ee101_osc_1.sqproj

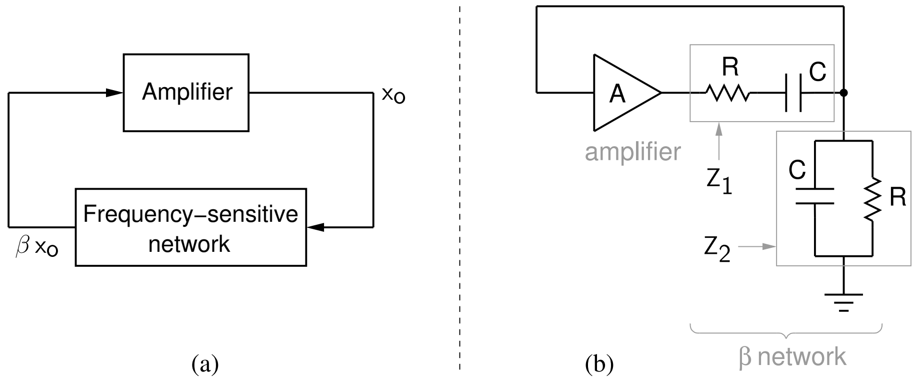

Figure 1: (a) Block diagram of a sinusoidal oscillator, (b) A specific example of the β network.

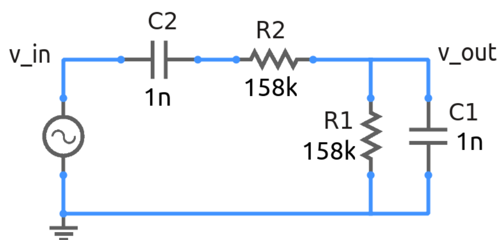

Figure 2: Circuit diagram of β network with component values.

Fig. 1 shows the block diagram of a sinusoidal oscillator based on positive feedback. It consists of an amplifier with gain A and a feedback network which is characterised by $\beta = v_{\text{out}}/v_{\text{in}}$ (see Fig. 2), given by

$$\beta(j\omega) = \frac{Z_2}{Z_1 + Z_2} \,. \tag{1}$$

The condition for oscillation is given by the Barkhausen criterion, viz.,

$$A(j\omega)\,\beta(j\omega) = 1 \,. \tag{2}$$

(See `opamp_circuits/wien_osc_1.sqproj` and `opamp_circuits/wien_osc_2.sqproj` for oscillator circuits using the above β network.)

Exercise Set

1. Apply the Barkhausen criterion and find the condition for oscillation, i.e., the frequency of oscillation and the condition to be satisfied by A for oscillations to occur (assuming A to be real).

2. Simulate the circuit and plot the magnitude and phase of β as a function of frequency. From the plots, find the numerical value of A that is required for the circuit to oscillate.

3. Compare the values you obtained in (1) with the simulation results.

References

1. S. Franco, *Design with Operation Amplifiers and Analog Integrated Circuits,* McGraw-Hill, 1998.

2. J. Millman and A. Grabel, *Microelectronics,* McGraw-Hill, 1988.