

NAME:

STUDENT NO.:

University of Puerto Rico
Electrical and Computer Engineering Department
INEL 4202 - Electronics II - Exam 4 - Prof. M. Toledo
25 POINTS EACH PROBLEM - BE CLEAR OR LOOSE POINTS

1. Design a low-pass, third order Butterworth filter with a cutoff frequency of 500Hz. Use cascaded Sallen-Key and first order stages. $B_3(s) = (s + 1)(s^2 + s + 1)$.

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2. How much would 250Hz and 1kHz signals be attenuated by the filter described in problem 1? Express your answer in decibels.

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3. The sketch below shows a sinusoidal oscillator. The phase-shift network is shown inside the dashed box. For this circuit,

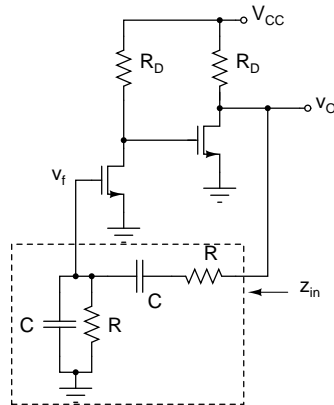
$$\beta(s) = \frac{v_f}{v_o} = \frac{sCR}{s^2C^2R^2 + 3sCR + 1}$$

and that

$$z_{in} = \frac{s^2C^2R^2 + 3sCR + 1}{sC(sCR + 1)}$$

z_{in} represents the input impedance to the phase shifter, as shown in the diagram.

- Find an expression for the frequency of oscillation, ω_r , in terms of C , R and R_D .
- Apply Barkhausen amplitude criterion to find an expression, in terms of g_m , C , R and R_D , that the circuit gain should satisfy for sustained oscillations.



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4. Design a Class A power amplifier capable of providing up to 25 watts to a 100 Ohms load. Specify all component values, including those needed to construct the current source. Also specify the power, voltage and current requirements for transistors and supplies, including average and maximum instantaneous values. Draw a sketch of your design.