

KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

Electrical Engineering Department

EE-416 Analog Filter Design

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H.W.# 4:

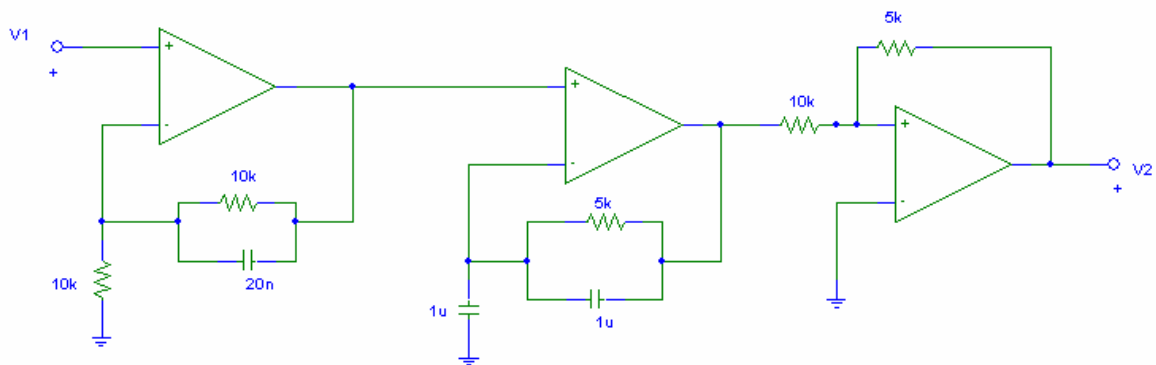
1) Design a fourth-order Bessel-Thomson filter to provide 100- μ s delay. What are the filter's attenuation error and the delay error in the frequency band $0 \leq f \leq 2.6\text{kHz}$?

2) A Bessel-Thomson approximation function is to be flat within 5% of its delay at dc of 1 ms up to the frequency 1800 rad/s.

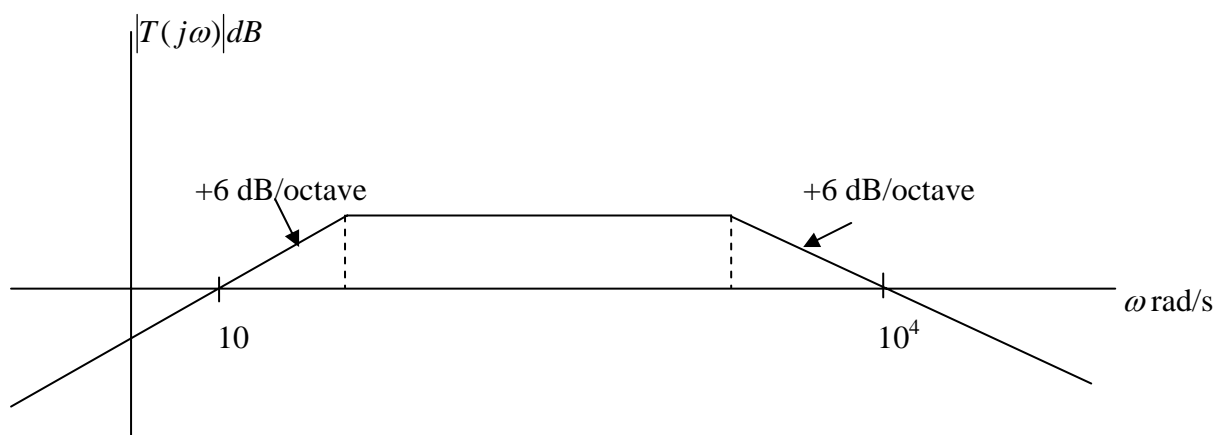
(a) Determine the appropriate Bessel-Thomson function.

(b) What is the attenuation of the function at 1800 rad/s and 14,000 rad/s?

3) For the circuit given in Figure below, prepare an asymptotic Bode plot for the magnitude of $T(j\omega)$. Carefully identify slopes and low- and high-frequency asymptotes.



4) Design an RC op-amp filter to realize the bandpass response shown in Figure below. Use a minimum number of op-amps in your design, and scale so that the elements are in a practical range.



5) Design a circuit that provides a set of three 60-Hz voltages of equal magnitudes but lagging each other in phase by 120° using two first-order all pass filters.