CASE WESTERN RESERVE UNIVERSITY
Case School of Engineering
Department of Electrical Engineering and Computer Science
ENGR 210. Introduction to Circuits and Instruments (4)

FORMULA SHEET

TRIG IDENTITIES:

$\cos(x+y) = \cos x \cos y - \sin x \sin y$ $\quad\quad$ $\sin(x+y) = \sin x \cos y + \cos x \sin y$

$\sin(2x) = 2\sin x \cos x$ $\quad\quad$ $\cos(2x) = 2\cos^2 x - 1 = 1 - 2\sin^2 x$

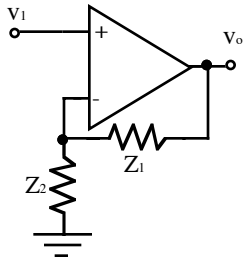
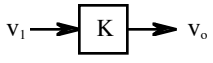
FOURIER COEFFICIENTS: $v(t) = V_A \cos(\omega t + \theta) = a\cos(\omega t) + b\sin(\omega t)$ where

$V_A = \sqrt{a^2 + b^2}$ and $\theta = Tan^{-1}\left(\frac{b}{a}\right)$. Conversely, $a = V_A \cos\theta$ and $b = -V_A \sin\theta$

	INDUCTORS	CAPACITORS
Terminal relationship	$v_L = L\frac{di_L}{dt}$	$i_C = C\frac{dv_C}{dt}$
Impedance	$Z_L = j\omega L$	$Z_C = \frac{1}{j\omega C}$
Time constant	$T_C = \frac{L}{R_T}$	$T_C = R_T C$

INITIAL/FINAL VALUE THEOREM: $f(t) = [IV - FV]e^{-\frac{t}{T_C}} + FV$
where IV=initial value and FV=final value.

OP AMP CIRCUITS:

CIRCUIT	BLOCK DIAGRAM	GAINS
	 Non-inverting amplifier	$K = \frac{Z_1 + Z_2}{Z_2}$

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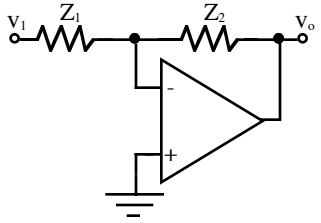
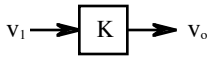
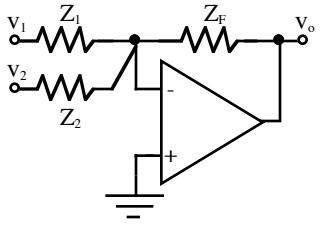
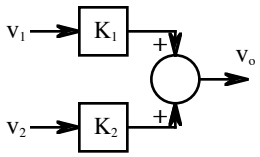
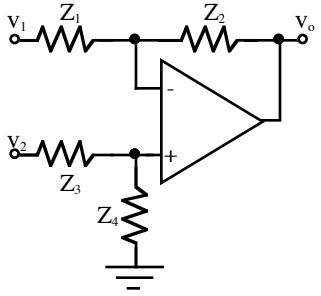
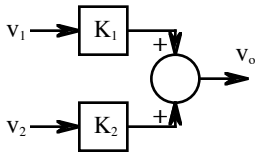
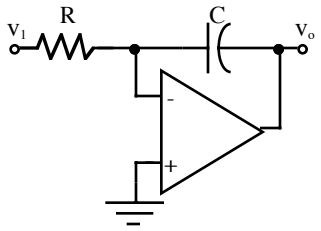
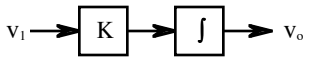
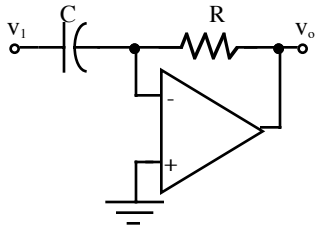
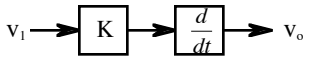
	 Inverting amplifier	$K = -\frac{Z_2}{Z_1}$
	 Summer	$K_1 = -\frac{Z_F}{Z_1}, \; K_2 = -\frac{Z_F}{Z_2}$
	 Subtractor	$K_1 = -\frac{Z_2}{Z_1}, \; K_2 = \left(\frac{Z_1 + Z_2}{Z_1}\right)\left(\frac{Z_4}{Z_3 + Z_4}\right)$
	 Integrator	$K = -\frac{1}{RC}$
	 Differentiator	$K = -RC$