Answer Section A and (either section B OR Section C (15 marks)).

Section A: 25 marks   Section B: 15 Marks   Section C: 15 Marks

Section A

A1: a) Answer each part as True or False (5 marks)

1. Every algorithm that decides any CFG is a member of P
2. Every multitape Turing machine (TM) has an equivalent single-tape Turing machine.
3. The complement of a recursively enumerable language is always not TM decidable.
4. The collection of decidable languages is closed under the union operation.
5. The language A= {0n1n|n>=0} is a member of SPACE(log n).

3

Q	1	2	3	4	5
(T/F) T=True, F=False	T	F	T	T	F

b) Give an implementation-level description of a Turing machine that decides the language

$\{0^n1^n0^n \mid n \geq 0\}$ over the alphabet {0,1} **(5 marks)**

$L = \{0^n 1^n 0^n \mid n \geq 0\}$

let P is xy^iz, $i \geq 0$

Turing machine is 7-tuple

$\{Q, \Sigma, \Gamma, \delta, q_0, q_{accept}, q_{reject}\}$

$Q \to$ set of state

$\Sigma \to$ input ~~alphabet~~ alphabet

$\delta \to$ transition function

$q_0 \to$ start state

$q_{accept} \to$ if the end accept

$q_{reject} \to$ ifthe end reject

2

A2 a. Let A_{REX} = {⟨R,w⟩ | R is a regular expression that generates string w}.

Prove that A_{REX} is decidable (5 marks)

NFA

1- convert RE R to DFA A
2. Run M on the theorem A_{DFA} on input <A,w>
3. If M accepts, accept otherwise reject.

5

theorem A_{DFA} Prove:
M = on input <A,W> A is a DFA and w is a string
1- Simulate A
2- If the simulation ends accepts, accept.
If it ends nonaccepts, reject.

b. Analyze the space complexity of the SAT problem. (5 marks)

for space complexity, SATIVTCH THEOREM shows that any nondeterministic TM that uses f(n) and can convert to deterministic that uses only $f^2(n)$

Q[illegible]: Give a high level description of a Turing machine that adds two binary numbers. (5 marks)

high level description of a Turing machine

and the turing machine have 7-tuple

$\{Q, \Sigma, \Gamma, \delta, q_0, q_{accept}, q_{reject}\}$

$Q \to$ set of state

$\Sigma \to$ input alphabet

$\delta \to$ transition function

$q_0 \to$ start of state

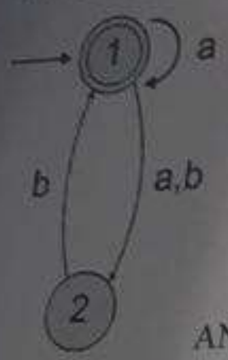
$q_{accept} \to$ if the end accept

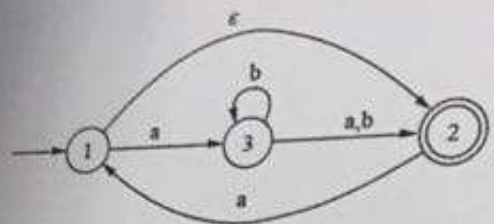
$q_{reject} \to$ if the end reject

Section II

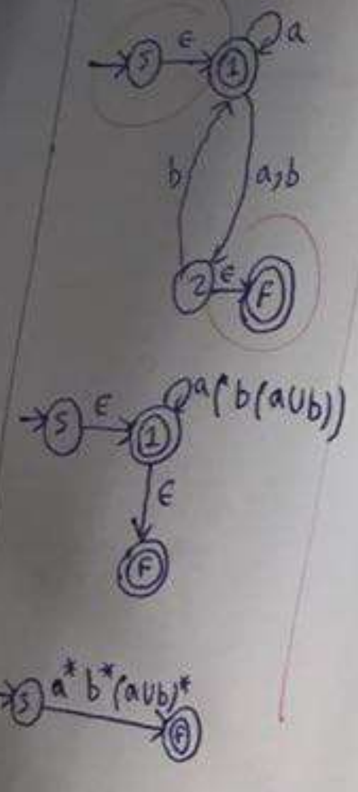
1. Find the language recognized by the union of the following two finite automata (6 Marks)

X





AND



2

[illegible] that $\Sigma = \{0,1\}$, construct a language for $\overline{\Sigma^{*}}$ [illegible] (6 Marks)

Convert the following NFA into its equivalent DFA ([illegible] Marks)

	a	b	ε
→1	∅	2	[illegible]
2	[illegible]	3	2
3	1	∅	3

	a	b
→[illegible]	1	2
1	∅	2
2	[illegible]	3
[illegible]	[illegible]	3
3	1	∅
[illegible]		

2

...the pumping lemma to show that the language $C = \{w \mid w$ has an equal number of 0s and 1s$\}$
...t regular (5 Marks)

$S \to 0S1 \mid \epsilon$

0011

and Proof of pumping lemma:

let $n = F(G)^{|N|+1}$

$w = L(G)$, $w \geq n$

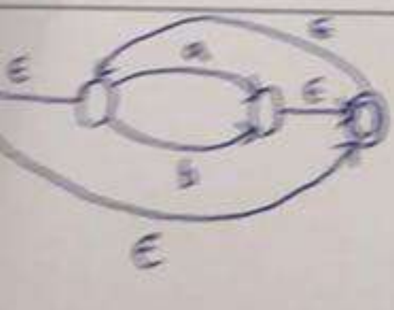
Let T is be pars of tree , the smallest hight

Let P is be path of length h, h is the hight of T

Since $w \geq F(G)^{|N|+1}$ and the length of $P \geq |v|+1$

and number of nodes in P is at least $|v|+2$

...ert the regular expression $(a \cup b)^*$ to an NFA. (6 Marks)

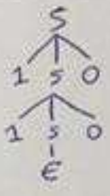


3. find a DFA that can accepts the language $\{(10)^n \mid n \geq 0\}$ (3 Marks)

language $\{1^n 0^n \mid n \geq 0\}$

$S \to 1S0 \mid \epsilon$

1100



10 ✓
1100 ✓
111000 ✓