

## HW #6

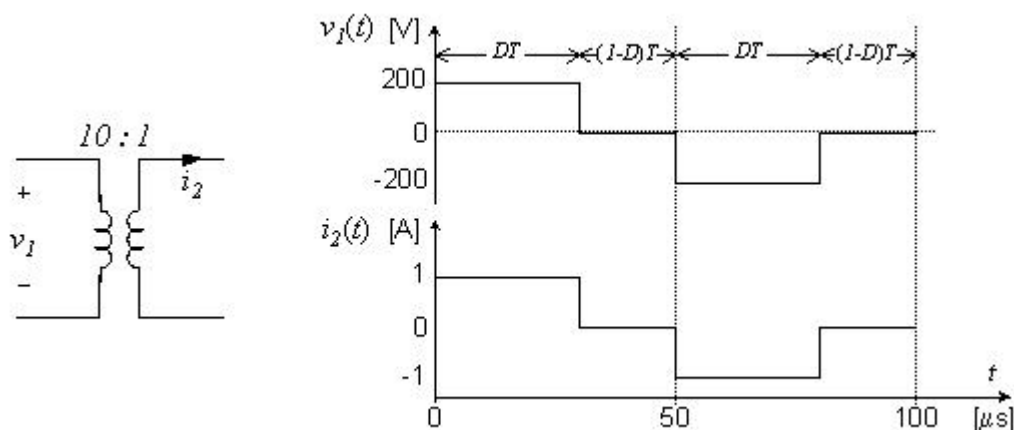
### PROBLEM 1: (Modified textbook Prob. 13.1)

A simple buck converter operates in CCM with a 50 kHz switching frequency and a dc input voltage of  $V_g = 40$  V. The output voltage is  $V = 20$  V. The load resistance is  $R > 4 \Omega$ .

- Determine the value of the output filter inductance  $L$  such that the peak-to-average inductor current ripple  $\Delta i$  is 10% of the dc component  $I$ .
- Determine the peak steady state inductor current  $I_{max}$ .
- Design the inductor which has the values of  $L$  and  $I_{max}$  from parts (a) and (b). Use ferrite EE core, with  $B_m = 0.25$  T. Assume the maximum allowed current density in the winding wires as  $J_m = 150$  A/cm<sup>2</sup>. Specify: core size, gap length, wire size, number of turns and the winding dc resistance.
- Sketch (by hand but to 2:1 scale) the cross section of the inductor showing the gap and the winding structure.

### PROBLEM 2:

An isolated buck converter uses half-bridge configuration on the primary and full-bridge rectifier on secondary. The transformer turns ratio is 10:1, the primary voltage and the secondary current in steady state have the forms shown in the figure below, and the duty cycle is  $D = 0.75$ .



- Design the transformer for this converter. Use a ferrite core with  $B_m = 0.25$  T, assume the maximum current density in the winding of  $J_m = 150$  A/cm<sup>2</sup>, and neglect the magnetizing current. Specify: core size, numbers of primary and secondary turns, wire sizes for primary and secondary.
- Find the magnetizing inductance assuming that the core relative permeability is  $\mu_r = 1,500$ . Sketch the magnetizing current waveform and find its peak value.
- Sketch (by hand but to 2:1 scale) the cross section of the transformer showing the winding structure.