Exam.Code:0923
Sub. Code: **6850**

1127
B.E. (Information Technology)
Fifth Semester
ITE-546: Theory of Computation

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.*

x-x-x

I
(a) Differentiate between DFA AND NFA. 2
(b) Write a regular expression over $\Sigma = \{a, b, c\}$ containing at least one 'a' and at least one 'b'. 2
(c) Write the production rules for Chomsky Normal Form. 2
(d) Define LR (0) grammar. 2
(e) Explain the concept of Universal Turing machine. 2

Section- A

II Design a NFA over $\Sigma = \{a, b\}$ for the regular expression $(a+b)^*abb$. Hence convert the designed NFA into DFA. 10

III a) State and prove pumping lemma for regular languages. 5
b) Define and explain left linear grammar and right linear grammar with suitable example. 5

IV Write short notes on:
(a) Closure properties of regular sets
(b) Moore and Mealy machines. 5+5

Section- B

V Define PDA. Design a PDA accepting $L = \{a^n b^n \mid n > 0\}$. 10

VI Explain Chomsky classification of formal languages. 10

VII Write short notes on following: 5+5
a) Linear Bounded Automata.
b) Properties of recursive & non-recursive enumerable languages.

x-x-x

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1128
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Fifth Semester
ITE-546: Theory of Computation

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following:-

a) How many DFA's exits with two states over input alphabet {0,1}

b) State true or false and why: There exists a regular language A such that for all languages B, A ∩ B is regular.

c) What is the basic limitation of finite automata?

d) Given an arbitary non-deterministic finite automaton (NFA) with N states. What is the least of the maximum number of states in an equivalent minimized DFA?

e) A minimum state deterministic finite automaton accepting the language L={w (w ε {0,1} *, number of 0s and 1s in w are divisible by 3 and 5, respectively}, has how many states?

f) State the Arden's theorem.

g) What is a recursive enumerable language?

h) What is meant by top down parsing?

i) Define the term 'undecidability'.

j) What is a Mealy machine? (10x1)

UNIT – I

II. a) Find a finite automaton that accepts bit strings whose last five bits include a 1. (5)

b) Let w be any string of length n is {0,1}*. Let L be the set of all substrings of w. What is the minimum number of states in a non-deterministic finite automaton that accepts L? (5,5)

III. Discuss how non regular languages can be identified using pumping lemma. (10)

IV. Discuss NDFA and DFA properties. How can a NDFA be converted to a DFA? (10)

P.T.O.

UNIT – II

V. a) Write a CFG, which generates palindrome for binary numbers.

b) State the various properties of a CFL. (5,5)

VI. Discuss Chomsky's four types of grammars, the class of language it generates, the type of automaton that recognizes it, and the form its rules must have. (10)

VII. Write short notes on:-

a) Universal Turing Machine

b) Closure properties of recursively enumerable languages (5,5)

x-x-x

(1)

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x-x-x

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(c) Write the production rules for Chomsky Normal Form. 2

(d) Define LR (0) grammar. 2

(e) Explain the concept of Universal Turing machine. 2

Section- A

II Design a NFA over $\Sigma = \{a, b\}$ for the regular expression (a+b)*abb. Hence convert the designed NFA into DFA. 10

III a) State and prove pumping lemma for regular languages. 5

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IV Write short notes on:

(a) Closure properties of regular sets

(b) Moore and Mealy machines. 5+5

Section- B

V Define PDA. Design a PDA accepting $L = \{a^n b^n \mid n > 0\}$. 10

VI Explain Chomsky classification of formal languages. 10

VII Write short notes on following: 5+5

a) Linear Bounded Automata.

b) Properties of recursive & non-recursive enumerable languages.

1127

Exam.Code:0917
Sub. Code: 6790

B.E. (Computer Science and Engineering), Fifth Semester
CS-505: Theory of Computation

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.*

x-x-x

I. Write short answers of the following:
a. When would you say that the CFG G is ambiguous?
b. What are unit and null productions? Give examples.
c. State with reason whether the given statement is True or False. "The set of all strings starting with an *a* and ending in *ab* is defined by the regular expression *a(a+b)*b*".
d. State the halting problem of Turing machines.
e. What are tractable and intractable problems?

Section-A

II.
a. Construct a minimum state automaton equivalent to DFA whose transition table is given below:

State	a	b
$\rightarrow q_0$	q_1	q_2
q_1	q_4	q_3
q_2	q_4	q_3
q_3 Final state	q_5	q_6
q_4 Final state	q_7	q_6
q_5	q_3	q_6
q_6	q_6	q_6
q_7	q_4	q_6

b. State and prove pumping lemma for regular sets.

III.
a. Let the grammar G be $S \rightarrow AB$, $A \rightarrow a$, $B \rightarrow C|b$, $C \rightarrow D$, $D \rightarrow E$ and $E \rightarrow a$. Eliminate unit productions and get an equivalent grammar.
b. What is Chomsky Normal Form (CNF)? Write a procedure to find CNF equivalent to a CFG. Reduce the following grammar G into CNF. G is $S \rightarrow aAD$, $A \rightarrow aB|bAB$, $B \rightarrow b$, $D \rightarrow d$.

IV.
a. Define regular expression. Prove that $(a^*ab + ba)^*a^* = (a + ab + ba)^*$
b. What do you mean by closure properties of regular languages? List principal closure properties for regular languages.

Section-B

V.
a. Convert the grammar $S \rightarrow 0AA, A \rightarrow 0S|1S|0$ to a PDA that accepts the same language by empty stack.
b. State pumping lemma for Context-free languages (CFL). Using the CFL pumping lemma, show that the language $\{0^n1^n0^n | n \geq 1\}$ is not context free.

VI.
a. Design a Push-down Automaton to accept the language $\{0^n1^m0^n | m, n \geq 1\}$. Accept either by final state or empty stack.
b. Describe multi-head and multi-tape Turing machines in detail.

VII. Write short notes on:
a. P and NP completeness
b. Recursive and recursively enumerable languages

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CS-505: Theory of Computation

...owed: 3 Hours

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x-x-x

Write short answers of the following:

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b. What are unit and null productions? Give examples.
c. State with reason whether the given statement is True or False. "The set of all strings starting with an a and ending in ab is defined by the regular expression $a(a+b)^*b$".
d. State the halting problem of Turing machines.
e. What are tractable and intractable problems?

Section-A

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q_2	q_4	q_3
q_3 Final state	q_5	q_6
q_4 Final state	q_7	q_6
q_5	q_3	q_6
q_6	q_6	q_6
q_7	q_4	q_6

b. State and prove pumping lemma for regular sets.

III.

a. Let the grammar G be $S \rightarrow AB$, $A \rightarrow a$, $B \rightarrow C|b$, $C \rightarrow D$, $D \rightarrow E$ and $E \rightarrow a$. Eliminate unit productions and get an equivalent grammar.
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a. Define regular expression. Prove that $(a^*ab + ba)^*a^* = (a + ab + ba)^*$
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a. Design a Push-down Automaton to accept the language $\{0^n1^m0^n | m, n \geq 1\}$. Accept either by final state or empty stack.
b. Describe multi-head and multi-tape Turing machines in detail.

VII. Write short notes on:

a. P and NP completeness
b. Recursive and recursively enumerable languages

x-x-x

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1128

B.E. (Computer Science and Engineering)
Fifth Semester
CS-505: Theory of Computation

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

I. Write short answers of the following:

a. Prove or disapprove: $(R+S)^*S = (R^*S)^*$
b. Is the grammar $S \rightarrow SS|S|S(S)S|\epsilon$ ambiguous? Why or why not?
c. What is difference between Kleene closure and Kleene positive closure? Give example.
d. What are regular expressions? List their applications.
e. What is polynomial time reduction? (2× 5=10)

Section-A

II.

a. Design a finite automaton M over $\{0,1\}$ to accept all strings satisfying the following conditions:
 i. Ending with 111 or 000
 ii. Starting with 111 or 000
 iii. Containing the substring 111 or 000
b. State pumping lemma for regular sets. Using pumping lemma, show that the set $\{w|w\ is\ a\ palindrome\ over\ \{0,1\}\}$ is not regular. (6,4)

III.

a. Construct a minimum state automaton equivalent to DFA whose transition table is given below:

State	0	1
$\rightarrow q_1$	q_2	q_3
q_2	q_3	q_5
q_3 Final state	q_4	q_3
q_4	q_3	q_5
q_5 Final state	q_2	q_5

b. Given a CFG $G(\{S,A,B\},\{0\},P,S)$ with its production set as $S \rightarrow AAA|B,\ A \rightarrow 0A|B,\ B \rightarrow \epsilon$. Remove null productions from this grammar and create a new grammar G_1 such that $L(G_1) = L(G) - \epsilon$. (6,4)

IV.

a. Prove that $(a^*ab+ba)^*a^* = (a+ab+ba)^*$.
b. Convert the CFG $S \rightarrow XY1|0,\ X \rightarrow 00X|1,\ Y \rightarrow 1X1$ into Greibach Normal Form. (4,6)

P.T.O.

Section-B

V.

a. State the pumping lemma for Context-free languages. Using pumping lemma, show that the language $\{0^m 1^n | m \neq n\}$ is not context-free.

b. Convert the grammar $S \rightarrow S0S1S0S|S0S0S1S|S1S0S0S|\epsilon$ to a PDA that accepts the same language by empty stack. (5,5)

VI.

a. Describe Turing machine model. Describe multi-tape Turing machine as an extension to the basic Turing machine. Does the multi-tape Turing machine and basic Turing-machine have same language-recognizing power? Comment.

b. Design a Turing machine over $\Sigma = \{0,1\}$ to accept the language $L = \{0^m 1^{2m} | m > 0\}$. (5,5)

VII. Write short notes on:

a. Recursive and recursively enumerable languages

b. P and NP completeness

(5,5)

x-x-x