Basic Circuit Analysis 2 Cheat Sheet

by Kevin694 via cheatography.com/18728/cs/1904/

Basic Concepts (H1)

Current	I[A]=Q[C]/t[s]
Voltage	U[V]=W[J]/Q[C]
Power	P[W]= W / t = U * I
Energy	W = P * t
Coulomb	1C = 6,241*10^{18} elek.

Resistance (H2)

Ohm's Law	I[A] = U[V] / R[Ohm]
Resistivity	R = rho * (l[m]/A[m^2])
Power Absorbtion	P = V^2/R = I^2R

DC Circuits (H3)

Voltage Law (KVL):
The sum of all voltage drops equals the sum of al voltage rises in a mesh.
Current Law (KCL):
The sum of all currents entering a closed surface equals the sum of all leaving one.
Equivalent Resistor:
Rt = (R1 * R2) / (R1+R2)
(in case of 2 resistors paralllel)

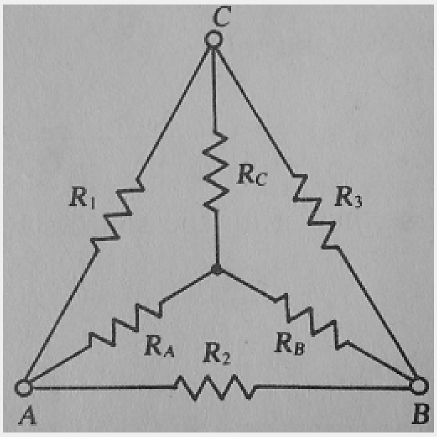
DC Circuits Analysis (H4)

Source Transformation:
Current and Voltage source with 1 resistor are interchangable.
I = V / R and U = I * R
Mesh Analysis:
Applying KVL to a mesh.
Nodal Analysis:
Applying KCL to a node.

Equivalent Circuits (H5)

Thevenin Circuit:
Circuits can be reduced to voltage source with resistor in serie.
Rt = Rth *(open circuit and independent sources deactivated)*
Vth = *open* circuit voltage
Isc = current in *short-circuit* between a and b
Norton Circuit:
Found by source transformation of Thevenin
Isc equals In
Maximum Power Transfer:
Vth^2 / 4Rth
Milliman's Theorem:
Multiple voltage sources with resistors can be combined into one by transformations giving one voltage source.
Vm = (G1V1 + .. + GnVn) / (G1 + .. + Gn)
Rm = 1 / (G1 + .. + Gn)
Delta-Y Transformation:
Ra = (R1 * R2) / (R1 +R2 + R3)
Rb = (R2 * R3) / (R1+ R2 + R3)
Rc = (R1 * R3) / (R1+ R2 + R3)
R1 = (RaRb + RaRc + RbRc) / Rb
R2 = (RaRb + RaRc + RbRc) / Rc
R3 = (RaRb + RaRc + RbRc) / Ra

Y-Delta Transformation



Operational Amplifier (H6)

U+ = U- and I+ = I- = 0
inverter:
Vo=-(Rf/Ri)*Vi
summer:
Vo=-((Rf/Ra)Va+(Rf/Rb)Vb+(Rf/Rc)Vc)

Capacitors (H8)

Capacitance	C = Q / U
Capacitance	C = e * (A/d)
Capacitance parallel	Ct = C1 + C2 + ..
Capacitance series	1 / Ct = (1/C1) + (1/C2) etc.
Energy Storage	Wc = 0.5C$V^2$2
Time-varying Current	i = dq/dt = C * dv/dt
RC time constant	tau = Rth * C
RC expression voltage	v(t) = v(oo) + [v(0+) - v(00)]$e^{-t/tau}$ V
RC expression current	i(t) = i(oo) + [i(0+) - i(00)]$e^{-t/tau}$ A

Inductors (H9)

Flux	v = N * dphi/dt
Inductance	L *i* = *N* phi
Coil inductance	L = (N^2*mu*A)/l
Inductor series	Lt = L1+ L2 + Ln
Inductor parallel	1 / Lt = (1/L1) + (1/L2) etc.
Energy Storage	Wl=0.5Li^2
RC time constant	tau = L / Rth

Alternating Current (H10)

Frequency	f [Hz] = 1 / T [s]
Angular Velocity	omega [rad/s] = 2*pi*f
Average Value factor	2 / pi = 0.637
Resistor Power	Pav = Vm^2 / 2R = Im^{2}R / 2
Effective Value (RMS)	Veff = Vm / 2$^{0.5}$
Inductor Law	Xl = omega*L and Im = Vm / Xl
Capacitor Law	Xc = -1/(omega*C)

Component Behavior (H10)

Resistor:
Current and Voltage in phase.
v=Vm * sin(omega*t+phi)
i=Im * sin(omga * t+phi)
Inductor:
Voltage leads Current by 90 deg.
v=Xl * Im*cos(omega*t + phi)
i=Im*sin(omega*t + phi)
Capacitor:
Current leadsVoltage by 90 deg.
v=Vm*sin(omega*t+phi)
i=omega * C * Vm * cos(omega*t + phi)

AC Circuit Analysis (H12)

Impedantie	Z=V/I
Impedantie (2)	Z=R+jX
Admitantie	Y=1/Z
AC Current	I=(Im/2$^{0.5}$)*hoek
AC Voltage	V=((R * Im)/2$^{0.5}$)*hoek

AC Circuit Analysis (H13)

Mesh Analysis:
Transform current to voltage source
Use of KVL
Nodal Analysis:
Transform voltage to current source
Use of KCL

AC Y-Delta transformation (H14)

Delta-Y Transformation:
Za = (Z1 * Z2) / (Z1 +Z2 + Z3)
Zb = (Z2 * Z3) / (Z1 +Z2 + Z3)
Zc = (Z1 * Z3) /(Z1 +Z2 + Z3)
Z1 = (ZaZb + ZaZc + ZbZc) / Zb
Z2 = (ZaZb + ZaZc + ZbZc) / Zc
Z3 = (ZaZb + ZaZc + ZbZc) / Za

Maximum Power Absorbed (H14)

The load is the Zth conjungate	Zl = Zth*
Max. Power Absorbed	Vth^2/(4Rth) (Vth is RMS of **Vth**)

Power in AC circuits (H15)

Instantaneous Power:
p = V * I cos(theta)
cos(theta) = Power Factor (PF)
theta = fase spanning - fase stroom
Reactive Power:
Q = V * I * sin(theta)
Complex Power:
S=P+jQ
Apparent Power:
S=VI
1hp = 745,7 W

Transformers (H16)

Ratio	v1/v2 = N1/N2 = i2/i1
Reflected Impedance	**Zr** = **V1**/**I1** = a^2**Z2**
Current rating	kVA transformer / voltage rating
PhiMax	PhiM = (sqrt(2)*Vrms)/(wN)
coupling coefficient	k = M / sqrt(L1*L2)

tijd-fase formules

	weerstand	spoel	condensator
Z	R	jwL	1/(jwC)
R	R	0	0
X	0	wL	-1/(wC)
Y	1/R	1/(jwL)	jwC
G	1/R	0	0
B	0	-1/(wL)	wC

3-Phase (H17)

Vline = sqrt(3)*Vphase
I line = sqrt(3)*Iphase

Dot rule transformer

Primary I into dot and secondary I out of dot:
I1 and I2 both positive or negative.