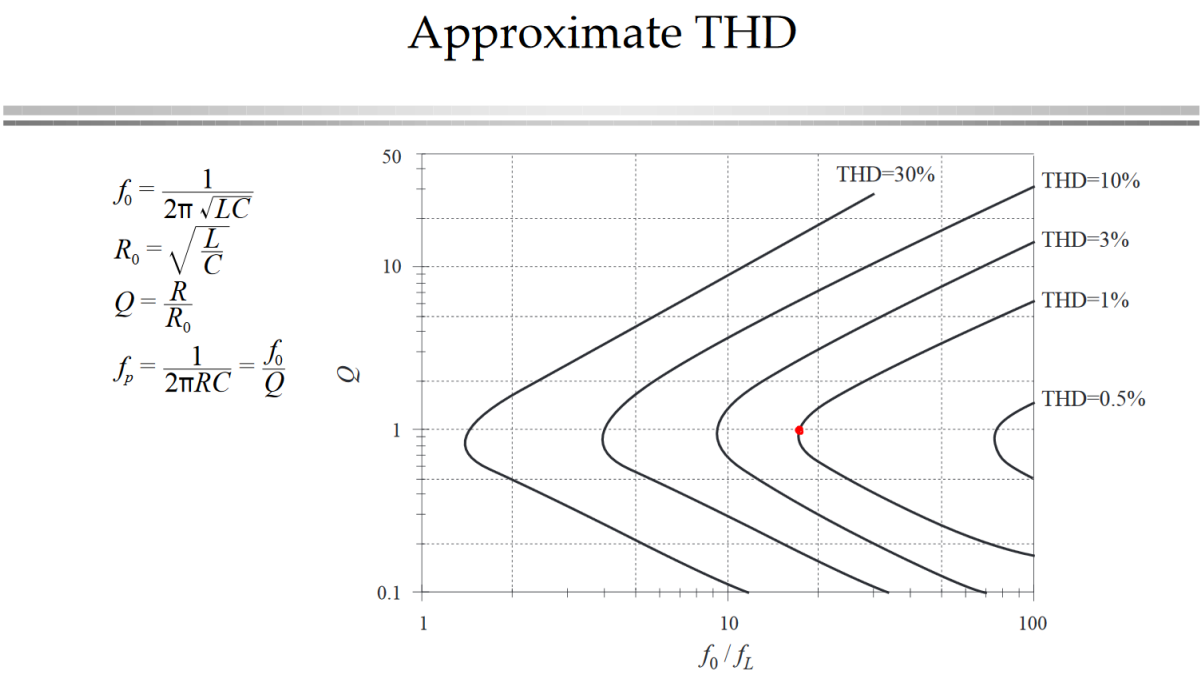
Homework 11 Solutions:

Using the Curve shown below:



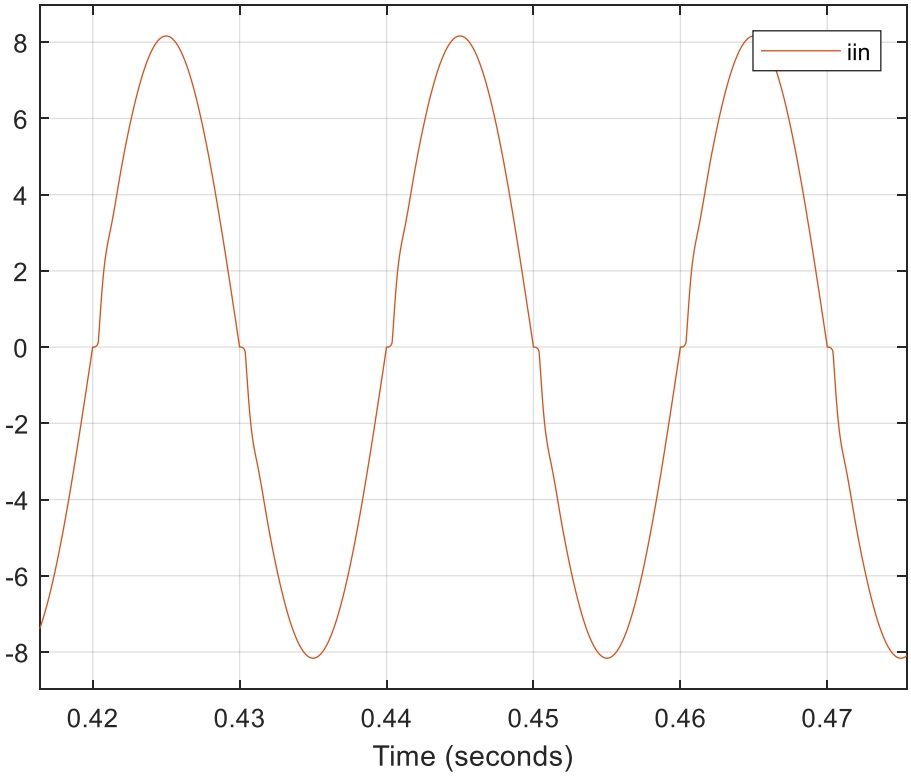
We can use the THD=1% contour curve to design our filter. The problem states that you want to minimize the corner frequency f_o and still maintain low Q. Minimizing the corner frequency will provide the most attenuation from the filter at switching frequencies of potential downstream switching converters. While you can select to have a very little Q, the resulting f_o will not be minimized. So the red dot indicates the point at which you minimize the filter corner frequency f_o and the filter Q. From the curve:

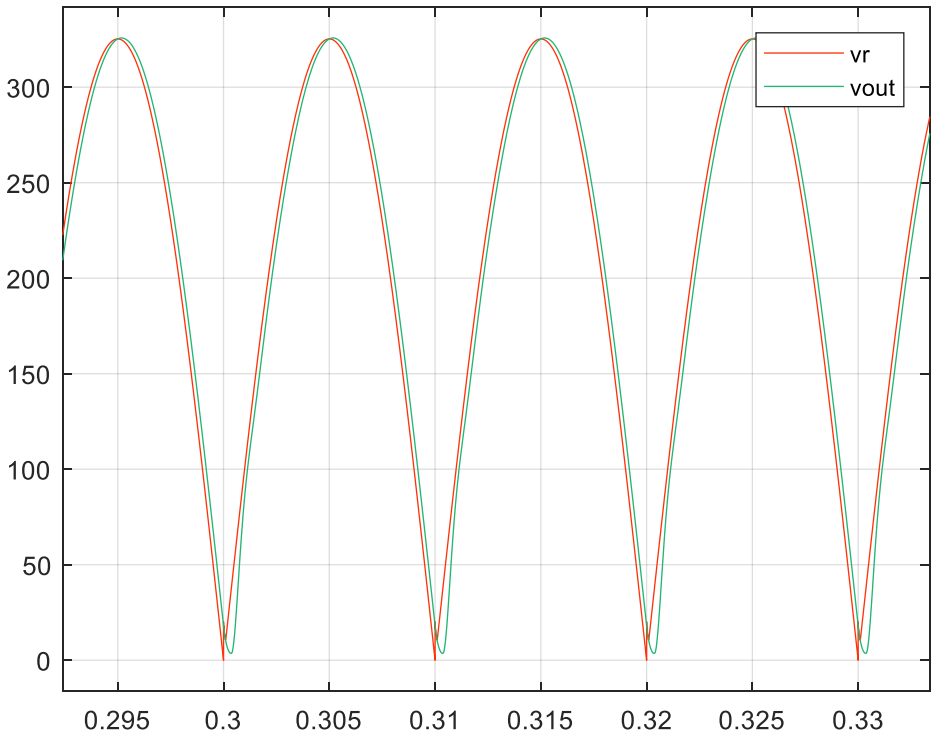
2 $Q = 1$

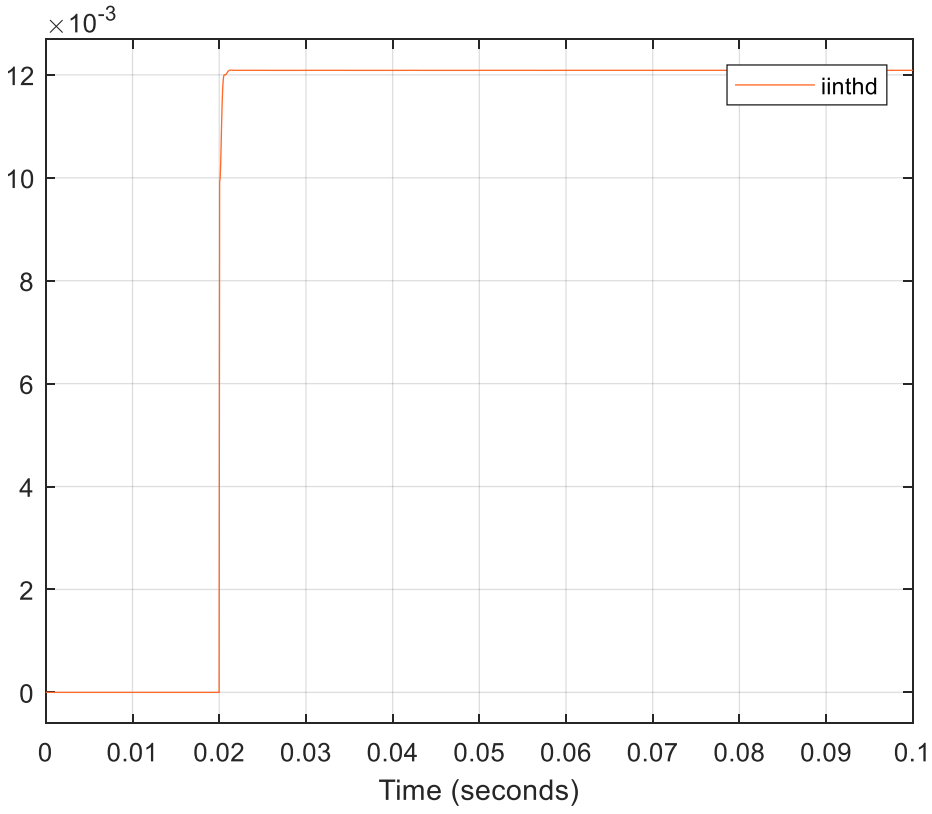
1 $\frac{fo}{fL} = 18 \rightarrow fo = 18 * 50 = 900Hz$

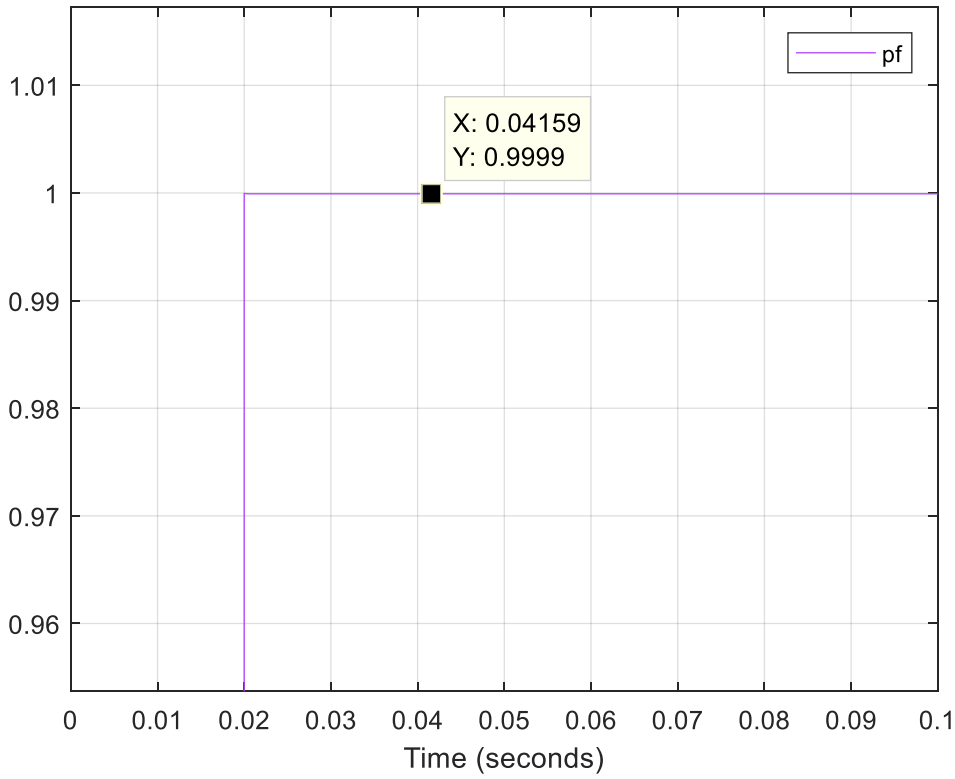
2 $C = \frac{Q}{2\pi R fo} = \frac{1}{2\pi * 40 * 900} = 4.42uF$

2 $L = \frac{1}{4\pi^2 C fo^2} = 7.07mH$


iin
8
6
4
2
0
-2
-4
-6
-8
0.42
0.43
0.44
0.45
0.46
0.47
Time (seconds)


vr
vout
300
250
200
150
100
50
0
0.295
0.3
0.305
0.31
0.315
0.32
0.325
0.33


×10-3
iinthd
12
10
8
6
4
2
0
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Time (seconds)



Given that the voltage output voltage has a very large variation due to the rectified sine wave, we would need a converter that can regulate an output voltage over this entire range including zero. A boost, buck-boost or flyback all have voltage transfer ratios ,M(d), that can achieve infinity (i.e. vin=0)