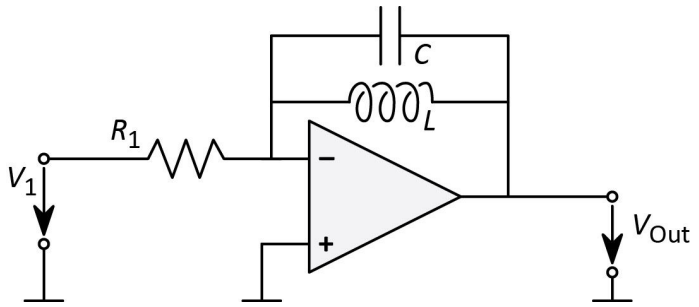
Homework 03

1. Consider an op amp circuit as shown in the figure below. The non-inverting input terminal is connected to ground. The feedback impedance is a capacitor *C* parallel to an inductor *L*.



   (a) Calculate and sketch the impedance of the feedback impedance as a function of angular frequency ω.
   (b) What is the resonance angular frequency (ω_0) of the feedback circuit?
   (c) Calculate the transfer function $| H(\omega) | = | V_{out}/V_1 |$. Sketch the transfer function.
   (d) Next, a resistor R_F is added in parallel to the *L* and *C*. Draw the feedback circuit. Calculate the impedance.
   (e) What is the feedback impedance at the resonance frequency ω_0? Sketch the impedance of the feedback impedance as a function of ω.
   (f) Assume that $R_1 = R_F$. What is the amplification of the amplifier at the resonance frequency?

2. An Op Amp has an open-circuit voltage gain of A_{VOC} (that can be adjusted by the feedback resistor) and a slew rate of SR = 1 V/μs.
   (a) Define the slew rate in your own words. Does the slew-rate limitation apply to the Op Amp's input or output voltage?
   (b) A triangular wave with period 1 μs and amplitude of 1 V is applied to the input of an Op Amp with an open-circuit voltage amplification of A_{VOC} = 5. Sketch the input waveform. Sketch the output waveform of the Op Amp. Is the output signal distorted?
   (c) For an Op Amp with A_{VOC} = 1, can you determine the maximum frequency of an input triangular wave with amplitude 100 mV that can be amplified with high fidelity?
   (d) For an Op Amp with A_{VOC} = 10, can you determine the maximum frequency of an input triangular wave with amplitude 100 mV that can be amplified with high fidelity?
   (e) For an Op Amp with A_{VOC} = 100, can you determine the maximum frequency of an input triangular wave with amplitude 100 mV that can be amplified with high fidelity?
   (f) Assume that the bandwidth of an Op Amp is the maximum frequency at which a signal is amplified with high fidelity. What is the mathematical product of (Op Amp gain) × (Op Amp bandwidth) for the previous 3 questions? Is the mathematical product a constant?
   (g) Is the constancy of the gain-bandwidth product a direct consequence of the finite slew rate of an Op Amp?

3. Are the statements ***True*** or ***False***? Justify your answer with one or two sentences.
   (a) A forward biased diode converts to heat the power of $V_f \times I$, where V_f is the forward voltage and I is the diode current.
   (b) A reverse-biased pn-junction diode generally consumes no or very little power.