1. A 120-V, 60-Hz, 1-ph, half-wave AC voltage controller feeding a resistive load of 10Ω. The conduction period of the thyristor is $2\pi/3$. Calculate:
   i. The rms output voltage.
   ii. The source power factor.

2. A 220-V, 50-Hz, AC regulator feeds a highly inductive load of $\phi \approx \pi/2$. Determine:
   a. the range of the triggering angle.
   b. the extinction angle, at $\alpha = 135^\circ$.
   c. the rms value of the fundamental phase voltage.

3. A three-phase, 380-V, 50-Hz, AC-regulator feeding a heater of a 100 Ω resistance, at a triggering angle of 75^0.
   a. write the expression of the instantaneous output phase voltage.
   b. the rms value of the output phase voltage.
   c. draw the waveform of the output phase voltage.

Mid-Term 2015/2016 (PE2)

Q1)

$\because \gamma = 2\pi/3; \rightarrow \alpha = \pi - 2\pi/3 = \pi/3 = 60^o$

$$i) Vorms = V_s\sqrt{\frac{1}{2\pi}(2\pi - \alpha + \frac{\sin(2\alpha)}{2})} = 120*\sqrt{\frac{1}{2\pi}(2\pi - \pi/3 + \frac{\sin(120)}{2})}$$

$\therefore Vorms = 104.9V$

ii) Pf=V_{orms}/V_s=104.9/120=0.87

Q2)

i) Range of triggering angle= 90< α<180

ii) As i(β)=0 ➔ sin(β-Φ)-sin(α- Φ)*e(α- β)/tan(Φ)=0

For highly inductive load Φ=90 so

sin(β-90)=sin(α- 90) ➔cos(β)=cos(α)

β= α neglected solution

or **β =2π-α** where cos(α)=cos(2π-α)=cos(4π-α) and so on

at α=135 ➔ **β=360-135=225º**

iii)

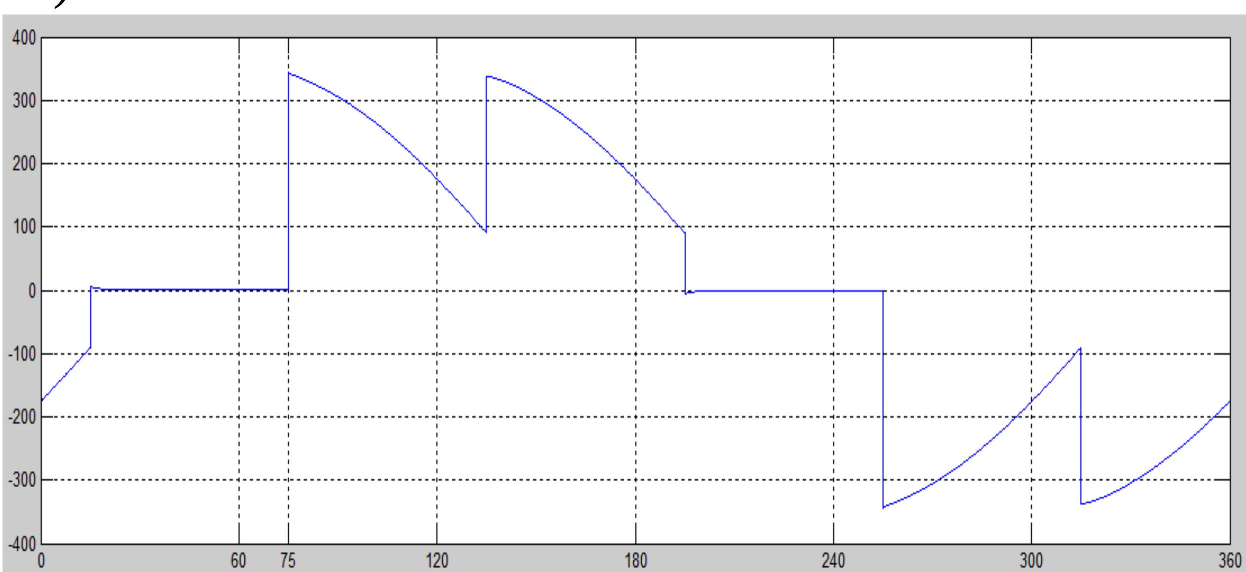
$$a_1 = \frac{220\sqrt{2}}{2\pi}(\cos(2*135) - \cos(2*225)) = 0V$$

$$b_1 = \frac{220\sqrt{2}}{2\pi}*(2*(225-135)*\frac{\pi}{180} + \sin(2*135) - \sin(2*225)) = 56.5V$$

$$\therefore V_1 = \sqrt{a_1^2 + b_1^2} = 56.5V \rightarrow V_1 = \frac{56.5}{\sqrt{2}} \approx 40V$$

Q3)

c)



a) Instantaneous output voltage for phase a

$$v_a(\omega t) = \begin{cases} v_{ac}/2 & 0^o < \omega t < 15^o \\ 0 & 15^o \le \omega t < 75^o \\ v_{ab}/2 & 75^o \le \omega t < 135^o \\ v_{ac}/2 & 135^o \le \omega t < 195^o \end{cases}$$

b) V_o substitute in equation 2 by α=75

Vo=

380/sqrt(3)*sqrt(1/(2*pi)*(pi+3*sqrt(3)/2*sind(30+150)))

=155V