

Exercise#3**Basic DC-DC Converters**

1. For a buck converter derive an expression for V_o/V_g , Δ_{iL} , Δv_o , $I_{o, \min}$, L_{\min} , f_{\min} in a CCM in terms of the circuit parameters.
2. For a boost converter derive an expression for V_o/V_g , Δ_{iL} , Δv_o , $I_{o, \min}$, L_{\min} , f_{\min} in a CCM in terms of the circuit parameters.
3. For a buck-boost converter derive an expression for V_o/V_g , Δ_{iL} , Δv_o , $I_{o, \min}$, L_{\min} , f_{\min} in a CCM in terms of the circuit parameters.
4. The buck converter has the following circuit parameters:

$$\begin{aligned} V_g &= 12 \\ D &= 0.4 \\ R &= 2 \\ L &= 100 \mu\text{H} \\ C &= 200 \mu\text{H} \\ f &= 100 \text{ kHz} \end{aligned}$$

- a) Find (i) V_o , (ii) Δ_{iL} , (iii) I_L , (iv) I_D , (v) I_S , (vi) I_g , (vii) I_o , (viii) $i_{L, \min}$, (ix) $i_{L, \max}$ (x) $i_{D, \max}$, (xi) $i_{S, \max}$ (xii) $i_{c, \max}$ (xiii) Δv_o . Sketch key waveforms and label key quantities.
 - b) If the other parameters are kept unchanged, find the required: (i) $I_{o, \min}$, (ii) L_{\min} , (iii) f_{\min} to keep the converter operation in a CCM.
5. The boost converter has the following circuit parameters:

$$\begin{aligned} V_g &= 12 \\ D &= 18 \\ R &= 6 \\ L &= 100 \mu\text{H} \\ C &= 200 \mu\text{H} \\ f &= 100 \text{ kHz} \end{aligned}$$

- a) Find (i) V_o , (ii) Δ_{iL} , (iii) I_L , (iv) I_D , (v) I_S , (vi) I_g , (vii) I_o , (viii) $i_{L, \min}$, (ix) $i_{L, \max}$ (x) $i_{D, \max}$, (xi) $i_{S, \max}$ (xii) $i_{c, \max}$ (xiii) Δv_o . Sketch key waveforms and label key quantities.
 - b) If the other parameters are kept unchanged, find the required: (i) $I_{o, \min}$, (ii) L_{\min} , (iii) f_{\min} to keep the converter operation in a CCM.
6. The buck-boost converter has the following circuit parameters:

$$\begin{aligned} V_g &= 12 \\ V_o &= 18 \\ R &= 3 \\ L &= 100 \mu\text{H} \\ C &= 200 \mu\text{H} \\ f &= 100 \text{ kHz} \end{aligned}$$

- a) Find (i) D , (ii) Δ_{iL} , (iii) I_L , (iv) I_D , (v) I_S , (vi) I_g , (vii) I_o , (viii) $i_{L, \min}$, (ix) $i_{L, \max}$ (x) $i_{D, \max}$, (xi) $i_{S, \max}$ (xii) $i_{c, \max}$ (xiii) Δv_o . Sketch key waveforms and label key quantities.
- b) If the other parameters are kept unchanged, find the required: (i) $I_{o, \min}$, (ii) L_{\min} , (iii) f_{\min} to keep the converter operation in a CCM.