

EXAMINATION NO. 2

NAME _____ SCORE _____ /100

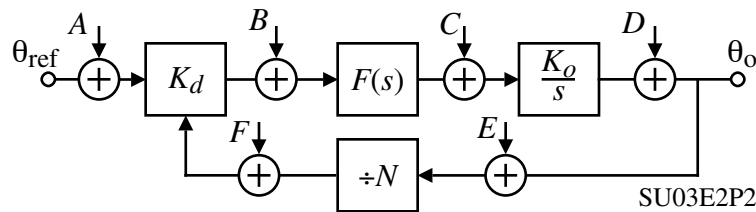
INSTRUCTIONS: This exam is lecture notes (the ones handed out). The exam consists of 4 questions for a total of 100 points. Please show your work leading to your answers so that maximum partial credit may be given where appropriate. Be sure to turn in your exam with the problems in numerical order, firmly attached together.

Problem 1 - (25 points)

A frequency synthesizer is shown below and has the following parameters:

$$F(s) = \frac{1 + 0.01s}{s} \quad K_o = 2 \times 10^6 \text{ (rads/V)} \quad K_d = 0.8 \text{ (V/rad.)}$$

$$\beta = 2\pi \quad N = 150 \quad f_{ref} = 120 \text{ kHz}$$



(a.) Where would you introduce the modulating voltage, v_p , if you wish to phase modulate the output of the synthesizer (A, B, C, D, E, or F)?

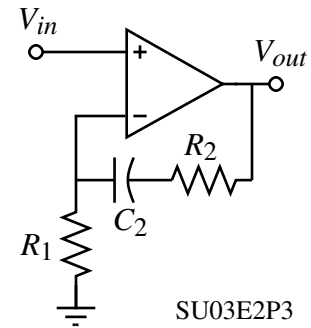
(b.) What is the peak amplitude of a 1kHz ac signal needed to produce an output peak phase deviation of 0.5 radians?

Problem 2 - (25 points)

(a.) Find the transfer function of the filter shown assuming an ideal op amp.

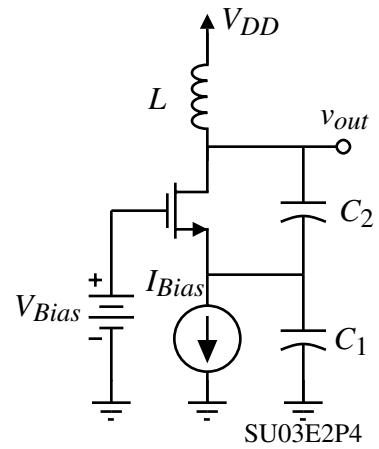
(b.) Sketch a Bode plot for the magnitude of this filter if $R_1 = R_2 = 10\text{k}\Omega$ and $C_2 = 0.159\mu\text{F}$.

(c.) For the values in part (b.), find the single sideband spur at a reference frequency of 25 kHz if the op amp has an input offset current of $I_{os} = 50\text{nA}$ and an input offset voltage of $V_{io} = 100\mu\text{V}$. Assume that the spurious deviation due to the offset voltage at 25 kHz can be expressed as $\theta_d = 100V_{pm}$, where V_{pm} is the phase modulation caused by the offset voltage of the filter.



Problem 3 - (25 points)

Find the oscillation frequency, ω_{osc} and the value of $g_m r_{ds}$ necessary to oscillate in terms of L , C_1 , and C_2 for the LC oscillator shown.



Problem 4 – (25 points)

A model for single sideband noise using the time-invariant theory is given by

$$\mathcal{L}\{f_m\} = 10 \log \left\{ \frac{2FkT}{P_s} \left[1 + \frac{1}{4Q^2} \left(\frac{f_o}{f_m} \right)^2 \right] \left(1 + \frac{f_c}{f_m} \right) \right\}$$

- (a.) Describe each variable in this equation and give the units of each variable.
- (b.) If $F = 2\text{dB}$, what is the noise floor if the carrier power is 10 dBm at room temperature (27°C) and $k = 1.381 \times 10^{-23}$ Joules/ K° ?
- (c.) Make an approximate sketch of $\mathcal{L}\{f_m\}$ in dBc as a function of $\log_{10}(f_m)$ and identify the various regions.

Extra Sheet