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17/ENG02/1003
Computer engineering

1. $R = 100k\Omega$; $L = 20mA$, $C = 5mf$

$w_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(20\times10^{-3})(5\times10^{-4})}} = \frac{1}{\sqrt{1\times10^{-10}}}$

$= 100000 rad/s$

$w_0 = 100 krad/s$

$Q = \frac{R}{w_0 L} = \frac{100\times10^3}{(100\times10^3)\times(20\times10^{-3})} = \frac{1}{20\times10^{-3}}$

$= 50 \quad Q = 50$

$B = \frac{w_0}{Q} = \frac{100\times10^2}{50} = 2000 = 2krad/s$

Since $Q > 10$, $w_1 = w_0 - \frac{B}{2} = 100\times10^{-3} - \frac{200}{2}$

$= 100\times10^3 - 100 = 99000$

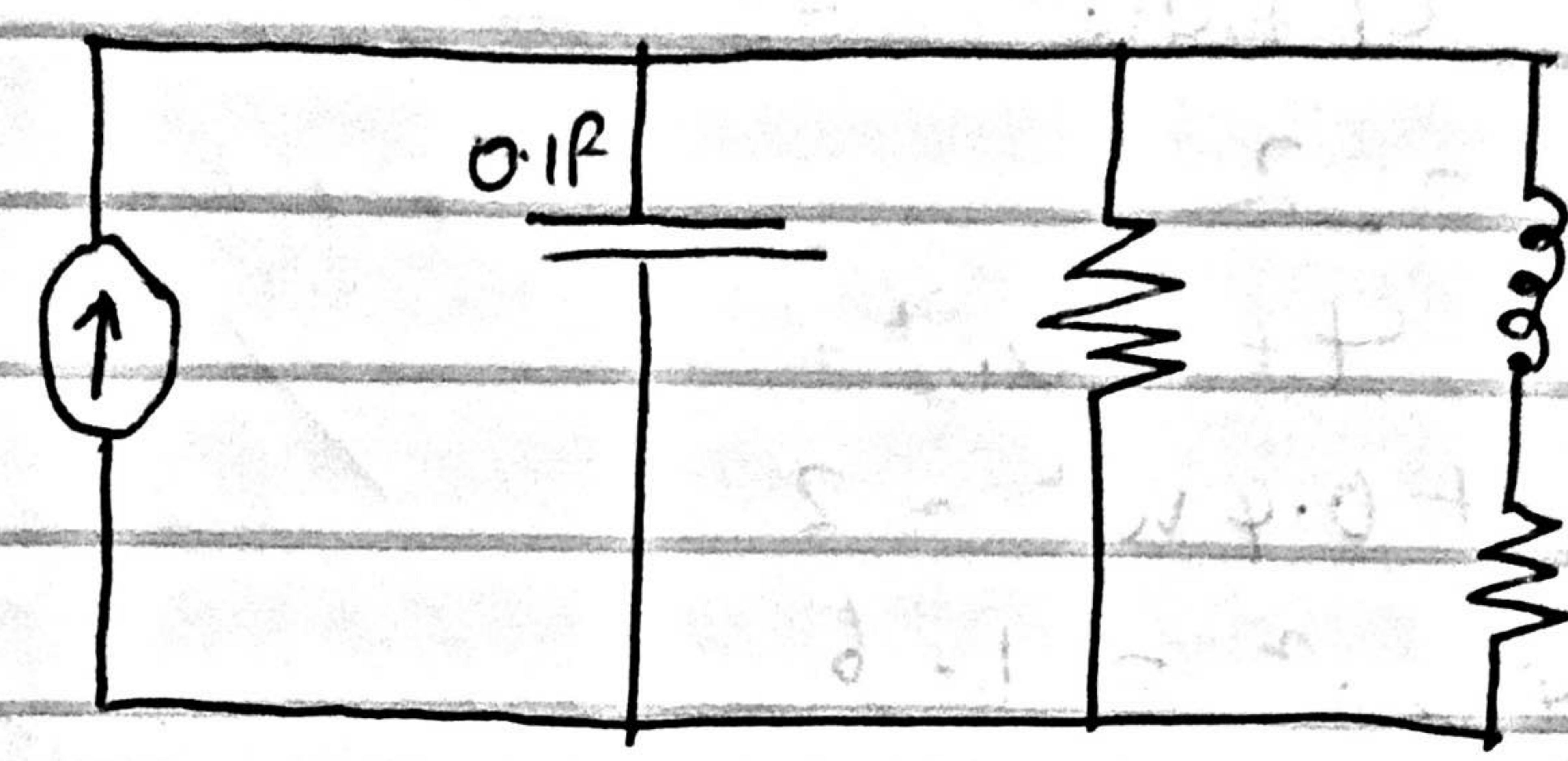
$w_1 = 99 krad/s$ //

$w_2 = w_0 + \beta/2 = 100\times10^3 + \frac{2000}{2} = 100\times10^3$

$+ 1000 = 101000$

$w_2 = 10.11$ krad/s

(2)



$$Y = \frac{1}{10} + jw0.1 + \frac{1}{2+jw_2} = 0.1 + jw0.1 + \frac{1}{2+jw_2}$$

$$\frac{1}{2+jw_2} = \frac{1}{2+jw_2} \times \frac{2-jw_2}{2-jw_2} = \frac{2-jw_2}{4+4w^2}$$

~~Y = 0.1 + jw0.1 + 2 - jw2 / 4+4w^2 + 0.1 ...~~

$$Y = 0.1 + \frac{2}{4+4w^2} + jw0.1 - \frac{jw_2}{4+4w^2} = 0.1 + \frac{2}{4+4w^2}$$

$$+ j\left(w0.1 - \frac{w_2}{4+4w_0^2}\right)$$

At resonance: $Im(y) = 0$

Therefore $w_0 0.1 - \frac{w_0 2}{4+4w^2} = 0$

$$0.1 - \frac{2}{4+4w^2} = 0$$

$$0.1 = \frac{2}{4+4w_0^2}$$

$$0.4 + 0.4w^2 = 2$$

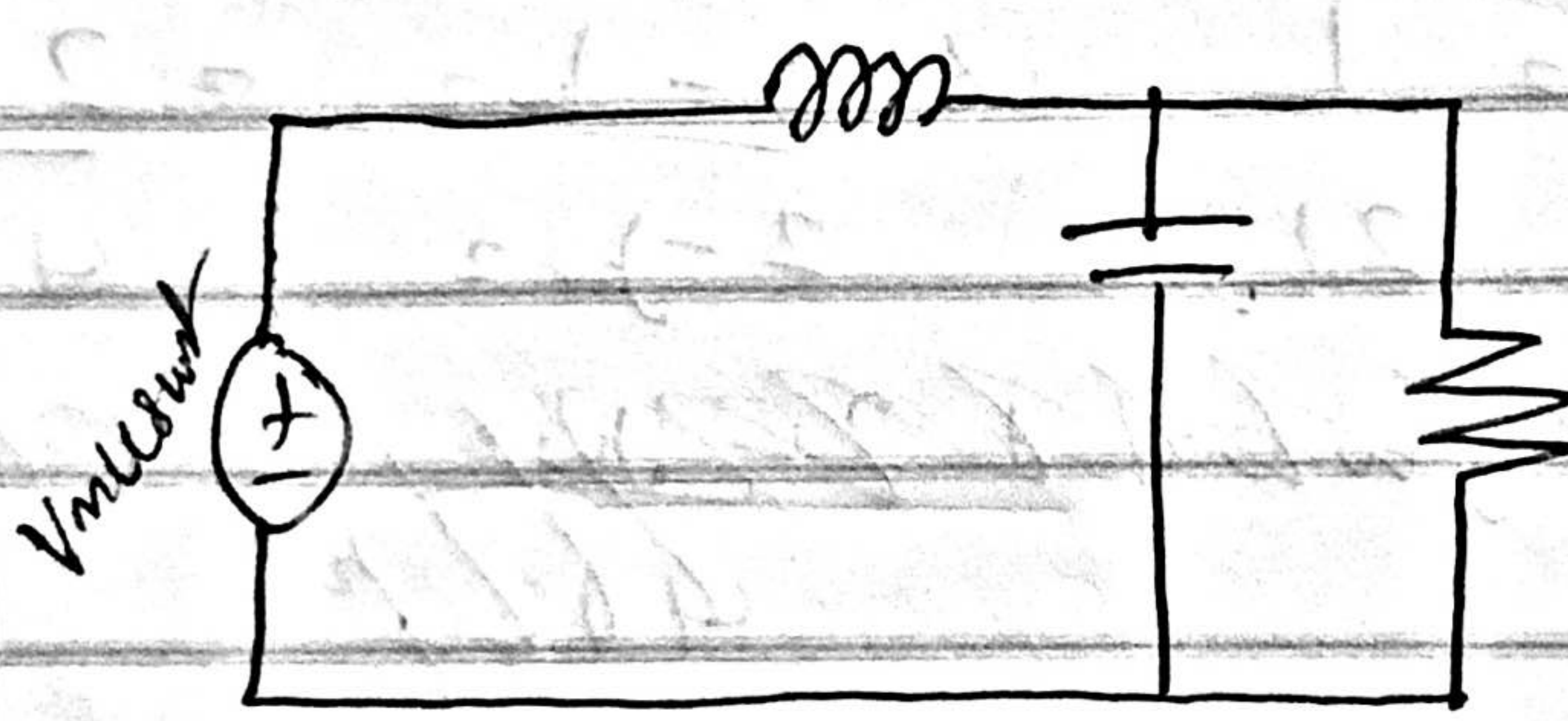
$$0.4w_0^2 = 1.6$$

$$w_0^2 = 0.4 \times 10^1$$

$$= 4$$

$$w_0 = \sqrt{4} = 2 \text{ rad/s}$$

(c)



$$Z = jw\,100\times10^{-3} + \left(\frac{20}{jw(0.5\times10^{-3}} \div \left(20 + \frac{1}{0.5\times10^{-3}jw}\right.\right.$$

$$= jw(100\times10^{-3}) + \left(\frac{20}{jw(0.5\times10^{-3}} \div \left(\frac{0.01jw+1}{0.5\times10^{-3}jw}\right)\right.$$

$$= jw(100\times10^{-3}) + \left(\frac{20}{jw(0.5\times10^{-3}} \times \left(\frac{jw(0.5\times10^{-3})}{0.01jw+1}\right)\right.$$

$$= jw(100\times10^{-3}) + \left(\frac{20}{0.01jw+1}\right)$$

$$\frac{20}{jw\,0.01+1} = \frac{20}{0.01\,jw+1} \times \frac{0.01jw-1}{0.01\,jw-1}$$

$$= \frac{jw\,0.2-20}{-1\times10^{-4}w^2-1} = \frac{-20+jw\,0.2}{-1\times10^{-4}w^2-1}$$

$$Z = jw(100\times10^{-3}) + \frac{20}{1\times10^{-4}w^2+1} \quad \frac{-0.2jw}{1+1\times10^{-4}w^2}$$

$$= \frac{20}{1+1\times10^{-4}w^2} + jw(100\times10^{-4})$$

$$-0.2jw \Big/ 1+1\times10^{-4}w^2$$

$$Z = 20 \Big/ 1+1\times10^{-4}w^2 + j\left(w(100\times10^{-3}) - \frac{0.2w}{1+1\times10^{-4}w^2}\right)$$

at resonance, the imaginary part of Z is 0

$\therefore 100(100 \times 10^{-3}) - \frac{0.2w_0}{1 + 1 \times 10^{-4} w_0^2} = 0$

$w_0(100 \times 10^{-3}) = 0.2w_0 / 1 + 1 \times 10^{-4} w_0^2$

$100 \times 10^{-2}(1 + 1 \times 10^{-4} w_0^2) = 0.2$

$100 \times 10^{-2} + 1 \times 10^{-5} w_0^2 = 0.2$

$1 \times 10^{-5} w_0^2 = 0.2 - 100 \times 10^{-3} = 0.1$

$1 \times 10^{-5} w_0^2 = 0.1$

$w_0^2 = 0.1 / 10^{-5}$

$w_0^2 = 10000$

$w_0 = \sqrt{10000}$

$w_0 = 100 \text{ rad/s}$