CONCEPTUAL TOOLS

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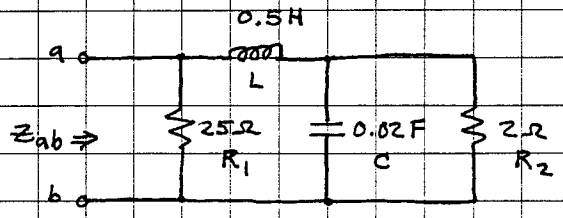
Ref: Nilsson & Riedel, Rev 6, Prob 13.8

LAPLACE TRANSFORM
POLES AND ZEROS
Example 2



Find poles and zeros of z_{ab}.

ans: $z_{ab} = \dfrac{25(s+5)(s+20)}{(s+30)(s+45)}$ zeros at $s = -5, -20$; poles at $s = -30, -45$

soln: We find z_{ab}, (which is a transfer function), by using Laplace transformed circuit elements, (with initial conditions set to zero).

$$z_{ab} = R_1 \| \left(sL + \frac{1}{sC} \| R_2 \right)$$

$$\frac{1}{sC} \| R_2 = \frac{\frac{R_2}{sC}}{\frac{1}{sC} + R_2} = \frac{R_2}{1 + sR_2C} = \frac{1/C}{\frac{1}{R_2C} + s}$$

$$= \frac{50}{s + 25} \qquad \frac{1}{R_2C} = \frac{1}{2(0.02)} = 25$$

$$sL + \frac{1}{sC} \| R_2 = \frac{s}{2} + \frac{50}{s+25} = \frac{s(s+25) + 50 \cdot 2}{2(s+25)}$$

$$= \frac{s^2 + 25s + 100}{2(s+25)} = \frac{(s+5)(s+20)}{2(s+25)}$$

$$z_{ab} = R_1 \| \frac{(s+5)(s+20)}{2(s+25)} = \frac{25 \cdot (s+5)(s+20)}{2s + 50} = \frac{25(s+5)(s+20)}{50s + 1250 + s^2 + 25s + 100}$$

$$\frac{25 + \frac{(s+5)(s+20)}{2s+50}}{2s+50}$$

$$= \frac{25(s+5)(s+20)}{(s+30)(s+45)}$$

zeros ≡ roots of numerator = −5 and −20

poles ≡ roots of denominator = −30 and −45.