JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2025

B.Tech-III Semester (CSE)

COURSE CODE (CREDITS): 25B11CI315 (3) MAX. MARKS: 25

COURSE NAME: Theory of Computation

COURSE INSTRUCTORS: ARV*, MNK, NSA, RMS, SKS, SMA MAX. TIME: 1 Hour 30 Min

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	Question	CO	Marks
Q1	Consider the language $L = \{ww^R \mid w \in \{a,b\}^+\}$, where w^R is the reverse of string w. (a) Classify this language in the Chomsky Hierarchy and specify why it belongs to that specific type of Chomsky Hierarchy. (b) Construct a respective grammar that generates L.	3	5[2+3]
Q2	Consider the Context-free grammar (CFG) G below with start Symbol S: $S \rightarrow aSb \mid X$ $X \rightarrow aX \mid Xb \mid a \mid b$ (a) Describe L(G) and give a short, clear derivation pattern (step-by-step) that shows how the productions build strings in the language. (b) For the string "aaabb", show all derivations (or parse trees / leftmost derivations) needed to decide whether the grammar is ambiguous or unambiguous for that string, and state your conclusion.	3	5 [2+3]
Q3	Construct the Context-Free Grammar (CFG) for the following languages: (a) The set of all even integers up to 998. (b) $L = \{a^n b^m: n >= 2, m >= 3\}$	3	5[2+3]
Q4	Consider the given grammar $G = (\{S, A, B, C, D, E\}, \{a, b\}, P, S)$ where P is given by $S \rightarrow aAa \mid bBb \mid \epsilon$ $A \rightarrow C \mid a$ $B \rightarrow C \mid b$ $C \rightarrow CDE \mid \epsilon$ $D \rightarrow A \mid B \mid ab$ (i) Construct a CFG G_1 by eliminating ϵ-productions from G. (ii) Construct a CFG G_2 by eliminating Unit productions from G_1. (iii) Construct a CFG G_3 by eliminating any useless symbols from G_2.	3	5[2+2+1]
Q5	(a) How many steps are required to generate a string of length 'n' if: (i) The given grammar is in CNF. (ii) The given grammar is in GNF. (b) Convert the following CFG in GNF. $A \rightarrow Aa \mid Bb$ $B \rightarrow Bc \mid d$	3	5[2+3]