Name:
Student ID:

Analog Electronics

Homework # 4

Due date:

Problem 1:

Design a Butterworth filter that meets the following low-pass specifications: $f_p = 8\ kHz$, $A_{max} = 3\ dB$, $f_s = 16\ kHz$, and $A_{min} = 24\ dB$. Find N, the natural modes, and $T(s)$. What is the attenuation provided at $24\ kHz$?

Hint: The details about poles' position are available in the textbook

Problem 2:

In figure 1, a voltage signal source with a resistance $R_s = 8k\Omega$ is connected to the input of a common-emitter BJT amplifier. Between base and emitter is connected a tuned circuit with $L = 1\ \mu H$ and $C = 100\ pF$. The transistor is biased at 1 mA and has β = 100, Cπ = 12 pF, and Cμ = 0.6 pF. The transistor load is a resistance of 4 $k\Omega$. Find ω_o, Q, the 3-dB bandwidth, and the center-frequency gain of this single-tuned amplifier. Ignore r_x and r_o.

Hint: Draw AC equivalent circuit. Calculate the equivalent capacitance (from $C, C\pi$ and $C\mu$, using Miller Effect at one point) and equivalent resistance (from R_s and r_π). Then, you start applying formulas regarding the second-order bandpass filter to finds out ω_o, Q, the 3-dB bandwidth. The center-frequency gain is the midband gain A_M

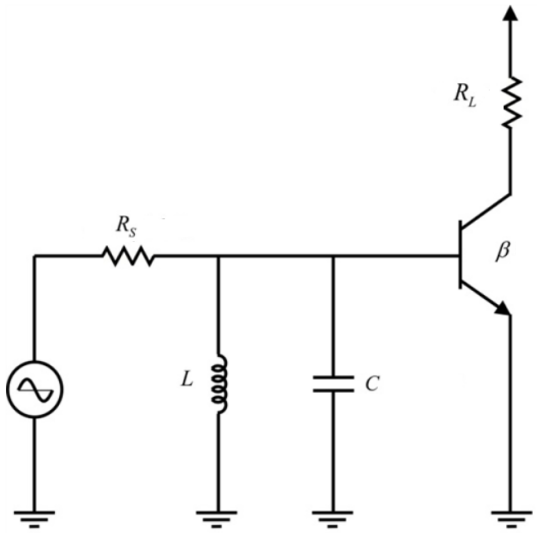

Figure 1

Problem 3:

Design the KHN circuit to realize a highpass filter with a cutoff frequency of 10 kHz and a 3-dB bandwidth of 500 Hz. Use 10-nF capacitors. Draw the complete circuit and specify all component values. What value of center-frequency gain is obtained?