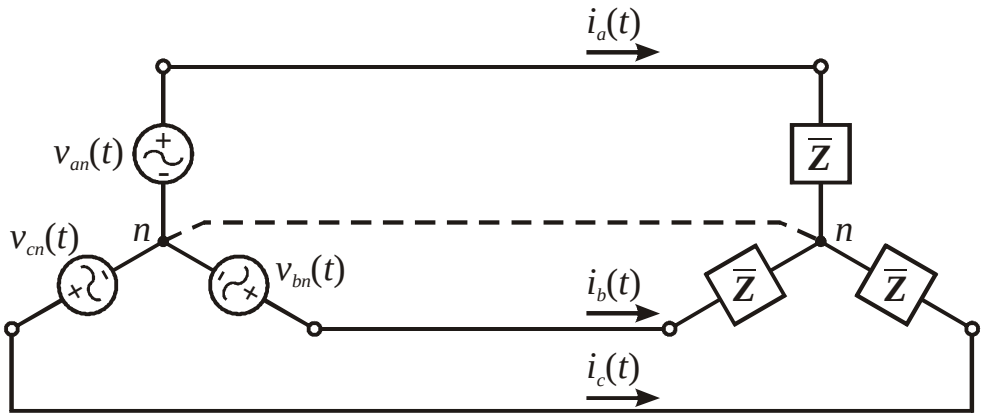
Three-phase Wye-load power example



Define some constants for the source & load.

$V := 120 \quad V_{rms}$ $\qquad Z := 20 \quad \Omega$ $\qquad \theta := 30 \cdot \frac{\pi}{180}$ $\qquad I := \frac{V}{Z}$

$I = 6 \quad A_{rms}$ $\qquad n := 0 .. 200$ $\qquad wt_n := n \cdot \frac{2 \cdot \pi}{180}$ $\qquad m := 0 .. 7$

Define phase voltages and currents.

$van_n := \sqrt{2} \cdot V \cdot \cos(wt_n)$ $\qquad ia_n := \sqrt{2} \cdot I \cdot \cos(wt_n - \theta)$

$vbn_n := \sqrt{2} \cdot V \cdot \cos\left(wt_n - 120 \frac{\pi}{180}\right)$ $\qquad ib_n := \sqrt{2} \cdot I \cdot \cos\left(wt_n - 120 \frac{\pi}{180} - \theta\right)$

$vcn_n := \sqrt{2} \cdot V \cdot \cos\left(wt_n - 240 \frac{\pi}{180}\right)$ $\qquad ic_n := \sqrt{2} \cdot I \cdot \cos\left(wt_n - 240 \frac{\pi}{180} - \theta\right)$

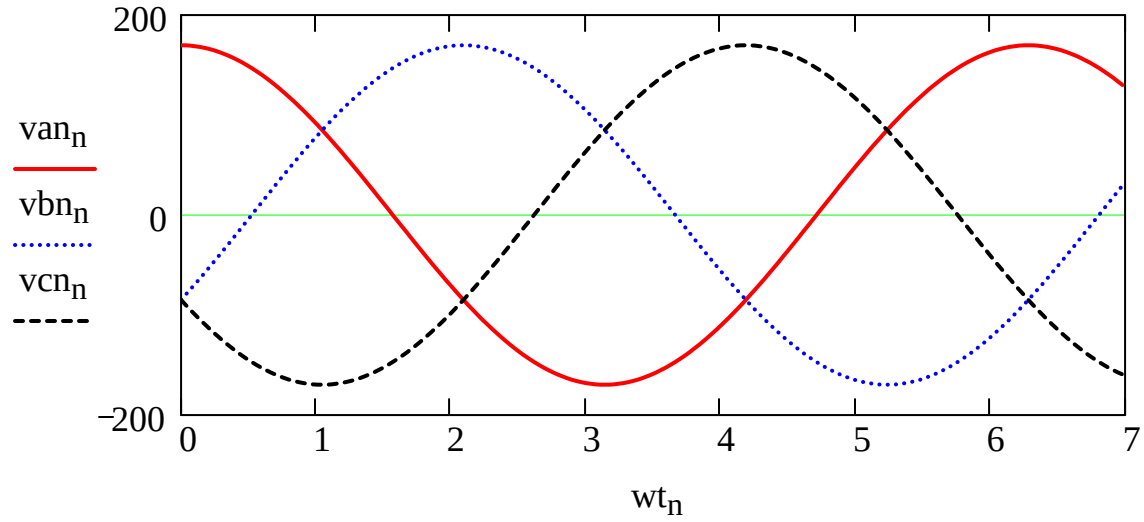
Calculate instantaneous power to each phase.

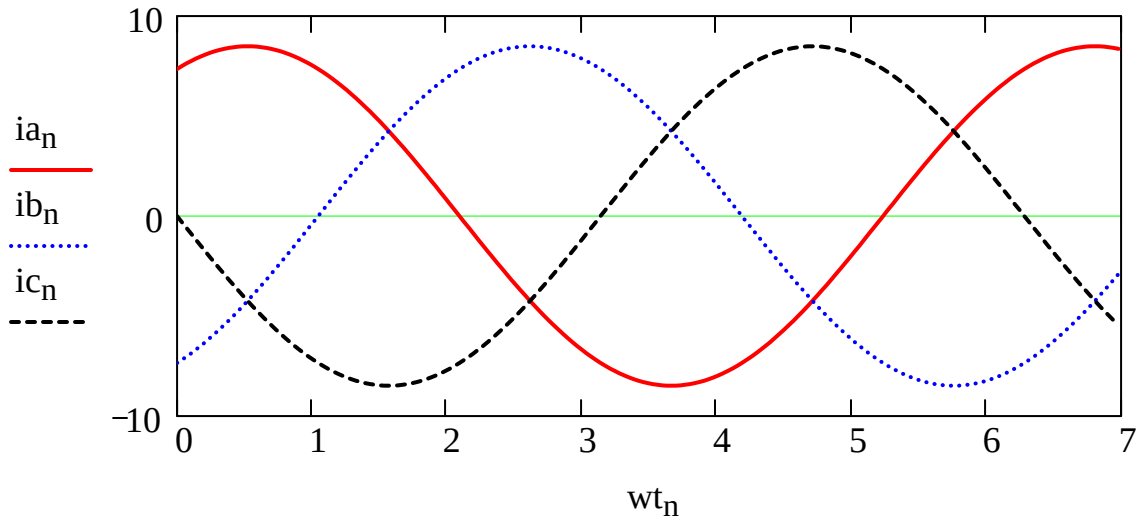
$pa_n := van_n \, ia_n$ $\qquad pb_n := vbn_n \, ib_n$ $\qquad pc_n := vcn_n \, ic_n$

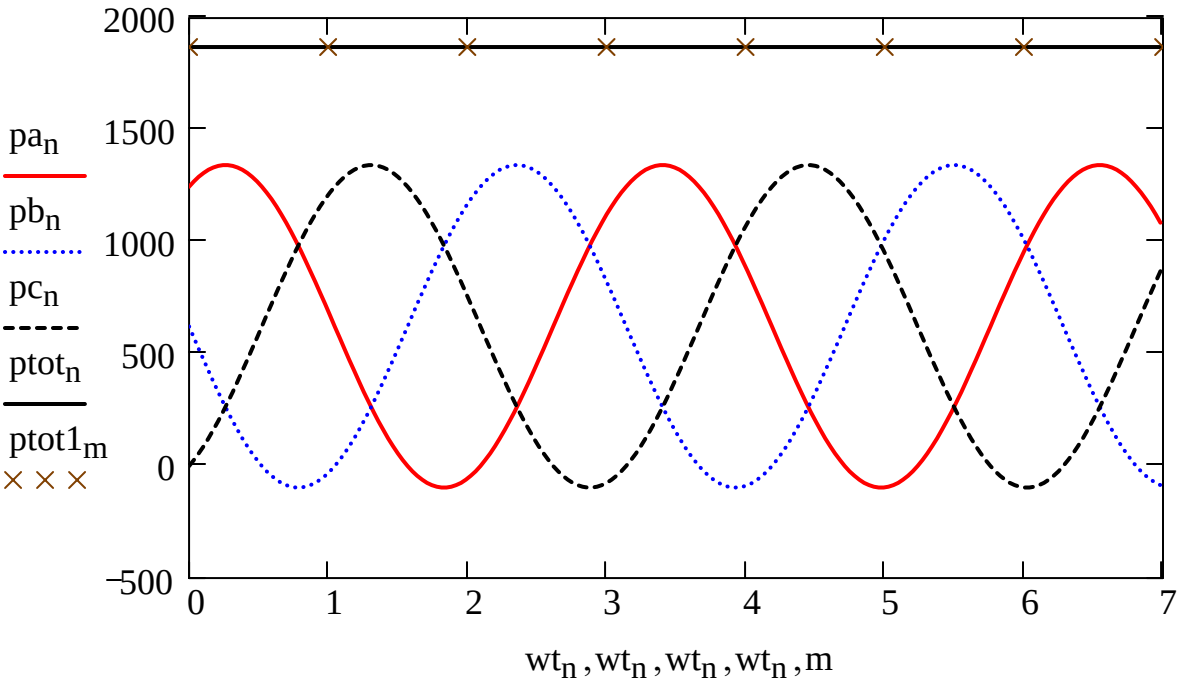
$ptot_n := pa_n + pb_n + pc_n$ $\qquad ptot1_m := 3 \cdot V \cdot I \cdot \cos(\theta)$

$ptot_{22} = 1870.615$ W $\qquad ptot1_1 = 1870.615$ W

3_phase_wye_load.mcd







Calculate apparent power S to each phase.

$Sa := V \cdot I$ $Sa = 720$ VA

$Sb := V \cdot I$ $Sb = 720$ VA

$Sc := V \cdot I$ $Sc = 720$ VA

$Stot := 3 \cdot V \cdot I$ $Stot = 2160$ VA

Calculate time-ave real power P to each phase.

$Pa := V \cdot I \cdot \cos(\theta)$ $Pa = 623.538$ W

$Pb := V \cdot I \cdot \cos(\theta)$ $Pb = 623.538$ W

$Pc := V \cdot I \cdot \cos(\theta)$ $Pc = 623.538$ W

$Ptot := 3 \cdot V \cdot I \cdot \cos(\theta)$ $Ptot = 1870.61$ W

Calculate reactive power Q to each phase.

$Qa := V \cdot I \cdot \sin(\theta)$ $Qa = 360$ VAR

$Qb := V \cdot I \cdot \sin(\theta)$ $Qb = 360$ VAR

$Qc := V \cdot I \cdot \sin(\theta)$ $Qc = 360$ VAR

$Qtot := 3\,V \cdot I \cdot \sin(\theta)$ $Qtot = 1080$ VAR

Calculate power factor (pf) for each phase.

$pf\_a := \cos(\theta)$ $pf\_a = 0.866$ lagging since $Q_a > 0$ & $\theta > 0$

$pf\_b := \cos(\theta)$ $pf\_b = 0.866$ lagging since $Q_b > 0$ & $\theta > 0$

$pf\_c := \cos(\theta)$ $pf\_c = 0.866$ lagging since $Q_c > 0$ & $\theta > 0$

$pf := \cos(\theta)$ $pf = 0.866$ lagging since $Q > 0$ & $\theta > 0$