07/01/26
12pm

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Supplementary Examination- 2026

B.Tech-III Semester (CSE)

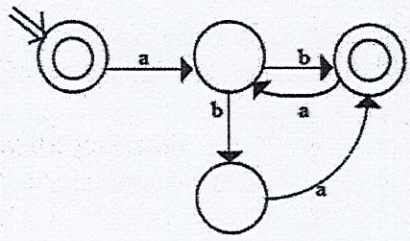
COURSE CODE(CREDITS): 25B11CI315 (3) MAX. MARKS: 75

COURSE NAME: Theory of Computation

COURSE INSTRUCTORS: ARV*, MNK, NSA, RMS, SKS, SMA MAX. TIME: 2 Hours

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	Design a CFG for the language L (G) = {ww^r: w ε {0, 1} *}	2	7
Q2	Find a regular expression for a corresponding state diagram. 	1	8
Q3	Show that L = {w ε $\sum^*$: n_a (w) < n_b (w)} is not regular (where $\sum$ = {a, b}).	2	8
Q4	Design a PDA for the following CFG: Let G = (V, $\sum$, R, S), where V = {(,), S}, $\sum$ = {(,)}, R = { S → ε, S → SS, S → (S) }	3	7
Q5	Design a PDA for the following language: L = {$a^n b^{2n}$: n > 0}	3	7
Q6	a) Design a Turing Machine that accepts the language of all strings which contain aba as a substring. b) Design a Turing Machine which finds the 2's complement of a binary number.	4	15
Q7	Write short notes on the following: a) Multiple tapes Turing Machine. b) Multiple heads Turing Machine.	5	8
Q8	a) Find regular expressions representing the set of all strings over {a, b} in which the number of occurrences of a is divisible by 5.	1, 2, 3, 4, 5	15

b) Find the Cartesian Product for the following:
$2^{\{1,2\}} \times \{1, 2\}$

c) Consider the language $L = a^n b^m c^m$. Which of the following strings are not in L?
(a) ε **(b)** ab **(c)** c **(d)** aabc

d) Describe in English, as briefly as possible, the following (in other words, describe the language defined by regular expression):
L (((a*a) b)* b)

e) Consider the language $L = \{a^m b^{2n} c^{3n} d^p : p > m$, and m, $n \geq 1\}$. What is the shortest string in L?

f) Write the regular expression for the language
$L = \{w : |w| \bmod 3 = 0\}$ where $w \in \{a, b\}^*$

g) Present a context-free grammar that generates Φ, the empty language.

h) Can we design a Finite state Machine from a grammar which is not regular?

i) Write a regular expression for the language of all strings ending with 1 and don't contain 00.

j) If a CFG is S→ SbS | a, show that G is ambiguous.

k) In the definition of a Turing machine, we allow rewriting a tape square without moving the head and moving the head left or right without rewriting the tape square. What would happen if we also allowed to leave the head stationary without rewriting the tape square?

l) If a language is accepted by a PDA, then it is regular language. Justify, whether this statement is True/False.

m) Suppose that L is a context free language and R is regular. Is L – R necessarily be context free?

n) Consider the following grammar (the start symbol is S; the alphabets are implicit in the rules):
S --> SS | AAA | ε
A --> aA | Aa | b
Describe the language generated by this grammar.

o) Given a context-free grammar generating L, every string in L has a right-most derivation. Justify, whether this statement is True/False.