Project #2 for Electronic Circuit Ⅱ

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- **Deadline :** 6:00 pm on May.12.2007. No late hand-in will be allowed.

- **Team :** Students are expected to form a team of two members to do the project and hand in one project report. Equal grades will be given to the members of the same team. Each team must do its own simulation and analysis.

- **Goal :** Design a high-order Chebyshev low pass filter(LPF) with active-RC & switched-capacitor that satisfies the following specification.

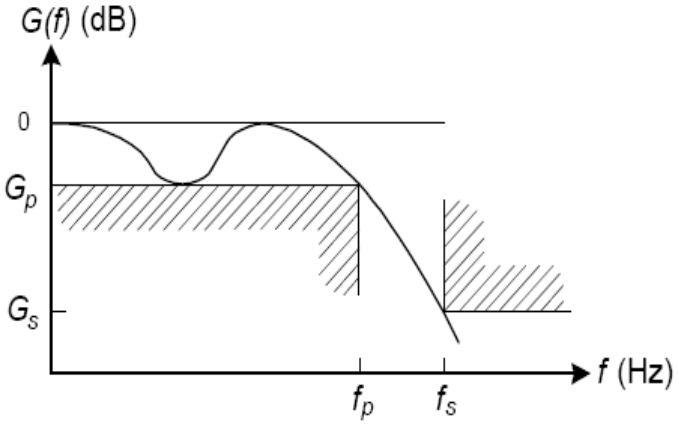

Fig. 1. Chebyshev low pass filter

- Specification

Gain=1 (0dB)
G_p= 1.2dB at f_p= 3kHz
G_s= 44dB at fs= 8kHz
where G_p : Pass-band gain
G_s : Stop-band gain

- Include the following items in the report.

· MATLAB and PSpice simulation process to measure each design parameter.
· Design processes (How you come up with your design values)
· Final results (plot , figure and discussions…)
· Filter transfer fuction range (100Hz≤x-range≤10KHz, -50dB≤y-range≤5dB)

Ⅰ. Verify a high-order Chebyshev LPF. (20%)

(a) Determine the filter transfer function that satisfies the given specification.

(b) Using MATLAB, confirm your answer for (a).

Ⅱ. Design an active-RC Chebyshev LPF that satisfies the given specification.(30%)

(a) Determine the transfer function of Tow-Thomas biquad shown in S&S Fig. 12.25(b).

(b) Cascading the biquad used in (a), realize an active RC Chebyshev LPF.

(c) Simulate the filter using PSpice, and determine that the filter satisfies specification.
(Using $R \leq 200\text{M}\Omega$, $1\text{pF} \leq C \leq 15\text{pF}$)

(d) Make sure all nodes in your circuit should be within the power supply voltage.
Show the simulation result of ac sweep for each node. (Use the supply voltage of 1 and 0 volts)

(e) For the optimal design, minimize the total capacitance value, minimize pass-band gain(G_p), and maximize stop-band gain(G_s).

Ⅲ. Design a switched-capacitor Chebyshev LPF that satisfies the given specification. (40%)

(a) Replace R's in the active-RC filter realized in Ⅱ with switched capacitors.
(Using $1\text{pF} \leq C \leq 15\text{pF}$, sampling frequency($f_s$)=50KHz)

(b) Simulate the switched-capacitor filter using PSpice, and show the filter transfer function

(c) Compare the performance of active-RC and switched capacitor filters.

(d) Make sure all nodes in your circuit should be within the power supply voltage.
Show the simulation result of ac sweep for each node. (Use the supply voltage of 1 and 0 volts)

(e) For the optimal design, minimize the total capacitance value, minimize pass-band gain(G_p), maximize stop-band gain(G_s).

Ⅳ. Design Report (10%)

Write a clear and well-organized report in which you provide answer to above questions as well as how you describe your design process.

Ⅴ. Design Presentation in English(15%, extra point)

Eight teams can make presentation of their design process and result for 15 minutes on 5/16.

Eight teams will be selected based on following criteria**(In switched capacitor):**

1. The total capacitance value.
(Calculate down to three point of decimals, and round off the numbers to two decimal point)
2. Minimize pass-band gain[dB]
3. Maximize stop-band gain[dB].

Ⅵ. Participation in English presentation(check one) : Yes No