KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
Electrical Engineering Department
EE-416 Analog Filter Design
Instructor: Dr. Hussain Alzaher
Exam-I (061)

Name: I.D.# Serial #:

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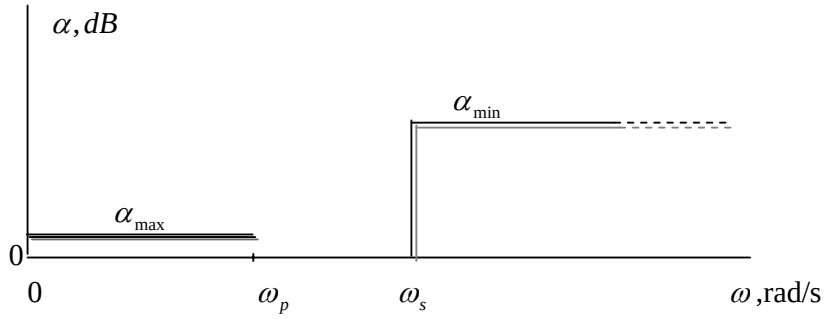
1) Determine the order n of the Butterworth filter for which α_{max} =1 dB, α_{min} =20 dB, and $\omega_s / \omega_p = 1.3$. What is the actual value of minimum stopband attenuation realized? If to be exactly 20 dB, to what value can α_{max} be reduced.

1) Design lowpass filters with **Chebyshev** and **Inverse-Chebyshev** responses satisfying the following specifications: α_{max} =0.1 dB, α_{min} =30 dB, $\omega_p = 1000$ rad/s, ω_s =1400 rad/s. Adjust the gain such that the dc gain becomes 0 dB. **[5/15]**



2) (a) Determine (estimate) the degrees necessary for maximally flat and Cauer (elliptic) filters to meet the following requirements.

$\alpha_{\max}[dB]$	$\alpha_{\min}[dB]$	$\omega_p[rad/s]$	$\omega_s[rad/s]$
1	40	1000	2000

(b) Determine the transfer functions of the above lowpass filters that meet the above specifications. **[6/15]**

3) Design a fourth-order Bessel-Thomson filter to provide 500-μs delay. What are the filter's attenuation error and the delay error in the frequency band $0 \leq f \leq 2.6kHz$?
[4/15]