(2 Points)

Problem 9 (a) In a Flyback converter operating in steady state, the input voltage, $V_{\text{in}} = 48$ V, duty-ratio, $D = 0.385$, turns ratio, $N_1/N_2 = 6$, the magnetizing inductance, $L_{\text{m1}} = 150$ μH, and the switching frequency, $f = 200$ kHz. Neglect the leakage inductances and assume this converter to be lossless. Assume the output voltage to be ripple-free.

(i) This converter is operating at the output power at which the flux in the core is at the border of incomplete-demagnetization and the complete-demagnetization modes (similar to the border of continuous and the discontinuous current-conduction modes in non-isolated dc-dc converters).

(a) Compute the output voltage, V_{o}.

(b) Calculate and draw the waveforms of the input current, and the current supplied to the output stage consisting of the parallel combination of the output capacitor and the load-resistance.

(c) Calculate the output power, P_{o}.

(ii) If this converter is operating at one-half the power calculated in part (i), calculate the following:

(a) Calculate the output voltage, V_{o}.

(b) Calculate and draw the waveforms of the input current, and the current supplied to the output stage consisting of the parallel combination of the output capacitor and the load-resistance.

(2 Points)

Problem 9 (b) Suppose an industrial plant is served from a three-phase 208 V (RMS line-line) transformer. The real power demand of the plant is 80 kW at a power factor of 0.5 (lag).

(i) Find the apparent power and RMS line current magnitude.

(ii) Suppose the power factor is corrected to 0.9 (lag) with capacitor banks. Find the new apparent power and RMS line current magnitude.

(iii) Suppose the line losses before power factor correction were 4 kW. What are the line losses after power factor correction?