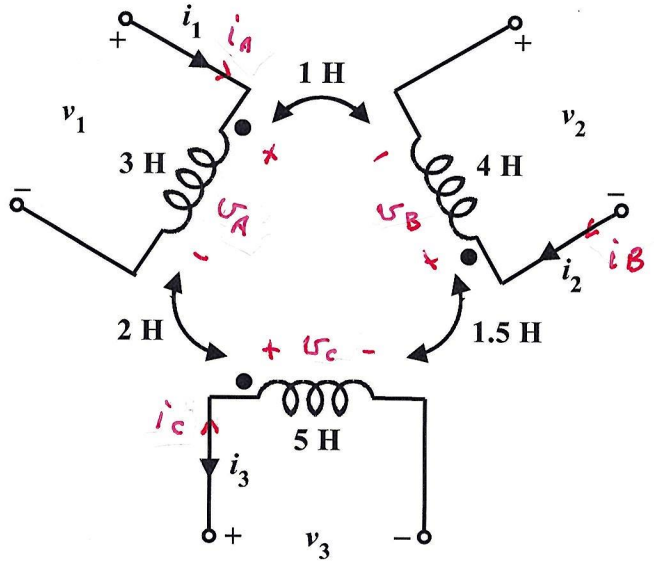
EE 3340

Homework Problem #037

If $i_1(t) = 2\,\text{A}$, $i_2(t) = 2\sin t\,\text{A}$ and $i_3(t) = \cos t\,\text{A}$, determine $v_1(t)$, $v_2(t)$ and $v_3(t)$. Express all trigonometric results in terms of the cosine basis function.



$$v_A = 3\frac{di_A}{dt} + 1\frac{di_B}{dt} + 2\frac{di_C}{dt}$$

$$v_B = 4\frac{di_B}{dt} + 1\frac{di_A}{dt} + 1.5\frac{di_C}{dt}$$

$$v_C = 5\frac{di_C}{dt} + 2\frac{di_A}{dt} + 1.5\frac{di_B}{dt}$$

But $v_A = v_1$, $v_B = -v_2$, $v_C = v_3$

and $i_A = i_1$, $i_B = i_2$, $i_C = -i_3$

So

$$v_1 = 3\frac{di_1}{dt} + 1\frac{di_2}{dt} - 2\frac{di_3}{dt}$$

$$v_2 = -4\frac{di_2}{dt} - \frac{di_1}{dt} + 1.5\frac{di_3}{dt}$$

$$v_3 = -5\frac{di_3}{dt} + 2\frac{di_1}{dt} + 1.5\frac{di_2}{dt}$$

Given $i_1 = 2A,\ i_2 = 2\sin t\ A,\ i_3 = \cos t\ A$

Then

$$v_1 = 3(0) + 1(2\cos t) - 2(-\sin t)$$
$$= 2\cos t + 2\sin t$$
$$|v_1| = \sqrt{2^2 + 2^2} = \sqrt{8}$$
$$\angle v_1 = \tan^{-1}\frac{2}{2} = -45^\circ$$

$$v_2 = -4(2\cos t) - 0 + 1.5(-\sin t)$$
$$= -8\cos t - 1.5\sin t$$
$$|v_2| = \sqrt{8^2 + 1.5^2} = \sqrt{66.25}$$
$$\angle v_2 = \tan^{-1}\frac{-1.5}{-8} = \tan^{-1}.1875 = 169.4^\circ$$

$$v_3 = -5(-\sin t) + 2(0) + 1.5(2\cos t)$$
$$= 3\cos t + 5\sin t$$
$$|v_3| = \sqrt{3^2 + 5^2} = \sqrt{34}$$
$$\angle v_3 = \tan^{-1}\frac{5}{3} = -59^\circ$$

$$v_1 = \sqrt{8}\cos(t - 45^\circ)\ V$$

$$v_2 = \sqrt{66.25}\cos(t + 169.4^\circ)\ V$$

$$v_3 = \sqrt{34}\cos(t - 59^\circ)\ V$$