Sheet (4) - solution

Oscillators – part 1

1. If the voltage gain of the amplifier portion of an oscillator is 75, what must be the attenuation of the feedback circuit to sustain the oscillation?

Unity gain around the closed loop is required for sustained oscillat

$$A_{cl} = A_v B = 1$$

$$B = \frac{1}{A_v} = \frac{1}{75} = \mathbf{0.0133}$$

2. Generally describe the change required in the oscillator of problem (3) in order for oscillation to begin when the power is initially turned on?

To ensure startup:

$A_{cl} > 1$

since $A_v = 75$, B must be greater than 1/75 in order to produce the cond

$A_v B > 1$.

For example, if $B = 1/50$,

$$A_v B = 75\left(\frac{1}{50}\right) = 1.5$$

3. A certain lead-lag circuit has a resonant frequency of 3.5 KHz. What is the rms output voltage if an input signal with a frequency equal to resonant frequency and with an rms value of 2.2V is applied to the input?

$$\frac{V_{out}}{V_{in}} = \frac{1}{3}$$

$$V_{out} = \left(\frac{1}{3}\right)V_{in} = \frac{2.2\text{ V}}{3} = \mathbf{733\text{ mV}}$$

4. Calculate the resonant frequency of lead-lag circuit with R_1=R_2=6.2KΩ and C_1=C_2=0.02μf?

$$f_r = \frac{1}{2\pi RC} = \frac{1}{2\pi(6.2\,\text{k}\Omega)(0.02\,\mu\text{F})} = \mathbf{1.28\ kHz}$$

5. Determine the necessary value of R_2 in figure 1 so that circuit will oscillate, neglect forward resistance of zener diodes (hint: the total gain of the circuit must be 3 when the zener diode is conducting)?

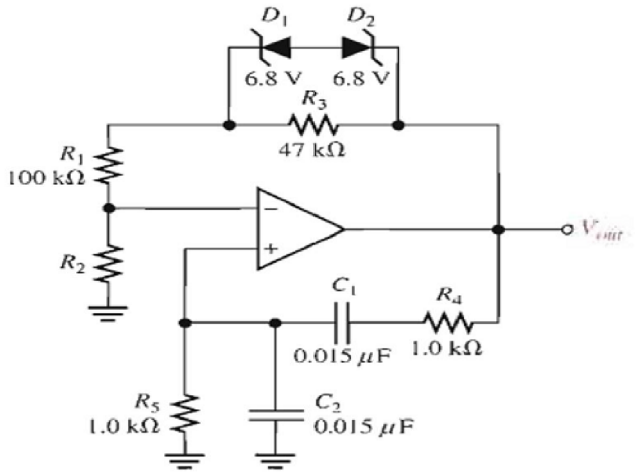

Figure 1

$$R_1 = 2R_2$$

$$R_2 = \frac{R_1}{2} = \frac{100\,\text{k}\Omega}{2} = \mathbf{50\ k\Omega}$$

6. Explain the purpose of R3 shown in figure1?

When dc power is first applied, both zener diodes appear as opens because there is insufficient output voltage. This places R_3 in series with R_1, thus increasing the closed-loop gain to a value greater than unity to assure that oscillation will begin.

7. For wein-bridge oscillator shown in figure 2, calculate the setting for R_f assuming the internal drain source resistance of JFET is 350Ω, when oscillations are stable.

$$R_f = (A_v - 1)(R_3 + r'_{ds}) = (3 - 1)(820\ \Omega + 350\ \Omega) = \mathbf{2.34\ k\Omega}$$

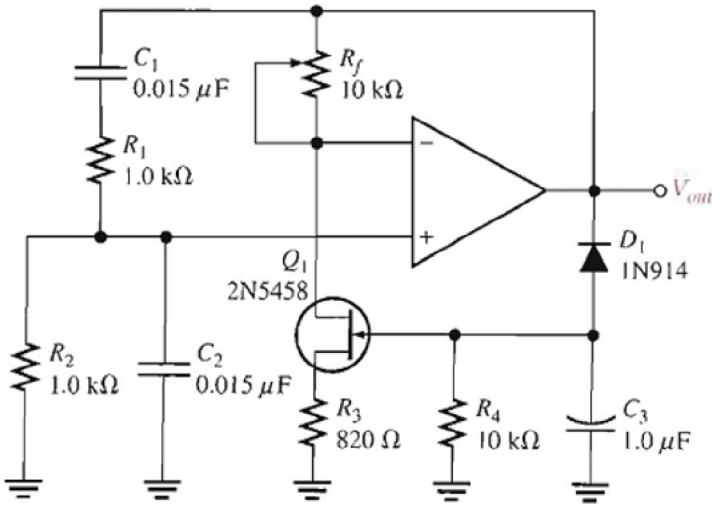

Figure 2

8. Find the frequency of oscillation for wein-bridge oscillator in problem (7)

$$f_r = \frac{1}{2\pi(1.0\ \text{k}\Omega)(0.015\ \mu\text{F})} = \mathbf{10.6\ kHz}$$

Good Luck

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