

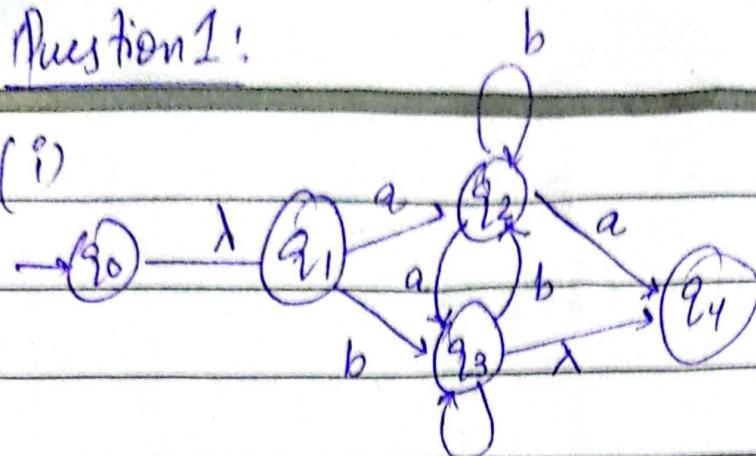
Assignment #02

21K-3192

Question 1:

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(i)



$$a \cdot b + aa^*b$$

$$\rightarrow q_0 \xrightarrow{\lambda} q_1 \xrightarrow{a+b} q_2 \xrightarrow{a+\lambda} q_4^*$$

$$\rightarrow q_0 \xrightarrow{\lambda(a+b)} q_1 \xrightarrow{b+a^*b} q_2 \xrightarrow{a+\lambda} q_4^*$$

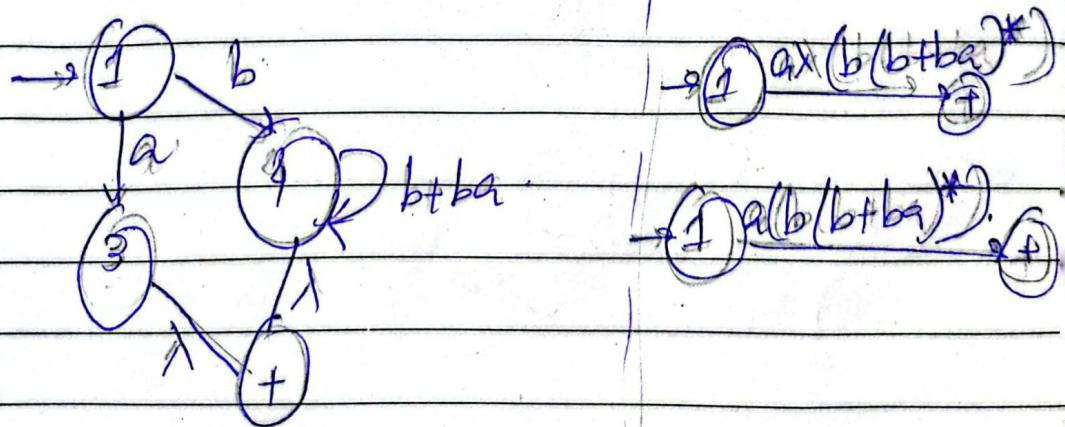
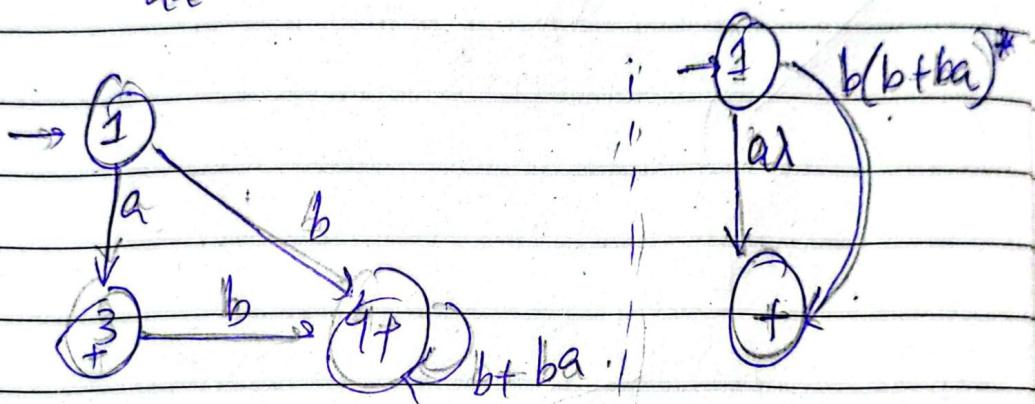
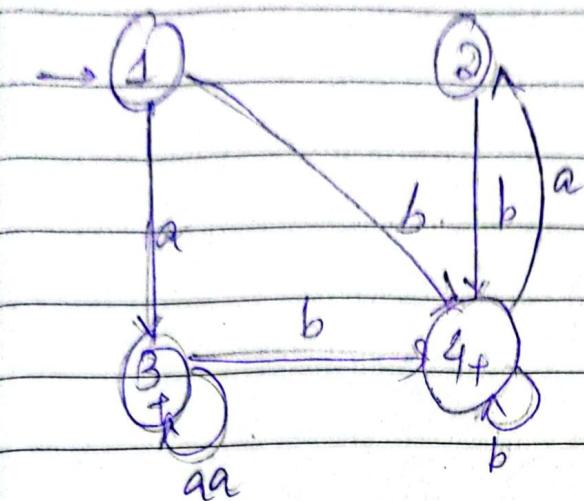
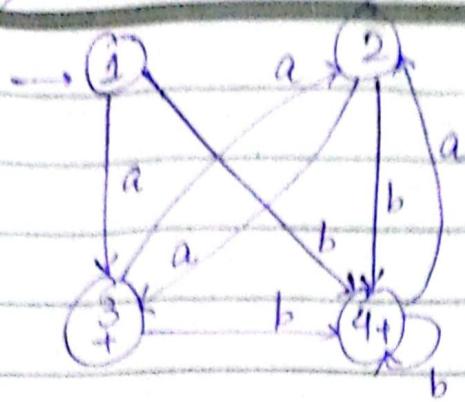
$$\rightarrow q_0 \xrightarrow{\lambda(a+b)(b+a^*b)^*(a+\lambda)} q_4^*$$

$$\rightarrow q_0 \xrightarrow{(a+b)(b+a^*b)^*(a)} q_4^*$$

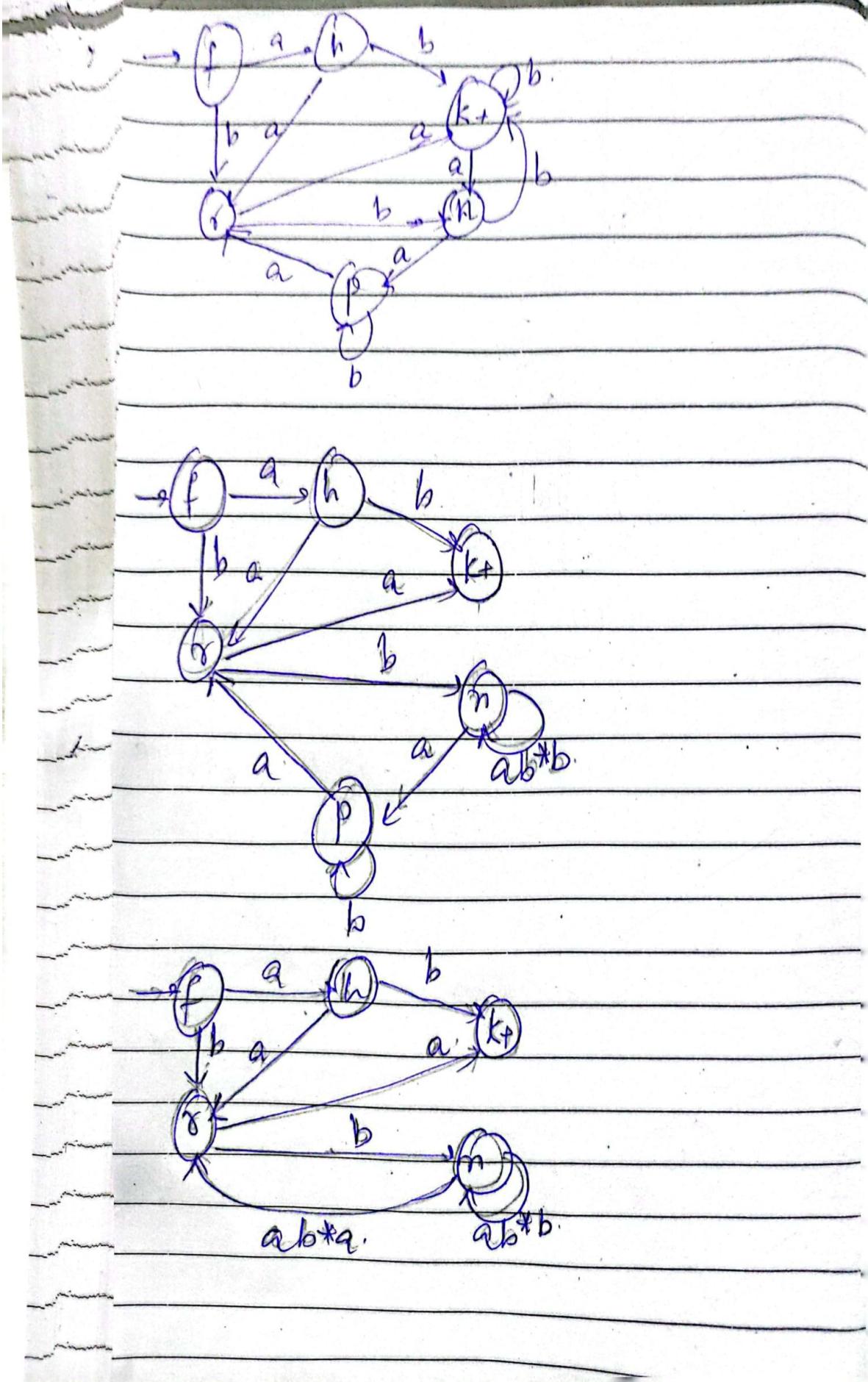
$$RE = (a+b)(b+a^*b)^*(a)$$

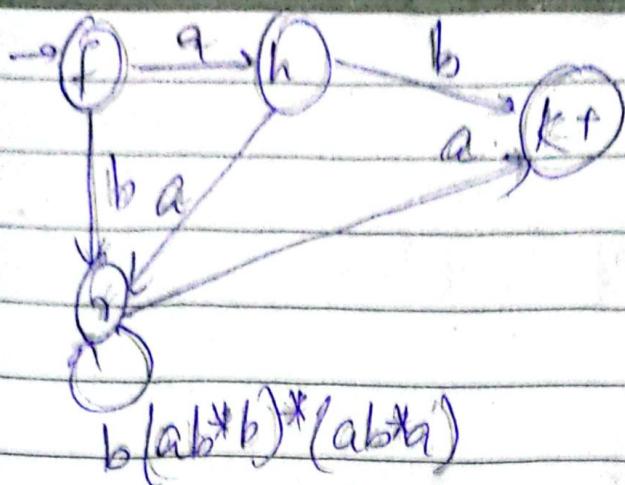
ii)

Date:

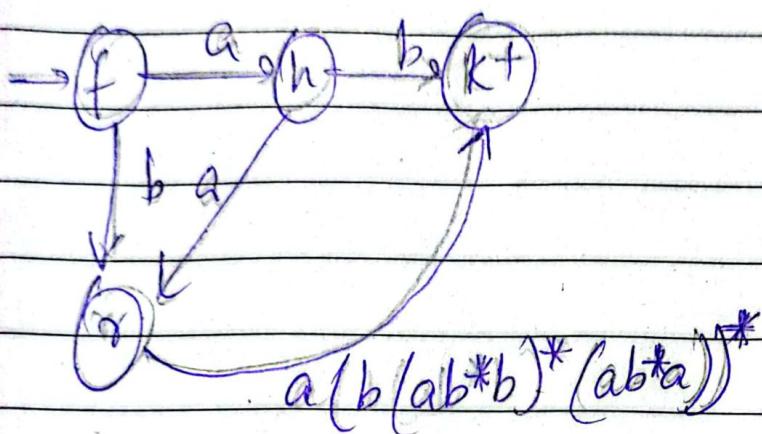


III).

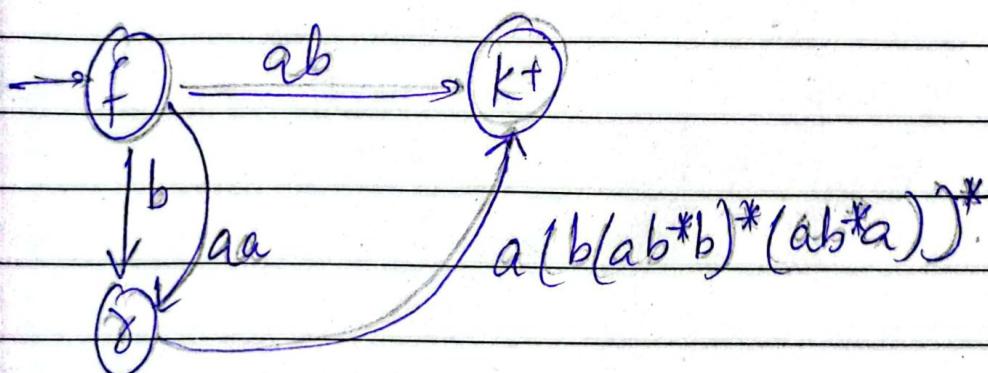




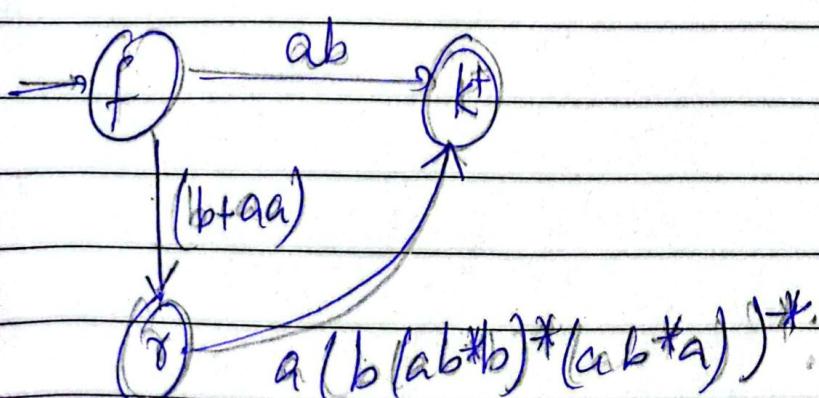
$$b(ab^*b)^*(ab^*a)$$



$$a(b(ab^*b)^*(ab^*a))^*$$



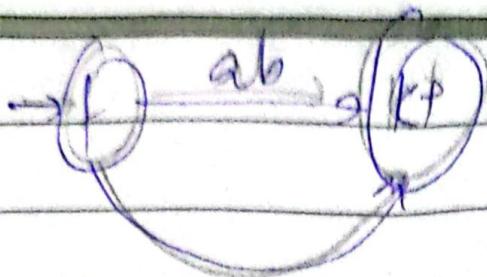
$$a(b(ab^*b)^*(ab^*a))^*$$



$$a(b(ab^*b)^*(ab^*a))^*$$

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$$(b+a^*)a(b(ab^*b)^*)^*(ab^*a)^*$$

$$\rightarrow \textcircled{1} \left[(b+a^*)a(b(ab^*b)^*)^*(ab^*a)^* \right] + ab \rightarrow \textcircled{K+}$$

b) Union

FA₁ old state

$$\rightarrow (x_1, y_1) = z_1$$

$$+ (x_2, y_2) = z_2$$

$$(x_1, y_3) = z_3$$

$$+ (x_2, y_4) = z_4$$

$$+ (x_1, y_4) = z_5$$

a

$$(x_2, y_2) = z_2$$

$$(x_2, y_4) = z_4$$

$$(x_2, y_2) = z_2$$

$$(x_2, y_4) = z_4$$

$$(x_2, y_4) = z_4$$

b.

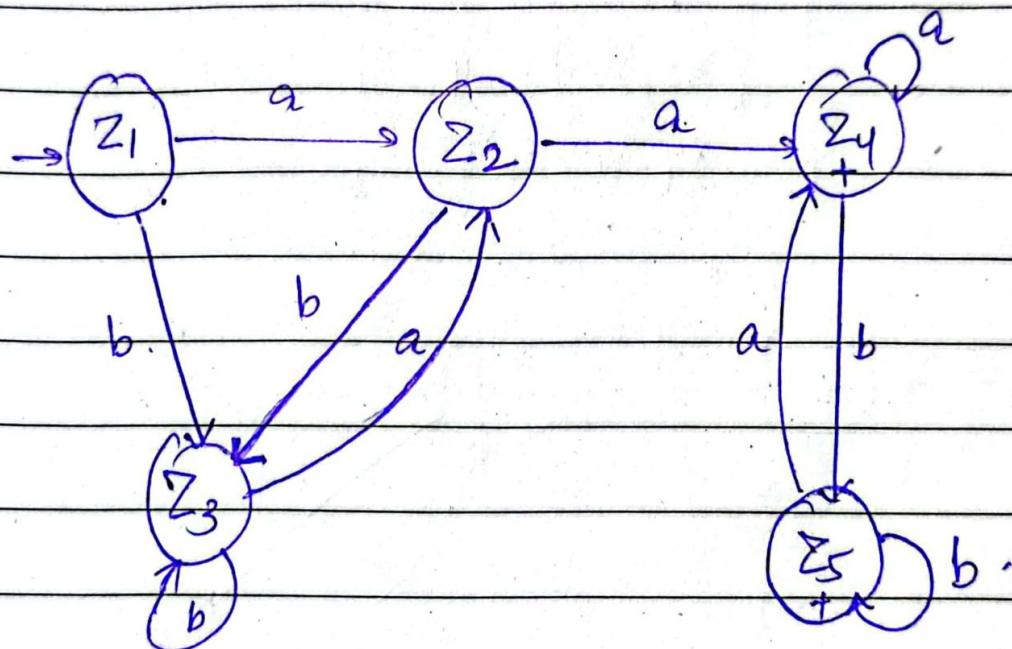
$$(x_1, y_3) = z_2$$

$$(x_1, y_3) = z_3$$

$$(x_1, y_3) = z_3$$

$$(x_1, y_4) = z_5$$

$$(x_1, y_4) = z_5$$



C) Concatenation:

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old states

$$\rightarrow (X_1) = Z_1$$

$$(X_2) = Z_2$$

$$+(X_3, Y_1) = Z_3$$

$$+(X_2, Y_2) = Z_4$$

$$(X_4, Y_1) = Z_5$$

$$(X_2, Y_1) = Z_6$$

$$+(X_4, Y_2) = Z_7$$

$$(X_2) = Z_2$$

$$(X_2) = Z_2$$

$$(X_2, Y_2) = Z_4$$

$$(X_2, Y_1) = Z_6$$

$$(X_4, Y_2) = Z_7$$

$$(X_2, Y_2) = Z_4$$

$$(X_4, Y_1) = Z_5$$

b.

$$(X_2) = Z_2$$

$$(X_3, Y_1) = Z_3$$

$$(X_4, Y_1) = Z_5$$

$$(X_3, Y_1) = Z_3$$

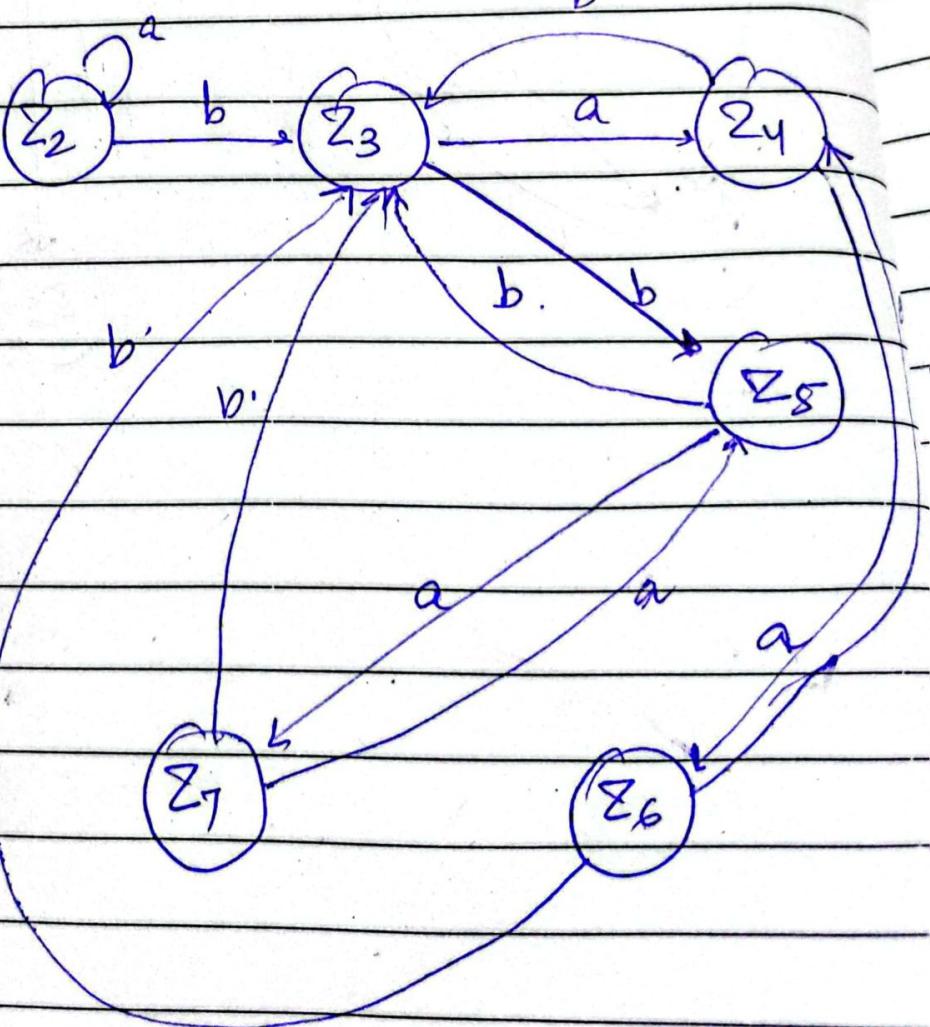
$$(X_3, Y_1) = Z_3$$

5.2

x

$p(x)$

\underline{x}



Question 2

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Date:

[1, 2, 3, 4, 5, 6, 7] [8, 9, 10, 11]

(1, 2) → same (1, 3) → same (1, 4) → same (1, 5)

1, a → 3]
2, a → 5] 3, a → 6] 4, a → 7] 5, a → 8]

1, b → 4] 1, b → 4] 1, b → 4] 1, b → 4]
2, b → 5] 3, b → 7] 4, b → 7] 5, b → 8]

1, c → 2] 1, c → 2] 1, c → 2] 1, c → 2]
2, c → 5] 3, c → 7] 4, c → 5] 5, c → 8]

(1, 6) → not same (1, 7) → not same

1, a → 3
6, a → 9
1, b → 4
6, b → 10
1, c → 2
6, c → 3

1, a → 3
7, a → 10
1, b → 4
7, b → 11
1, c → 2
7, c → 4

[1, 2, 3, 4] [5, 6, 7] [8, 9, 10, 11]

(2, 3) → same (2, 4) → same (2, 5) → same

2, a → 5
3, a → 6
2, b → 5
3, b → 7
2, c → 5
3, c → 7

2, a → 5
4, a → 7
2, b → 5
4, b → 7
2, c → 5
4, c → 5

2, a → 5
3, a → 6
2, b → 5
3, b → 7
2, c → 5
3, c → 7

[1, 2, 3, 4] [5, 6, 7] [8, 9, 10, 11]

(5, 6) → same (5, 7) → same (6, 7) → same

5, a → 11
6, a → 9
5, b → 8
6, b → 10
5, c → 2
6, c → ?

5, a → 11
7, a → 10
5, b → 8
7, b → 11
5, c → 2
7, c → 4

6, a → 9
7, a → 10
6, b → 10
7, b → 11
6, c → 3
7, c → 4

[1, 2, 3, 4] [5, 6, 7] [8, 9, 10, 11]

$(8,9) \rightarrow \text{save}$. $(8,10) \rightarrow \text{save}$. $(8,11) \rightarrow \text{save}$.

$8,a \rightarrow 11$	$8,a \rightarrow 11$	$8,a \rightarrow 11$
$9,a \rightarrow 10$	$10,a \rightarrow 9$	$11,a \rightarrow 11$
$8,b \rightarrow 5$	$8,b \rightarrow 5$	$8,b \rightarrow 5$
$9,b \rightarrow 6$	$10,b \rightarrow 7$	$11,b \rightarrow 7$
$8,c \rightarrow 7$	$8,c \rightarrow 7$	$8,c \rightarrow 7$
$9,c \rightarrow 7$	$10,c \rightarrow 7$	$11,c \rightarrow 7$

$(9,10) \rightarrow \text{save}$. $(9,11) \rightarrow \text{save}$. $(10,11) \rightarrow \text{save}$.

$9,a \rightarrow 10$	$9,a \rightarrow 10$	$10,a \rightarrow 9$
$10,a \rightarrow 9$	$11,a \rightarrow 11$	$11,a \rightarrow 11$
$9,b \rightarrow 6$	$9,b \rightarrow 6$	$10,b \rightarrow 7$
$10,b \rightarrow 7$	$11,b \rightarrow 7$	$11,b \rightarrow 7$
$9,c \rightarrow 7$	$9,c \rightarrow 7$	$10,c \rightarrow 7$
$10,c \rightarrow 7$	$11,c \rightarrow 7$	$11,c \rightarrow 7$

$[1,2,3,4]$ $[5,6,7]$ $[8,9,10,11] \rightarrow \text{again}$.

new fd -

$(1,2) \rightarrow \text{not save}$. $(1,3) \rightarrow \text{not save}$. $(1,4) \rightarrow \text{not save}$.

$1,a \rightarrow 3$	$1,a \rightarrow 3$	$1,a \rightarrow 3$
$2,a \rightarrow 5$	$3,a \rightarrow 6$	$4,a \rightarrow 7$
$1,b \rightarrow 9$	$1,b \rightarrow 9$	$1,b \rightarrow 9$
$2,b \rightarrow 5$	$3,b \rightarrow 7$	$4,b \rightarrow 7$
$(1,c \rightarrow 2)$	$1,c \rightarrow 2$	$1,c \rightarrow 2$
$(2,c \rightarrow 5)$	$3,c \rightarrow 7$	$4,c \rightarrow 5$

$[1] [2,3,4] [5,6,7] [8,9,10,11]$.

$(2,3) \rightarrow \text{save}$. $(2,4) \rightarrow \text{save}$. $(3,4) \rightarrow \text{save}$.

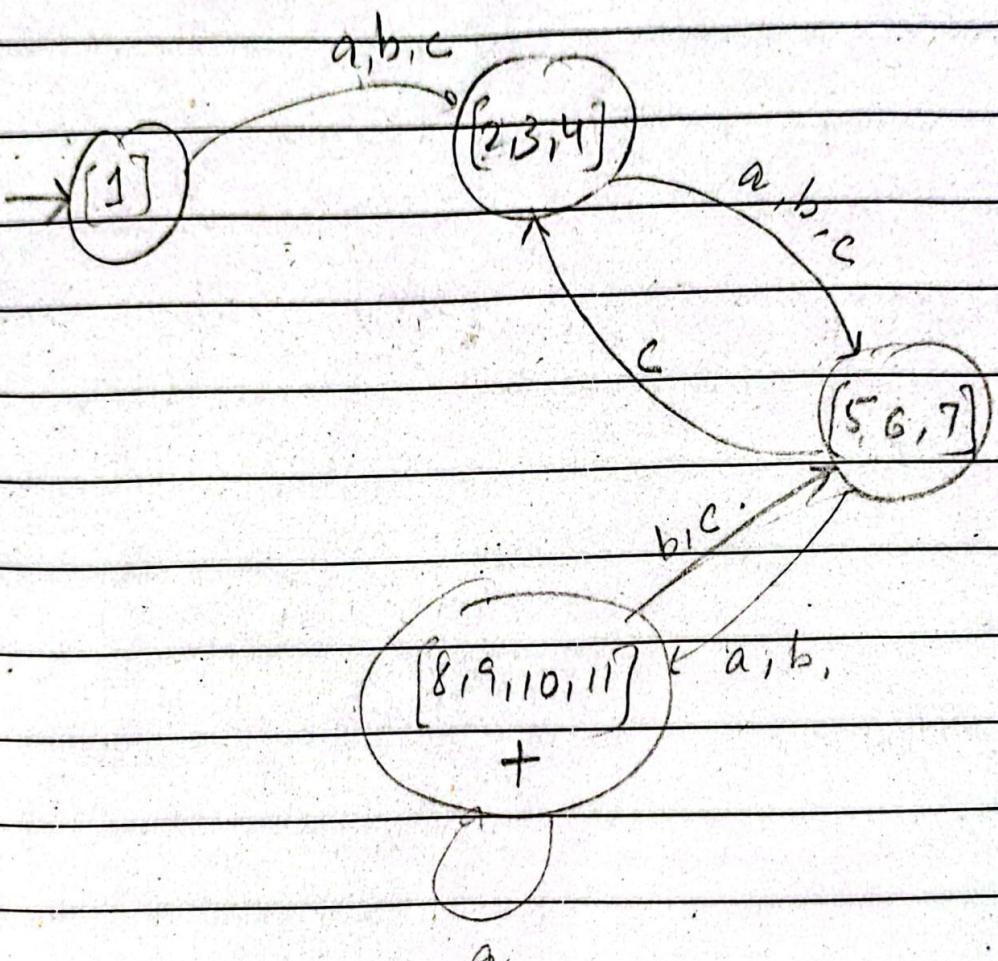
$2,a \rightarrow 3$	$2,a \rightarrow 5$	$3,a \rightarrow 6$
$3,a \rightarrow 6$	$4,a \rightarrow 7$	$4,a \rightarrow 7$
$2,b \rightarrow 5$	$2,b \rightarrow 5$	$3,b \rightarrow 7$
$3,b \rightarrow 7$	$4,b \rightarrow 7$	$4,b \rightarrow 7$
$2,c \rightarrow 5$	$2,c \rightarrow 5$	$3,c \rightarrow 7$
$3,c \rightarrow 7$	$4,c \rightarrow 5$	$4,c \rightarrow 5$

$[1] [2,3,4] - [5,6,7] [8,9,10,11]$.

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[5] [1, 2, 3] [5, 6, 7] [8, 9, 10, 11]



Question 3 :

a) $L_1 = \{0^i 1^j 2^k \mid i, j, k \geq 0 \text{ and either } i=j \text{ or } i=k\}$.

~~Suppose~~

Supposing $i > k$:

$w = \underbrace{011}_x \underbrace{2}_z \in L$

$y^2 = 011112 \in L$

$y^3 = 0111112 \in L$

\Rightarrow does not fail.

Supposing $i \neq j$:

$\underbrace{0122}_x \underbrace{2}_z \in L$

$y^2 = 01122 \notin L$

\hookrightarrow yes it is non

regular.

b) $L_2 = \{w \in \{0, 1, 2\}^* \mid$

$w = \underbrace{00122}_x \underbrace{2}_z \in L_2$

$y^2 = 0010122 \notin L_2 \rightarrow \text{non-regular.}$

c) $L_3 = \{0^n 1^n \mid n \leq m\}$.

$w = \underbrace{00111}_x \underbrace{111}_z \in L_3$.

$w = \underbrace{00111}_x \underbrace{111}_y$

$w = \underbrace{00111}_x \underbrace{11}_z$

$y^2 = 00011 \notin L_3 \rightarrow \text{not regular}$

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d) $L_4 = \{w \in \{0,1\}^* \mid w \text{ has more } 1's \text{ than } 0's\}$

$w = 1100$

$w = \underbrace{0 \ 1 \ 1}_{x \ y \ z} \in L_4$

$w = \underbrace{1 \ 0 \ 1}_{x \ y \ z} \notin L_4$

$y^2 = 0111 \in L_4$

$y^3 = 01111 \in L_4$

\vdots

$y^n = 011^n1 \in L_4$

\rightarrow does not failing.

$y^2 = 1001 \notin L$

\vdots

not regular,

e) $L_5 = \{0^n \mid n \geq 0\}$

$w = 0^m = 0^1 = 0 \in L$

for $n \geq 2$.

$w = \underbrace{0 \ 0 \ 0 \ 0}_{x \ y \ z} \in L$

$y^2 = 0 \ 0 \ 0 \ 0 \ 0 \notin L$