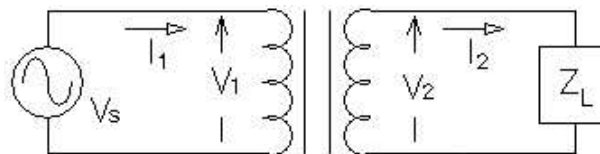# EE1050   Exam 3   given: Spring 01

(The space between problems has been removed.)

1. (29 pts) A transformer is rated at 240V primary, 120V secondary, and 180VA. Assume the transformer is ideal and all voltages and currents are RMS.


$$|Z_L| = 20 \cdot \Omega \quad V_L := 24 \cdot V$$
$$pf := 80 \cdot \%$$

a) What is the current rating of the primary?

b) What is the current rating of the secondary?

c) The secondary has 100 turns of wire. How many turns does the primary have?

d) $V_L := 24 \cdot V$ How big is the source voltage ($|V_S|$)?

e) The secondary load (Z_L) has a magnitude of 20 Ω at a power factor of 80%. Find the secondary current, I_2 (magnitude **and angle**).

f) Find the primary current, I_1 (magnitude **and angle**).

g) How much average power does the load dissipate?

h) How much average power does the power source (V_S) supply?

i) What is the load as seen by V_S? (magnitude **and angle**)

2. (21 pts) You're in the lab. You have a signal generator hooked to the input of a circuit (V_{in}) and a scope hooked to the output (V_o). By varying the frequency of the signal generator and taking peak-to-peak voltage measurements with the scope, you are able to plot the frequency response curve shown.

Signal generator   Scope
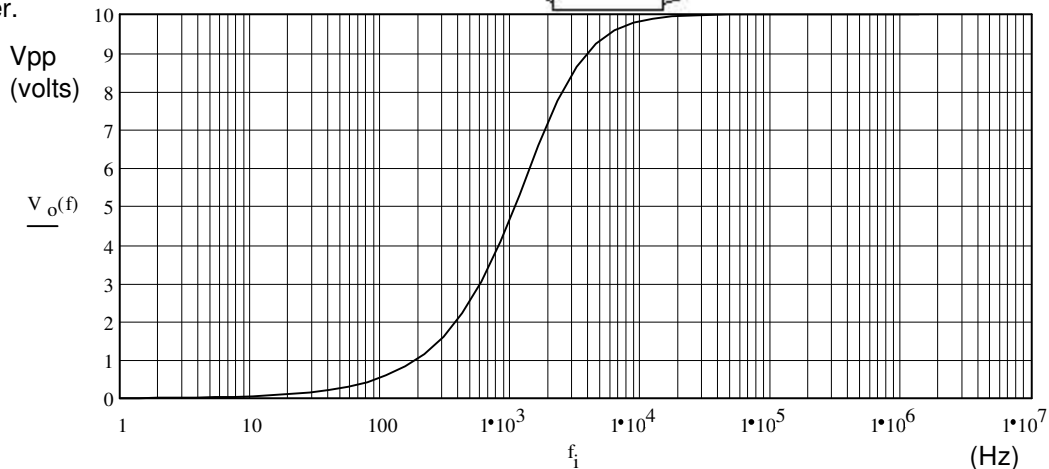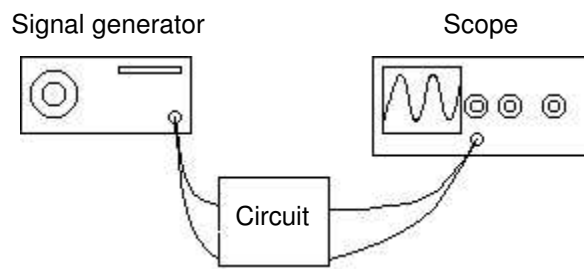
a) The circuit is what type of filter? Circle the best answer.

 i)   coffee

 ii)   low pass

 iii) high pass

 iv) band pass

 v)   band reject

 vi) can't tell

b) What is the corner or "break" frequency (f_c)?

c) Which of the following could be your input voltage (as a function of time). Circle all that are right.

 i) $v_{in}(t) = 10 \cdot \cos(\omega \cdot t)$ ii) $v_{in}(t) = 5 \cdot \cos(\omega \cdot t)$ iii) $v_{in}(t) = 20 \cdot \cos(\omega \cdot t)$ iv) $v_{in}(t) = \dfrac{10}{\sqrt{2}} \cdot \cos(\omega \cdot t)$

 v) $v_{in}(t) = \left(10 \cdot \sqrt{2}\right) \cdot \cos(\omega \cdot t)$

d) Which of the circuits shown below could possibly be your circuit? (Circle all that could be, there may be more than one right answer.) In each case: $C := 0.2 \cdot \mu F$ and/or $L := 32 \cdot mH$
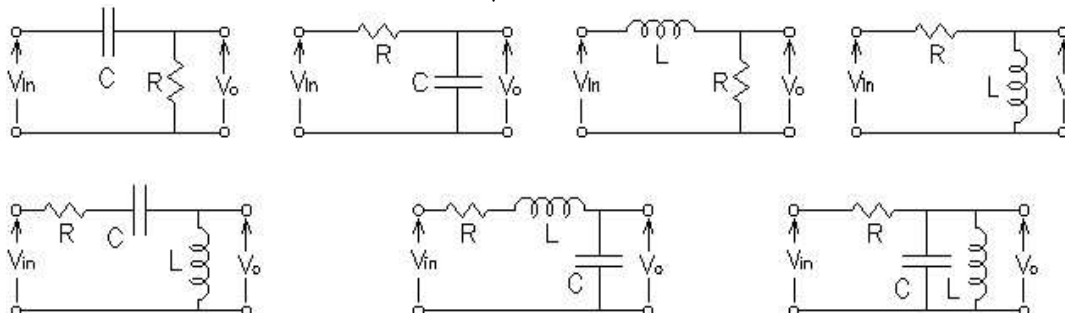
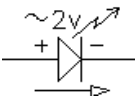**EE1050   Exam 3   given: Spring 01   p1**

2e) Using your answers to part b) and d), find the value of R.
   If you circled more than one circuit in part d, just pick one of those you circled and find R for that one.
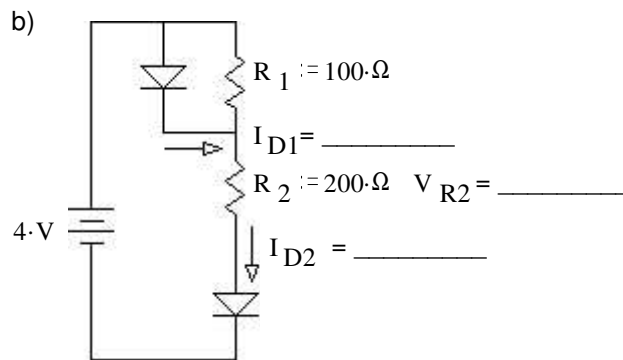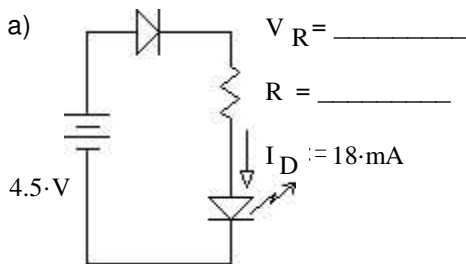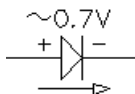
   In each case: $C := 0.2 \cdot \mu F$ and/or $L := 32 \cdot mH$

3. (17 pts) Fill in the blanks in the following circuits.

   Assume the LEDs have a 2V forward voltage drop: ~2V $\nearrow\nearrow$ $+ \boxed{\triangleright\!|} -$

   Assume the diodes are silicon with a 0.7V forward voltage drop: ~0.7V $+ \boxed{\triangleright\!|} -$

a)
$V_R =$ _____
$R =$ _____
$I_D := 18 \cdot mA$
$4.5 \cdot V$

b)
$R_1 := 100 \cdot \Omega$
$I_{D1} =$ _____
$R_2 := 200 \cdot \Omega$ $V_{R2} =$ _____
$4 \cdot V$
$I_{D2} =$ _____

4. (25 pts) Analysis of the circuit shown yields the characteristic equation and s values below.

   The switch has been in the closed position for a long time and is opened (as shown) at time t = 0. Find the initial and final conditions and write the full expression for $v_C(t)$, including all the constants that you find. Don' t let the odd position of the switch throw you, just use it to find your initial conditions.

   Clearly show important numbers (like initial and final conditions) to get partial credit. If you can' t find some of these, guess so that you can move on and demonstrate what you do know.

   $R_1 := 40 \cdot \Omega$
   $L := 80 \cdot mH$
   $V_{in} := 10 \cdot V$
   $R_2 := 60 \cdot \Omega$
   $C := 0.125 \cdot \mu F$
   $t = 0$
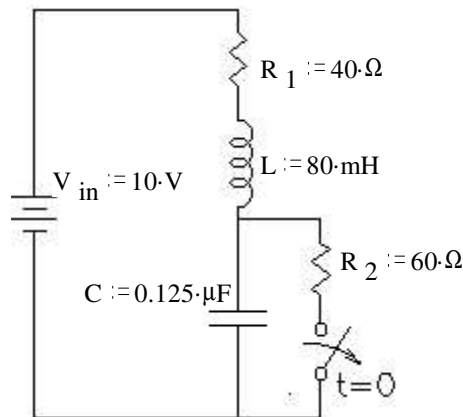
   $$0 = s^2 + \frac{R_1}{L} \cdot s + \frac{1}{L \cdot C}$$

   $$s_1 := (-250 + 10^4 \cdot j) \cdot \frac{1}{sec} \quad , \quad s_2 := (-250 + 10^4 \cdot j) \cdot \frac{1}{sec}$$

5. (8 pts) The circuit in the previous problem has this characteristic equation: $$0 = s^2 + \frac{R_1}{L} \cdot s + \frac{1}{L \cdot C}$$
   What value of R_1 would make this circuit critically damped?

Answers

1. a) 0.75A   b) 1.5A   c) 200 turns   d) 48V   e) 1.2A $/36.9°$ f) 0.6A $/36.9°$ g) 23W   h) 23W   i) 80Ω $/36.9°$

2. a) high pass   b) 2000Hz   c) ii)   d) 1st & 4th in first row   d) 398Ω or 402Ω

3. a) 1.8V 100Ω   b) 6mA 2.6V 13mA

4. $v_C(t) := e^{-250 t} \cdot (-4 \cdot V \cdot \cos(10^4 \cdot t) + 79.9 \cdot V \cdot \sin(10^4 \cdot t)) + 10 \cdot V$

5. 1.6kΩ