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2K19/CO/319

DIGITAL ELECTRONICS
ASSIGNMENT - 2

Q1

Clock Pulse	Register Contents	Next Operation
0	01001100	Shift left
1	10011000	Shift right
2	01001100	Shift right
3	00100110	Shift right
4	00010011	Shift left
5	00100110	Shift left
6	01001100	Shift right
7	00100110	Shift left
8	01001100	Shift right
9	00100110	Shift left
10	01001100	Shift left
11	10011000	

Q2 Sequence: 00, 10, 01, 11, 00

i) Using J-K FF

Since all numbers are 2 bit so therefore we need 2 JK flip flop.

	Present State		Next State		FF			
	A	B	A	B	J_A	K_A	J_B	K_B
0	0	0	1	0	1	X	0	X
1	1	0	0	1	X	1	1	X
2	0	1	1	1	1	X	X	0
3	1	1	0	0	X	1	X	1

$J_A \rightarrow$

A \ B	$\bar{B}$	B
$\bar{A}$	1 (0)	1
A	X (2)	X (3)

$\Rightarrow J_A = 1$

$K_A \rightarrow$

A \ B	$\bar{B}$	B
$\bar{A}$	X (0)	X (1)
A	1 (2)	1 (3)

$\Rightarrow K_A = 1$

J_B

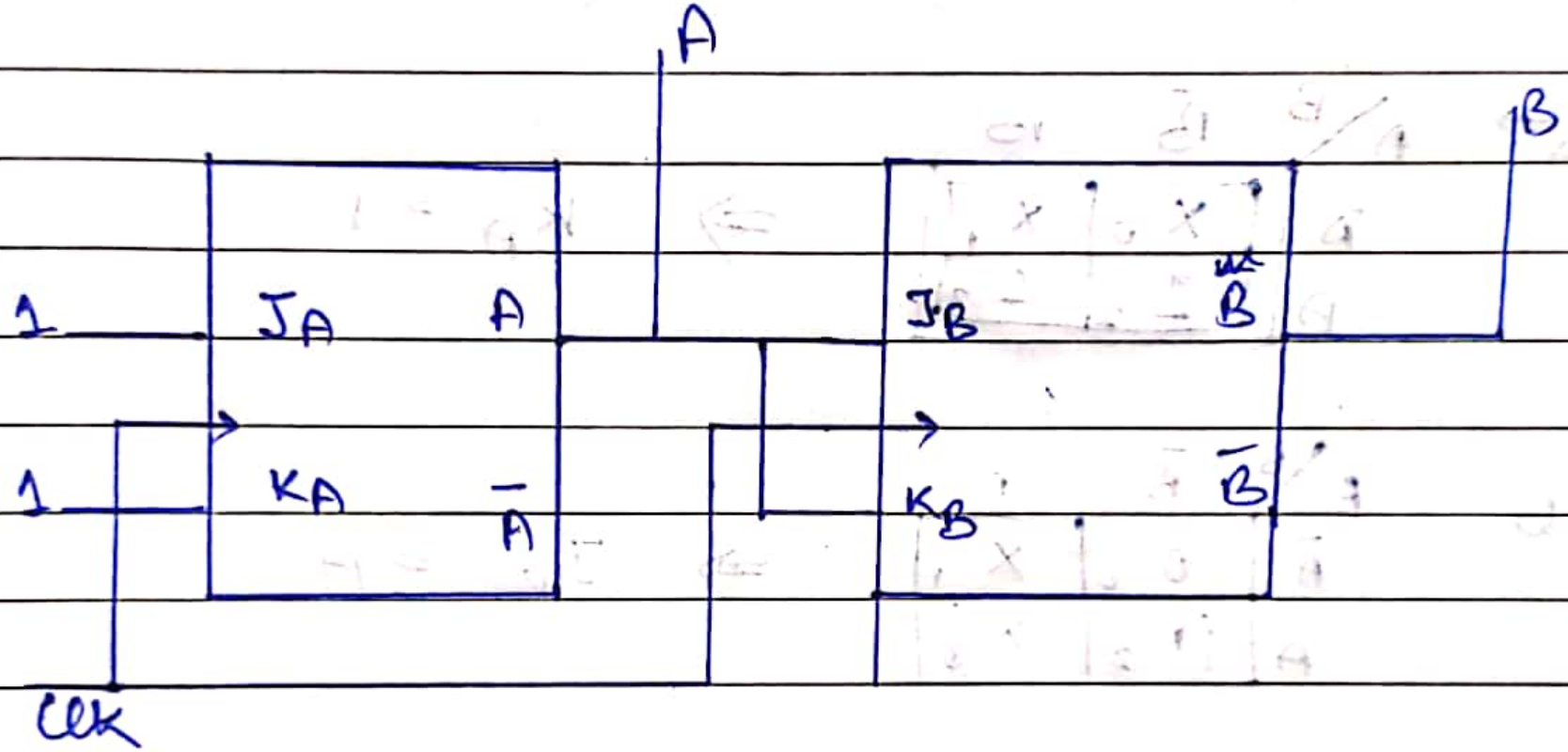
A \ B	$\bar{B}$	B
$\bar{A}$	0 (0)	X (1)
A	1 (2)	X (3)

$\Rightarrow J_B = A$

K_B

A \ B	$\bar{B}$	B
$\bar{A}$	X (0)	0 (1)
A	X (2)	1 (3)

$\Rightarrow K_B = A$



A is MSB and B is LSB

vijeta

ii) Using DFF

	Present State		Next State		FF	
	A	B	A	B	D_A	D_B
0	0	0	1	0	1	0
2	1	0	0	1	0	1
1	0	1	1	1	1	1
3	1	1	0	0	0	0

For D_A:

A \ B	$\bar{B}$	B
$\bar{A}$	1_0	1_1
A	0_2	0_3

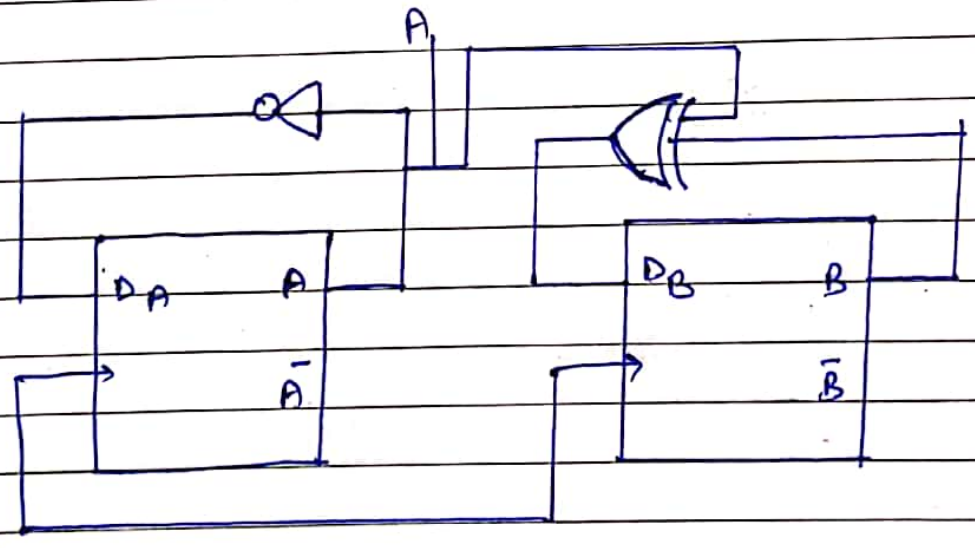
$\Rightarrow D_A \Rightarrow \bar{A}$

For D_B:

A \ B	$\bar{B}$	B
$\bar{A}$	0_0	1_1
A	1_2	0_3

$= \bar{A}B + A\bar{B}$

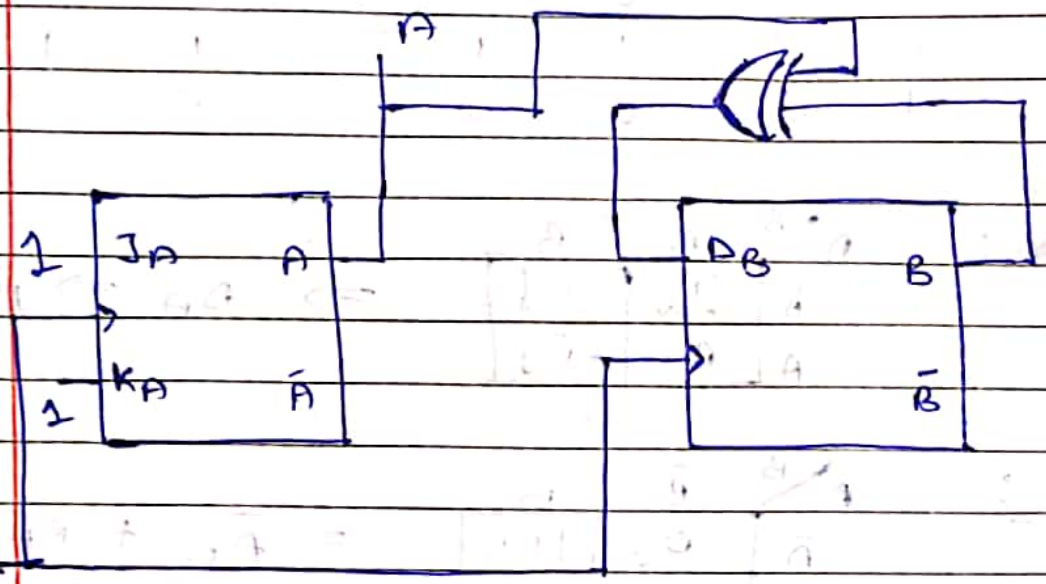
$= A \text{ XOR } B$



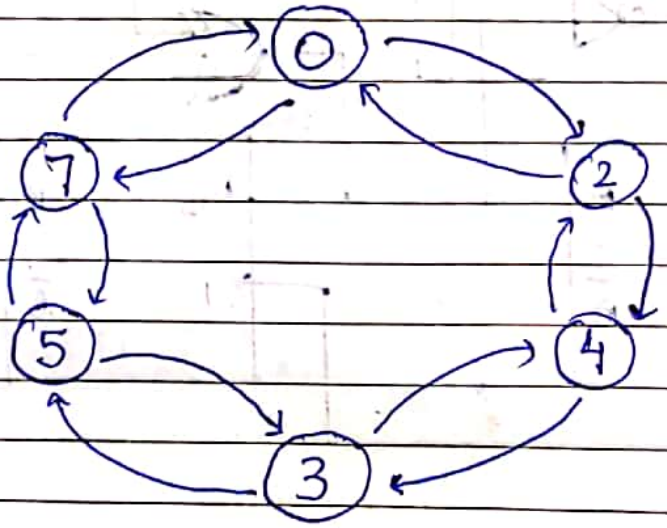
iii) Using JK for MSB and DFF for LSB.

From above parts we know, $J_A = 1$, $K_A = 1$ &

$D_B = A \text{ XOR } B$.



Q3



Present State			Inp	Next State			F.F		
A	B	C	Y	A	B	C	D_A	D_B	D_C
0	0	0	0	1	1	1	1	1	1
1	1	1	0	1	0	1	1	0	1
1	0	1	0	0	1	1	0	1	1
0	1	1	0	1	0	0	1	0	0
1	0	0	0	0	1	0	0	1	0
0	1	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	1	0
0	1	0	1	1	0	0	1	0	0
1	0	0	1	0	1	1	0	1	1
0	1	1	1	1	0	1	1	0	1
1	0	1	1	1	1	1	1	1	1
1	1	1	1	0	0	0	0	0	0

* $Y = 0 \rightarrow$ Down
  $Y = 1 \rightarrow$ Up

For D_A :

YA \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{Y}\bar{A}$	1	x	1	0
$\bar{Y}A$	0	0	1	x
YA	0	1	1	x
$Y\bar{A}$	0	x	1	1

$D_A = BC + YC + YB + \bar{Y}\bar{A}\bar{B}$

For D_B:

Y_A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{Y}\bar{A}$	1	X	0	0
$\bar{Y}A$	1	1	0	X
YA	1	1	0	X
$Y\bar{A}$	1	X	0	0

$$D_B = \bar{B}$$

For D_C:

Y_A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{Y}\bar{A}$	1	X	0	0
$\bar{Y}A$	0	1	1	X
YA	1	1	0	X
$Y\bar{A}$	0	X	1	0

$$D_C = Y\bar{A}C + YA\bar{B} + \bar{Y}AC + \bar{Y}\bar{A}\bar{B}$$

Q4

a) 1 KHz → [DIV 4] → 250 Hz → [DIV 8] → 31.25 Hz → [DIV 2] → 15.625 Hz

① = 250 Hz

② = 31.25 Hz

③ = 15.625 Hz

⇒ Overall it is MOD (4 × 8 × 2) = MOD 64 counter

d) 100 kHz → [DIV 10] → 10kHz → [DIV 10] → 1kHz → [DIV 10] → 100Hz → [DIV 2] → 50Hz

① = 10 kHz
② = 1 kHz
③ = 100 Hz
④ = 50 Hz

⇒ Overall it is MOD(10 x 10 x 10 x 2) = **MOD 2000 counter**

Q5 In the given circuit each flip flop get clock pulse at the same time. So when the clock is applied, in 50 ns all flip flop will give output + we need inputs for the next stage of flip-flops so additional 20 ns + 20 ns will be needed. So, minimum time period for clock = 50 + 20 + 20 = 90 ns

$$f_{max} = \frac{1}{T_{min}} = \frac{1}{90 \times 10^{-9}} s = \frac{10^9}{90} = 0.0111 \times 10^9 \text{ Hz}$$

$$= 11.1 \text{ MHz}$$