Part 3 – Review of solving circuit loops

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clear

% Find the loop current given the loop circuit in subsection 2.5 in the
% lab report.

% symbolic variables
syms s
syms V_s

% define the parameters

% resistors
R1 = 5; % [ohm]
R2 = 2;
R3 = 2;
R4 = 1;

% inductors
L1 = 1; % [H]
L2 = 1;

% currents
C1 = 1/5; % [F]
C2 = 1/3;
C3 = 1/4;

% the columns, representing the coefficients for each current
M_I1 = [ (1/(s*C1) + R1 + s*L1 + R2); (R2 + s*L1); R1 ];
M_I2 = [ (-s*L1 - R2); (1/(s*C2) - R2 - s*L1 + s*L2 + R3); (R3 + s*L2) ];
M_I3 = [ R1; (R3 + s*L2); (R4 + 1/(s*C3) - R3 + s*L2 - R1) ];
```

The matrix of coefficients

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M = [ M_I1, M_I2, M_I3 ]
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M =
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$$\begin{pmatrix} s+\frac{5}{s}+7 & -s-2 & 5 \\ s+2 & \frac{3}{s} & s+2 \\ 5 & s+2 & s+\frac{4}{s}-6 \end{pmatrix}$$

The expected total voltage of each loop

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y = [ V_s ; 0 ; 0 ]
```

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y =
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$$\begin{pmatrix} V_s \\ 0 \\ 0 \end{pmatrix}$$

This requires that the current

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% Solve for I
I = M^-1*y
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I =
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$$\begin{pmatrix} \frac{V_s\, s\, (s^4 + 4\, s^3 + s^2 + 18\, s - 12)}{\sigma_1} \\ -\frac{V_s\, s^2\, (-s^3 + 9\, s^2 + 18\, s - 8)}{\sigma_1} \\ -\frac{V_s\, s^2\, (s^3 + 4\, s^2 + 4\, s - 15)}{\sigma_1} \end{pmatrix}$$

where

$$\sigma_1 = 13\, s^5 + 50\, s^4 + 53\, s^3 + 178\, s^2 + 6\, s - 60$$