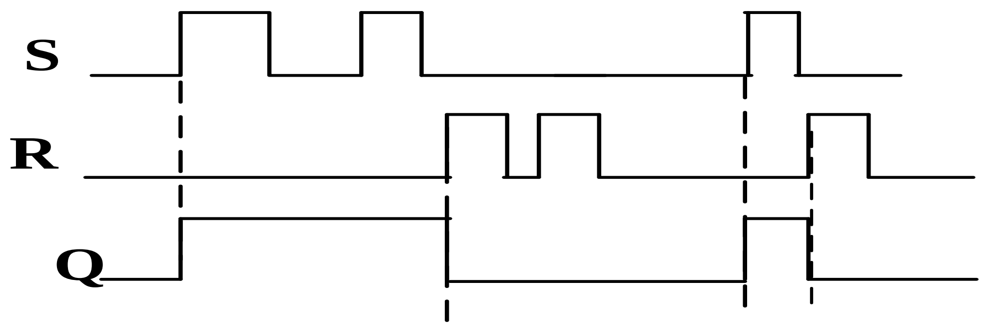
SOLUTIONS

Solution of pre-tutorial:



Solution of problem 2:

Let w, x, y, p are the inputs and E be the output.

Truth Table: -

w	x	y	p	E
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

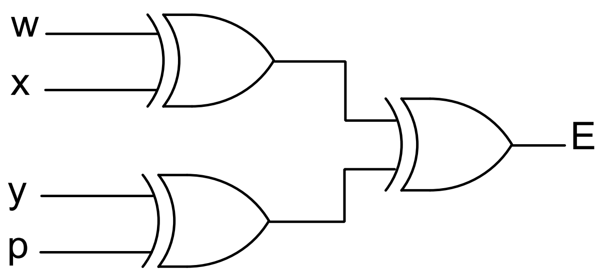
Therefore, $E = \overline{w}\,\overline{x}\,\overline{y}\,p + \overline{w}\,\overline{x}\,y\,\overline{p} + \overline{w}\,x\,\overline{y}\,\overline{p} + \overline{w}\,x\,y\,p + w\,\overline{x}\,\overline{y}\,\overline{p} + w\,\overline{x}\,y\,p + w\,x\,\overline{y}\,p + w\,x\,y\,\overline{p}$

$= \overline{w}\,\overline{x}\,(y \oplus p) + \overline{w}\,x\,\overline{(y \oplus p)} + w\,\overline{x}\,\overline{(y \oplus p)} + w\,x\,(y \oplus p)$

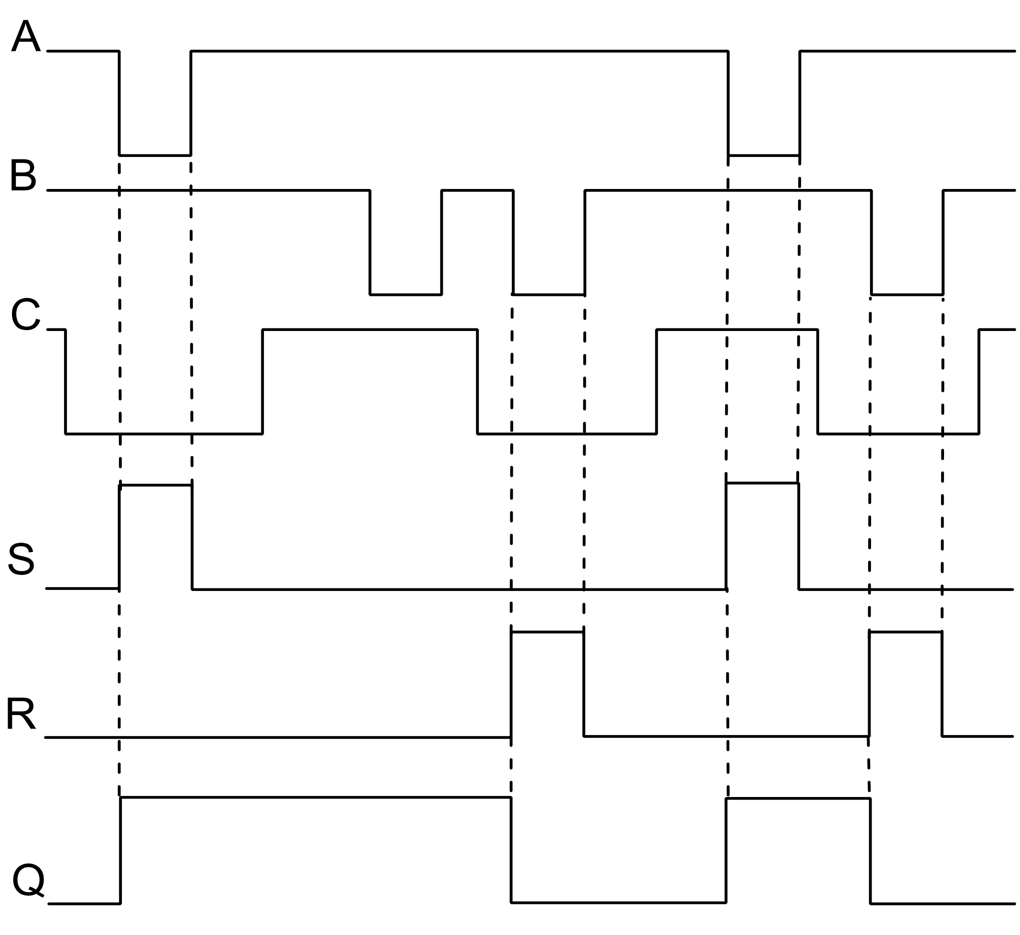
$= (y \oplus p)(\overline{w}\,\overline{x} + w\,x) + \overline{(y \oplus p)}\,(\overline{w}\,x + w\,\overline{x})$

$= (y \oplus p)(\overline{w \oplus x}) + \overline{(y \oplus p)}\,(w \oplus x)$

$= (y \oplus p) \oplus (w \oplus x)$



Solution of problem 3:

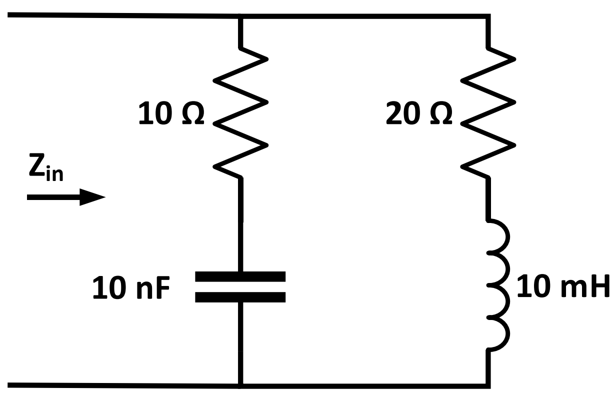


$$S = \overline{A}B$$

$$R = \overline{B}\,\overline{C}$$

S	R	Q	$\overline{Q}$
0	0	Latch	Latch
0	1	0	1
1	0	1	0
1	1	0	0

Solution of problem 4:



(a)

$$Z_{in} = \frac{\left(R_1 - \frac{j}{\omega C}\right)(R_2 + j\omega L)}{R_1 + R_2 + j\left(\omega L - \frac{1}{\omega C}\right)}$$

Solving the above equation, we will get,

$$Z_{in} = \frac{\left(R_1R_2 + \frac{L}{C}\right)(R_1 + R_2) + \left(\omega L R_1 - \frac{R_2}{\omega C}\right)\left(\omega L - \frac{1}{\omega C}\right) + j\left((R_1 + R_2)\left(\omega L R_1 - \frac{R_2}{\omega C}\right) - \left(\omega L - \frac{1}{\omega C}\right)\left(R_1R_2 + \frac{L}{C}\right)\right)}{(R_1 + R_2)^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

For resonance,

$$(R_1 + R_2)\left(\omega L R_1 - \frac{R_2}{\omega C}\right) = \left(\omega L - \frac{1}{\omega C}\right)\left(R_1R_2 + \frac{L}{C}\right)$$

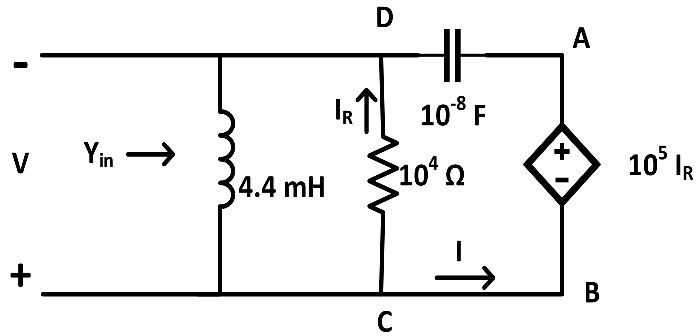
Where, $R_1 = 10\,\Omega\,, R_2 = 20\,\Omega\,,\ C = 10\,nF\ and\ L = 10\,mH$

Solving the above equation we will get $f_0 = 15913.106\,Hz$

(b) Q of RC branch $\frac{1}{\omega RC} = 100.01$

(c) Q of RL branch $\frac{\omega L}{R} = 49.99$

Solution of problem 5:



$I_R = \frac{V}{10^4}$

Writing KVL for ABCD loop,

$$V + 10^5 I_R = \frac{-jI}{\omega C}$$

$$\Rightarrow V + 10V = \frac{-jI}{\omega C}$$

$$\Longrightarrow \frac{V}{I} = Z' = \frac{-j}{11\omega C}$$

a) $Y_{in} = \frac{-j}{\omega L} + 10^{-4} + \frac{1}{Z'} = 10^{-4} + j(11\omega C - \frac{1}{\omega L})$

b) $\omega_0 = \frac{1}{\sqrt{11LC}} = 45454.54$ rad/sec

$Z_{in}(\omega_0) = 10^4 + j0\ \Omega$