

# ECE 201 Spring 2010

## Homework 9 Solutions

### Problem 37

(a)

The following loop equation can be written,

$$\begin{aligned} -(I_1 - 0.75)200 - 300I_1 - (I_1 + 0.1)500 &= 0 \\ \Rightarrow I_1 &= 0.1 \text{ A} \\ P &= VI \\ P_{s1} &= 200(0.75 - 0.1)0.75 \\ &= 97.5 \text{ W} \\ P_{s2} &= 500(0.1 + 0.1)0.1 \\ &= 10 \text{ W} \end{aligned}$$

(b)

Again, writing the loop equation and comparing the equation obtained with that given in the problem,

$$\begin{aligned} -(I_1 - 0.4)R_1 - 600I_1 - (I_1 + 0.1)R_2 &= 0 \\ (R_1 + R_2 + 600)I_1 &= 0.4R_1 - 0.1R_2 \\ \Rightarrow R_1 + R_2 &= 1400 \\ 4R_1 - R_2 &= 600 \\ \Rightarrow R_1 &= 400 \text{ } \Omega \\ R_2 &= 1000 \text{ } \Omega \end{aligned}$$

## Problem 42

(a)

The following loop equations can be written,

$$\begin{aligned}21 - 20I_1 - 80(I_1 - I_2) &= 0 \\24 + 80I_2 - 80(I_1 - I_2) &= 0 \\ \Rightarrow I_1 &= 0.15 \text{ A} \\ I_2 &= -0.075 \text{ A} \\ V_{R_3} &= (I_1 - I_2)R_3 \\ &= 0.225 \times 80 = 18 \text{ V} \\ P_{R_3} &= 18(0.225) = 4.05 \text{ W}\end{aligned}$$

(b)

Again, writing the loop equations,

$$\begin{aligned}21 - (I_1 + I_2)20 - 80I_2 - 24 &= 0 \\21 - (I_1 + I_2)20 - 80I_1 &= 0 \\ \Rightarrow I_1 &= 0.225 \text{ A} \\ I_2 &= -0.075 \text{ A} \\ V_{R_3} &= I_1 R_3 \\ &= 0.225 \times 80 = 18 \text{ V} \\ P_{R_3} &= 18(0.225) = 4.05 \text{ W}\end{aligned}$$

## Problem 52

(a)

Assume clockwise loop currents  $I_1$  and  $I_2$  in the two rightmost loops respectively. The following equations can then be written for the two loops,

$$\begin{aligned}-(I_1 - I_{s1})R_1 - r_m I_x - R_2(I_1 - I_2) &= 0 \\ I_x &= I_{s1} - I_1 \\ -R_2(I_2 - I_1) - R_3 I_2 - V_{s2} &= 0\end{aligned}$$

Putting in matrix form,

$$\begin{bmatrix} r_m - R_1 - R_2 & R_2 \\ R_2 & -(R_2 + R_3) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} (r_m - R_1)I_{s1} \\ V_{s2} \end{bmatrix}$$

(b)

Putting the respective literal values,

$$\begin{bmatrix} -80 & 40 \\ 40 & -120 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} -40 \\ 40 \end{bmatrix}$$
$$\Rightarrow I_1 = 0.4 \text{ A}$$
$$I_2 = -0.2 \text{ A}$$

(c)

$$V_A = (1 - 0.4)100 = 60 \text{ V}$$
$$V_B = 0.6(40) = 24 \text{ V}$$

(d)

$$P_{s1} = 60 \times 1 = 60 \text{ W}$$
$$P_{s2} = 40 \times 0.2 = 8 \text{ W}$$

(e)

$$P_{dep} = 60 \times 0.6 \times -0.4 = -14.4 \text{ W}$$