(c) Design a Turing machine for the following:

Reverse a given string {abb}. 8

8. (a) What is a multitape Turing machine? 5

(b) What are the techniques for TM construction? 4

(c) Describe the Chomsky hierarchy of languages. 5

UNIT-V

9. (a) When can we say a problem is decidable? Give an example of an undecidable problem. 5

(b) Mention the difference between P and NP problems. 4

(c) Explain Church Turing Thsis. 5

10. (a) Compare and contrast recursive and recursively enumerable language. 5

(b) Explain briefly about NP-Hard and NP-Complete problems with examples. 5

(c) Explain the implications of halting problems. 4

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UG/Integrated Even Semester Examination, 2025

COMPUTER SCIENCE

(6th Semester)

Course No.: MCS-551/MCA-551

(Theory of Computation)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) Explain equivalence relation with an example. Are all relations functions? Justify. 5

(b) Construct a DFA for the language over {0,1}*, such that is contains “000” as a substring. 4

(c) Use mathematical induction to show that, for all integers n>1. 5

$1.2+2.3+3.4+.....+n(n+1)= \frac{n(n+1)(n+2)}{3}$

2. (a) Define : 4

(i) Finite Auttomata (FA)

(ii) Function

(b) Are the following true? Justify. 4

(i) All injective functions are bijective

(ii) All symmetric relations are also transitive.

(c) In a survey, it was found that 21 people read English newspapers, 26 people read Hindi newspapers, and 29 people read regional language newspapers. If 14 people read both English and Hindi newspapers; 15 people read both Hindi and regional language newspapers; 12 people read both English and regional language newspapers and 8 read all types of newspapers, find:

(i) How many people are surveyed?

(ii) How many people read only regional language newspapers? 6

UNIT-II

3. (a) Prove that the class of language accepted by finite automata is closed under union and concatenation. 8

(b) Construct NFA for the regular expression a*b*. 4

(c) Differentiate between a regular expression and regular language. 2

4. (a) Give regular expressions for the following: 6

L1= set of all strings of 0 and 1 ending in 00.

L2= set of all strings of 0 and 1 beginning with 0 and ending with 1.

(b) State and prove the pumping lemma for regular languages. 8

UNIT-III

5. (a) What is ambiguous grammar? 2

(b) Is the following grammar ambiguous? Justify your answer. 3

$E \rightarrow E+E|E*E|id$

(c) Prove by pumping lemma, that the language 0^^n1^^n is not regular. 5

(d) Construct a PDA for the language L={wwR|W in (a+b)*)} 4

6. (a) What is meant by context Free Grammar (CFG)? Construct a CFG for a set of string that contain an equal number of a's and b's over Σ={a,b}. 5

(b) Define PDA. What are the different types of language accepted by a PDA and define them? 5

(c) Define parse tree with an example. 2

(d) Find the context-free languages for the following grammar 2

$S \rightarrow aSbS|bSaS|\varepsilon$

UNIT-IV

7. (a) What is Turing machine? 3

(b) What are the differences between a Finite automata and a Turing machine? 3