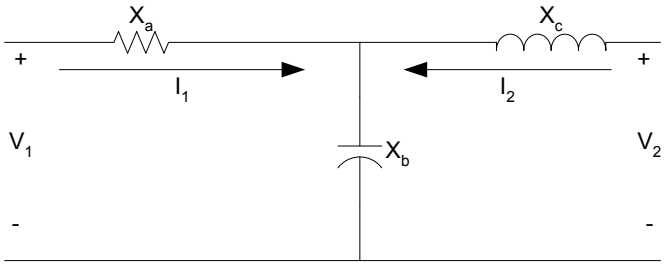
31-05-2014

ECE 232 Final

Q1) For the circuit below the impedances of the circuit elements are **X_a=1 Ohm, X_b=-j Ohm and X_c=j Ohm.**

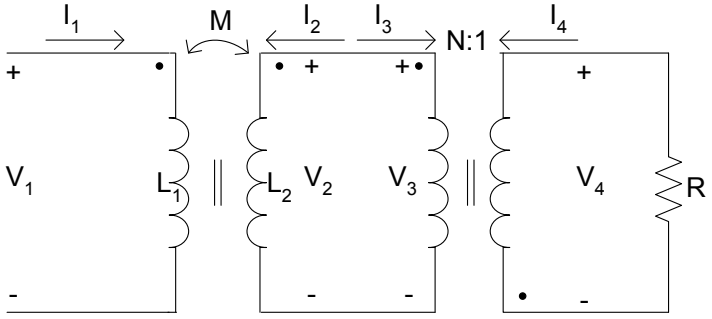


The **impedance port equation** for the circuit is given by the formula,

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} \\ r_{21} & r_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

Find the port parameters r_{11}, r_{12}, r_{21}, r_{22}. **(20 points)**

Q2) The **time-domain** configuration of a circuit is given as in the figure below.

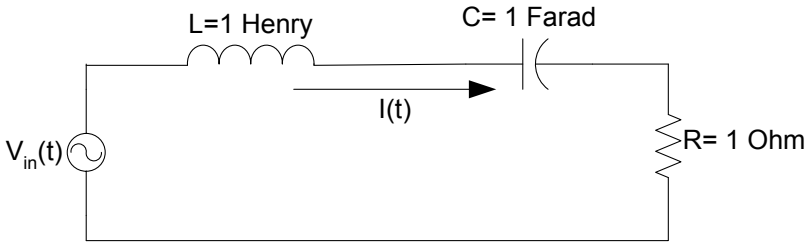


In **Laplace-domain** the corresponding equations for the coupled inductor and the transformer in this circuit can be written as

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} sL_1 & sM \\ sM & sL_2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}, \; V_3 = -NV_4 \text{ and } I_4 = NI_3$$

Find the expression for the input impedance $Z_{in} = \dfrac{V_1}{I_1}$ of this circuit in **Laplace-domain. (20 points)**

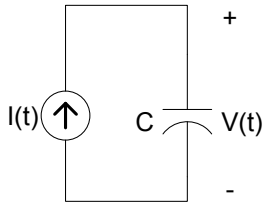
Q3) The **time-domain** configuration of a circuit is given as in the figure below.



The applied input voltage to the circuit is $\mathbf{V_{in}(t) = Sin(wt)\ Volt}$ where the angular frequency of the input is **w = 1 rad/sec**.

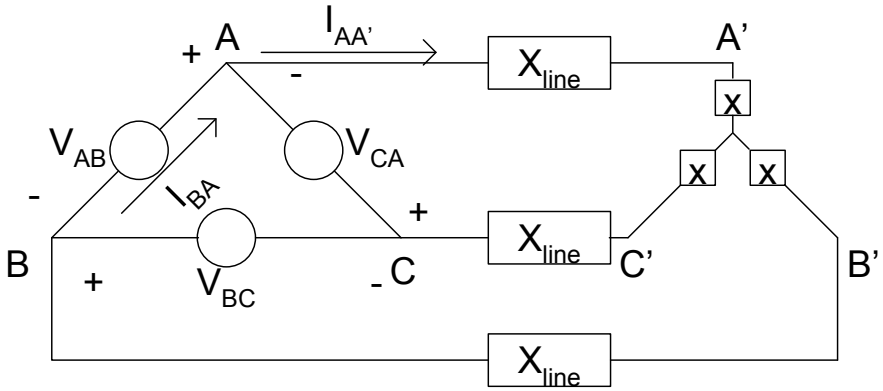
a) Find the **sinusoidal steady-state** value of I(t). **(15 points)**
b) What is the average power dissipated over the resistor R? **(5 points)**

Q4) For the circuit below a capacitor is fed by a current source I(t). Due to this current source the capacitor is charged and its voltage is V(t). Hence I(t) is the input for this circuit and V(t) is the output. The capacitance of the circuit is C = 1 Farad.



a) Find the transfer function H(s) of this circuit. **(3 points)**
b) Find the impulse response h(t) of this circuit. **(3 points)**
c) Use convolution integral to find $V(t) = \int_{-\infty}^{t} I(t-\tau)h(\tau)d\tau$ where I(t) = u(t) (unit step function). **(14 points)**

Q5) Fort the **balanced three-phase** circuit below, the **source side is delta** connected and the **load side is Y** connected. The source deleivers **900 VA complex power** with a **lagging power factor** of $\frac{1}{\sqrt{2}}$. The magnitude of the **source side line-to-line voltage** is $|V_{AB}| = 100\sqrt{3}$ Volt (rms). The line impedance is $X_{line} = \frac{50\sqrt{2} - j10\sqrt{2}}{3}$ Ohm.



a) Find $|I_{BA}|$, $|I_{AA'}|$, $|V_{A'B'}|$. **(16 points)**
b) Find the load impedance value x. **(3 points)**
c) Is x inductive or capacitive? **(1 point)**