

Minor 1: ELL 751 *Power Electronic Converters*

Date: 26th August 2019, Time: 5:15 PM to 6:45 PM

Answer all questions, total marks - 20

1. Electricity from solar panel is the sole source of energy in space. In a mission critical satellite application, it is required to design a power supply which can convert power generated from the solar panels of the satellite to a usable form. The converter specifications are as follows:
- Input voltage V_{in} : 42 V to 48 V, input power: 5 W to 50 W.
 - Output voltage V_o : 2.2 V (held constant by closed loop control action).
 - Maximum peak to peak inductor current ripple: 50% of average inductor current.
 - Maximum peak to peak capacitor voltage ripple: 0.05% of its average value.
 - Switching frequency f_{sw} =250 kHz.

For this application, there is no constraint on the cost of the converter rather improving performance of the converter is important.

- Choose a suitable converter for this application and justify your selection? (2)
- For the chosen converter, what are the values of inductor(s) and capacitor(s)? (4)
- In the inventory, 200 V, 90 A MOSFET with $R_{DS(on)}$ =10 m Ω and 200 V, 50 A diode with V_d =1.3 V are available in large quantity. What devices would you choose for designing your converter? (2)
- Draw the inductor current(s), output capacitor current, and output capacitor voltage ripple along with the duty cycle for V_{in} = 42 V, P_{out} =50 W. (3)
- For your design, express the converter efficiency in terms of circuit parameters (i.e., V_{in} , D , $R_{DS(on)}$, V_d , etc.). What is the efficiency at V_{in} = 48 V, P_{out} =10 W, 20 W, and 50 W? (For efficiency calculation, you may consider the inductor current to be ripple free) (6+3)