Faculty of Information Technology

Electrical Computer Engineer Department

Power LAB (ENEE 5102)

ASSIGNMENT

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Calculation:

Load consume power (P) of 308 W and drawing current (I) of 2A at voltage (V) 220V

$PF_{old} = \frac{P}{V \times I}$ eq.1

$= \frac{308}{220 \times 2} = 0.7$

$Q_{old} = V \times I \times \sin(\cos^{-1}(PF_{old}))$ eq.2

$= 220 \times 2 \times \sin(\cos^{-1}(0.7))$

$= 314.2228$ VAR

$I_{new} = \frac{P}{V \times PF_{new}}$ eq.3

$= \frac{308}{220 \times 0.97}$

$= 1.44$ A

$Q_{new} = V \times I_{new} \times \sin(\cos^{-1}(PF_{new}))$

$= 220 \times 1.44 \times \sin(\cos^{-1}(0.97))$

$= 77.192$ VAR

where;

Q_{old} is the reactive power consumption by the load befor adding the shunt capacitor.

Q_{new} is the reactive power consumption by the load after adding the shunt capacitor.

The value of the capacitor (C) that must be used to raise the power factor of the load to 0.97, can be calculated as expressed in eq.4

$C = \frac{Q_{old} - Q_{new}}{V^2 \times 2\pi \times f}$ eq.4

$= \frac{314.2228 - 77.192}{220^2 \times 2\pi \times 50} = 15.588$ μF.

In matlab/Simulink RL load was used to implement the induction motor and the values of the RL were calculated as expressed in eq.5 and eq.6

$|Z| = \frac{V}{A} = \frac{220}{2} = 110$A eq.5

Since Z= R+jX eq.6

Thus;

$R = |Z| \times PF_{old}$ eq.7

$= 110 \times 0.7 = 77\ \Omega$

$X = |Z| \times \sin(\cos^{-1}(PF_{old}))$ eq.8

$= 110 \times 0.714 = 78.55\ \Omega$

$L = \frac{X}{2\pi \times f}$ eq.9

$= \frac{78.55}{2 \times \pi \times 50} = 250.05$ mH.

Simulink model:

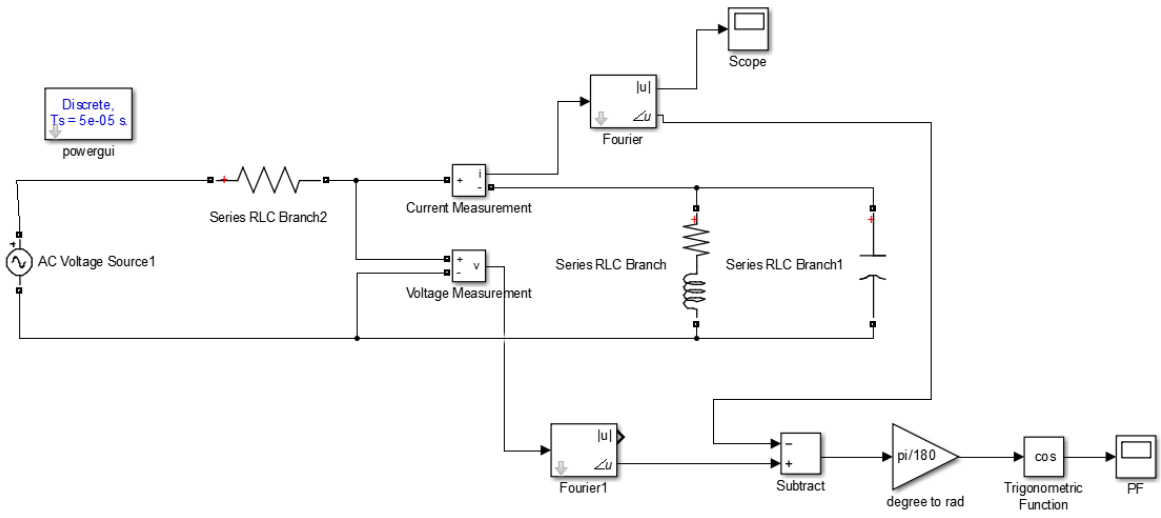
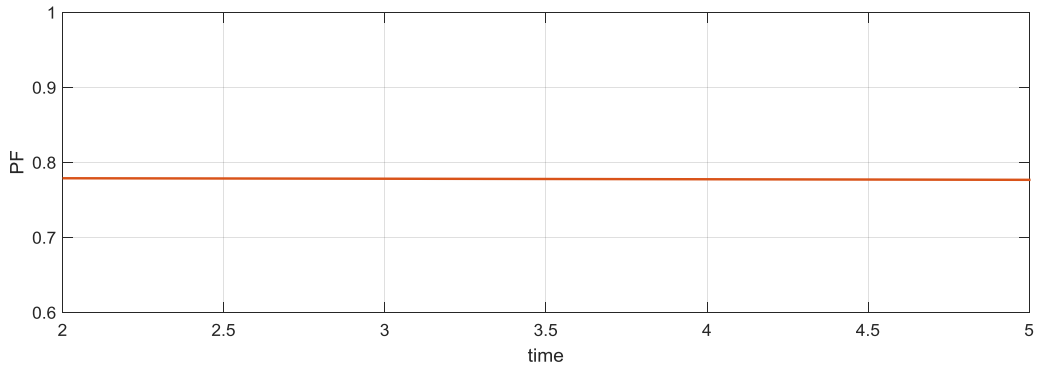


Figure 1: Power factor correction implementation on Simulink

Results:

(a)



(b)

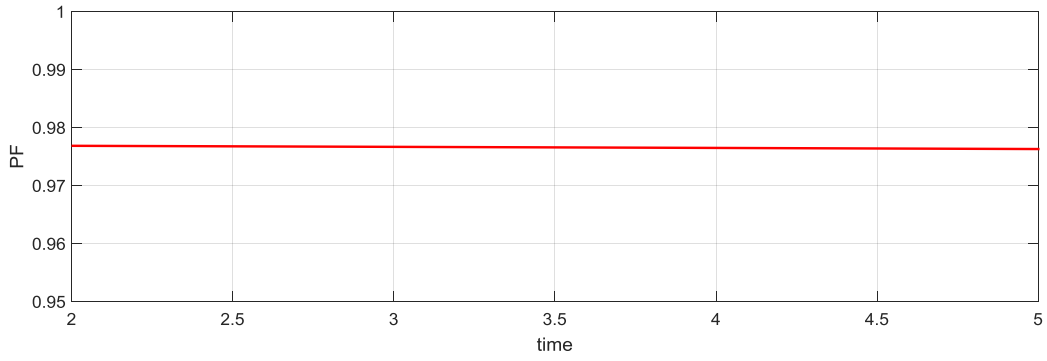
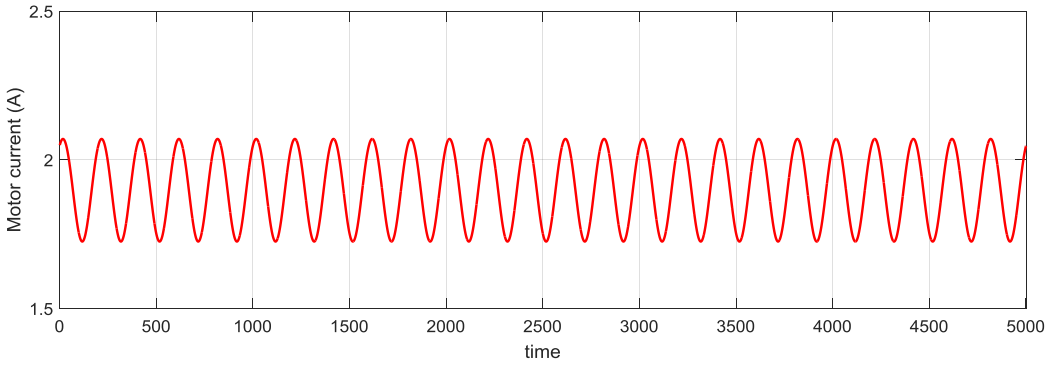


Figure 2: The value of power factor (a) before adding shunt capacitor (b) after adding shunt capacitor.

(a)



(b)

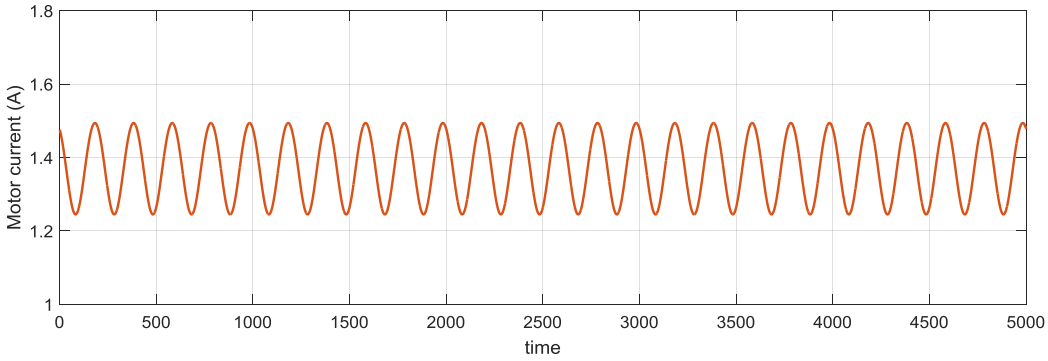


Figure 3: The value of motor current (a) before adding shunt capacitor (b) after adding shunt capacitor.

Table 1: Conclusion table.

	PF	Motor current (A)
Before adding shunt capacitor	0.7	≈ 2.0
After adding shunt capacitor	0.977	≈ 1.4