EE 220 – Final Exam

Useful Equations:

V = I R P = I V $i = \frac{dq}{dt}$ $q(t) = \int_{-\infty}^{t} i\,d\tau = \int_{0}^{t} i\,d\tau + q(0)$

Unit Definitions:

1 V = 1 J/C 1 W = 1 V * 1 A = 1 J/s 1 electron = $1.602 \times 10^{-19} coulmb$

1 A = 1 C/s 1 Wh = 1 J/s * 1 h = 3,600 J 1 coulmb = 6.24×10^{18} electrons

Three resistors case

Parallel resistance

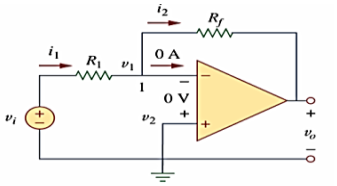
$$R_{eq} = (G_1 + G_2 + G_3)^{-1} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)^{-1}$$

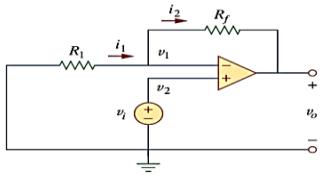
Voltage division

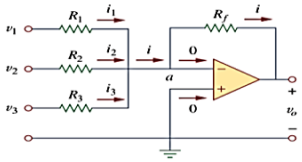
$$v_2 = \frac{R_2}{R_1 + R_2 + R_3} \cdot v_s$$

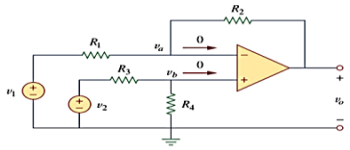
Current division

$$i_2 = \frac{G_2}{G_1 + G_2 + G_3} \cdot i_s$$









RC Circuits	RL Circuits
$i = C\frac{dv}{dt}$	$v = L\frac{di}{dt}$
$v = \frac{1}{C}\int_{t_o}^{t} i(\tau)d\tau + v(t_0)$	$i = \frac{1}{L}\int_{t_o}^{t} v(\tau)d\tau + i(t_0)$
$\tau = RC$	$\tau = L/R$
$v(t) = V + [v(0) - V]\,e^{-t/\tau}$	$i(t) = I + [i(0) - I]\,e^{-t/\tau}$

Standard Op-Amp Circuits:

$$v_o = -\frac{R_f}{R_1} v_i$$

$$v_o = \left(1 + \frac{R_f}{R_1}\right) v_i$$

$$v_o = -\left(\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \frac{R_f}{R_3} v_3\right)$$

$$v_o = \frac{R_2}{R_1}(v_2 - v_1)$$

$$\sin(\omega t) = \cos(\omega t - 90^\circ) = \cos\left(\omega t - \frac{\pi}{2}\right)$$

$$\cos(\omega t) = \sin(90^\circ - \omega t) = \sin\left(\frac{\pi}{2} - \omega t\right)$$

$$\sin(\omega t + 180^\circ) = -\sin(\omega t)$$

Polar to rectangular

$$x = r\cos\phi$$

$$y = r\sin\phi$$

$$z = r(\cos\phi + j\sin\phi)$$

Rectangular to polar

$$r = \sqrt{x^2 + y^2} \qquad \phi = \tan^{-1}\frac{y}{x}$$

$$z = \sqrt{x^2 + y^2}\angle \tan^{-1}\frac{y}{x}$$

$$\mathbf{Z} = \mathrm{R} \qquad \mathbf{Z} = \frac{1}{j\omega C} \qquad \mathbf{Z} = j\omega L$$

Maximum power transfer:

$$p_{L_{\max}} = \frac{v_s^{\,2}}{4R_t}$$