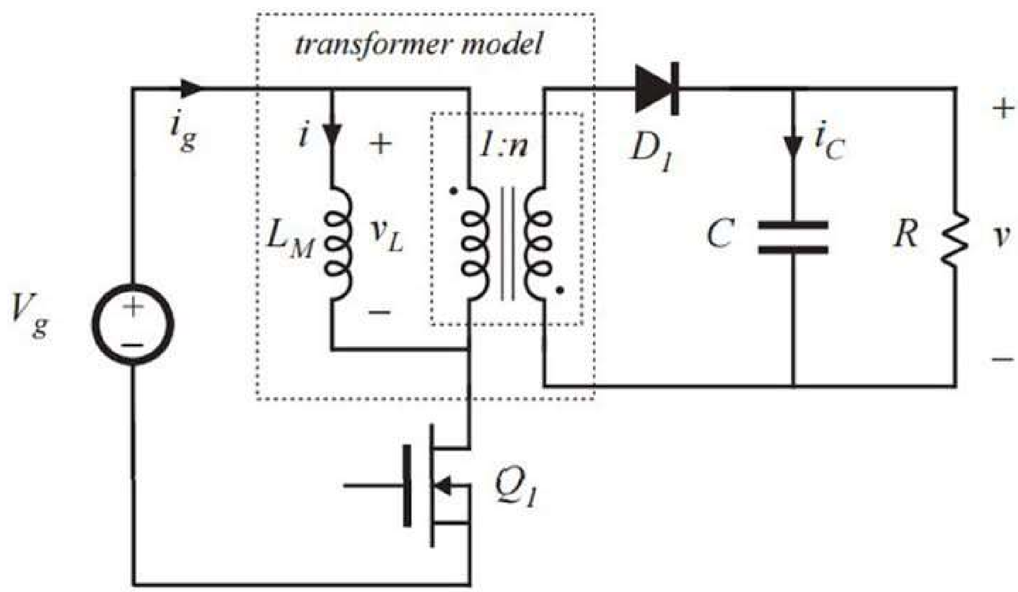
Design and simulate a 100W Flyback converter for EV battery Charging.
Input: 48V output 5V
Choose the appropriate transform/inductor turn ratio, magnetizing inductance, switching frequency, etc. Topology: Conventional flyback Design a single loop control with appropriate SSE, Settling time, and PM.
Show a step response in simulation and verify the setting time.
From the digiky.in or mouser.in find the appropriate switching devices (Ex.MOSFET and Diode)



$V_g = 48V$, $V = 5V$, $P = 100W$, $f = 50KHz$

$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} = \frac{5^2}{100} = 0.25\Omega$

taking $\frac{N_1}{N_2} = 6$

$\Rightarrow V_0 = V_g \frac{D}{1-D} \frac{N_1}{N_2}$

$\boxed{D = 0.384}$

$\Rightarrow P_0 = P_{in}$

$\frac{V_0^2}{R} = V_g I_g$ $\quad$ $[I_g = D I_m]$

$I_m = \frac{P}{DV_g} = \frac{100}{0.384 \times 48} = 5.42A$

taking $\Delta I_L = 5\%$

$\Rightarrow \Delta I_{Lm} = \frac{V_s D}{L_m f}$

$\Rightarrow 0.05 \times 5.42 = \frac{48 \times 0.384}{L_m \times 50 \times 10^3}$

$\boxed{L_m = 1.36\ mH}$

$\Rightarrow \frac{\Delta V}{V} = \frac{D}{RCf}$

$0.01 = \frac{0.384}{0.25 \times C \times 50 \times 10^3}$

$\boxed{C = 3.072mF}$

$$G_c = \frac{n\left(v_g + \frac{V}{n}\right)\left[1 - \frac{SLI}{D'\left(v_g + \frac{V}{n}\right)}\right]}{\frac{n^2LC}{D'^2}s^2 + \frac{D^2LS}{RD'^2} + 1}$$

$$= \frac{21.108\left[1 - \frac{s}{6518.35}\right]}{3.058\times10^{-7}s^2 + 3.9823\times10^{-4}s + 1}$$

$$= \frac{G_o\left[1 - \frac{s}{\omega_z}\right]}{\left(\frac{s}{\omega_o}\right)^2 + \left(\frac{s}{Q\omega_o}\right) + 1}$$

By comparision

$G_o = 21.108$, $\omega_z = 651835$ rad/s

$\omega_o = 1808.22$ rad/s , $Q = 1.388$

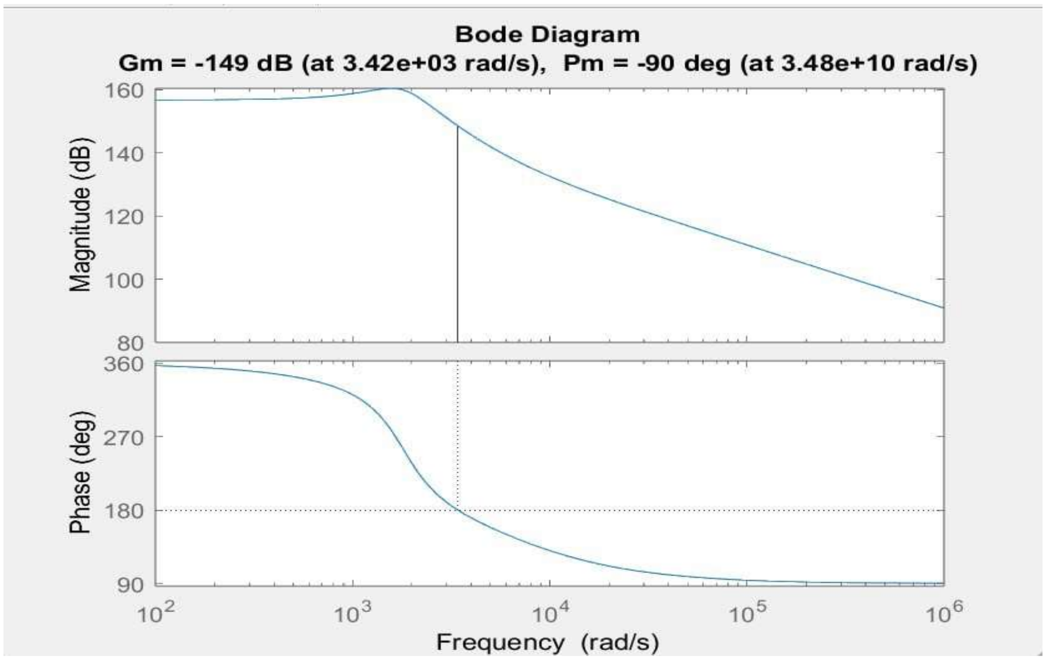
System has Right hand zero that contributing -ve angle at ω_c

So our PM is -ve and system is unstable. to make PM +ve we add a pole at ω_p i.e at 1 decade before RH zero.

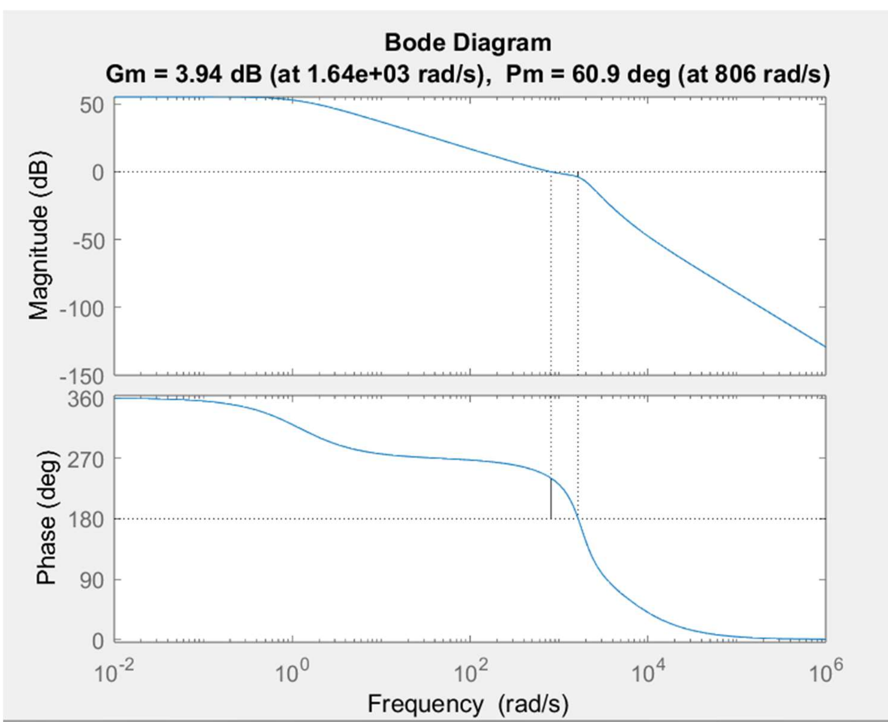
$$H(s) = \frac{30}{1 + 0.833s}$$

$$\text{So } G(s)H(s) = \frac{633.24\left[1 - \frac{s}{6518.35}\right]}{0.833s^3 + 1087s^2 + 2.701\times10^6 s + 3.27\times10^6}$$

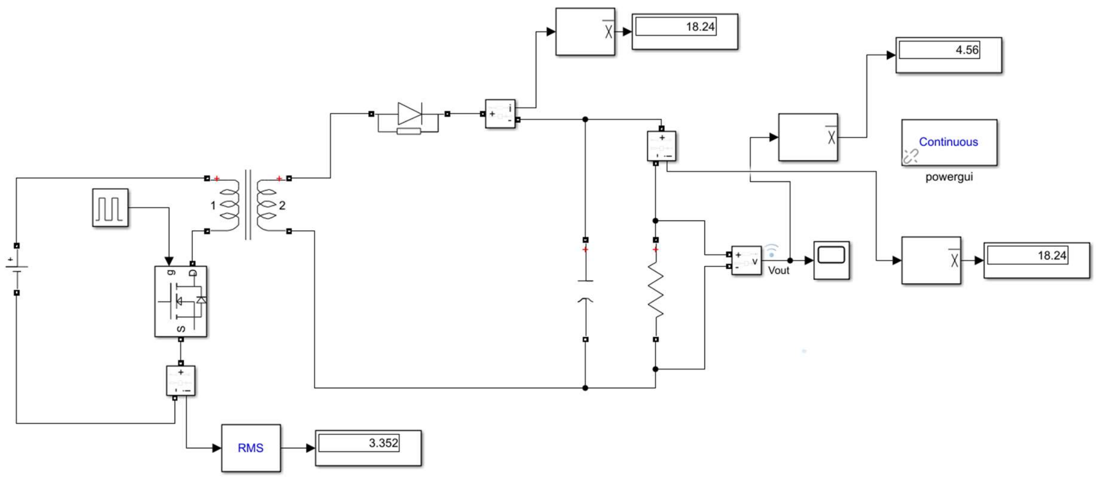
- **Bode plot of uncompensated system**



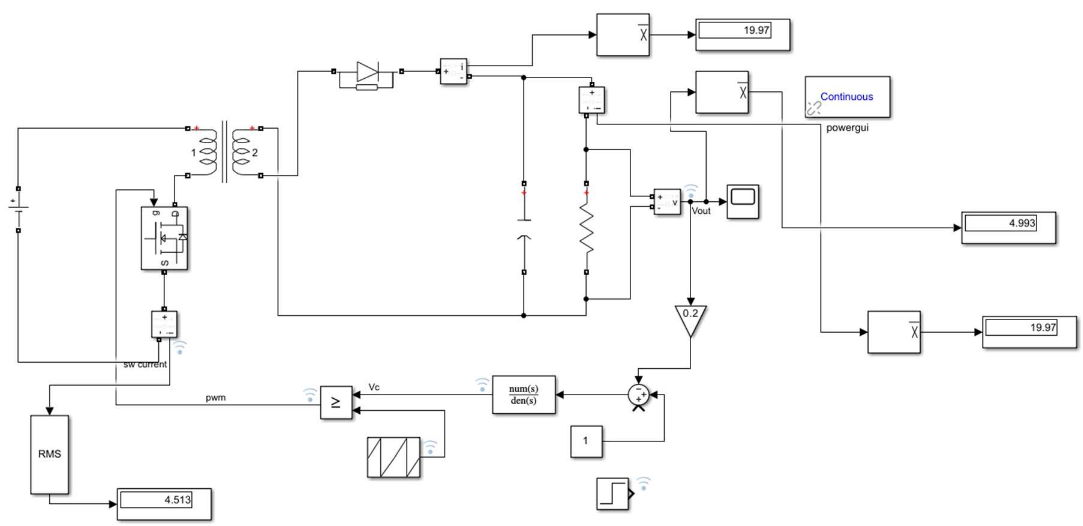
- **Bode plot of compensated system**



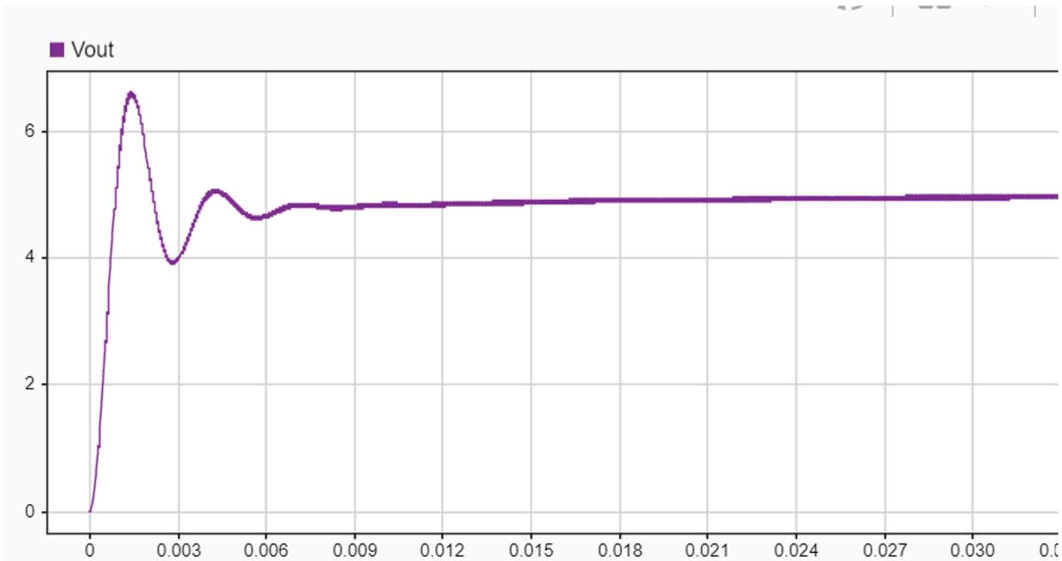
- **Uncompensated circuit**



- **Compensated circuit**



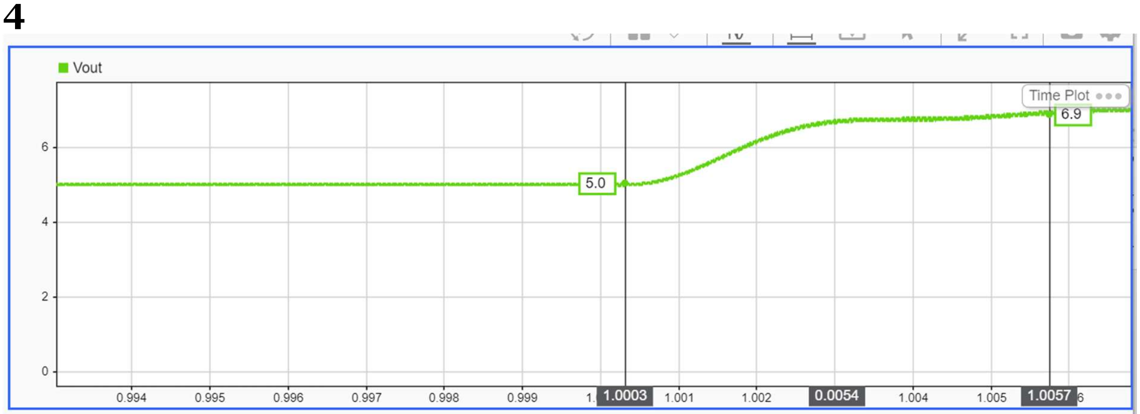
- **Output voltage waveform**



Vo=4.993

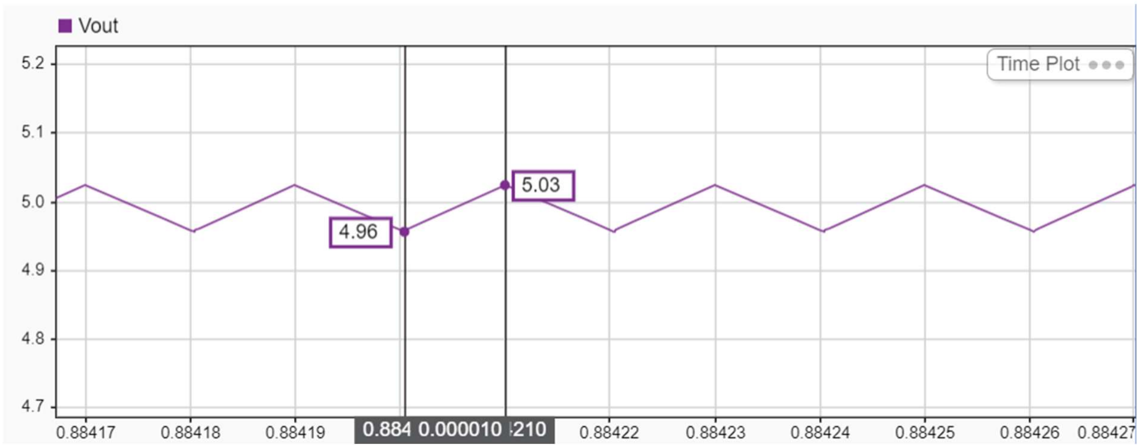
- **Settling time**

4



Ts= 5.4 msec (approx.)

- **Steady state error**



Ess=0.07 V i.e 1.4 %

- **SWITCH SELECTION**

1.MOSFET SELECTION

Vds=[vg+(Vo+vd)*(Np/Ns)]*2

Safety factor =2

Vds= 165 V
Irms= 5*2=10 A

For the flyback converter presented, the required minimum voltage rating of the MOSFET calculates to be 160V. An IXFH150N17T2 N-channel power MOSFET is chosen.

2. Diode selection

Vd= (Vo+Vg*(Np/Ns))*2=26 V
Id= 20*2=40 A

Schottky for a specific application depends mainly on the working peak reverse voltage rating, the average forward current rating of the device.
An VS-42CTQ030-M3 Schottky diode is chosen

- **Results**

1. **Uncompensated system**

   Vo=4.56 V
   Wgc=3.48e10 rad/sec
   PM= -90 deg
   GM= -149 db
   unstable system

2. **Compensated system**
   Vo=4.996 V
   Wgc=806 rad/sec
   Ts= 5 msec (theoretical)
   Ts= 5.4 sec (simulation)
   PM= 60.9 deg
   Gm 3.94 db

   Stable system