ELEC 2501 Mid Term #2, Nov. 21st, 2020

Instructions (READ!!!!!)

1) The exam will last 1.5hours.
2) This is a closed book exam.
3) Show all work.
4) Your solutions to all problems must fit on six one sided 8 ½ X 11 sheets of paper or less.
5) Place a large and very obvious BOX around your final answer for each question.
6) Solutions MUST be uploaded within 15mins after the exam ends to be counted.
7) There are seven questions. Each is worth equal marks.

Formulas that might be useful:

$\omega = 2\pi f,\ T = \frac{1}{f},\quad \sqrt{\frac{1}{T_2 - T_1}\int_{T_1}^{T_2}(f(t))^2 dt}\ ,\ i(t) = \frac{dq(t)}{dt}\quad ,\quad v = \frac{dw}{dq}, p(t) = v(t)\cdot i(t),\ \ v = iR,$

$\sum_{j=1}^{N} i_j(t) = 0,\ \sum_{j=1}^{N} v_j(t) = 0\ ,\ \frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N},\ R_S = R_1 + R_2 + \cdots + R_N$

$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3} R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3} R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$

$R_1 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_b} R_2 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_c}\ R_3 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_a}$

$C = \frac{\epsilon \cdot A}{d}, i = C\frac{dv}{dt}, E(t) = \frac{1}{2}Cv^2(t), \frac{1}{C_S} = \sum_{i=1}^{N}\frac{1}{C_i} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_N}, C_P = \sum_{i=1}^{N} C_i$

$v(t) = L\frac{di(t)}{dt}, E(t) = \frac{1}{2}Li^2(t), L_S = \sum_{i=1}^{N} L_i, \frac{1}{L_P} = \sum_{i=1}^{N}\frac{1}{L_i} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \cdots + \frac{1}{L_N}$

$x(t) = K_1 + K_2 e^{\frac{-t}{\tau}}, \tau = RC, \tau = \frac{L}{R}$

$Z = R, Z = j\omega L, Z = \frac{1}{j\omega C}, Z_S = Z_1 + Z_2 + \cdots + Z_N, \frac{1}{Z_P} = \frac{1}{Z_1} + \frac{1}{Z_2} + \cdots + \frac{1}{Z_N}, Y = \frac{1}{Z},$

$Y_P = Y_1 + Y_2 + \cdots + Y_N,\quad \frac{1}{Y_S} = \frac{1}{Y_1} + \frac{1}{Y_2} + \cdots + \frac{1}{Y_N}$

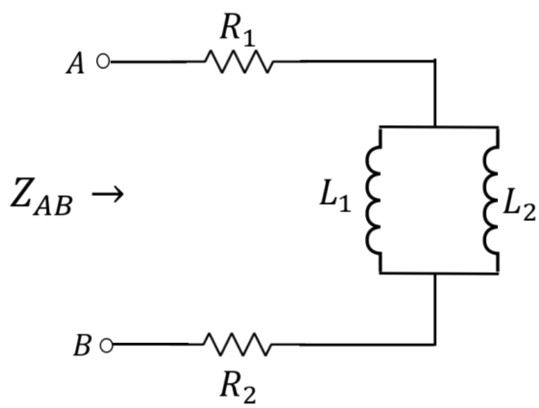
$\omega_o = \frac{1}{\sqrt{LC}}, Q = \frac{\omega_o L}{R} = \frac{1}{\omega_o CR} = \frac{1}{R}\sqrt{\frac{L}{C}}, \omega_{LO} = \omega_o\left[\frac{-1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1}\right] \omega_{HI} = \omega_o\left[\frac{1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1}\right]$

$BW = \omega_{HI} - \omega_{LO} = \frac{\omega_o}{Q}, \omega_{HI}\cdot\omega_{LO} = {\omega_o}^2, Q = 2\pi\frac{\omega_S}{\omega_D},\ \omega_r = \sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$

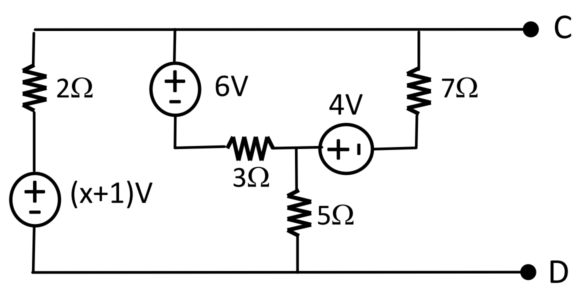
$P = \frac{V_M I_M}{2}\cos(\theta_v - \theta_i) = V_{RMS} I_{RMS}\cos(\theta_v - \theta_i),\ PF = \cos(\theta_v - \theta_i) = \cos(\theta_{Z_L}) = \cos(-\theta_{Z_L}),$

$S = V_{RMS} I_{RMS}^{\ *}\ , \frac{i_1}{i_2} = \frac{v_2}{v_1} = \frac{N_2}{N_1}\ , Z_p = \left(\frac{N_p}{N_s}\right)^2 Z_s$

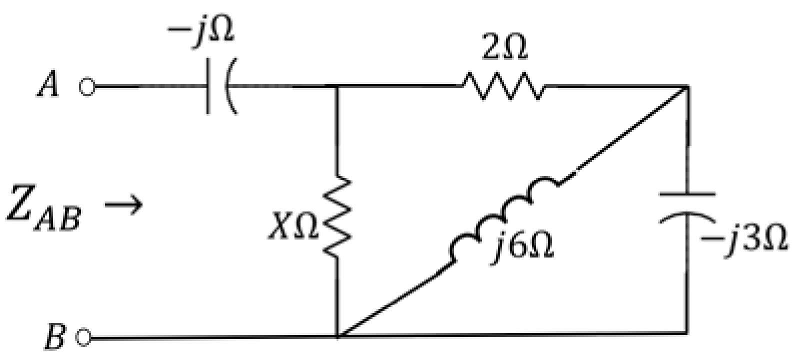
1) At angular frequency of $1000\ rad/s$, the complex impedance between terminals A and B is $Z_{AB} = 3 + jY\ \Omega$. What is the complex impedance Z_{AB} at an angular frequency of $1500\ rad/s$? Note that Y is the last digit of your student number, if your student number ends with a zero then $Y = 10$.



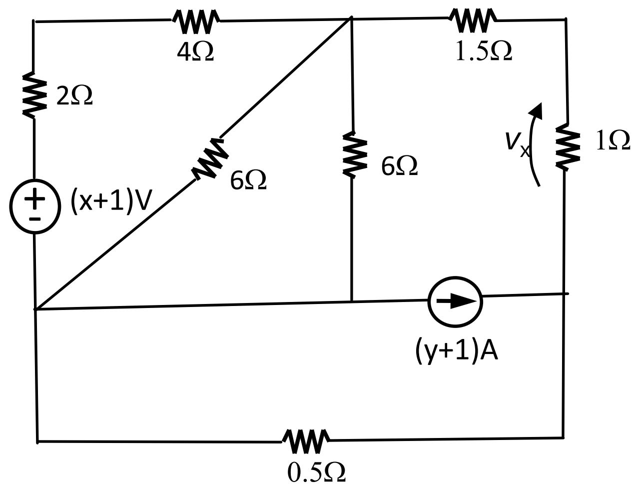
2) Find the Thevenin equivalent circuit between points C and D. Note that x is the last digit of your student number.



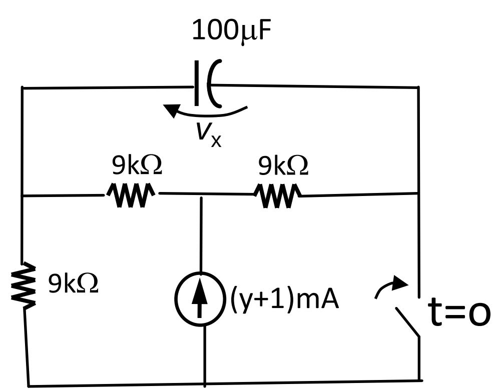
3) Find the complex impedance Z_{AB} in the network shown. The value X is the last digit of your student number. If your student number ends in 0 use $X = 10$.



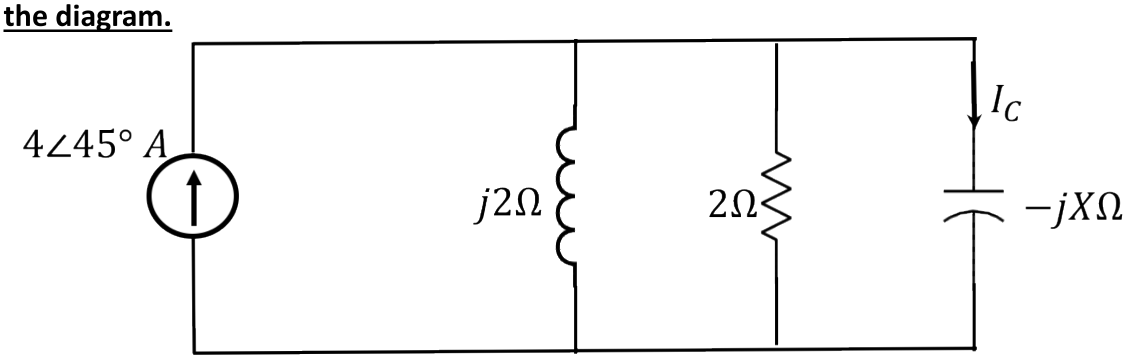
4) Find Vx. Note that xy are the last two digits of your student number.



5) Find Vx as a function of time. Note at time t =0s the switch is closed. Note that y is the last digit of your student number.



6) Analyze the circuit shown below and find the current in the capacitor I_C. The value X is the last digit of your student number. If your student number ends in 0 use $X = 10$. Note that the current source is sinusoidally varying. **Note impedances are labeled on the diagram.**



7) If the current i(t) =1.5t A flows through a (y+1)H inductor, find the energy stored at t = 4s. Note that y is the last digit of your student number.