Last Name, First Name *Student No.*

Check your tutorial section(REQUIRED!):

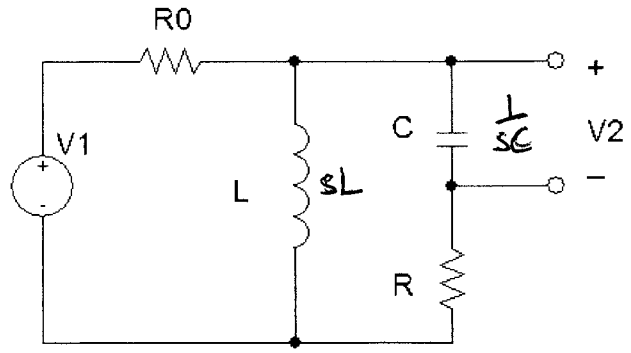
TUT0101	TUT0102	TUT0103	TUT0104	TUT0105	TUT0106	TUT0107	TUT0108
Thu. 9 am	Thu. 9 am	Thu. 9 am	Thu. 9 am	Mon.10am	Mon.10am	Mon. 3 pm	Mon. 3 pm
BA2165	BA2155	BA2145	BA2195	BA2145	BA2165	BA2145	HA410
Claudia	Ahmadreza	Hugo	Isaac	Shuo	Ashwin	Shuo	Farid

University of Toronto
Department of Electrical & Computer Engineering
ECE212F – Circuit Theory
Quiz 3 – November 25, 2002, 4:00-5:00 PM

Instructions: Non-programmable calculators allowed. No other aids. Answer in the space provided on these sheets. The back sides of these sheets can be used as well. For full marks (25) you must show methods, state UNITS and compute numerical answers when requested. ***Please write in pen, NOT IN PENCIL! Quizzes written in pencil can not be considered for mark revision.***

1. **Network Functions.** In the circuit below R_0=2kΩ, R=3kΩ, L=50mH, and C=25nF.
   (a) Transform the circuit into the s-domain. **(2 marks)**
   (b) Find the driving-point impedance Z(s) and the transfer function $T(s)=V_2(s)/V_1(s)$. **(6 marks)**
   (c) Find all poles and zeroes of T(s) and Z(s). **(2 marks)**
   (d) For $v_1(t)=\delta(t)$ find $v_2(t)$. **(2 marks)**

(a)



(b) $Z(s) = R_0 + \dfrac{1}{\frac{1}{sL} + \frac{1}{\frac{1}{sC}+R}} = \dfrac{5000s^2 + 1.6\cdot10^8 s + 1.6\cdot10^{12}}{(s+20000)(s+40000)}$

$$T(s) = \frac{(1/sC)/(\frac{1}{sC}+R)}{(\frac{1}{sL}+\frac{1}{\frac{1}{sC}+R})(R_0 + \frac{1}{\frac{1}{sL}+\frac{1}{\frac{1}{sC}+R}})}$$

$$= \frac{s}{1.25\cdot10^{-4}s^2 + 4s + 40000}$$

(c) $Z(s)$: poles ; $s = -20000$, $s = -40000$
zeros : $-16000 + 8000j$, $-16000 - 8000j$

$T(s)$: poles : $-16000 + 8000j$, $-16000 - 8000j$
zero : $s = 0$

(d) $$V_1(s) = \frac{8000}{(s+16000)^2 + 6.4 \cdot 10^7}$$

$$v_1(t) = e^{-16000t} \sin(8000t)\, u(t)$$

VA

Power in the sinusoidal steady state. The load in the circuit below absorbs an apparent power of 40 with a power factor of 0.9, lagging. The wires have an impedance of Zwire=5+j10 Ω. The load voltage is 117 V (rms).

(a) Calculate complex power, average power, and reactive power absorbed by the load. **(2 marks)**

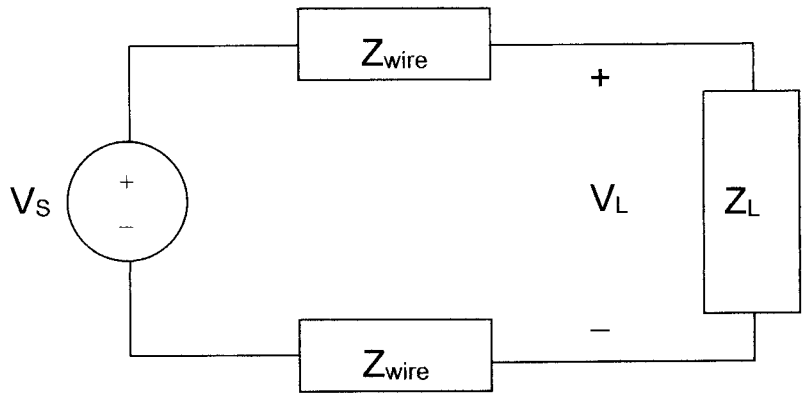
(b) Find the rms line current. **(2 marks)**

(c) Find the complex power absorbed by the wires. **(2 marks)**

(d) Find the rms source voltage. **(2 marks)**

(e) Calculate the transmission efficiency. **(2 marks)**

(f) Find the load impedance. **(2 marks)**



(a) $S_L = |S_L| \cdot (pf + j\sqrt{1-pf^2}) = 36 + j17.44$

avg reactive

(b) $I_{rms} = |S_L| / V_L^{rms} = 342 \text{ mA}$

(c) $S_{wire} = 2 \cdot Z_{wire} I_{rms}^2 = 1.17 + j2.34$

(d) $S_s = S_L + S_{wire} = 37.17 + j19.77$

$V_s^{rms} = |S_s| / I_{rms} = 123.15 \text{ V}$

(e) $\eta = \frac{Re(S_L)}{Re(S_s)} \cdot 100 = 96.9\%$

(f) $Z_L = S_L / I_{rms}^2 = 308 + j149$

If you assumed $P_L = 40W$:

(a) $S_L = 40 + j\frac{40}{0.9}\sqrt{1-0.9^2} = 40 + j\,19.4$

(40: avg.; 19.4: reactive)

$|S_L| = 44.4$

(b) $I_{rms} = 380\,mA$

(c) $S_{wire} = 1.44 + j\,2.89$

(d) $S_S = 41.44 + j22.26$

$V_{rms} = 123.84\,V$

(e) $\eta = 96.52\%$

(f) $Z_L = 277.2 + j\,134.26$