ASSIGNMENT-I

Course Name: Automata Theory & Compiler Design **Course Code: IT3202**

1. Construct a DFA with minimum number of states, accepting all strings over {a, b} such that the number of a's is divisible by two and the number of b's is divisible by three.
2. Draw a DFA which accepts all strings over {a, b} such that no string has three consecutive occurrences of the letter b.
3. Design a DFA to recognize all strings over {a,b} such that L={awa : w ϵ {a,b}*}.
4. Design a DFA for Σ = {a, b} that can accept all strings with no more than three a's.
5. Find DFA for the following languages on Σ = {a, b}:
   a. L = {w : |w| mod 3 = 0
   b. L = {w : $n_a(w)$ mod 3 > $n_b(w)$ mod 3}
6. Consider the set of strings on {0,1}. Design a DFA to accept all strings where every 00 is followed immediately by a 1.
7. Suppose Σ = {0, 1, 2}. Draw a DFA for the language L = {w | the sum of digits in w is divisible by 5}.
8. Draw a DFA for L = {0^n1^m | m $\geq$ 1 , n $\geq$ 0 ; (n + m) is divisible by 3}.
9. Suppose Σ = {a, b}. Find a DFA for the set of strings w such that the number of occurrences of the substring ab in w equals the number of occurrences of the substring ba in w.
10. Construct a DFA accepting all strings w over Σ = {0, 1} such that the number of 1's in w is 3 mod 4.
11. Represent the following sets by regular expression:
    a. {1^{2n+1} | n>0
    b. {The set of all strings over {0,1} which has at most two zeros.
12. Construct a transition system corresponding to the following regular expressions:

a. (ab + c*)*b b. a + bb + bab*a
c. (ab + a)*(aa + b) d. (a*b + b*a)*a

13. Find the regular expressions representing the following sets:
    a. The set of all strings over {0,1} having at most one pair of 0's or at most one pair of 1's.
    b. The set of all strings over {a,b} in which the number of occurrences of a is divisible by 3.
    c. The set of all strings over {a,b} in which there are at least two occurrences of b between any two occurrences of a.
    d. The set of all strings over {a,b} with three consecutive b's.
14. Prove the following:
    a. (0*1*)* = (0 + 1)*
    b. (ab)* ≠ (a*b*)
    c. (r + s)* ≠ r* + s*
    d. λ + 1*(011)*(1*(011)*)* = (1 + 011)*
15. Construct R.E. using Arden's theorem from the following FA's:
    a.

	a	B
→q1	q1	q2
*q2	q3	q2
q3	φ	φ

    b.

	0	1
→* q1	q1	q2
q2	q3	q2
q3	q1	q2

16. Consider the grammar-

S → bB / aA
A → b / bS / aAA
B → a / aS / bBB

For the string w = bbaababa, find-

1. Leftmost derivation
2. Rightmost derivation
3. Parse Tree

17. Consider the following grammar and eliminate left recursion-

A → ABd / Aa / a
B → Be / b

18. Consider the following grammar and eliminate left recursion-

S → A
A → Ad / Ae / aB / ac
B → bBc / f

19. Do left factoring in the following grammar-

S → aAd / aB
A → a / ab
B → ccd / ddc

20. Check whether the given grammar is ambiguous or not-

S → SS
S → a
S → b

21. Consider the given grammar-

E → E + T / E – T / T
T → T x F / T ÷ F / F
F → G ↑ F / G
G → id

Evaluate the following expression in accordance with the given grammar-

2 x 1 + 4 ↑ 2 ↑ 1 x 1 + 3

22. Removal of Useless Symbols

T → xxY | xbX | xxT
X → xX
Y → xy | y

$Z \rightarrow xz$

23. Remove the ε production from the CFG given below by preserving its meaning.

$S \rightarrow ABA$
$A \rightarrow 0A \mid \varepsilon$
$B \rightarrow 1B \mid \varepsilon$

24. Removing Unit Productions:

$S \rightarrow 0X \mid 1Y \mid Z$
$X \rightarrow 0S \mid 00$
$Y \rightarrow 1 \mid X$
$Z \rightarrow 01$

25. Convert the given CFG to CNF. Consider the given grammar G:

$S \rightarrow a \mid aA \mid B$
$A \rightarrow aBB \mid \varepsilon$
$B \rightarrow Aa \mid b$