulting grammar. **(6.5)**

Q5 (a) Define CNF and convert the following grammar into CNF. **(6)**

$S \rightarrow Aba$

$A \rightarrow aab$

$B \rightarrow Ac$

(b) Prove that the family of context-free languages is closed under union, concentration and star-closure. **(6.5)**

Q6 Design a turning machine to accept the set of all palindromes over {0, 1}. Also, indicate the moves made by Turing machine for the string. **(12.5)**

(6.25x2=12.5)

Q7 Write short notes on following:-
(a) Post Correspondence Problem.
(b) Multitape turing machine

Q8 (a) Differentiate between Recursive and Recursively enumerable languages **(6.5)**

(b) Differentiate between P,NP, NP hard and NP complete problems using suitable examples. **(6)**

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(Please write your Exam Roll No.)

END TERM EXAMINATION

FIFTH SEMESTER [B.TECH] DECEMBER 2019

Paper Code: IT 301 **Subject: Theory of computation**

Time : 3 Hours **Maximum Marks :75**

Note: Attempt five questions including Q. NO. 1 which is compulsory. Select one question from each unit.

Q1. Attempt any five of the following: **(5*5=25)**

a) Prove that $L=\{a^n b^n \mid n>=1\}$ is non-regular.

b) Show that the context free languages are not closed under intersection

c) What is probabilistic Turing machine?

d) Prove that a problem solvable in the space of O(f(n)) requires worst case time of the order of $O(2^{f(n)})$ [*Make necessary assumptions*].

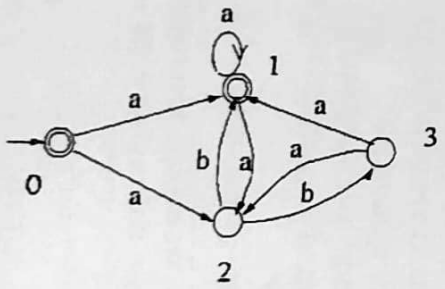
e) Prove that vertex cover problem is poly-time reducible to clique problem.

f) What is parsing? Define LL(1) parsing technique.

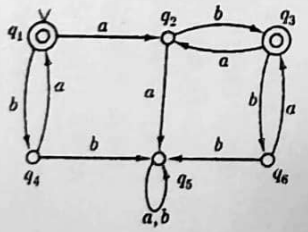
g) Define any two variants of standard turing machine.

Unit-I

Q2. Differentiate in between deterministic and non-deterministic finite automata. Convert following NDFA into DFA. **(12.5)**



Q3. Explain the process of minimizing number of states of a DFA. Minimize the number of states of following DFA. **(12.5)**



Unit II

Q4. What is context free grammar? Explain pumping lemma for context free language through an example. **(12.5)**

Q5. Define Pushdown automata (PDA). Create a pushdown automaton that accepts the language $\{0^{2n}1^n \mid n > 0\}$. Show that your PDA accepts **000011** and that it rejects **0001.** **(12.5)**

Unit III

Q6. Can you write a program which outputs itself? if 'yes' then give an example. Define Recursion theorem and show that construction of **'SELF'** Turing machine is possible. **(12.5)**

Q7. Differentiate in between computationally intractable and Undecidable problems. Prove that Halting problem is undeciadable. **(12.5)**

Unit IV

Q8. Define IP and BPP complexity classes? Prove that $NSPACE(f(n)) = SPACE(f(n)^2)$. **(12.5)**

Q9. Discuss the proof outline of Cook-levin theorem. State whether following statements are TRUE or FALSE with justifications. **(12.5)**

(a) Some problems in NP complete can not be transformed into satisfiability problem in Polynomial time.

(b) Non deterministic RAM may give different results for the same decision problem.

(c) A problem with exponentially possible solutions can only be in P if P=NP.

d) Every problem who solution requires exponential time on the deterministic RAM can be made to run in polynomial time on deterministic RAM.

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