ee 292 midterm 01 review

9/22 chapter 1 p1.13, p1.18, p1.25, p1.26, p1.66, p1.68, p1.72, p1.74, t1.3, t1.5

current - time rate of flow of electrical charge through a circuit element

$$i(t) = \frac{dq(t)}{dt} \qquad q(t) = \int_{t_0}^{t} i(t)\,dt + q(t_0)$$

power - rate of energy transfer

$p(t) = v(t)\,i(t)$ passive reference

$p(t) = -v(t)\,i(t)$ not passive reference

energy

$$w = \int_{t_1}^{t_2} p(t)\,dt$$

$p, w > 0$ energy absorbed by element

$p, w < 0$ energy supplied by element

KCL - conservation of charge

① net current into a node is zero

② sum of currents into a node equals sum of currents leaving a node

KVL - conservation of energy

· the sum of voltages around a loop is zero

Ohm's Law - relationship for an ideal resistor

$V = iR \Rightarrow v(t) = i(t)R$

$p(t) = i^2(t)R = \frac{v^2(t)}{R}$ always > 0 absorbs energy

chapter 3 p3.4, p3.13, p3.26, p3.47, p3.51, p3.62

capacitance - energy stored in electric fields.

capacitor

$q = Cv \Rightarrow q(t) = Cv(t) \Rightarrow i(t) = \frac{dq(t)}{dt} = C\frac{dv(t)}{dt}$

constant voltage $\Rightarrow \frac{dv}{dt} = 0 \Rightarrow i(t) = 0 \Rightarrow$ open circuit

no current flow

power - $p(t) = v(t)\,C\,\frac{dv(t)}{dt}$

energy - $w = \frac{1}{2}Cv^2(t)$

inductor - circuit element to store energy in a magnetic field

$$v(t) = L\frac{di(t)}{dt}$$

constant current $\Rightarrow \frac{di(t)}{dt} = 0 \Rightarrow v(t) = 0 \Rightarrow$ short circuit.

power - $p(t) = L\frac{di}{dt}i(t)$

energy - $w(t) = \frac{1}{2}Li^2(t)$

series connections

capacitors - $C_{eq} = \left[\sum \frac{1}{C_i}\right]^{-1}$ inductors - $L_{eq} = \sum L_i$

parallel connections

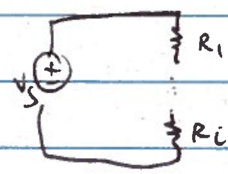
capacitors - $C_{eq} = \sum C_i$ inductors - $L_{eq} = \left[\sum \frac{1}{L_i}\right]^{-1}$

chapter 2

series resistance - $R_{eq} = \sum R_i$

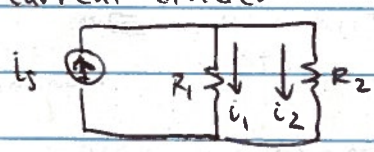
parallel resistance - $R_{eq} = \left[\sum \frac{1}{R_i}\right]^{-1}$

voltage divider - series combination of resistors.



$$V_{R_i} = V_s\left(\frac{R_i}{\sum R_i}\right)$$

current divider - two parallel resistors.



$$i_1 = i_s\left(\frac{R_2}{R_1+R_2}\right) \qquad i_2 = i_s\left(\frac{R_1}{R_1+R_2}\right)$$

node-voltage analysis - voltages are unknown in the circuit

define ground and use KCL at nodes

- by convention, define currents leaving node (unless it is a source)

super nodes - required for a voltage source not connected to ground

acts as a node for KCL, gives a relationship for node voltages.

mesh current analysis - mesh currents ~~are~~ are unknown in circuit

requires a planar circuit,

define clockwise mesh currents and apply KVL around the loops.

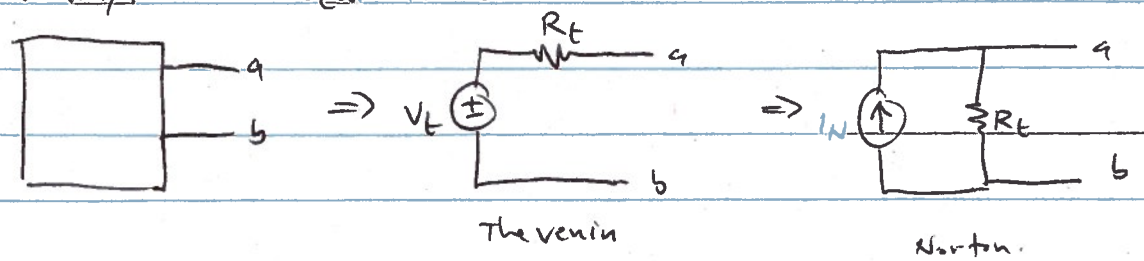
current through a circuit element is sum of mesh loop currents.

supermeshes - required for a shared current source.

do KVL around supermesh, gives relationship between shared mesh current

superposition - linear sources can be treated independently and the total response is the sum of individual responses.

Thevenin/Norton equivalents:



1. open circuit voltage $v_{oc} = V_t$
2. short circuit current $i_{sc} = I_N$
3. equivalent resistance $R_{eq} = R_t = \frac{V_{oc}}{i_{sc}}$