

# Unit 9 - Week 7

## Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

- Type-III Compensator using Gm-C Architecture
- Feed-Forward Line Compensation, Loop Gain Compensation by Modulating Gm
- Designing a Buck Converter, Power Loss Budgeting
- Sizing Power MOSFETs
- Estimating Switching Losses and Choosing the Switching Frequency
- Choosing Inductance and Capacitance Values
- Choosing 'C' Depending on Factors that Limit the Load Transient Response
- Inductor and Capacitor Characteristics, Reducing the Effect of Capacitor ESL

Quiz : Assignment 7

Week 7 Feedback

Week 8

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Assignment solutions

## Assignment 7

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2020-03-18, 23:59 IST.

Consider the non-synchronous buck converter shown in Figure 1, for questions 1 to 8. It needs to be designed for the following specifications.  
 $V_{IN} = 1.8\text{ V}$ ,  $V_O = 1.2\text{ V}$ ,  $V_{REF} = 0.6\text{ V}$ ,  $L = 2.2\text{ }\mu\text{H}$ ,  $C_O = 22\text{ }\mu\text{F}$ , switching frequency  $F_{SW} = 1\text{ MHz}$  and  $I_{LOAD}$  varies from  $0.1\text{ A}$  to  $1\text{ A}$ . Assume that the  $R_{DS\_ON}$  of the PMOS switch  $M_P$  is  $0.1\text{ }\Omega$ , forward voltage of the diode  $D_N$  is  $V_F = 0.1\text{ V}$  and ramp amplitude  $V_M = 0.9\text{ V}$ .

Adhere to the units mentioned in the question while filling in numerical answers. The duty cycle  $D$  always lies between 0 and 1.

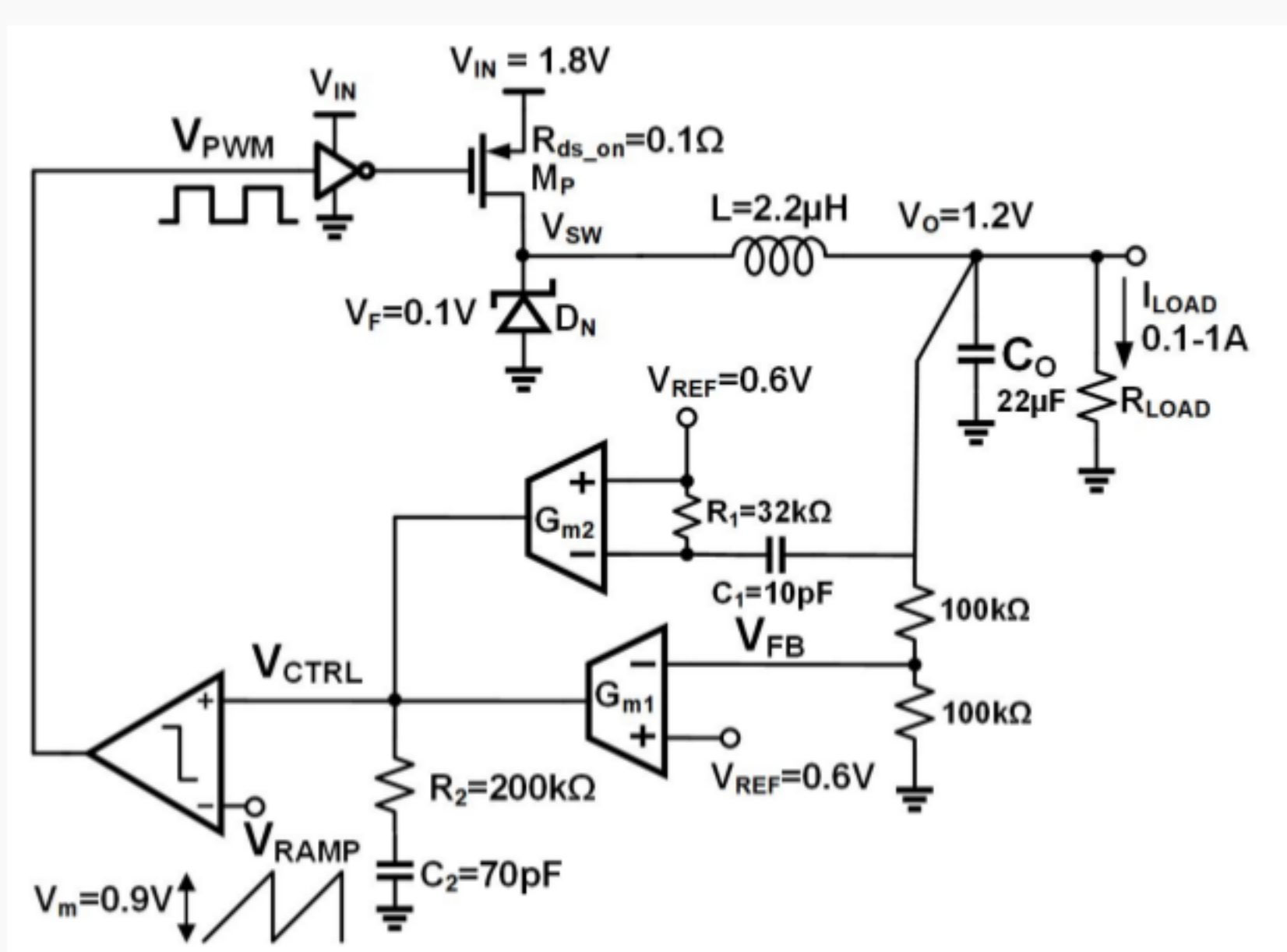


Figure 1

1) Fill in the blank with a numerical answer: The duty cycle of  $V_{PWM}$  (in respect of the circuit shown in Figure 1) at heavy load (i.e. when  $I_{LOAD} = 1\text{ A}$ ) is  $D = \underline{\hspace{2cm}}$  (up to 2 decimal places).

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 0.67,0.78

1 point

2) Fill in the blank with a numerical answer: The control voltage  $V_{CTRL}$  (in respect of the circuit shown in Figure 1) corresponding to the duty cycle of  $V_{PWM}$  found in question 1 is  $\underline{\hspace{2cm}}$  volt (up to 2 decimal places).

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 0.6,0.7

1 point

3) Fill in the blank with a numerical answer: The number of poles in the loop gain transfer function of the non-synchronous buck converter (shown in Figure 1) is  $\underline{\hspace{2cm}}$ .

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Numeric) 4

2 points

4) Fill in the blank with a numerical answer: The number of zeros in the loop gain transfer function of the non-synchronous buck converter (shown in Figure 1) is  $\underline{\hspace{2cm}}$ .

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Numeric) 2

1 point

5) Fill in the blank with a numerical answer: The value of the ratio  $G_{m2}/G_{m1}$  that is required to achieve a unity loop gain frequency  $F_{UGB}$  of  $100\text{ kHz}$  and a minimum phase margin of  $60$  degrees over the entire range of the load current  $I_{LOAD}$  is  $\underline{\hspace{2cm}}$  (up to 1 decimal place).

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 7,12

2 points

6) Fill in the blank with a numerical answer: The value of the transconductance  $G_{m1}$  that is required to achieve a unity loop gain frequency  $F_{UGB}$  of  $100\text{ kHz}$  and a minimum phase margin of  $60$  degrees over the entire range of the load current  $I_{LOAD}$  is  $\underline{\hspace{2cm}}$   $\mu\text{S}$  (up to 2 decimal places).

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 19,30

2 points

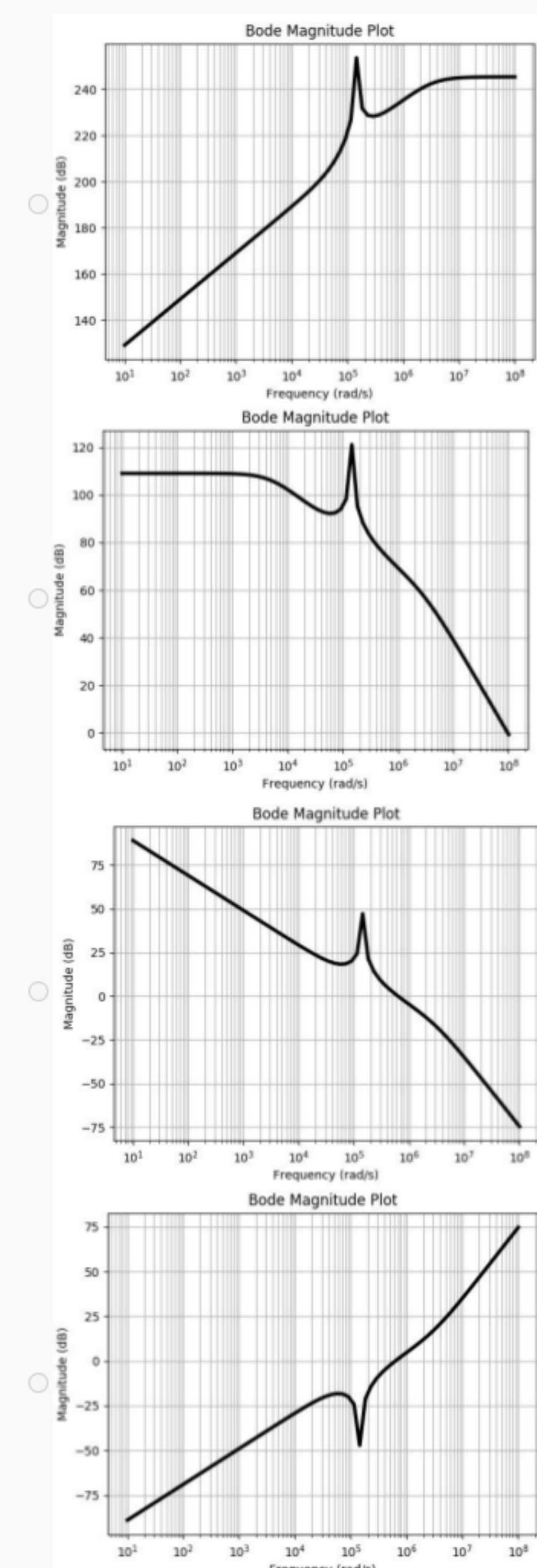
7) Fill in the blank with a numerical answer: The value of the transconductance  $G_{m2}$  that is required to achieve a unity loop gain frequency  $F_{UGB}$  of  $100\text{ kHz}$  and a minimum phase margin of  $60$  degrees over the entire range of the load current  $I_{LOAD}$  is  $\underline{\hspace{2cm}}$   $\mu\text{S}$  (up to 2 decimal places).

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
(Type: Range) 200,250

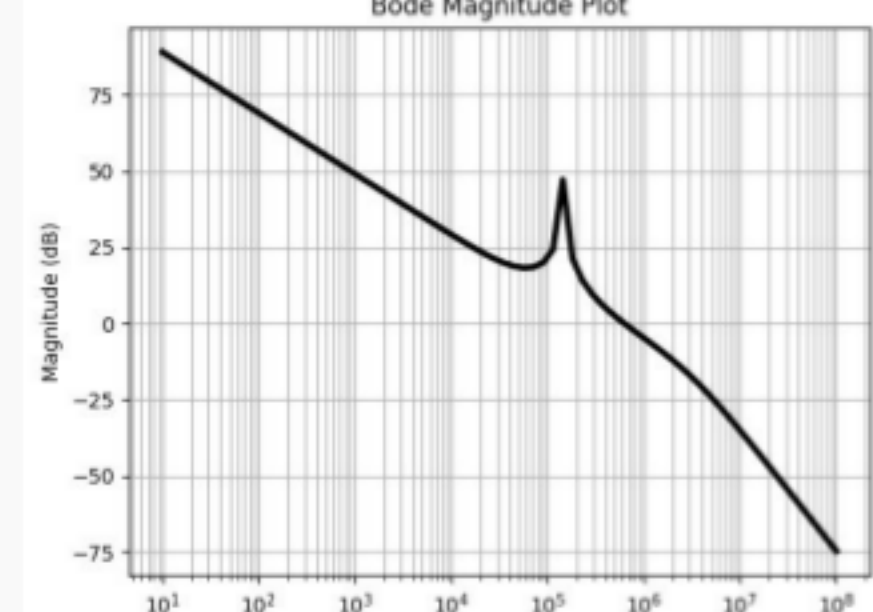
1 point

8) Identify the Bode magnitude plot of the loop gain transfer function (in respect of the non-synchronous buck converter shown in Figure 1 operating in CCM) amongst the choices provided below.



No, the answer is incorrect.  
Score: 0

Accepted Answers:



1 point