UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 1 av 13

1

$L = 25 \mu H$

$V_{in} = 12V$

$D = 0.4$

$f_s = 400kHz$

$T_s = 2.5 \cdot 10^{-6} s$

$P_o = 25 W$

$V_o = \frac{V_{in}}{1-0.4} = \frac{12}{0.6} = 20V$

$I_o = \frac{25}{20} = 1.25A$

$I_{in} = \frac{25}{12V} = 2.083$

$\Delta i = \frac{1}{L}(D-1)(V_o - V_{in}) T_s = 0.48A$

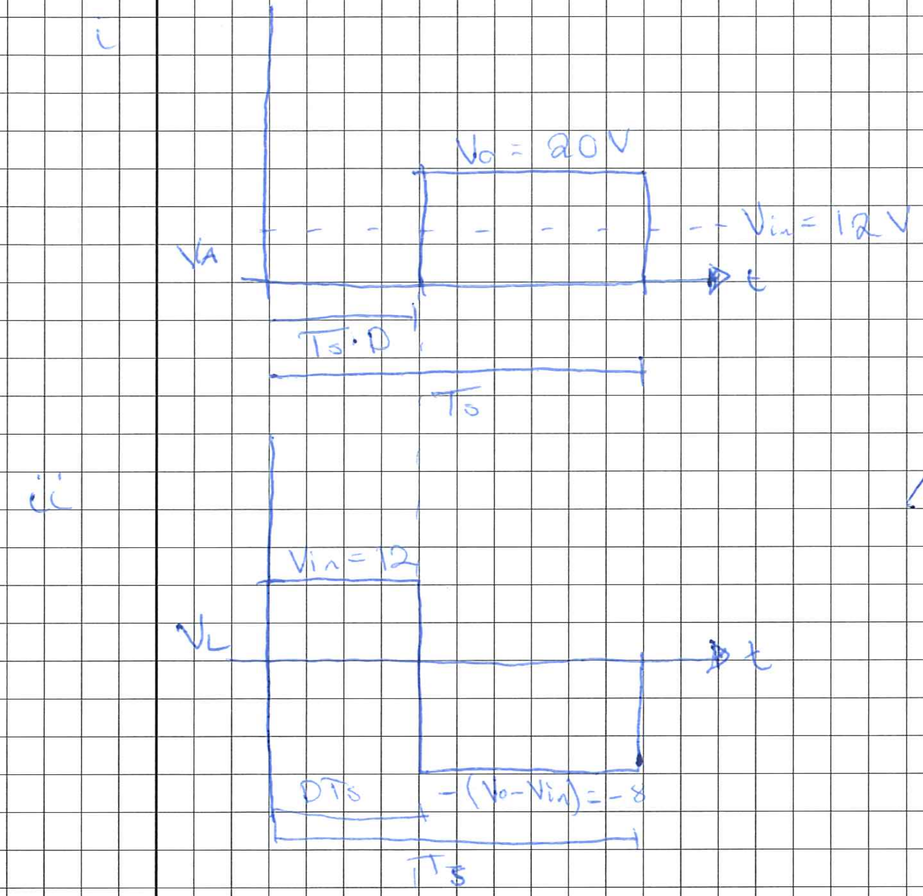
UNIVERSITETET I AGDER

Emnekode : ENE229

Kandidatnr. : 228

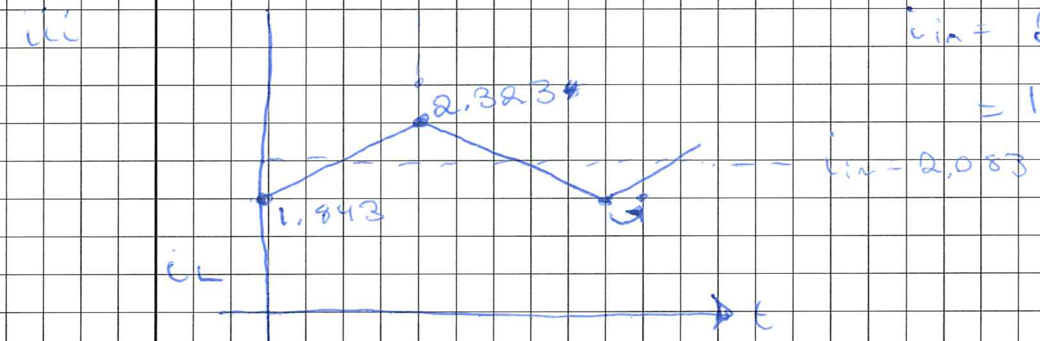
Dato : 23/05/17

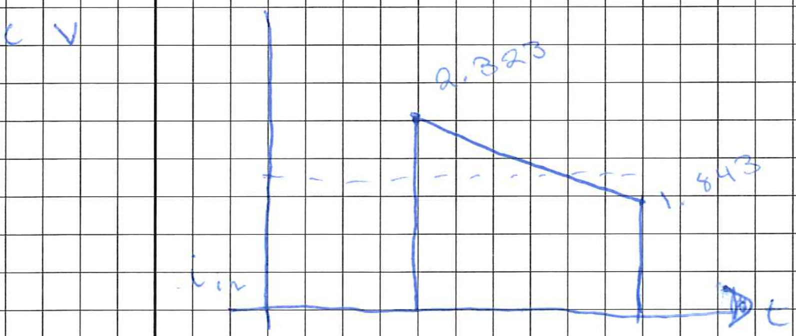
Ark nr. : 2 av 13



$i_{in} = 2,083 \pm \frac{0.48}{2}$

$= 1.843,\ 2.823$





UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05

Ark nr. : 3 av 13

b

$P_o = 15W$

$V_o = \frac{V_{in}}{1-D} = \frac{12V}{0.6} = 20V$

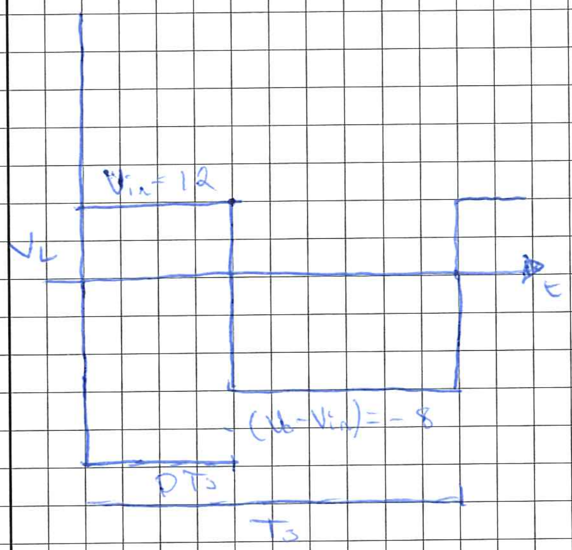
$I_o = \frac{15W}{20V} = 0.75A$

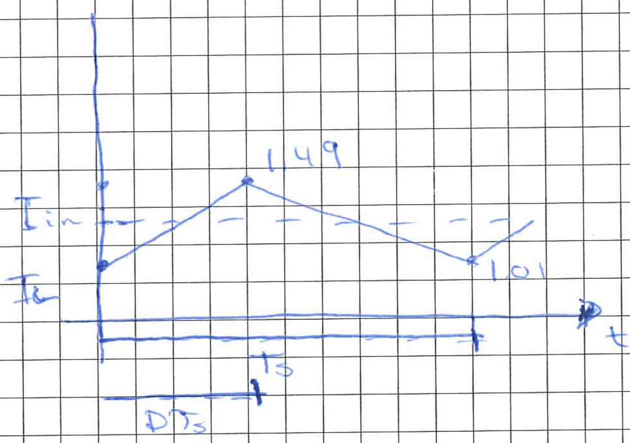
$I_{in} = \frac{15W}{12V} = 1,25A$

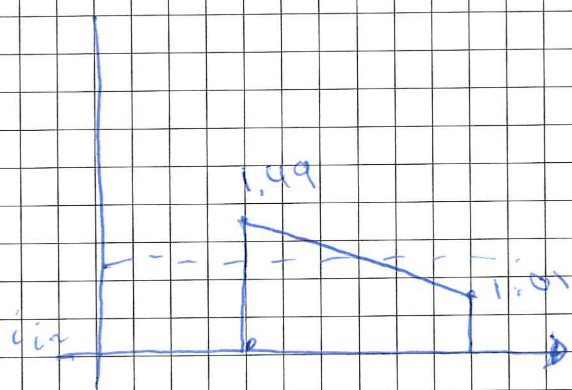
$\Delta i = 0.48A$

$i_{in} = 1,25 \pm \frac{0.48}{2}$

$= 1,01 \ , \ 1,49$







The ripple is the same as in question (a)

Emnekode	: ENE 229
Kandidatnr.	: 228
Dato	: 23/05/17
Ark nr.	: 4 av 13

UNIVERSITETET I AGDER

2a)

Load	(Active) AP	(Reactive) RP	(apparent) AppP	(power factor) pf
1	10 kW	0	10 kVA	1
2	20 kW	34.64 kVAR	40 kVA	0.5 lagg
3	15 kW	~~24.15~~ 20 kVAR	25 kVA	0.6 lagg
Total	45 kW	54.64 kVAR	70.78	0.64 lagg

Showing work

Will just show some of the work because its the same for all the loads

$S = \frac{10}{1} = \frac{P}{pf} = 10\,kVA$

$Q = \sqrt{10^2 - 10^2} = \sqrt{S^2 - P^2} = 0$

Total: added $\sum P = P_{tot}$, $\sum Q = Q_{tot}$

$\sqrt{P_{tot}^2 + Q_{tot}^2} = S_{tot}$

$pf = \frac{P_{tot}}{S_{tot}}$

$I_{eff} = \frac{70.78\,kVA}{6\,kV} = \underline{11.8\,A}$

UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 5 av 13

2b

$V = 240V$

$Z = 3.5\angle 25$

~~S_{12}~~

$I^* = 240\angle 0 V / 3.5\angle 25 = 68.57\angle -25$

~~$I = 68$~~

$S = 240\angle 0 V \cdot 68.57\angle 25 = 16456.8\angle 25$

$S = \underbrace{14914.9}_{P} + j\underbrace{6955}_{Q}$

$lagg = \frac{14914.9}{16456.8} = 0.906$

New lagg = ~~0.906~~ 0.95, P stays the same

$S = \frac{14914.9}{0.95} = 15698.9$ VA

$Q = 15698.9 \sin(\cos^{-1}(0.95)) = 4902$

$Q_{new} = 6955 - 4902 = \underline{\underline{2053 \text{ VAR}}}$

The capasitor must supply 2053 VAR

UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 6 av 13

2 c)

Line voltage $U = 169.7V$, $U_f = 98$

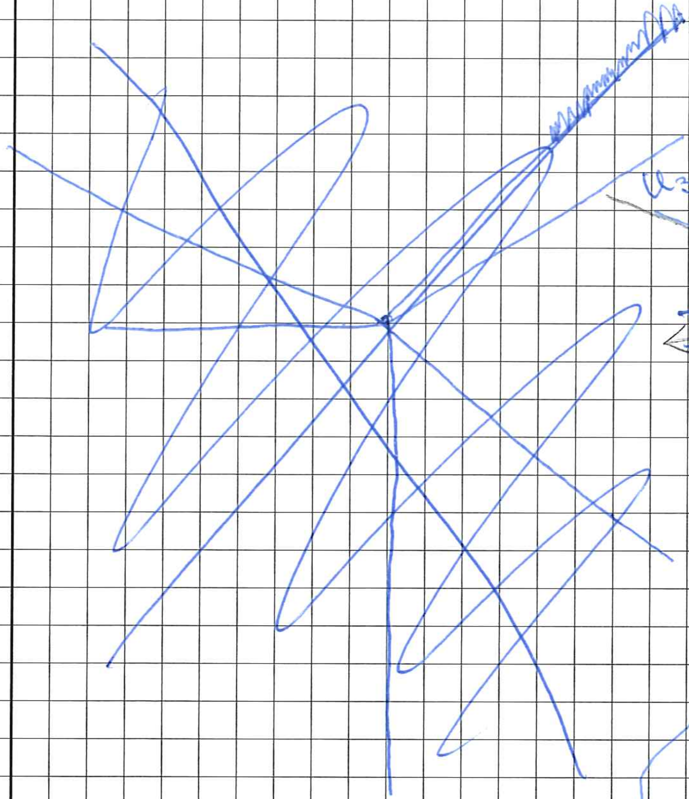
$U_1 = 98\angle{-90}$, $U_2 = 98\angle 30$, $U_3 = 98\angle 150$

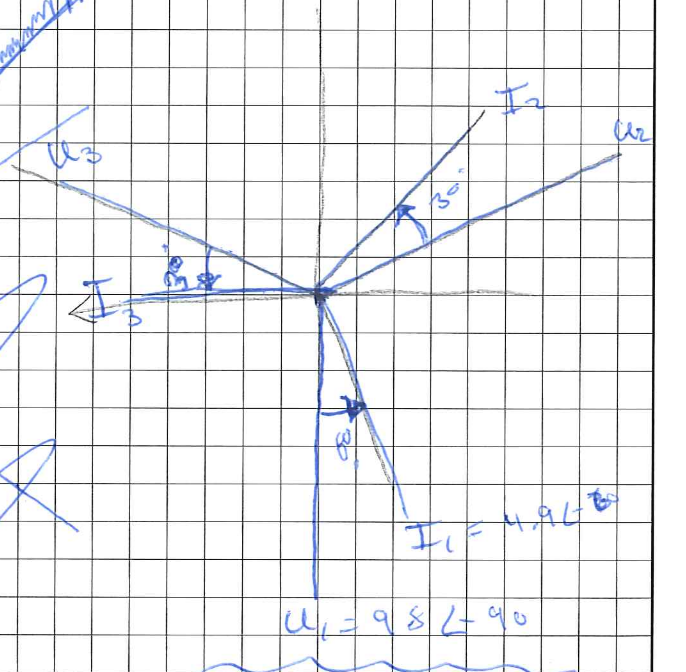
Impedans $Z = 20\angle{-30}$

$$I_1 = \frac{98\angle{-90}}{20\angle{-30}} = \underline{\underline{4.9\angle{-60}}}$$

$$I_2 = \frac{98\angle 30}{20\angle{-30}} = \underline{\underline{4.9\angle 60}}$$

$$I_3 = \frac{98\angle 150}{20\angle{-30}} = \underline{\underline{4.9\angle 180}}$$





~~Draw the lin~~

I did not draw the lines in their real proportion. The Angle is right but not the ~~lines~~ length of the lines compared to each other.

UNIVERSITETET I AGDER

Emnekode : ENE 229
Kandidatnr. : 228
Dato : 23/05/17
Ark nr. : 7 av 13

3 a) Formation of a YBus

$$Y_{Bus} = \begin{bmatrix} Y_{11} & Y_{12} & Y_{13} \\ Y_{21} & Y_{22} & Y_{23} \\ Y_{31} & Y_{32} & Y_{33} \end{bmatrix}$$

← I hope this description is good enough

An admitance matrix is prefered in comparisont to a impedance ZBus for several reasons.

1. A YBus ~~have~~ is a lot smaller and ~~have a lot no~~ can often have a lot of zeros ~~~~ ~~that is~~ where a ZBus can in theory have an infinet amount of numbers.

2. One often use ~~YBus~~ matrikes to find current with ~~an~~ already known voltage then it is easier to calculate using $I = V \cdot Y_{Bus}$ then $I = \frac{V}{Z_{Bus}}$

UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 8 av 13

3a)

3. A YBus often has a lot smaller numbers which can be easier when doing calculations

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 9 av 13

3 b

Three phase 345 kV

$p.u = \frac{p.phase}{base}$

Series impedances

$Z_{12} = 5.55 + j\,56.4$

$Z_{13} = 7.4 + j\,75.2$

$Z_{23} = 5.55 + j\,56.4$

Base = 100 MVA

$Z_{base} = \frac{(345 \cdot 10^3)^2}{100 \cdot 10^6} = 1190.25$

$Z_{12} = (5.55 + j56.4) / 1190.25 = 4.66 \cdot 10^{-3} + 0.05j$

$Z_{13} = (7.4 + 75.2) / 1190.25 = 6.2 \cdot 10^{-3} + 63 \cdot 10^{-3} j$

$Z_{23} = 4.66 \cdot 10^{-3} + j\,47.39 \cdot 10^{-3}$

Bruker $Z = \frac{1}{Y}$

$Y_{12} = 2 - j20.9$

$Y_{13} = 1 - j15.67$

$Y_{23} = 2 - j20.9$

$Y_{11} = 2 + 1 - 20.9 - j15.67$

$= 3 - j36.57$

$Y_{12} =$

$$Y_{Bus} = \begin{bmatrix} 3 - j36.57 & -2 + j20.9 & -1 + j15.67 \\ -2 + j20.9 & 4 - j41.8 & -2 + j20.9 \\ -1 + j15.67 & -2 + j20.9 & 3 - j36.57 \end{bmatrix}$$

UNIVERSITETET I AGDER

Emnekode : ENE229

Kandidatnr. : 228

Dato : 23/05/17

Ark nr. : 10 av 13

$Y_{11} = 3 - j36.57$

$Y_{12} = -2 + j20.9$

$Y_{13} = -1 + j15.67$

$Y_{21} = -2 + j20.9$

$Y_{22} = 2 - j20.9 + 2 - j20.9 = 4 - j41.8$

$Y_{23} = -2 + j20.9$

$Y_{31} = -1 + j15.67$

$Y_{32} = -2 + j20.9$

$Y_{33} = 1 + 2 - 15.67 - 20.9 = 3 - j36.57$

UNIVERSITETET I AGDER

Emnekode : ENE229
Kandidatnr. : 228
Dato : 23/05/17
Ark nr. : 12 av 13

4a)

$f = 50\ Hz \quad \omega = 314$

Supply = 15 MW : P

pf = 0.8 lagg

Tl = 20 km

$R = 0.02\ ohm/km = 0.4\ \Omega$

$Z = 0.65\ mH/km = j4.082\ \Omega$

$E_r = 10\ kV$

$S = 15/0.8 = 18.75\ MVA$

$Q = 18.75 \cdot \sin(\cos^{-1}(0.8)) = 11.25$

$I = \frac{18.75\ MVA}{10000\ kV \cdot 3} = 625\ A$

$E_s = E_r + 625 \cdot 0.4\cos(37) + 625 \cdot 4.082\sin(37)$

$= \underline{\underline{11735}}$

$VR = \frac{E_s - E_r}{E_r} = \frac{11735 - 10000}{10000} = \underline{\underline{0.1735}}$

UNIVERSITETET I AGDER

Emnekode : ENE 229

Kandidatnr. : 228

Dato : 23/05/17

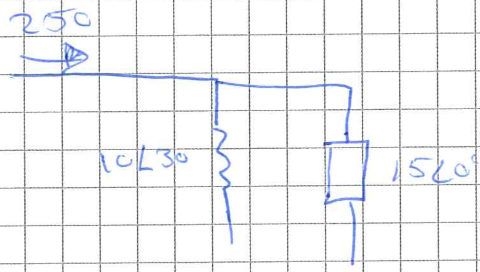
Ark nr. : 13 av 13

c)

$V = 250$

$Z_\Delta = 15 \angle 0°$

$Z_Y = 10 \angle 30°$



$S_\Delta = \frac{250^2}{15 \angle 0} = 4166 \angle 0$

$S_Y = \frac{250^2}{10 \angle 30} = 6250 \angle -30$

$S_y = \underbrace{5412}_{P} - j\underbrace{3125}_{Q}$

$S_{tot} = S_\Delta + S_y = 5412 + 4166 - j3125$

$S_{tot} = 9578 - j3125 = 10074.9 \angle -18$

$pf = \frac{9578}{10074.9} = \underline{\underline{0.95 \text{ leading}}}$

$P = \underline{\underline{9578 \text{ W}}}$