CLASS TEST

Sl. : 03 SK_EC+EE_ABCD_030823

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DIGITAL ELECTRONICS

EC + EE

Date of Test : 03/08/2023

ANSWER KEY

1.	(b)	7.	(b)	13.	(c)	19.	(b)	25.	(a)
2.	(a)	8.	(d)	14.	(b)	20.	(a)	26.	(d)
3.	(c)	9.	(b)	15.	(d)	21.	(b)	27.	(c)
4.	(b)	10.	(d)	16.	(a)	22.	(b)	28.	(d)
5.	(c)	11.	(a)	17.	(d)	23.	(d)	29.	(b)
6.	(d)	12.	(d)	18.	(a)	24.	(b)	30.	(b)

DETAILED EXPLANATIONS

1. (b)

$$(1110011.0011)_2 \rightarrow \text{ Convert this binary no. to octal}$$

$\underline{001}\,\underline{110}\,\underline{011}.\underline{001}\,\underline{100}$

$(163.14)_8$

$$(163.14)_8 \rightarrow \text{ Convert this octal no. to decimal}$$

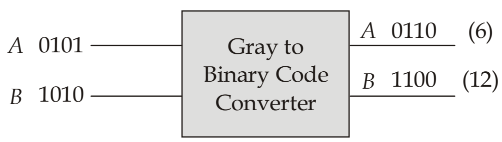
$$1\times 8^2 + 6\times 8 + 3 + \frac{1}{8} + \frac{4}{64}$$

$$= 64 + 48 + 3 + \frac{8+4}{64}$$

$$= 115 + \frac{3}{16}$$

$$= (115.1875)_{10}$$

2. (a)



$$6 < 12$$
$$A < B$$
$$X = 1$$

3. (c)

Clk	J_1	K_1	Q_1	J_2	K_2	Q_2
0	1	1	0	0	1	1
1	0	1	1	1	1	0
2	1	0	0	0	1	1
3	0	1	1	1	1	0

4. (b)

$$X = \bar{A}\bar{B} + A\bar{B} = \bar{B}$$
$$Y = \bar{X}A + XA$$
$$Y = A$$

5. (c)

Conversion time for an n-bit successive approximation type ADC

$$= n\ T_{clk}$$

Given, $n = 8$

Therefore, $T_{conversion} = 8\ T_{clk}$

$$= \frac{8}{f_{clk}} = \frac{8}{5\times 10^6}$$

$$= 1.6 \times 10^{-6} \text{ sec}$$

$$= 1.6\ \mu\text{sec}$$

6. (d)

$$\bar{Z} = (P + A)(Q + \bar{A})$$
$$\bar{Z} = PQ + AQ + \bar{A}P$$
$$Z = \bar{A} + B$$
$$\bar{Z} = \overline{\bar{A} + B} = A\bar{B}$$
$$Q = \bar{B},\ P = 0$$

7. (b)

In ripple counter, $R = 4 \times 10 = 40$ ns

In synchronous counter, $S = T_c = 10$ ns

8. (d)

From figure, $Z = \bar{A}\bar{B}C + \bar{A}B + A\bar{B} + AB = \bar{A}(\bar{B}C + B) + A(\bar{B} + B)$

$$= \bar{A}(\bar{B}C + B) + A = (\bar{A} + A)(A + B + \bar{B}C)$$
$$= (A + [(B + \bar{B})(B + C)]$$
$$= A + (B + C)$$

Hence option (d) is correct

9. (b)

$$F = y_0 + y_2 + y_3 + y_4 + y_5 + y_7 = \Sigma m(0, 2, 3, 4, 5, 7)$$

10. (d)

$$t_{pd\ (\text{max})} = n \times t_{pdff}$$
$$= 3 \times 8 = 24 \text{ ns}$$

11. (a)

$$Q(n) = Q(n - 1) \oplus X$$

Output $Y = X \cdot Q$

12. (d)

$$Y = \overline{A\bar{B}C} \cdot (\bar{A}BC + \bar{A}BD + B\bar{C})$$
$$= (\bar{A} + B + \bar{C})(\bar{A}BC + \bar{A}BD + B\bar{C})$$
$$Y = \bar{A}BC + \bar{A}BD + \bar{A}B\bar{C} + B\bar{C} + \bar{A}B\bar{C}D$$
$$Y = \bar{A}BC + \bar{A}BD + B\bar{C} + \bar{A}B\bar{C}D$$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$				
$\bar{A}B$	1	1	1	1
AB	1	1		
$A\bar{B}$				

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

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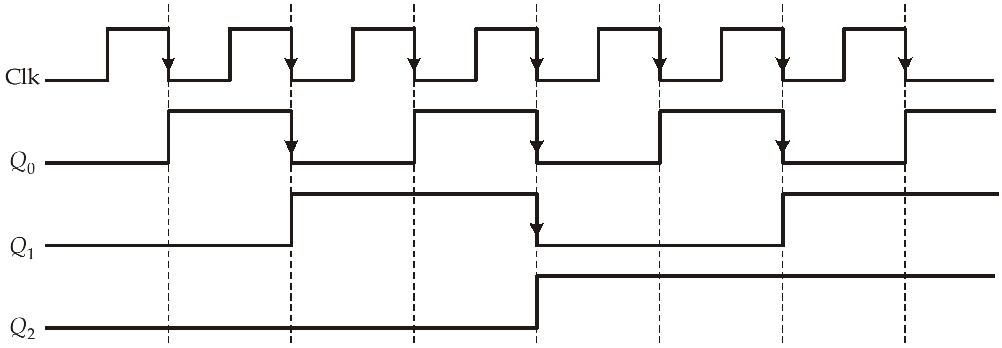
13. (c)

Timing Diagram



Sequence followed by counter

000 – 001 – 010 – 011 – 100 – 101 – 110 – 111

It is an up-counter.

Flip-flops are cleared when $Q_2\overline{Q_1}Q_0 = 111$

$$Q_2Q_1Q_0 = 101$$

Therefore it follows → 000 – 001 – 010 – 011 – 100

It is a MOD-5 Up-counter.

14. (b)

$$\text{Output of series NMOS} = A\overline{B}$$

$$\text{Output of CMOS inverter} = \overline{\overline{A\overline{B}\cdot 1}} = \overline{\overline{A\overline{B}}} = A\overline{B}$$

15. (d)

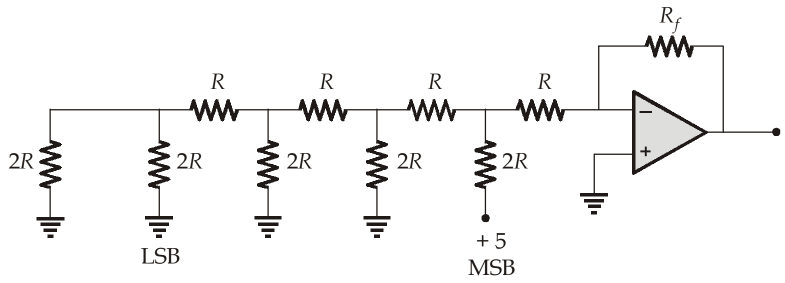
	J_0	K_0	Q_0	J_1	K_1	Q_1	J_2	K_2	Q_2
	1	1	0	0	1	0	1	1	0
1	1	1	1	1	1	0	1	1	1
2	1	1	0	0	1	1	0	1	0
3	1	1	1	1	1	0	1	1	0
4	1	1	0	0	1	1	0	1	1
5	1	1	1	1	1	0	1	1	0

4-clock pulse are required for the state $Q_2\ Q_1\ Q_0$ to become 110.

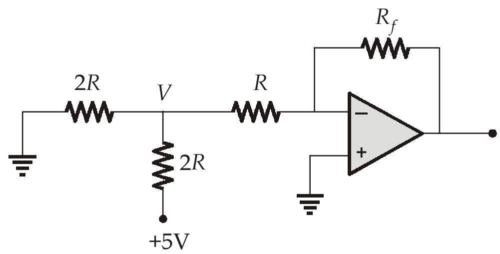
$$\text{Time required} = 4T$$

$$= 4\times\frac{1}{f} = 4\times\frac{1}{10\times 10^6} = 0.4\ \mu\text{sec}$$

16. (a)



Reducing the ladder



Using nodal analysis to find voltage V.

$$\frac{V}{2R}+\frac{V-5}{2R}+\frac{V}{R} = 0$$

Given, $R = 5\ \text{k}\Omega$

$$\frac{V}{10K}+\frac{V-5}{10K}+\frac{V}{5K} = 0$$

$$\frac{V}{5K}+\frac{V}{5K} = \frac{5}{10K}$$

$$\frac{2V}{5K} = \frac{5}{10K}$$

$$V = \frac{5}{4}\text{Volt}$$

Applying KCL at inverting terminal of op-amp.

$$\frac{V-0}{R} = \frac{0-V_0}{R_f}$$

$$V_0 = \frac{-R_f}{R}\text{V}$$

$$V_0 = \frac{-10}{5}\times\frac{5}{4}$$

$$V_0 = -2.5\ \text{Volts}$$

17. (d)

For input $AB = 00$

Transistor Q_1 and Q_2 are off

Q_3 is ON, $\Rightarrow$ $V_0 = 1$

For $AB = 10$

Q_1 ON, Q_2 OFF, Q_3 OFF

Output is not connected to ground and V_{CC}.

$\therefore$ Output is in high impedance (Z) state.

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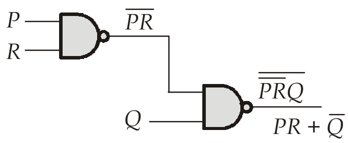
18. **(a)**

Clk	D_0	D_1	Q_0^+	Q_1^+
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1

19. **(b)**

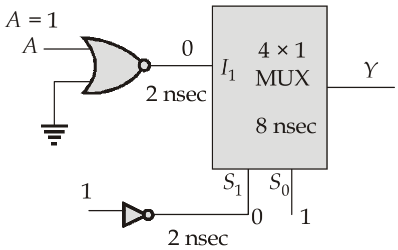
$$Y = (R+\bar{Q})(\bar{P}\bar{Q}+PQ)+P(\bar{P}Q+P\bar{Q})$$
$$Y = \bar{P}R\bar{Q}+PRQ+\bar{P}\bar{Q}+P\bar{Q}$$
$$Y = PRQ+\bar{Q}(P+\bar{P}+\bar{P}R)$$
$$Y = PRQ+\bar{Q}(1+\bar{P}R)$$
$$Y = PRQ+\bar{Q}$$
$$Y = (\bar{Q}+Q)(\bar{Q}+PR)$$
$$Y = PR+\bar{Q}$$



2- NAND are required to realise $PR+\bar{Q}$.

20. **(a)**

For $A = 1$, $B = 0$, the circuit is simplified as



Select line of 2nd MUX is ready after 2ns because input at I_1 is available after 2ns.

Delay of MUX = 8 nsec

Total delay of the circuit = 8 + 2 = 10 ns

Output will be stable after 10 ns.

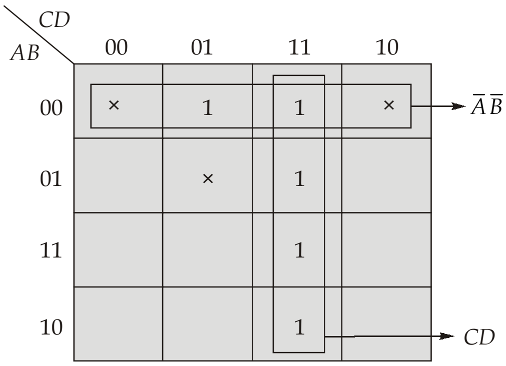
21. **(b)**

Given Boolean function is,

$$Y(A, B, C, D) = \Sigma m(1, 3, 7, 11, 15) + d(0, 2, 5)$$

The function is defined in form of minterm don't care conditions K-map representation of the given function is shown. The simplified Boolean expression is,

$$Y(A, B, C, D) = CD+\bar{A}\bar{B}$$



22. (b)

The function f of the network is given by

$$f = 1\cdot\bar{S}_0 + \bar{A}\cdot S_0$$

Output at MUX-1, f_1 is given to S_0 of the MUX-2, i.e.

$$f_1 = 0\cdot\bar{C} + B\cdot C = BC$$

Hence, we get the output of the network as,

$$f = 1\cdot\bar{f}_1 + \bar{A}\cdot f_1 = \overline{BC} + \bar{A}BC$$

$$= (\overline{BC} + \bar{A})\cdot(\overline{BC} + BC)$$

$$= \overline{BC} + \bar{A}$$

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

$$= \overline{ABC}$$

23. (d)

$$Q_{n+1} = J\bar{Q}_n + \bar{K}Q_n$$

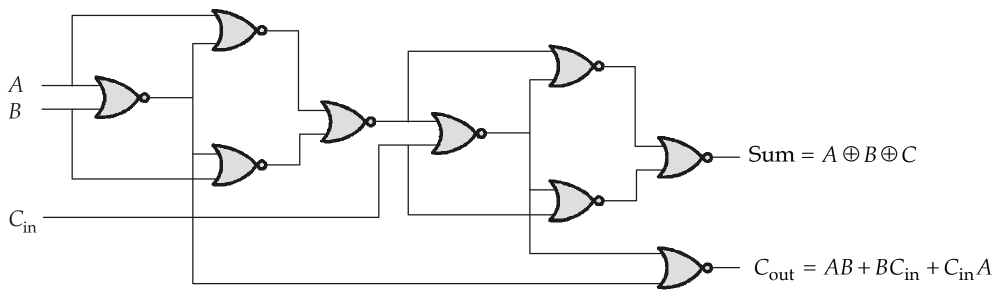
$$= \bar{Q}_n\cdot\bar{Q}_n + \bar{1}Q_n$$

$$Q_{n+1} = \bar{Q}_n$$

24. (b)

$$\text{Sum} = A \oplus B \oplus C$$

$$C_{\text{out}} = AB + BC_{\text{in}} + C_{\text{in}}A$$



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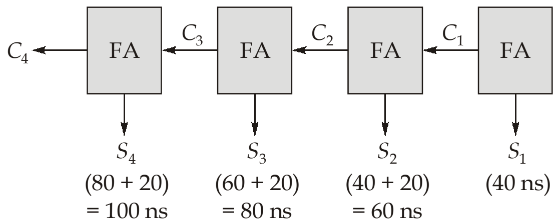
25. (a)



$$\text{Maximum rate of addition} = \frac{1}{100\text{ ns}} = 10^7\ /\text{sec} = 10\times 10^6\ /\text{sec}$$

26. (d)

J_2	K_2	J_1	K_1	J_0	K_0	Q_2^+	Q_1^+	Q_0^+
						1	0	1
0	1	1	0	1	1	0	1	0
1	0	0	1	0	0	1	0	1
0	1	1	0	1	1	0	1	0
1	0	0	1	0	0	1	0	1

101 repeated after every two cycles, hence frequency of the output will be $\frac{15}{2} = 7.5\text{ MHz}$.

27. (c)

$$(7.FD6)_{16} = (0111.1111111010110)_2$$

The binary number is converted into octal number as:

$$\underbrace{000}_{0}\ \underbrace{111}_{7}\cdot\underbrace{111}_{7}\ \underbrace{111}_{7}\ \underbrace{010}_{2}\ \underbrace{110}_{6} \quad : \text{Binary} \quad : \text{Octal}$$

Thus, $(7.FD6)_{16} = (7.7726)_8$

Thus, $x = 8$

Also, $(7864)_{10} \rightarrow (1EB8)_y$

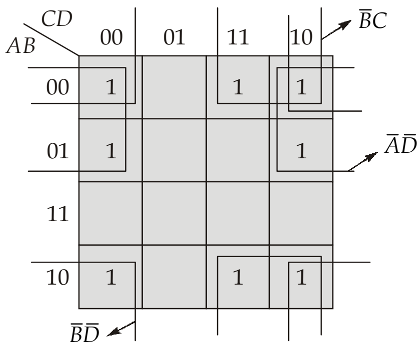
for $y = 16$, on converting decimal number $(7864)_{10}$ into hexadecimal number, we obtain $(1EB8)_{16}$ as follows:

16	7864	
16	491	$8 \rightarrow 8$ (LSB)
16	30	$11 \rightarrow B$
16	1	$14 \rightarrow E$
	0	$1 \rightarrow 1$ (MSB)

Thus, $(7864)_{10} = (1EB8)_{16}$

Hence, $y = 16$

28. (d)



The above k-map has 3 quads. Which are $\bar{A}\bar{D}, \bar{B}\bar{D}, \bar{B}C$

Therefore the minimized expression is $\bar{A}\bar{D} + \bar{B}\bar{D} + \bar{B}C$.

29. (b)

x	y	z	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

When $z = 0$

x	y	f
0	0	0
0	1	0
1	0	0
1	1	1

$f = xy$

When $z = 1$

x	y	f
0	0	0
0	1	1
1	0	1
1	1	1

$$f = \bar{x}y + x\bar{y} + xy$$
$$f = y + x$$

30. (b)

	$T_A = Q_A Q_B$	$T_B = \overline{\overline{Q_A} Q_B}$	Q_A	Q_B	
	0	1	0	0	(Initially)
1st clock →	0	0	0	1	
2nd clock →	0	0	0	1	

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