Department of Electrical & Computer Engineering
University of California, Santa Barbara

ECE 2B
Summer 2009
Shynk
H.O. #21

EXAMPLE FINAL EXAM

INSTRUCTIONS

1. This exam is **open book and open notes**. You may use a calculator.
2. It consists of 3 problems and is worth a maximum of 90 points. The problems are of equal worth but not of equal difficulty, so use discretion in allocating your time. Answer all questions in any order.
3. Show your answers in the spaces provided, and use the back side of the exam pages if you need additional work space. **Show your reasoning and the essential steps clearly and concisely.**

Last Name, First Name: _____

Scores:

1. _____

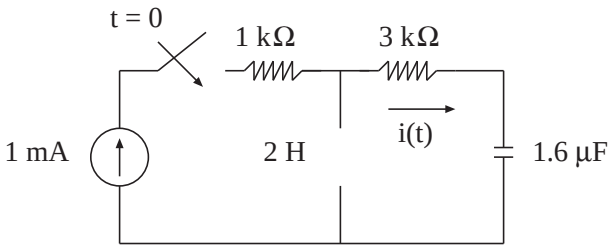
2. _____

3. _____

Total: _____

1. S-DOMAIN CIRCUIT ANALYSIS (30 points)

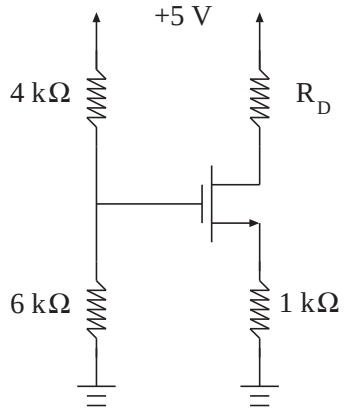
Assume there is no energy in the following RLC circuit before the switch closes at $t = 0$. (a) Find an expression for the s-domain current $I(s)$ through the 3 kΩ resistor. (b) Specify the type of second-order circuit and sketch the poles and zeros on the s-plane. (c) Use the initial- and final-value theorems to find the currents $i_L(0^+)$ and $i_L(\infty)$ through the inductor. (c) From a partial fraction expansion of $I(s)$, find an expression for $i(t)$ for $t \geq 0$.



Solution:

2. TRANSISTOR CIRCUIT ANALYSIS (30 points)

The following circuit contains a MOSFET transistor with $V_t = 1$ V and $k_n' W/L = 2$ mA/V^2. (a) Find the drain resistor R_D such that the transistor is operating at the saturation boundary with a drain current of $i_D = 1$ mA. (b) Next, find R_D such that the transistor is operating in the triode region with $i_D = 0.5$ mA. (c) Determine the transistor resistance r_{DS} for the conditions in part (b).



Solution:

3. FREQUENCY-SELECTIVE CIRCUIT ANALYSIS (30 points)

A parallel RLC circuit has the following transfer function:

$$H(s) = \frac{(L/R)s}{LCs^2 + (L/R)s + 1} \tag{1}$$

with $R = 500\ \Omega$, $L = 4/3$ H, and $C = 1\ \mu$F. (a) Find the center frequency ω_o and the cutoff frequencies ω_{c1} and ω_{c2}. (b) Specify the filter bandwidth B and the quality Q for this circuit. (c) Find the poles and zeros of the transfer function and sketch a Bode diagram of the frequency response.

Solution: