module - 1

1) Define the following terms with Example : [8m]

a) Alphabet. b) string. c) Power of an alphabet.

d) String Concatenation. e) Language.

f) Concatenation at Languages.

2) Design DFSM. [10marks]

1. To accept strings having odd number of a's & odd number of b's. Imp

2. To accept strings having no. of a's divisible by 5 and number of b's divisible by 3.

3. $L = \{ w \in \{0,1\}^* :$ w does not Ending 01 $\}$ Imp

4. $L = \{ w \in \{a,b\}^* :$ Every a in w is immediately preceded & followed by b $\}$

5. To accept $L = \{ w(ab+ba) \mid w \in \{a,b\}^* \}$

6. To accept $L = \{ wbab \mid w \in \{a,b\}^* \}$

7. To accept strings over $\{a,b\}$ such that Each block of 5 (length five) consecutive symbols have atleast two a's. Imp

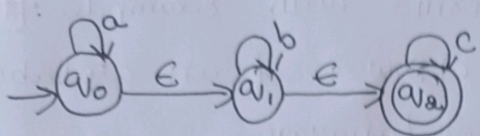
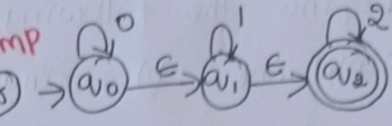
8. To accept strings having Even no of a's & even no of b's.

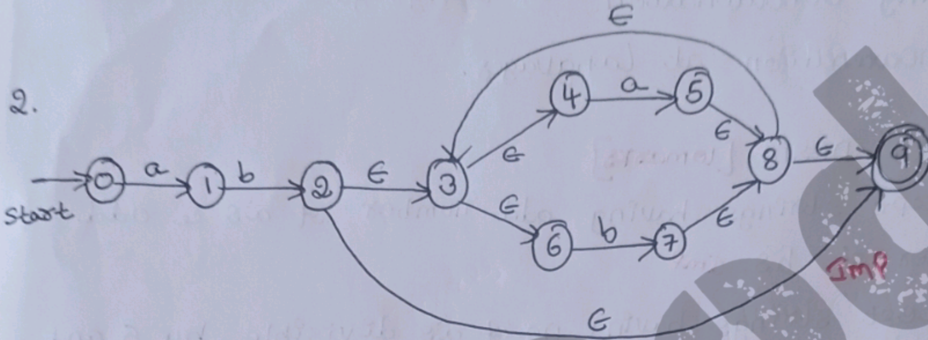
9. To accept binary numbers divisible by 5 Imp

10. obtain a DFA to accept the language $L = \{ w : |w| \bmod 5 \neq 0 \}$ on $\Sigma = \{a, b\}$.

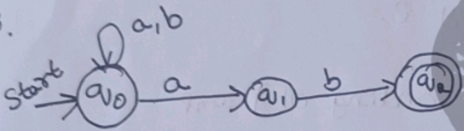
Convert the following ε-NDFSM of DFSM

[εNFA to DFA Conversion]

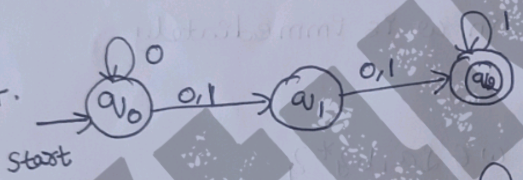
1.  Imp (or) 

2. 

Imp

3.  accept {NFA to DFA}

10marks or 8marks

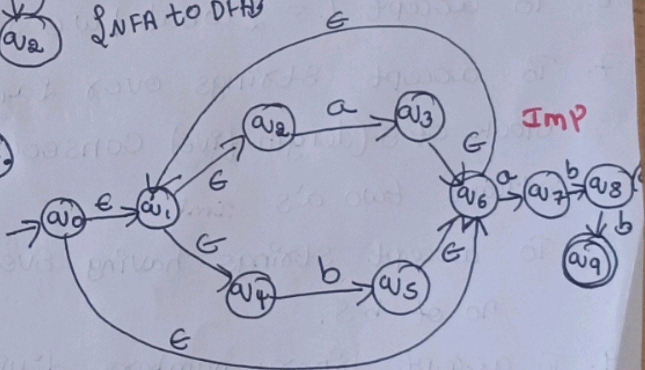
4.  accept {NFA to DFA}

5.  {NFA to DFA}

6. Imp

δ_D	0	1
→P	{P, Q}	{P}
Q	{R}	{R}
R	{S}	φ
*S	{S}	{S}

{NFA to DFA}

7. 

Imp

minimization Problems [Distinguishable & Indistinguishable] ②

1.

δ	a	b
→A	B	E
B	C	F
*C	D	H
D	E	H
E	F	I
*F	G	B
G	H	B
H	I	C
*I	A	E

8marks or 10marks

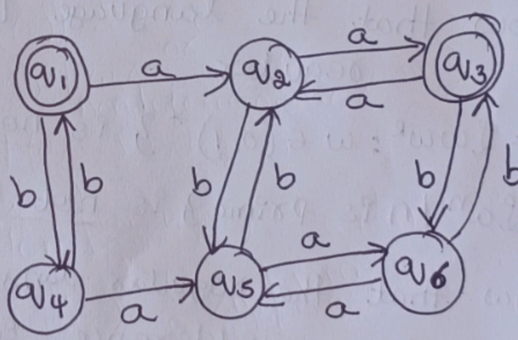
2. Imp

δ	0	1
→A	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	F
H	G	C

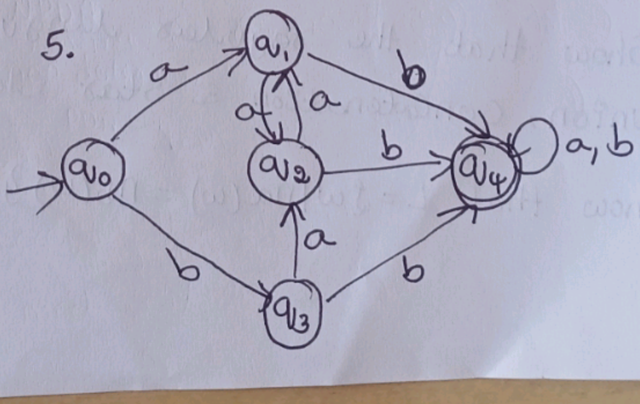
3.

δ	0	1
→A	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

4. Imp



5.



module - 2

1. State & prove pumping lemma theorem for regular languages. Show that $L = \{a^n b^n \mid n \geq 0\}$ is not Regular. [10marks] Imp

2. Show that regular languages are closed under Complement and intersection. 5m/7m

3. Using Kleen's theorem. prove that for any regular Expression R, their exits a finite automata $M = \{Q, \Sigma, \delta, q_0, F\}$ which accepts $L(R)$. [10marks]

OR

4. Prove Kleen's theorem. Any language that can be defined with a regular Expression can be accepted by some FSM & so is regular.

5. Show that the language $L = \{a^i b^j \mid i > j\}$ is not regular.

6. $L = \{ww^R : w \in (0,1)^*\}$ is not regular. 3m

7. $L = \{a^n \mid n \text{ is prime}\}$ is not regular 3m

8. Show that the regular languages are closed under homomorphism, difference & complementation 5m

9. Show that the regular languages are closed under union, concatenation & star closure. 5m

10. Show that $L = \{w \mid n_a(w) = n_b(w)\}$ is not regular. 3m

Obtain Regular Expression for the following languages. (3)

1. $L = \{a^n b^m c^p \mid n \le 4,\ m \ge 2,\ p \le 2\}$ Imp
2. $L = \{w : |w| \bmod 3 = 0\ \&\ w \in \{a,b\}^*\}$ (8m)
3. $L = \{a^n b^m \mid m+n$ is even$\}$
4. $L = \{w : n_a(w) \bmod 3 = 0$ where $w \in (a,b)^*\}$ Imp
5. $L = \{a^{2n} b^{2m} \mid n \ge 0,\ m \ge 0\}$
6. $L = \{w :$ strings ends with ab or ba where $w \in \{a,b\}^*\}$
7. $L = \{a^n b^m \mid n \ge 4,\ m \le 3\}$
8. $L = \{0^n 1^m \mid m \ge 1,\ n \ge 1\ \ mn \ge 3\}$
9. $L = \{w \in \{a,b\}^* :$ string with atmost one pair of consecutive a's$\}$ Imp
10. $L = \{a^n b^m \mid m \ge 1,\ n \ge 1,\ nm \ge 3\}$

Obtain an NFA for the Regular Expression (8m)

1) $a^* + b^* + c^*$ Imp
2) $(a+b)^* aa (a+b)^*$ Imp
3) $(0+1)^* 01 (0+1)^*$
4) $0^* 1^* + (0+1)^* 01$

{ є-NFA Constrn }

module 4

Push Down Automata. [PDA]

1. What is NPDA? Design NPDA for language $L = \{a^n b^n \mid n \geq 1\}$. Draw transition diagram. write sequence of moves made by NPDA to accept the string aaabbb. Imp

2. Design a PDA for the language. Imp
$L = \{wcw^R \mid w \in (a,b)^*$ where w^R is reverse of $w\}$ and show the moves made by PDA for the string "aabcbaa" & "abacbba".

3. Is the PDA to accept the language $L = \{ww^R \mid w \in (a+b)^*\}$ is deterministic?

4. Is the PDA to accept the language $L = \{a^n b^{2n} \mid n \geq 1\}$ is deterministic? or nondeterministic?

PDA problem Imp

8m / 10m

DPDA [deterministic PDA]

NPDA [non-deterministic PDA]

Module - 3

④

1. Define Context free grammar. Design CFG for the following language.

   i) $L = \{0^i 1^j \mid i \neq j \geq 0, j \geq 0\}$ Imp

   ii) $L = \{a^n b^m \mid n \geq 0, m > n\}$

   iii) $L = \{0^m 1^m 2^n \mid m \geq 1 \text{ and } n \geq 0\}$ Imp

   iv) $L = \{ww^R \mid w \in (a,b)^*\}$

   v) $L = \{a^n b^m c^k \mid n+2m = k \text{ for } m \geq 0 \text{ \& } n \geq 0\}$

   vi) $L = \{w : |w| \bmod 3 = 0\}$ over $\Sigma = \{a\}$ Imp

   VII) $L = \{a^n b^m c^k : m = n+k\}$ over $\Sigma = \{a,b,c\}$

   VIII) $L = \{w : w$ has a substring $ab\}$

8m/6m

2. Define Ambiguity. Consider the grammar Imp.

   $E \to E+E \mid E*E \mid (E) \mid id$

   Find LMD & RMD derivations & Parse tree for the string $id + id * id$. Show that the grammar is ambiguous.

10/8 marks

3. Define Leftmost derivation. Rightmost derivation and Parse tree. Consider the grammar.

   $S \Rightarrow AbB$ $\quad A \Rightarrow aA \mid \epsilon$

   $B \Rightarrow aB \mid bB \mid \epsilon$ $\quad D \Rightarrow a \mid \epsilon$

   Obtain LMD, RMD & Parse tree for the string "aaabab".

4. Define Ambiguity. Consider the grammar
$E \to E+E \mid E-E \mid E*E \mid E/E \mid a/b$ Find LMD & RMD Parse tree for the string a+b*a+b. Show that the grammar is ambiguous. Imp

5. Is the following grammar ambiguous?

1) $S \to aB \mid bA$
$A \to aS \mid bAA \mid a$
$B \to bS \mid aBB \mid b$
String "aabbab"

2) $S \to iCtS \mid iCtSeS \mid a$
$C \to b$
String "ibtibtaea"

3) $S \to 0S1S \mid 1S0S \mid \epsilon$
String "0101"

6. Eliminate left recursion from the following grammar

1. $E \to E+T \mid T$ Imp
$T \to T*F \mid F$
$F \to (E) \mid id$

2) $S \to Ab \mid a$
$A \to Ab \mid Sa$

* Define left recursion?

7. Explain Chomsky Normal form? (CNF)

8. Define left factoring. Consider the following grammar Imp.

1. $S \to iEtS / iEtSeS / a$ $E \to b$
2. $S \to aSSbS / aSaSb / abb / b$
3. $S \to a / ab / abc / abcd$
4. $S \to aAd / aB$
$A \to a / ab$ $B \to ccd / ddc$

module - 5

5

1. Define Turing machine (TM)? Explain the Turing machine model Imp

2. Design the turing machine to accept the language $L = \{a^n b^n c^n \mid n \geq 1\}$. Draw the transition diagram & Shown the moves made by turing machine for the string "aabbcc". 10/12m

3. Explain various technique used for Construction of turning machine. 7m/8m

4. Explain the following: Imp

a) multitape Turing machine.

b) Non-deterministic TM

c) Linear bounded Automata (LBA)

d) post Correspondence problem

e) Quantum Computers

f) Church - Turing Thesis

g) Decidable & Undecidable language.

h) halting Problem.

i) P and NP classes.

j) Recursively Enumerable languages.

Short note questions for 20marks

Design of TM Problems

(6)

1. To accept the language $L = \{0^n 1^n 2^n \mid n >= 0\}$. Draw the transition diagram. write the sequence of moves made by ~~~~ TM for ~~a~~ string "001122" Imp

2. $L = \{0^n 1^n \mid n \geq 1\}$ string 0011 & 00111. [10marks]

3. $L = \{ww^R \mid w \in (a+b)^*\}$