1-1 (5 min)

a) 8 4 2 1

$\times 0 \quad \times 1 \quad \times 1 \quad \times 0$

$0 + 4 + 2 + 1 = \boxed{6_{10}}$

b) $8 + 2 + 1 = \boxed{11_{10}}$

c) $8 + 1 = \boxed{9_{10}}$

d) $4 + 2 + 1 = \boxed{7_{10}}$

e) $8 + 4 = \boxed{12_{10}}$

f) 128 64 32 16 8 4 2 1

$64 + 8 + 2 + 1 = \boxed{75_{10}}$

g) $32 + 16 + 4 + 2 + 1 = \boxed{55_{10}}$

h) $128 + 32 + 16 + 4 + 1 =$

$160 + 20 + 1 = \boxed{181_{10}}$

i) $128 + 32 + 4 + 2 + 1 = \boxed{167_{10}}$

j) $64 + 32 + 16 + 4 + 2 + 0 =$

$96 + 20 + 2 = \boxed{118_{10}}$

1-2 a)

$2\overline{)186}$ = 93, R 0 LSB

18

6

6

0

$2\overline{)93}$ = 46, R 1

$2\overline{)46}$ = 23, R 0

$2\overline{)23}$ = 11, R 1

$2\overline{)11}$ = 5, R 1

$2\overline{)5}$ = 2, R 1

$2\overline{)2}$ = 1, R 0

$2\overline{)1}$ = 0, R 1 MSB

$\boxed{10111010}$ (3 min)

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1-2 b)

$2\overline{)214}$ = 107 R0 LSB

$2\overline{)107}$ = 53 R1

$2\overline{)53}$ = 26 R1

$2\overline{)26}$ = 13 R0

$2\overline{)13}$ = 6 R1

$2\overline{)6}$ = 3 R0

$2\overline{)3}$ = 1 R1

$2\overline{)1}$ = 0 R1 MSB

$\boxed{11010110}$

(2 MIN)

1-2 c)

$2\overline{)27}$ = 13 R1 LSB

$2\overline{)13}$ = 6 R1

$2\overline{)6}$ = 3 R0

$2\overline{)3}$ = 1 R1

$2\overline{)1}$ = 0 R1

BECAUSE PROBLEM ASKED FOR 8 BIT BINARY { 0, 0, 0 MSB

$\boxed{00011011}$

(2 MIN)

1-2d

$2\overline{)251}$ = 125 R 1 LSB

$2\overline{)125}$ = 62 R 1

$2\overline{)62}$ = 31 R 0

$2\overline{)31}$ = 15 R 1

$2\overline{)15}$ = 7 R 1

$2\overline{)7}$ = 3 R 1

$2\overline{)3}$ = 1 R 1

$2\overline{)1}$ = 0 R 1 MSB

$\boxed{1111011}$

(2min)

1-2e

$2\overline{)146}$ = 73 R 0 LSB

$2\overline{)73}$ = 36 R 1

$2\overline{)36}$ = 18 R 0

$2\overline{)18}$ = 9 R 0

$2\overline{)9}$ = 4 R 1

$2\overline{)4}$ = 2 R 0

$2\overline{)2}$ = 1 R 0

$2\overline{)1}$ = 0 R 1 MSB

$\boxed{10010010}$

(2min)

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1-3) a. 011 001

3 1

$\boxed{31_8}$

b. 011 101

3 5

$\boxed{35_8}$

c. 001 011 100

1 3 4

$\boxed{134_8}$

d. 001 011 001

1 3 1

$\boxed{131_8}$

e. 001 101 101

1 5 5

$\boxed{155_8}$

(4 min)

1-4) a. 46_8 $\boxed{100110_2}$

b. 74_8 $\boxed{111100_2}$

c. 61_8 $\boxed{110001_2}$

d. 32_8 $\boxed{011010_2}$

e. 57_8 $\boxed{101111_2}$

(3 min)

1-7)

0000	0	1000	8
0001	1	1001	9
0010	2	1010	A
0011	3	1011	B
0100	4	1100	C
0101	5	1101	D
0110	6	1110	E
0111	7	1111	F

a. 10111001 = $\boxed{B9_{16}}$

b. 1101 1100 = $\boxed{DC_{16}}$

c. 0111 0100 = $\boxed{74_{16}}$

d. 1111 1011 = $\boxed{FB_{16}}$

e. 1100 0110 = $\boxed{C6_{16}}$

(5 min)

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1-8 USED SAME TABLE AS 1-7. ONLY IN REVERSE

a) $C5_{16}$ = $\boxed{1100\ 0101_2}$

b) FA_{16} = $\boxed{1111\ 1010_2}$

c) $D6_{16}$ = $\boxed{1101\ 0110_2}$

d) $A94_{16}$ = $\boxed{1010\ 1001_2}$

e) 62_{16} = $\boxed{0110\ 0010_2}$ (3min)

1-9

16^2	16^1	16^0
256	16	1

a. ϕ 8 6

$0 + 128 + 6 = \boxed{134_{10}}$

b) F4 = F=15

16 1

×15 ×4

$240 + 4 = \boxed{244_{10}}$

c) 16 1

9 2

~~151~~ + 2 = ~~153_{10}~~

144

$\boxed{146_{10}}$

d) A=10

B=11

16 1

×10 ×11

$160 + 11 = \boxed{171_{10}}$

e) 3C5

C = 12

256 16 1

×3 ×12 ×5

$768 + 192 + 5 = \boxed{965_{10}}$

768

+192

5

(6min)

TOPS 35500

1-11 USE TABLE FROM PROBLEM 1-7 SOLUTION

a) $\underset{9}{1001}\ \underset{8}{1000}_{BCD} = \boxed{98_{10}}$

b) $\underset{6}{0110}\ \underset{9}{1001}_{BCD} = \boxed{69_{10}}$

c) $\underset{7}{0111}\ \underset{4}{0100}_{BCD} = \boxed{74_{10}}$

d) $\underset{3}{0011}\ \underset{6}{0110}_{BCD} = \boxed{36_{10}}$

e) $\underset{8}{1000}\ \underset{1}{0001}_{BCD} = \boxed{81_{10}}$ (2 min)

1-12 USE TABLE FROM PROBLEM 1-7 SOLUTION

a) $87_{10} = \boxed{1000\ 0111_{BCD}}$

b) $142_{10} = \boxed{0001\ 0100\ 0010_{BCD}}$ * MUST HAVE PRECEEDING ZEROS.

c) $94_{10} = \boxed{1001\ 0100_{BCD}}$

d) $61_{10} = \boxed{0110\ 0001_{BCD}}$

e) $44_{10} = \boxed{0100\ 0100_{BCD}}$ (2 min)

1-13

a) % $010\ 0101_{2}$

b) \$14 0100100 0110001 0110100

c) N-6 1001110 0101101 0110110

d) CPU 1000011 1010000 1010101

e) Pg 1010000 1100111 (6 min)

2-1) $t_p = \frac{1}{f}$

a) $t_p = \frac{1}{20MHz} = \frac{1}{20\times10^6}\,sec = \boxed{50\,ns}$

b) $t_p = \frac{1}{500KHz} = \frac{1}{500\times10^3}\,sec = \boxed{2\,\mu s}$

c) $t_p = \frac{1}{4.27MHz} = \frac{1}{4.27\times10^6}\,sec = 2.34\times10^{-7}s = \boxed{234\,ns}$

d) $t_p = \frac{1}{17MHz} = \frac{1}{17\times10^6}\,sec = 5.88\times10^{-8}s = \boxed{58.8\,ns}$

$f = \frac{1}{t_p}$

e) $f = \frac{1}{2\times10^{-6}} = 500000\,Hz = \boxed{500\,KHz}$

f) $f = \frac{1}{100\mu sec} = \frac{1}{100\times10^{-6}} = 10000\,Hz = \boxed{10\,KHz}$

g) $f = \frac{1}{0.75ms} = \frac{1}{0.75\times10^{-3}} = 1333\,Hz = \boxed{1.33\,KHz}$

h) $f = \frac{1}{1.5\mu s} = \frac{1}{1.5\times10^{-6}} = 666666.7\,Hz = \boxed{667\,KHz}$

(9 min)

2-2) a) 1st Convert to Binary

$45B_{16} = 0100\ 0101\ 1011$

2nd Draw Serial Representation and Parallel Representation (Next Page) with clock.

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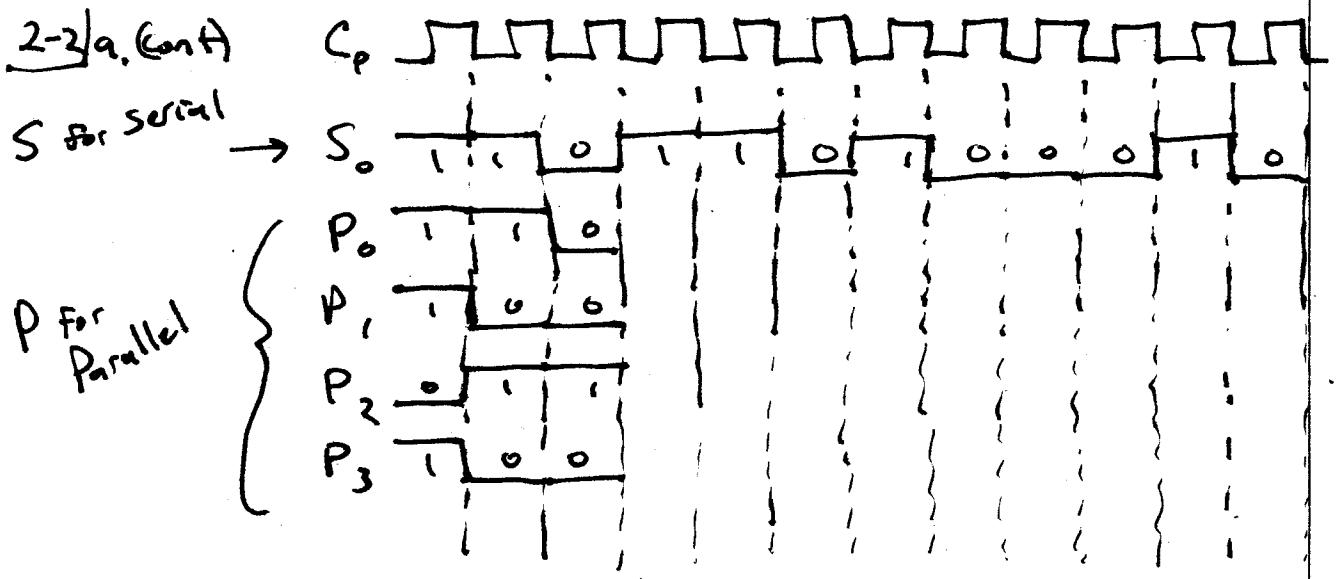
2-3/a. (Cont)



3rd) Determine period

$$t_p = \frac{1}{2\times10^6} = 500\,ns$$

4th) Calculate t_{serial} and $t_{parallel}$

$$t = (\#\text{ symbols}) \times \left(\frac{\text{bits}}{\text{symbol}}\right) \times (\text{Period}) \times \left(\frac{\text{cycle}}{\text{bits}}\right)$$

$$\left(\frac{\text{bits}}{\text{cycle}}\right)^{-1}$$

$$t_{serial} = \frac{3 \text{ symbols}}{} \left| \frac{4 \text{ bits}}{\text{symbol}} \right| \frac{500\,ns}{\text{cycle}} \left| \frac{1 \text{ cycle}}{1 \text{ bit}} \right.$$

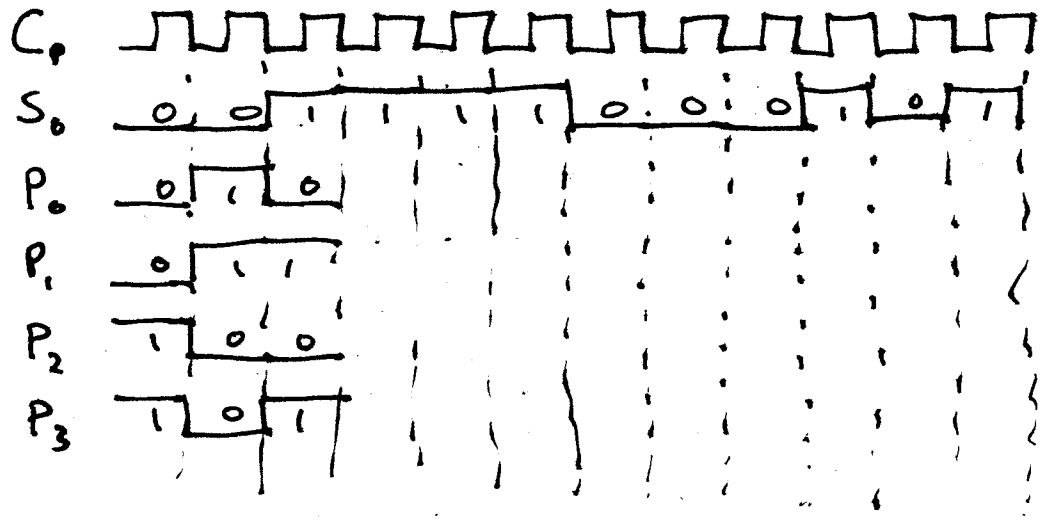
$$= \boxed{6\,\mu s}$$

$$t_{parallel} = 3 \text{ symbols} \left| \frac{4 \text{ bits}}{\text{symbol}} \right| \frac{500\,ns}{\text{cycle}} \left| \frac{\text{cycle}}{4 \text{ bits}} \right|$$

$$= \boxed{1.5\,\mu s}$$

(15 min)

2-2 b. $A3C_{16} = 1010\ 0011\ 1100_2$



t_{SERIAL}, $t_{PARALLEL}$ are the same as for part a. since same # of symbols, clock rate and bits per symbol.

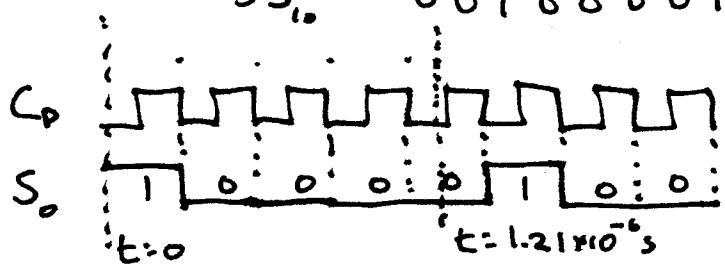
(4 min)

2-3 a. $t_{SERIAL} = (\#\text{symbols}) \times \left(\frac{\text{bits}}{\text{symbol}}\right) \times \left(\frac{\text{time}}{\text{cycle}}\right) \times \left(\frac{\text{cycles}}{\text{bits}}\right)$

$$t_{SERIAL} = 1 \times \frac{8\text{ bits}}{\text{symbol}} \times \frac{\text{sec}}{3.7\times10^6\ \text{cycle}} \times \frac{\text{cycle}}{1\text{ bit}}$$

$$= \boxed{2.16\,\mu s}$$

b. $33_{10} = 00100001_2$ (32 16 8 4 2 1)



$$t_p = \frac{1}{f} = \frac{1}{3.7\times10^6} = 2.70\times10^{-7}\,s$$

$$\frac{1.21\times10^{-6}\,s}{2.7\times10^{-7}\,s} = 4.44$$

$\boxed{\text{LOW}}$ (8 min)

2-4 a.

$$t_{parallel} = (\#\text{symbols}) \times \left(\frac{\text{bits}}{\text{symbol}}\right) \times \left(\frac{\text{time}}{\text{cycle}}\right) \times \left(\frac{\text{bits}}{\text{cycle}}\right)^{-1}$$

$$\left(\frac{\text{bits}}{\text{cycle}}\right)^{-1} = \left(\frac{\text{cycle}}{\text{bits}}\right)$$

$$t_{parallel} = 3 \times \frac{8\text{ bits}}{\text{symbol}} \times \frac{\text{sec}}{8\times10^6\text{ cycles}} \times \left(\frac{8\text{ bits}}{\text{cycle}}\right)^{-1}$$

$$= \boxed{375\text{ ns}}$$

b.

$$t_{parallel} = \underline{6\text{ symbols}} \times \left(\frac{8\text{ bits}}{\text{symbol}}\right) \times \left(\frac{\text{sec}}{4.17\times10^6\text{ cycles}}\right) \times \left(\frac{\text{cycle}}{8\text{ bits}}\right)$$

$$\approx \boxed{1.44\ \mu s}$$

(5 min)

3-2

A	B	C	D	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

(2 min)

3-3

# of combinations $= 2^n$

where n is the # of inputs $\Rightarrow$

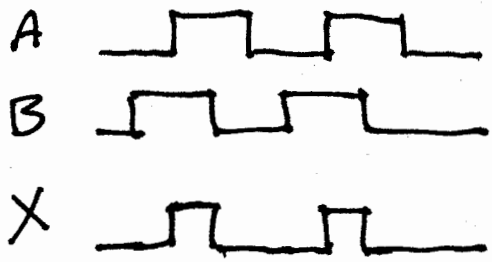
# of combinations $= 2^8 = \boxed{256}$

(1 min)

3-6 a. $X = ABC$

b. $X = A + B + C$ (1 min)

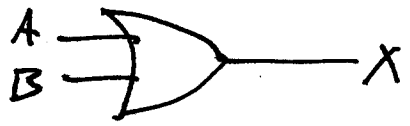
3-7 b.

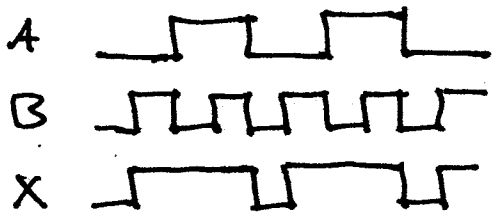


(2 min)

3-8

a.

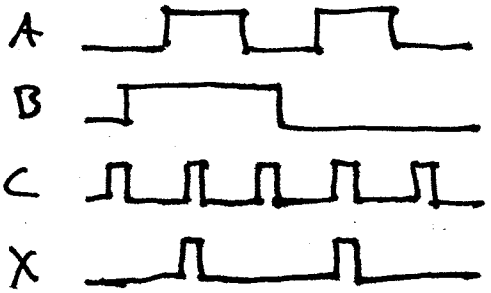




(2 min)

3-9

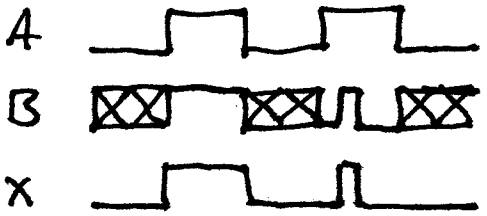
a.



(2 min)

3-10

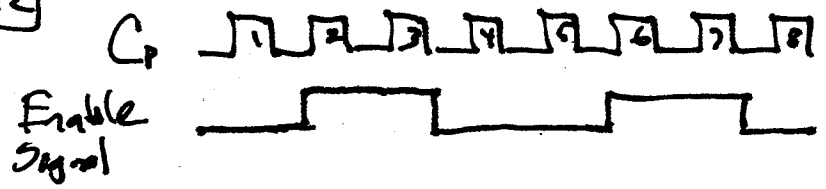
a.



⊠ = Can be either Hi or Low "Don't Care"

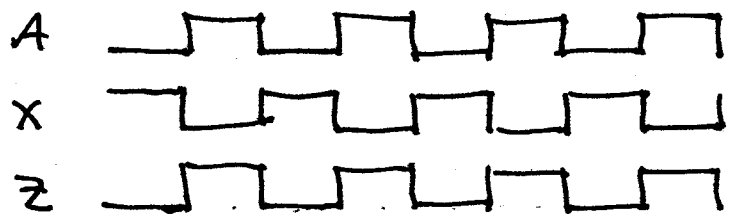
(2 min)

3-12



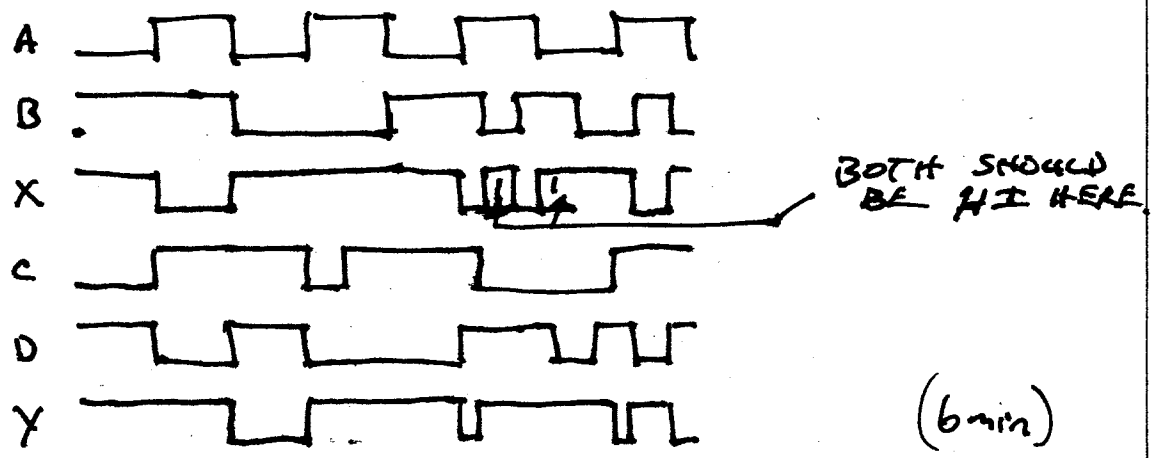
(2 min)

3-27



(8 min)

3-30



(6 min)

3-18

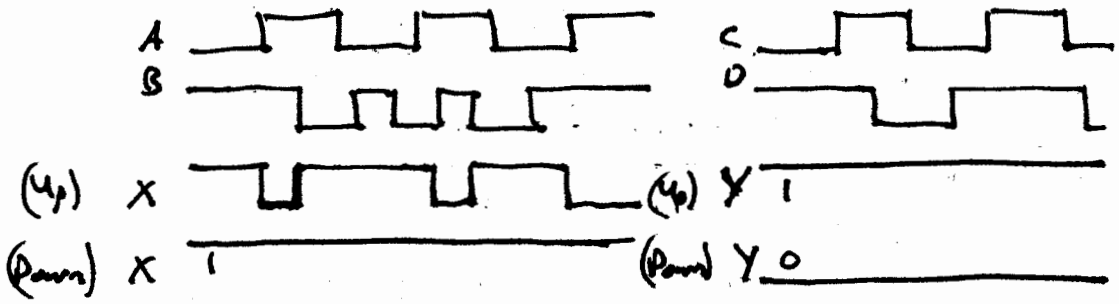
HIGH

LOW

FLOATING – THIS MEANS OPEN CKT NEITHER HIGH NOR LOW.

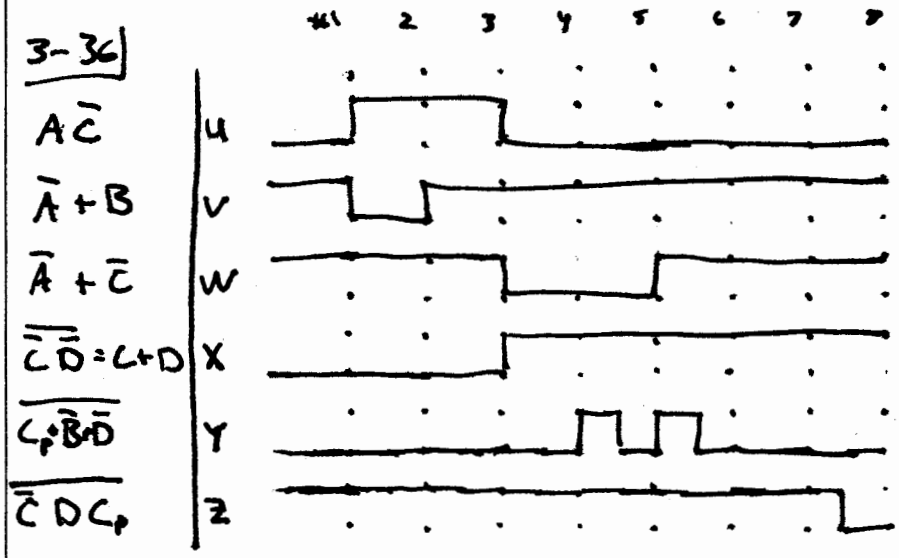
(2 min)

3-31



(4 min)

3-36



(10 min)

3-49

AND GATES U3:A LOCATION C2

U3:B LOCATION D2

OR GATE U12:A LOCATION B7 or C7

(4 min)

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4-20

a) <u>Library</u> – "Library Declaration" – The section of a VHDL program declaring the software libraries to be included in the program.

b) <u>Entity</u> – "Entity Declaration" – The section of a VHDL program defining the input and output ports.

c) <u>Architecture</u> – "Architecture Body" – The section in a VHDL program defining the logic functions to be implemented.

(5 min)

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