Solution to lecture 3 exercises

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The diode 1 voltage will before turn-on (wt=0) follow Uac since D5 is conducting. During D1 conduction (0<wt<120deg) the D1 voltage is ideally zero. After turn-off (wt=120deg) the voltage is given by Uab since D3 is turning on at this time. After D5 turn on (wt=240deg) D1 voltage is given by Uac until D1 again turns on at wt=360.

The diode 2 voltage will before turn-on (wt=60) follow Ubc since D6 is conducting. During D2 conduction (60<wt<180deg) the D2 voltage is ideally zero. After turn-off (wt=180deg) the voltage is given by Uac since D4 is turning on at this time. After D6 turn on (wt=300deg) D2 voltage is given by Ubc until D2 again turns on at wt=60.

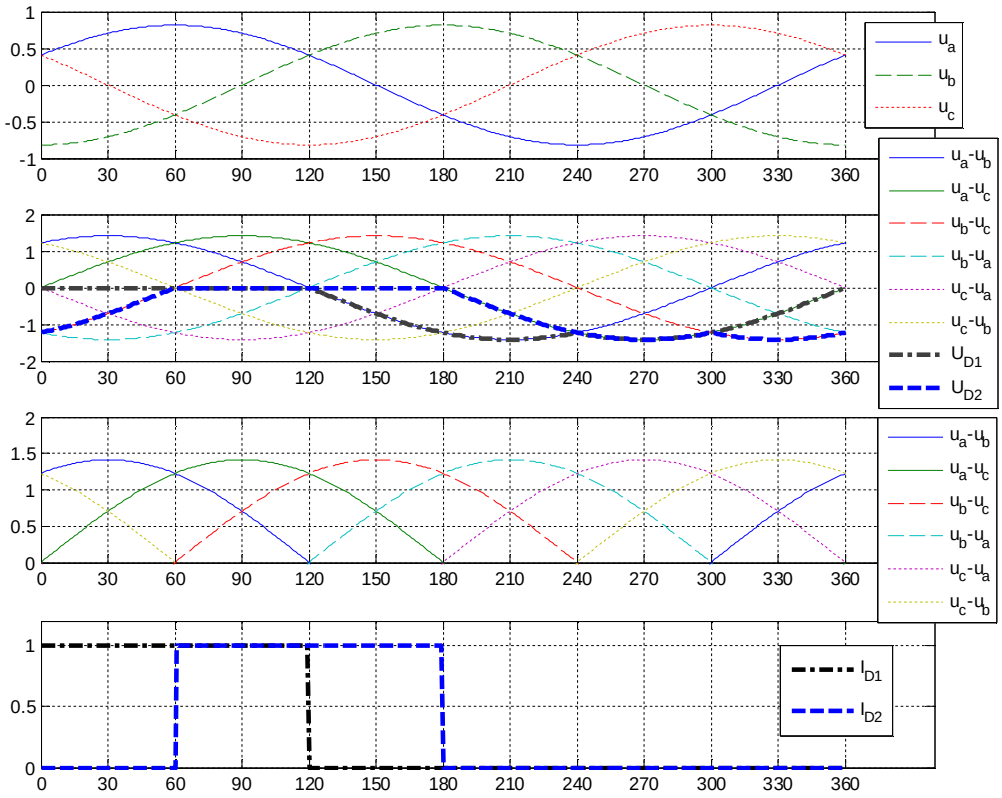

Figure 1

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a)

Is=sqrt(2/3)*Id
Ismax=10Arms
⇨ Idmax = 12.2A

b)

Ud0=1.35*400=540V
$\Delta U_d = \frac{3}{\pi}\omega L_s I_d$ =25.6V
Ud=Ud0-ΔU_d=514V

c)

Pmax = Ud*Idmax = 6.3kW

d)

See Figure 1 above.

Average diode D1 current is $I_{D1AV} = \frac{1}{2\pi}\int_0^{2\pi/3} I_{D1} d\omega t = \frac{I_d}{3}$ =4.1A

e)

See Figure 1 above.

RMS diode current is: $I_{D1RMS} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi/3} I_{D1}^2 d\omega t} = \sqrt{\frac{1}{3}} I_d$=7.1A

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Diode conduction losses:

$P_{av} = \frac{1}{2\pi}\int_0^{2\pi/3}(V_0 i_{D1} + R_s i_{D1}^2) d\omega t = V_0 i_{D1AV} + R_s i_{D1RMS}^2$=

=0.79*4.1+0.013*7.1^2=3.9W

Total rectifier losses are 6*3.9 = 24W

Losses in % of the load = 24/6300=0.4%