TTK4240 - Høst 2016

Øving 8

Vsevolod Karpov-vsevolok

a) Mindre ledninger i en 3 fase system. Ergo mer økonomisk.

b) Fase V: spenning i forhold til den nøytrale linjen.

Line to Line V: Spenning mellom to fase spenninger.

c) $V_{bn} = \sqrt{2} V_{rms} \cos(\omega t + \frac{2\pi}{3})$

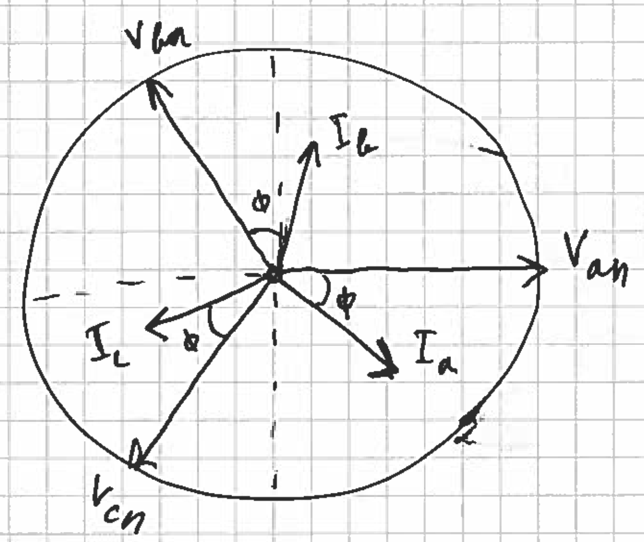
$I_{b} = \sqrt{2} I_{rms} \cos(\omega t + \phi + \frac{2\pi}{3})$

$V_{cn} = \sqrt{2} V_{rms} \cos(\omega t + \frac{4\pi}{3})$

$I_c = \sqrt{2} I_{rms} \cos(\omega t + \phi + \frac{4\pi}{3})$

d) $V_{an} = V_{rms}$, $V_{bn} = V_{rms} e^{j\frac{2\pi}{3}}$, $V_{cn} = V_{rms} e^{j\frac{4\pi}{3}}$

$I_a = I_{rms} e^{-i\frac{\pi}{4}}$, $I_b = I_{rms} e^{j(\frac{2\pi}{3} - \frac{\pi}{4})}$, $I_c = I_{rms} e^{j(\frac{4\pi}{3} - \frac{\pi}{4})}$



$|\phi| = \frac{\pi}{4}$

e) $V_{bc} = V_{bn} - V_{cn}$

$V_{ca} = V_{cn} - V_{an}$

$$V_{ab} = V_{an} - V_{bn} = V_{rms} - V_{rms}\, e^{j\frac{2\pi}{3}}$$

$$= V_{rms}\left(1 - \cos\left(\tfrac{2\pi}{3}\right) - j\sin\left(\tfrac{2\pi}{3}\right)\right)$$

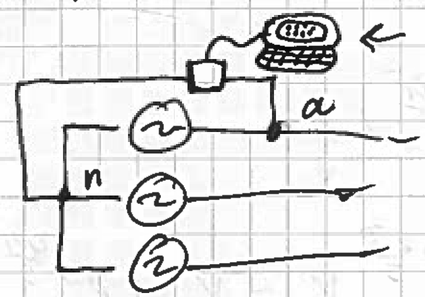
$$= V_{rms}\sqrt{3}\, e^{-j30^\circ}$$

(omvendt fortegn hvis a-b-c rekkefølgen er definert omvendt)

f) Anta $V_{rms} = 230 = V_{an}$

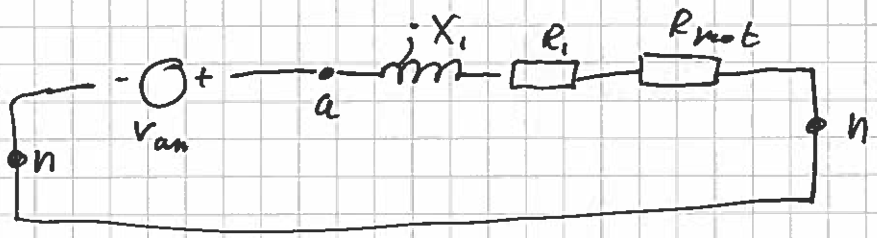
$\Rightarrow |V_{ab}| = 230 \cdot \sqrt{3} = 400$

Mobilen kobles til kun en av linjene, og nøytralen



← En blackberry.

Oppgave 2a)



$$Z_a = R_1 + R_{mot} + jX_1 = \underline{\underline{0.51 + j0.025\,\Omega}}$$

$$V_{ab} = 400V \Rightarrow |V_{an}| = \frac{V_{ab}}{\sqrt{3}} = \underline{\underline{230.94V}}$$

b) Setter fasen til V_{an} som referanse:

$$V_{an} = 230.94e^{j0^\circ}$$

$$Z_{an} = 0.51 \cdot e^{j2.8^\circ}$$

$$\Rightarrow I_{an} = \frac{V_{an}}{Z_{an}} = 452.82e^{-j2.8^\circ}$$

$$P_{Rmot} = |I_{an}|^2 \cdot R_{mot} \cdot 3 = \underline{\underline{307.6\ kW = 410\ hp}}$$

c) $\Delta E = \frac{1}{2}m(\Delta v)^2 = \frac{1}{2} \cdot 2000 \cdot \cancel{\ } \cdot (27.78\,m/s)^2$
$= 771.73\ kJ$

$$\Rightarrow t = \frac{\Delta E}{P} = \frac{771.73\ kJ}{307.6\ kW} = \underline{\underline{2.5s}}$$

d) $E = 70\ kWh = 2.52 \cdot 10^8\ J = 2.52 \cdot 10^5\ kJ$

$$t = \frac{E}{P \cdot 0.8} = \frac{2.52 \cdot 10^5\ kJ}{307.6\ kW \cdot 0.8} = 1024\,s = \underline{\underline{17.07\ min}}$$

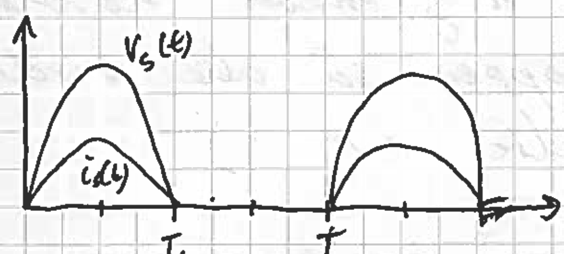
Oppgave 3

a) Ideel diode oppfører seg som en perfekt leder når det går strøm i "forward biased" retning av dioden og oppfører seg som en perfekt insulator når strømretningen er omvendt.

b) $V_o(t) = \dfrac{|V_s(t)| + V_s(t)}{2}$

$i(t)$ (uten diode) $= V_s(t)/R = V_s(t)/2$

$\Rightarrow i_o(t) = \dfrac{V_o(t)}{2}$



c) $w = 2\cdot\pi\cdot 50 \Rightarrow T = \dfrac{1}{50}$

$\Rightarrow$ ~~Average~~ gjennomsnittspenning

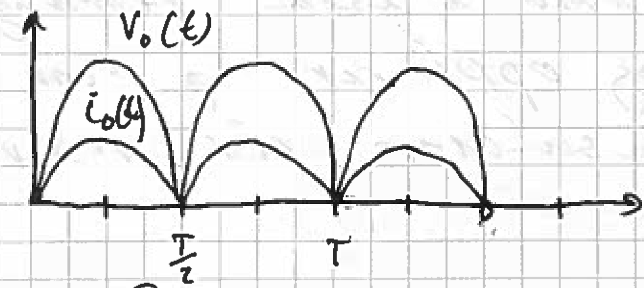
$= V_{gjen} = \int_0^{T/2} V_o(t)\,dt \,/\, T = \frac{2}{\pi}/T = \frac{100}{\pi} = 31.83\,V$

$V_{s,rms} = \dfrac{|V_s|}{\sqrt{2}} \Rightarrow \dfrac{V_o}{V_{s,rms}} = \dfrac{V_o\cdot\sqrt{2}}{|V_s|} = \dfrac{\sqrt{2}}{\pi}$

5

d) $V_o(t) = |V_s(t)|$

$i_o(t) = \frac{|V_s(t)|}{2}$

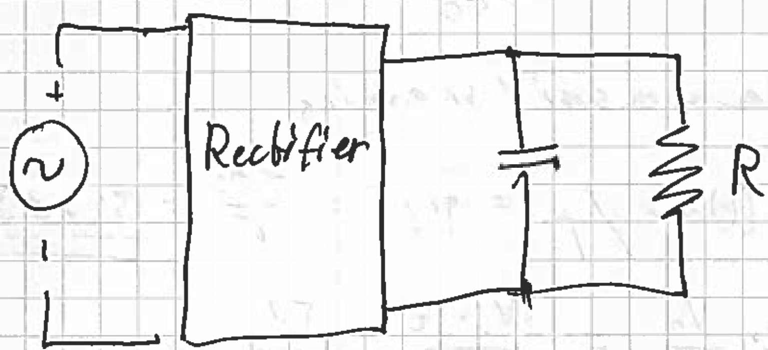


e) $V_o = \int_0^{T/2} V_s(t) / \left(\frac{T}{2}\right) = \frac{200}{\pi} = 63.7\,V$

$$\frac{V_o}{V_{o,rms}} = \frac{V_o \cdot \sqrt{2}}{|V_s(t)|} = \frac{2 \cdot \sqrt{2}}{\pi}$$

Dette er jo veldig logisk. Med full rectifier slipper vi gjennom dobbelt så mange bølgetopper så alle verdier må være dobbelte av c)

f) En LP filter hvor kondensatoren er parallel med lasten



Oppgave 4

a) $V_0 = 5V \Rightarrow V_i = \frac{5V}{0.9} = 5.556V$

$\frac{V_s}{N_1} = \frac{V_i}{N_2} \Rightarrow \frac{N_1}{N_2} = \frac{V_{s\,rms}}{V_i} = \underline{\underline{43.29}}$

b) $V_i = \frac{4.5}{0.9} = 5V$

$V_1 = V_i \cdot \frac{N_1}{N_2} = 216.45\,V$

$i_s' = \frac{V_s - V_i}{R} = 0.02355A$

$\Rightarrow i_i' = i_s' \cdot \frac{N_1}{N_2} = 1.0194A$

$i_0' = \frac{i_i'}{0.9} = \underline{\underline{1.13A}}$

c) $P_R = R \cdot \bar{I}_s^2 = 0.5546025$

$P_L = I_0 \cdot V_0 = 5.085$

$\frac{P_R}{P_L} \cdot 100 = \underline{\underline{10.9\,\%}}$