

PART ONE

SECTION ONE

Topology 1-15

- 1) Sketch a well labeled circuit diagram of the chopper topology and using equivalent circuits discuss its mode of operation. Analyze the converter for expressions of transfer function $M(\alpha) = V_o/V_{in}$ and inductor current I_L .
- 2) Design inductor L and capacitor C for the ripple requirement.
- 3) Determine the rated values for switch, diode and capacitor. Research and determine a manufacturer part number for your switch, diode and capacitor. Provide data sheets for each.
- 4) Analytically determine and draw the expected current and voltage waveforms for each component in your circuit at both light and heavy load.
- 5) Analytically determine the effect of the following non idealities on each of the waveforms
 - i) The diode has an on-state voltage drop of V_{Don} .
 - ii) The transistor switch has an on-state voltage drop of V_{Ton} .
 - iii) Derive an expression for the efficiency considering the non-idealities.
- 6) Taking values of $V_{Don}=0.5\text{ V}$ and $V_{Ton}=0.9\text{ V}$, compute the efficiency of your circuit both at heavy load and at light load conditions.

Topology 16-17

In addition to 1) up to 6) above,

- 7) Determine the transformer turns ratio for topology 17
- 8) Determine the wire diameter for each winding based on the rms current of the output
- 9) Design the RCD snubber for the primary section only

SECTION TWO

All topologies

- 1) Using SimPowerSystems toolbox of MATLAB/SIMULINK software, simulate the ideal circuit under heavy and light load conditions.
- 2) Plot the voltage and current waveform of each component over 3 switching intervals in the steady state. Validate that the output of your simulation matches your analytical calculations in section one above.
- 3) Edit your simulation model created in 1) above to include the non-idealities in section one 5) above.
- 4) Measure the efficiency of your circuit versus load and compare with what you calculated in section one 6).

Note:

Write a report that documents and describes your results and observations for both sections. Make sure all plots are well labeled and that explanations contain solid analytical foundations.