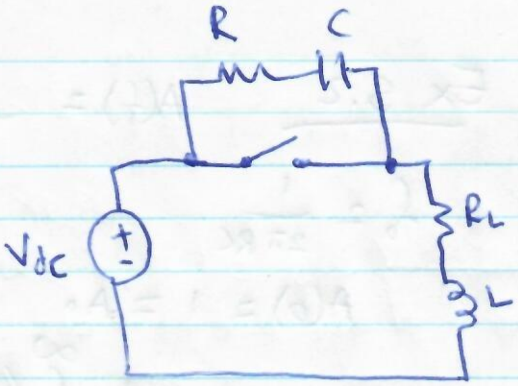
ECE 4320/5230

TOPIC 5

EX 5.1



The value of R is chosen according to

$$\frac{V_{dc}}{I_{A min}} < R < R_L$$

$$\frac{50}{0.25} < R < 500 \implies \boxed{200\,\Omega < R < 500\,\Omega}$$

To find C, two conditions should be satisfied

(a) to limit initial rate of rise of the available circuit voltage

$$\frac{V_{dc}}{CR_L} \leq E_B V = 10^8 * 0.01 = 10^6$$

$$\rightarrow \quad C \geq \frac{V_{dc}}{R_L} * 10^{-6} = 0.1\,\mu F$$

(b) peak available circuit voltage must be below the voltage required to initiate a glow discharge

$$\frac{V_{dc}}{R_L}\sqrt{\frac{L}{C}} < 320\,V$$

$$C \geq \left(\frac{1}{320}\frac{V_{dc}}{R_L}\right)^2 L$$

$$C \geq \left(\frac{1}{320} * 0.1\right)^2 (10^{-2}) = 976.6\,pF$$

$$= 0.0009766\,\mu F$$

$\implies$ Choosing the largest of the two, we pick $\boxed{C = 0.1\,\mu F}$

☒

Ex 5.2 $\quad A(f) = \dfrac{f_0}{jf + f_0}$

$f_0 = \dfrac{1}{2\pi RC}$

$A(0) = 1 = A_0$

Now, $\quad B = \dfrac{1}{|1|^2} \int_0^\infty \left(\left| \dfrac{f_0}{jf + f_0} \right|^2 \right) df$

$= f_0^2 \int_0^\infty \left(\dfrac{1}{\sqrt{f^2 + f_0^2}} \right)^2 df$

$= f_0^2 \int_0^\infty \left((f^2 + f_0^2)^{-1} \right) df$

integration by substitution

let $\quad f = f_0 \tan\theta \quad$ and $\quad df = f_0 \sec^2\theta \, d\theta$

$\rightsquigarrow \quad B = f_0^2 \int_0^{\pi/2} \dfrac{1}{f_0^2 \tan^2\theta + f_0^2} \cdot f_0 \sec^2\theta \, d\theta$

$= f_0 \int_0^{\pi/2} \dfrac{1}{\tan^2\theta + 1} \cdot \sec^2\theta \, d\theta$

recall that $\quad \tan^2\theta + 1 = \sec^2\theta$

$\rightsquigarrow \quad B = f_0 \int_0^{\pi/2} d\theta$

$\boxed{B = \frac{\pi}{2} f_0}$ $\qquad$ i.e $\boxed{1.57 * \overset{(f_0)}{3dB} \text{ BW}}$

$\boxed{\checkmark}$

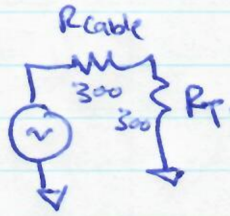
Ex: 5.3

@ the input of the TV, the 300Ω T-line, generates a thermal noise voltage of

(open circuit thermal noise voltage) $V_{t_0} = \sqrt{4KTRB} = \sqrt{4 * 1.38 * 10^{-23} * 290 * 300 * 4 * 10^{6}}$

↑ room temp

$= 4.3829\ \mu V$



$V_{t\text{-}TV} = \frac{1}{2} V_{t_0}$

$= 2.1915\ \mu V$

$= 6.815\ dB\mu V$

$= -53.2\ dBmV$

All impedances are referenced to 300Ω

The TV will add 14dB of noise (Because of its 14dB NF)

then, $V_{in\text{-}TV\text{-}noise} = -53.2 + 14$

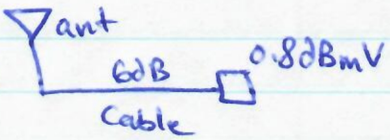
$= -39.2\ dBmV$

Since we need 40dB SNR, then signal level @ TV input should be

$V_{sig}|_{dB} = SNR|_{dB} + V_{in\text{-}TV\text{-}noise}$

$= 40 - 39.2 \quad = 0.8\ dBmV$

$V_{sig\text{-}ant}|_{dB} = 6 + 0.8 = 6.8\ dBmV$



$\boxed{V_{sig\text{-}ant}|_{V} = 2.19\ mV}$