1. synchronous sequential circuits are governed by clock signals.
However, Asynchronous sequential circuits aren't driven by clock, they're governed by time-delay devi
In short, Synchronous Sequential system's state is updated at discrete times.
Asynchronous Sequential System's state is updated at any time.

2.

A. (a) $1101011_2 \rightarrow 107$
(b) $110101101_2 \rightarrow 429$
(c) $1110010_2 \rightarrow 114$
(d) $825 \rightarrow 1100111001_2$
(e) $514 \rightarrow 1000000010_2$

B. (a) $1011100100001011_2 \rightarrow 5C8B$
(b) $1110011111110111_2 \rightarrow 73F9$
(c) $1111001101011_2 \rightarrow 1CD6$
(d) $3B2A \rightarrow 1110110010101010_2$
(e) $FEA9 \rightarrow 1111111010101001_2$

3.

(a) $000111 + 010111 = 011110$ ($7+23=30$)
(b) $110000 + 010010 = 1000010$ — overflow ($48+18=66$)
(c) $100011 + 100111 = 1001010$ — overflow ($35+39=74$)
(d) $010011 + 101111 = 1000010$ - overflow ($19+47=66$)
(e) $010011 + 011100 = 101111$ ($19+28=47$)

4.

(a) $+15 = 001111_2$
(b) $-13 = 110011_2$
(c) $0 = 000000_2$
(d) $-32 = 100000_2$
(e) 6-bit two's complement format's range is $-32 \sim 31$. out of range.

5.

(a) $11100_2 = -7$

(b) $100110_2 = -26$

(c) $111111_2 = -1$

(d) $011011_2 = 27$

(e) $010110_2 = 22$

6.

(a) ~~$1010_2 + 000111_2$~~ (Sum) $= 000001_2$ $(-6+7=1)$

(b) ~~$101010 + 100110$~~ (Sum) $= 1010000$ — overflow $(-22-26 = -48 \neq 16)$

(c) Sum $= \not{1}01010$ — ~~overflow~~ $(-7-15=-22)$
ignored carry

(d) Sum $= 1011000$ — overflow $(-20-20=-40 \neq 24)$

(e) Sum $= 110010$ $(-26+12=-14)$

7.

(a) $f = bc' + b'c + ac$

$g = (a+c)(a'+b+c')$

| abc | bc' | b'c | ac | f | (a+c) | (a'+b+c') | g |
|---|---|---|---|---|---|---|---|
| 000 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 001 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 010 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 011 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 100 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 101 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 110 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 111 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |

$\therefore f \neq g$

(b) $f = a'b + ac' + a'bd'$

$g = ad' + a'bc + a'bd'$

| a'bcd | a'b | ac' | a'bd' | f | ad' | a'bc | a'bd' | g |
|---|---|---|---|---|---|---|---|---|
| 0000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0100 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0101 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0110 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 0111 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1000 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1001 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1010 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1100 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1101 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1110 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

$\therefore f \neq g$

8.

(a) $x'z + xy'z + xyz$

$= x'z + xzy' + xzy$ (commutative Law)

$= x'z + xz(y'+y)$ (Distributive Law)

$= x'z + xz \cdot 1$ $(x+x'=1)$

$= (x'+x)z$ (Distributive Law)

$= 1 \cdot z$ $(x+x'=1)$

$= z$

(b) $x'y'z' + x'y'z + xy'z + xyz'$

$= x'y'(z'+z) + xy'z + xyz'$ (Distributive Law)

$= x'y' \cdot 1 + xy'z + xyz'$ $(x+x'=1)$

$= y'x' + y'xz + xyz'$ (Commutative Law)

$= y'(x' + xz) + xyz'$ (Distributive Law)

$= y'(x+x')(z+x') + xyz'$

(Distributive Law $y+YZ=(x+Y)(x+Z)$)

$= y' \cdot 1 \cdot (x'+z) + xyz'$

$= y'(x'+z) + xyz'$

(c) $(x+y+z)(x+y+z')(x+y'+z)(x+y'+z')$

$\Rightarrow x+y$ .... redundancy law ~~$(A \vee B)A$~~ $(A+B)(A+B') = A$

$\therefore (x+y)(x+y'+z)(x+y'+z')$

$\hookrightarrow x+y'$ .... redundancy law $(A+B)(A+B') = A$

$\therefore (x+y)(x+y')$

$= x$ ... redundancy law $(A+B)(A+B') = A$

8. (d)

$(a+b+c)(a+b'+c)(a+b'+c')(a'+b'+c')$

$= (a+b+c)(a+c+b')(a+b'+c')(a'+b'+c')$ ... commutative law

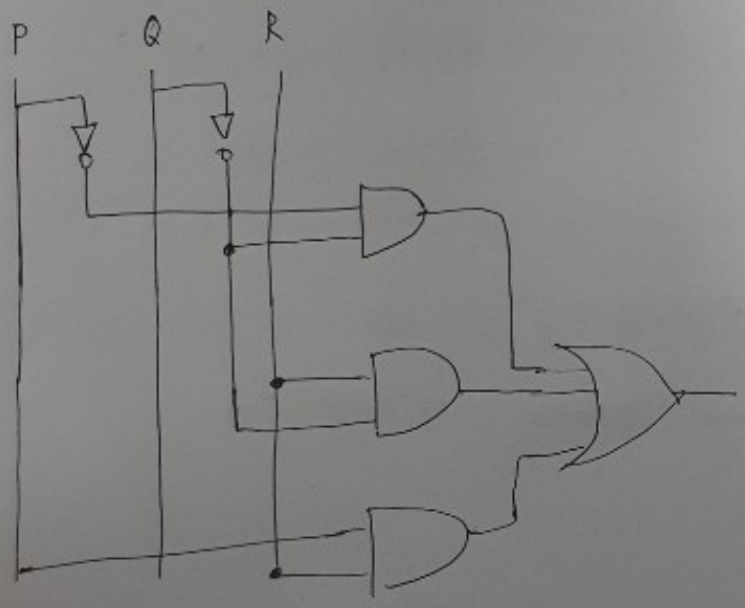
$= (a+c+b)(a+c+b')(a+b'+c')(a'+b'+c')$ ... commutative law

$= (a+c)(a+b'+c')(a'+b'+c')$ ... redundancy law $(A+B)(A+B') = A$

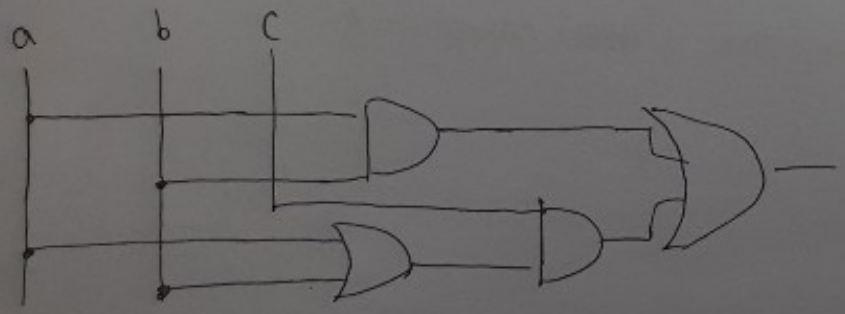
$= (a+c)(b'+c'+a)(b'+c'+a')$ ... commutative law

$= (a+c)(b'+c')$ ... reductancy law

9. (a) $P'Q'+PR+Q'R$




(b) $ab+c(a+b)$



10.

(a)

i) $a'bc + b'd + ac' = f$

ii) $a'bc + b'd + ac' = f$

(b)

i) $(a'+b+c)(b'+d)(a+c') = f$

ii) $(a'+b+c)(b'+d)(a+c')$

$= (a'+b+c)(ab' + b'c' + ad + c'd)$

$= (aa'b + a'b'c' + aa'd + a'c'd + abb' + bb'c' + abd + bc'd + ab'c + b'cc' + acd + c'c'd)$

since $X \cdot X' = 0$,

$= (a'b'c' + a'c'd + abd + bc'd + ab'c + acd)$

$= a'b'c' + a'c'd + abd + bc'd + ab'c + acd$