Nationa

Theory of Automata
CS-3005

Course Instructor(s):
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ections A,B,C,D,E,H,G,J,K

[redacted] Roll No [redacted] Course Section [redacted] Student Signature

Sessional-II Exam

otal Time (Hrs): 1
otal Marks: 60
otal Questions: 3

ate: Nov 5, 2024

ructions : Attempt all questions on answer sheet and properly mention the question number, otherwise it will not narked.
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empt all the questions.

LO 1 : Identify formal language classes and prove language membership properties]

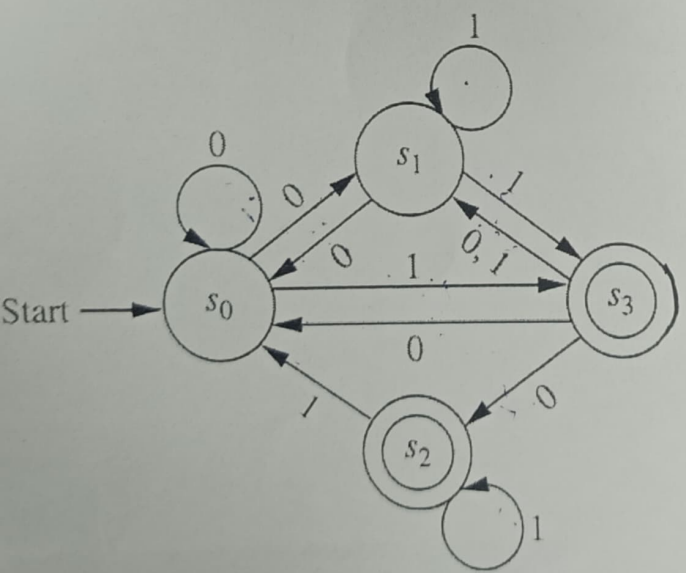
estion 1:Show that L= $\{a^n b^k c^{n+k} : n>=0,\ k>=0\}$ is not regular, by using the pumping lemma orem.

[10 Marks]

LO 2: Differentiate and manipulate formal descriptions of languages, automata and mmars with focus on non-regular, regular, context-free languages using automata (DFA, A, PDA) and Turing Machines.]

estion 2: *[30 Marks]*

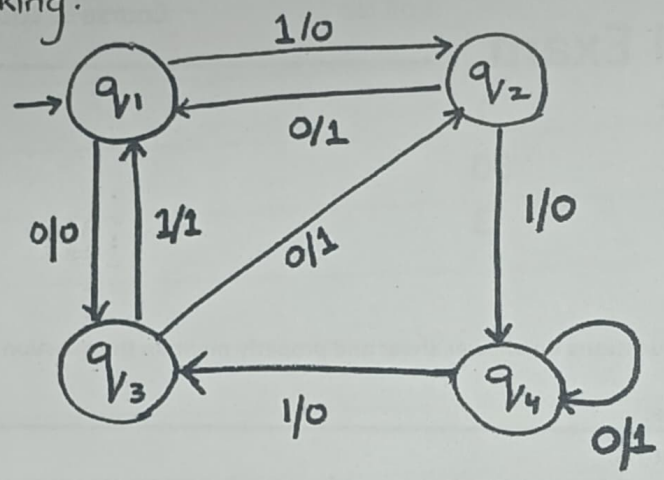
a. *[10 Marks]* Design cfg for the language L = { a^n b^n a^m b^t a^t b^m | n,m>=0 , t>0},
b. *[10 Marks]* Design cfg for equal number of a's and b's in string.
c. *[10 Marks]* Convert the following NFA to DFA? Show the complete working.



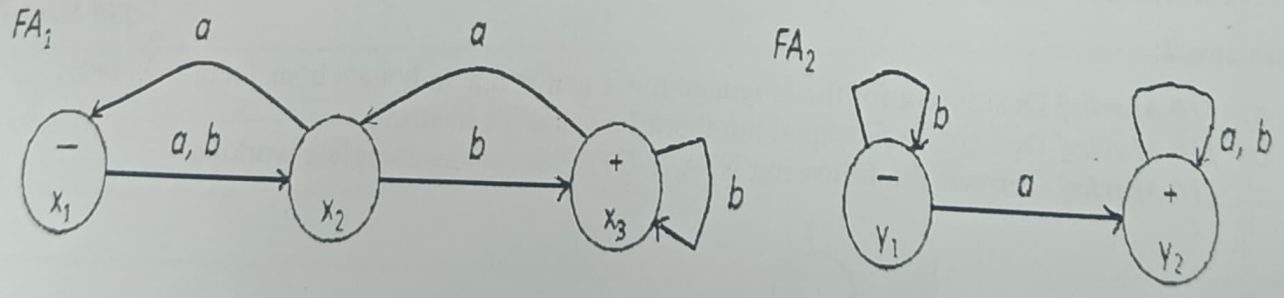
[CLO 3: Prove and disprove theorems establishing key properties of formal languages and automata]

Question 3: *[20 Marks]*

a. ***[10 Marks]*** Convert the following Mealy Machine into Moore Machine. Show the complete working.



b. ***[10 Marks]*** Let r1 and r2 be regular expressions and FA1 and FA2 be finite automata that accept exactly the languages defined by r1 and r2 respectively. By applying kleene's theorem, build another FA that accepts all the words of the language defined by r1+r2. Show the complete working.



Question #01

$$L = \{a^n b^k c^{n+k} : n >= 0, k >= 0\}$$

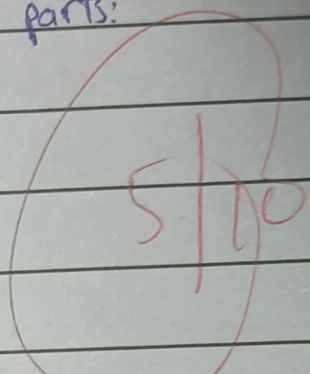
To prove its irregularity,

Let $n = 2$ and $k = 2$, (can be any number)

The string will be = aa bb cccc

Let's divide it into 3 parts:

aa , bbc , ccc



=> aa bbc ccc

x y z

Lets pump y^i with $i = 2$

=> aa bbc bbc ccc

As the string formed $\notin L$ thus the string is not regular.

Question #02

(a)

$L = \{a^n b^n a^m b^t a^t b^{m+1} \mid n, m >= 0, t > 0\}$

CFG:

$S \rightarrow XY$

$X \rightarrow aXb \mid \lambda$

$Y \rightarrow aYb \mid Z$

$Z \rightarrow bZt \mid bt$

10

(b)

Equal number of a's and b's

CFG =

$S \rightarrow SaSSbS \mid SbSSaS \mid \lambda$

10

(c)

NFA to DFA

Transition table of given NFA:

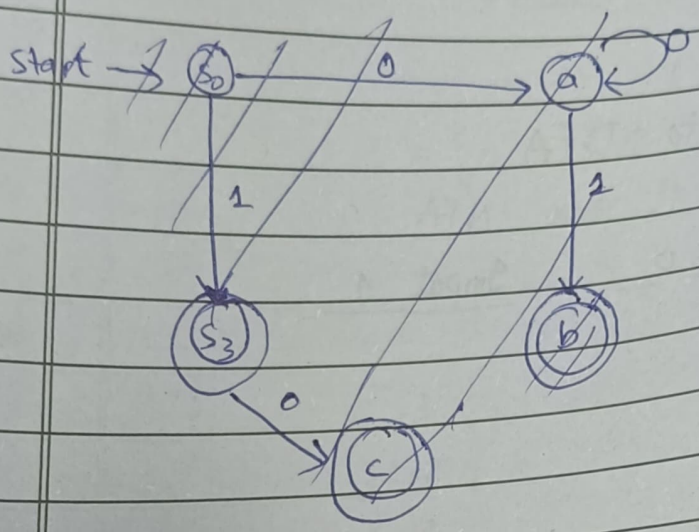
	States	Input 0	Input 1
→	S_0	$S_0 S_1$	S_3
	S_1	S_0	$S_1 S_3$
+	S_2	–	$S_2 S_0$
+	S_3	$S_0 S_1 S_2$	S_1

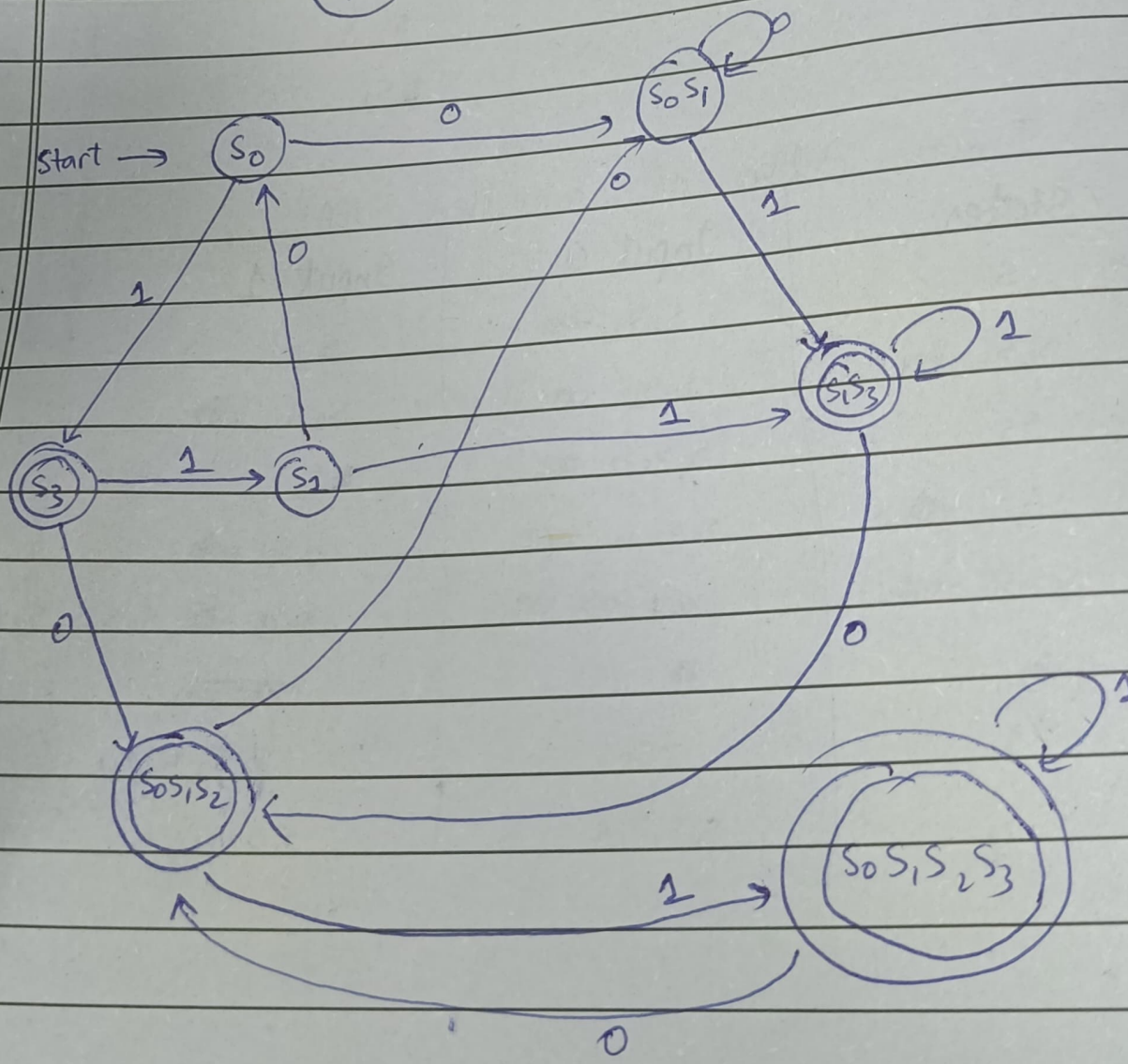
Transition table of converted DFA:

	States	Input 0	Input 1
→	S_0	$S_0 S_1$	S_3
	$S_0 S_1$	$S_0 S_1$	$S_1 S_3$
+	S_3	$S_0 S_1 S_2$	S_1
+	$S_1 S_3$	$S_0 S_1 S_2$	$S_1 S_3$
+	$S_0 S_1 S_2$	$S_0 S_1$	$S_0 S_1 S_3$
	S_1	S_0	$S_1 S_3$
+	$S_0 S_1 S_3$	$S_0 S_1 S_2$	$S_0 S_1 S_3$

10/10

Converted DFA



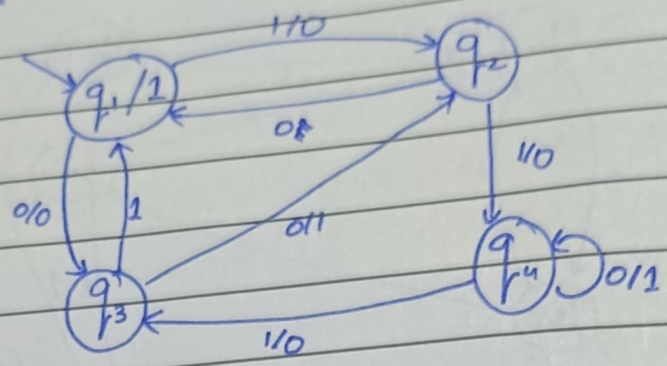


O/Part No.

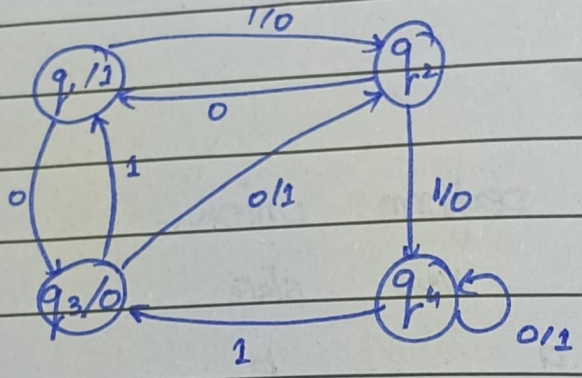
Question # 03

Part A :-

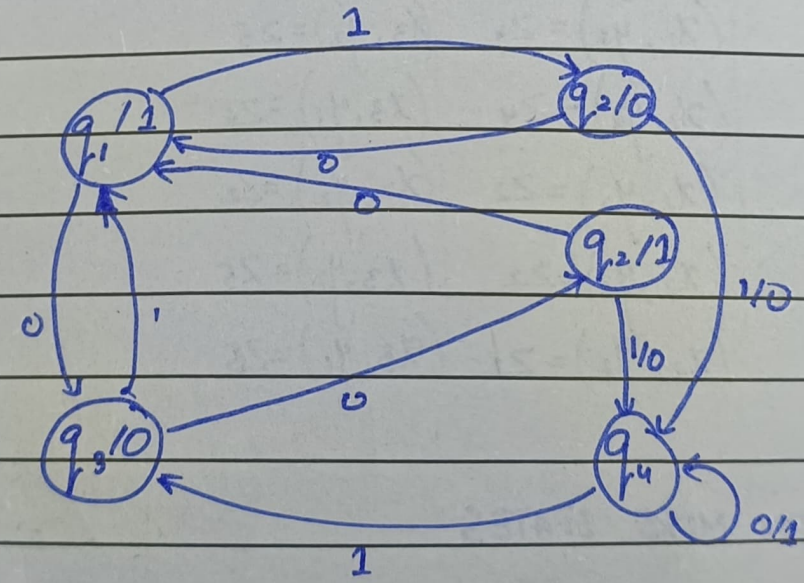
Step 1 :-



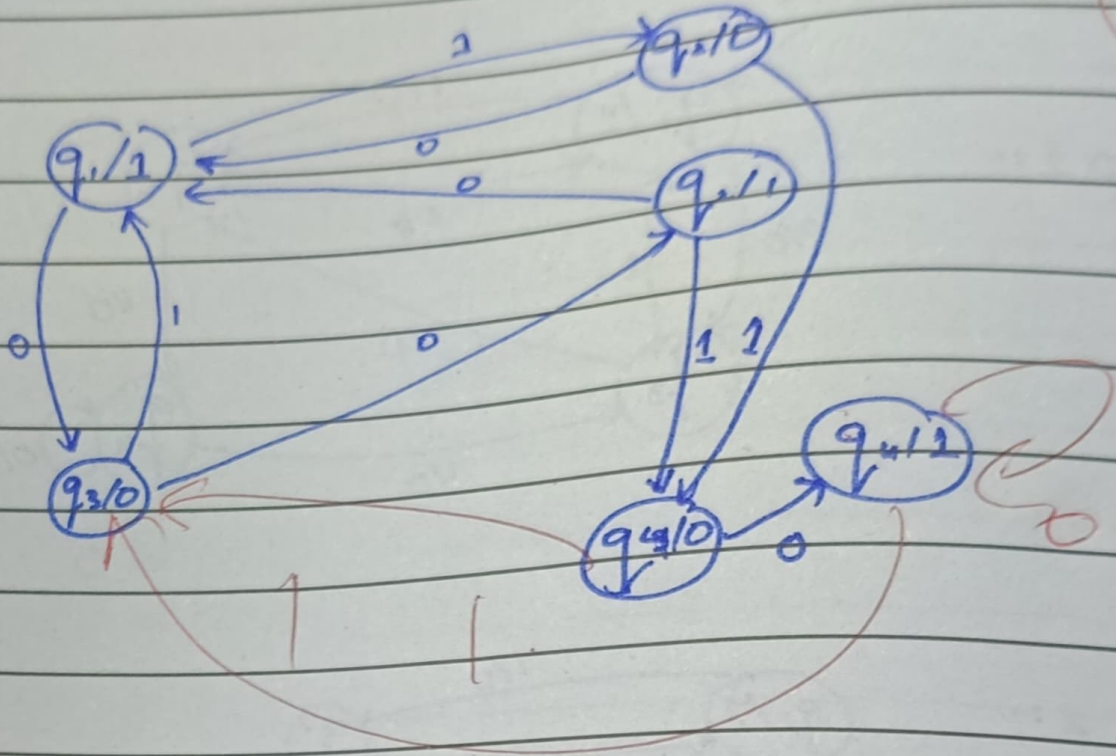
Step 2 :-



Step 3 :-



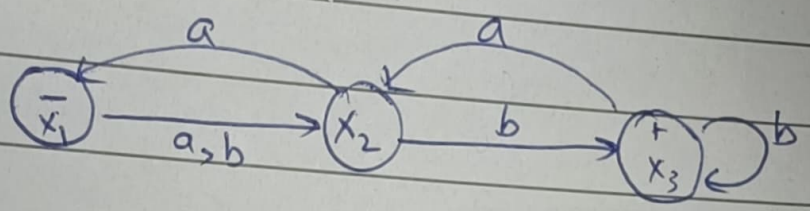
Step 4:



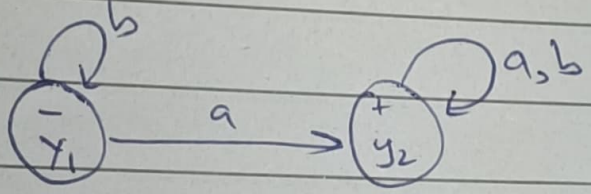
(b)

Union of FA_s

FA_1



FA_2



10 | 10

for FA_3, transition table:

States	"a"	"b"
→ $X_1Y_1 = Z_1$	$X_2Y_2 = Z_2$	$X_2Y_1 = Z_3$
← $X_2Y_2 = Z_2$	$X_1Y_2 = Z_4$	$X_3Y_2 = Z_5$
$X_2Y_1 = Z_3$	$X_1Y_2 = Z_4$	$X_3Y_1 = Z_6$
+ $X_1Y_2 = Z_4$	$X_2Y_2 = Z_2$	$X_2Y_2 = Z_2$
+ $X_3Y_2 = Z_5$	$X_2Y_2 = Z_2$	$X_3Y_2 = Z_5$
+ $X_3Y_1 = Z_6$	$X_2Y_2 = Z_2$	$X_3Y_1 = Z_6$

Q/Part No.

$FA_1 + FA_2 = FA_3$: