IQRA NATIONAL UNIVERSITY

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Attributes Coverage																	
PLOs												EA1	EA2	EA3	EA4	EA5
1	2	3	4	5	6	7	8	9	10	11	12					

The Term Project is of 20 marks and will count as 20% weightage of your whole grade.

Proposal is of 5 marks (5% of total weightage)

Final Report is of 15 marks (15% of total weightage)

Task: To write a report on the complete analysis of a Power Electronics Application.

Due Date: End of semester.

Final Report

Problem Description

1. Select any one switching device from the following list and state its characteristics
   a. Power diode
   b. Thyristors (SCR)
   c. Bipolar -Junction Transistor (BJT)
   d. Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET)
   e. Insulated-Gate Bipolar Transistor (IGBT)

2. What are the merits and demerits of your selected switching device as compared to the others?

Ans) Merits of BJT :

- They have a better voltage gain
- They have a high current density
- They have a low forward voltage
- It can be operated in low to high power application
- BJT has a large gain bandwidth
- BJT shows better performance at high frequency

Demerits of BJT :
- BJT has a low thermal stability
- BJT is most effective by radiation
- BJT has more noise produced
- BJT has a low switching frequency
- BJT has a very complex control
- The switching time is not very fast compared to a high alternating frequency of current and voltage

2. Select one power electronics circuit (rectifier, invertor, DC converter) in which your selected switch is used.
   ANS)

DC converter

4. Explain the working of the circuit, what is the purpose of the switch in this circuit and what are the jobs of the other components used in the circuit
   ANS)

Operation

The key principle that drives the boost converter is the tendency of an inductor to resist changes in current by creating and destroying a magnetic field. In a boost converter, the output voltage is always higher than the input voltage. A schematic of a boost power stage is shown in Figure 1.
(a) When the switch is closed, current flows through the inductor in the clockwise direction and the inductor stores some energy by generating a magnetic field. Polarity of the left side of the inductor is positive.
(b) When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously created will be destroyed to maintain the current towards the load. Thus the polarity will be reversed (meaning the left side of the inductor will become negative). As a result,

two sources will be in series causing a higher voltage to charge the capacitor through the diode D.

If the switch is cycled fast enough, the inductor will not discharge fully in between charging stages, and the load will always see a voltage greater than that of the input source alone when the switch is opened. Also while the switch is opened, the capacitor in parallel with the load is charged to this combined voltage. When the switch is then closed and the right hand side is shorted out from the left hand side, the capacitor is therefore able to provide the voltage and energy to the load. During this time, the blocking diode prevents the capacitor from discharging through the switch. The switch must of course be opened again fast enough to prevent the capacitor from discharging too much.
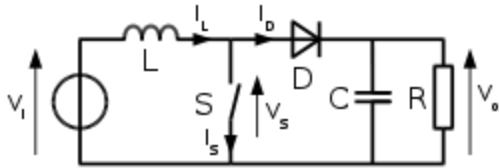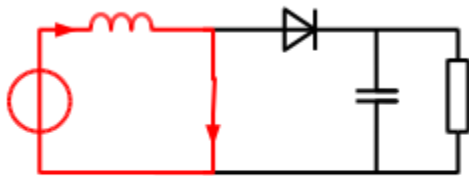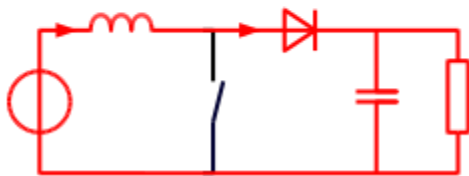
Fig. 1: Boost converter schematic

On-State

Off-State

Fig. 2: The two current paths of a boost converter, depending on the state of the switch S.

The basic principle of a Boost converter consists of 2 distinct states (see figure 2):

in the On-state, the switch S (see figure 1) is closed, resulting in an increase in the inductor current;

in the Off-state, the switch is open and the only path offered to inductor current is through the flyback diode D, the capacitor C and the load R. This results in transferring the energy accumulated during the On-state into the capacitor.

The input current is the same as the inductor current as can be seen in figure 2. So it is not discontinuous as in the buck converter and the requirements on the input filter are relaxed compared to a buck converter.
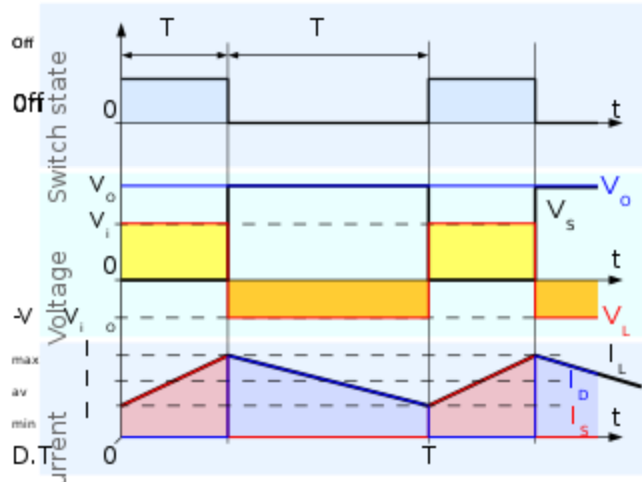
Continuous mode

Fig. 3: Waveforms of inductor current and voltage in a boost converter operating in continuous mode.

When a boost converter operates in continuous mode, the current through the inductor (   ) never falls to zero. Figure 3 shows the typical waveforms of inductor current and voltage in a converter operating in this mode.

In the steady state, the DC (average) voltage across the inductor must be zero so that after each cycle the inductor returns the same state, because voltage across the inductor is proportional to rate of change of current through it (explained in more detail below). Note in Figure 1 that the left hand side of L is at and the right hand side of L sees the voltage waveform from Figure 3. The average value of is where D is the duty cycle of the waveform driving the switch.

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5. Select one application of your selected circuit. Explain the application in detail and the purpose/working of your selected circuit in the application.

6. Design the complete circuit of your selected application.

   ## **Circuit of the selected application**
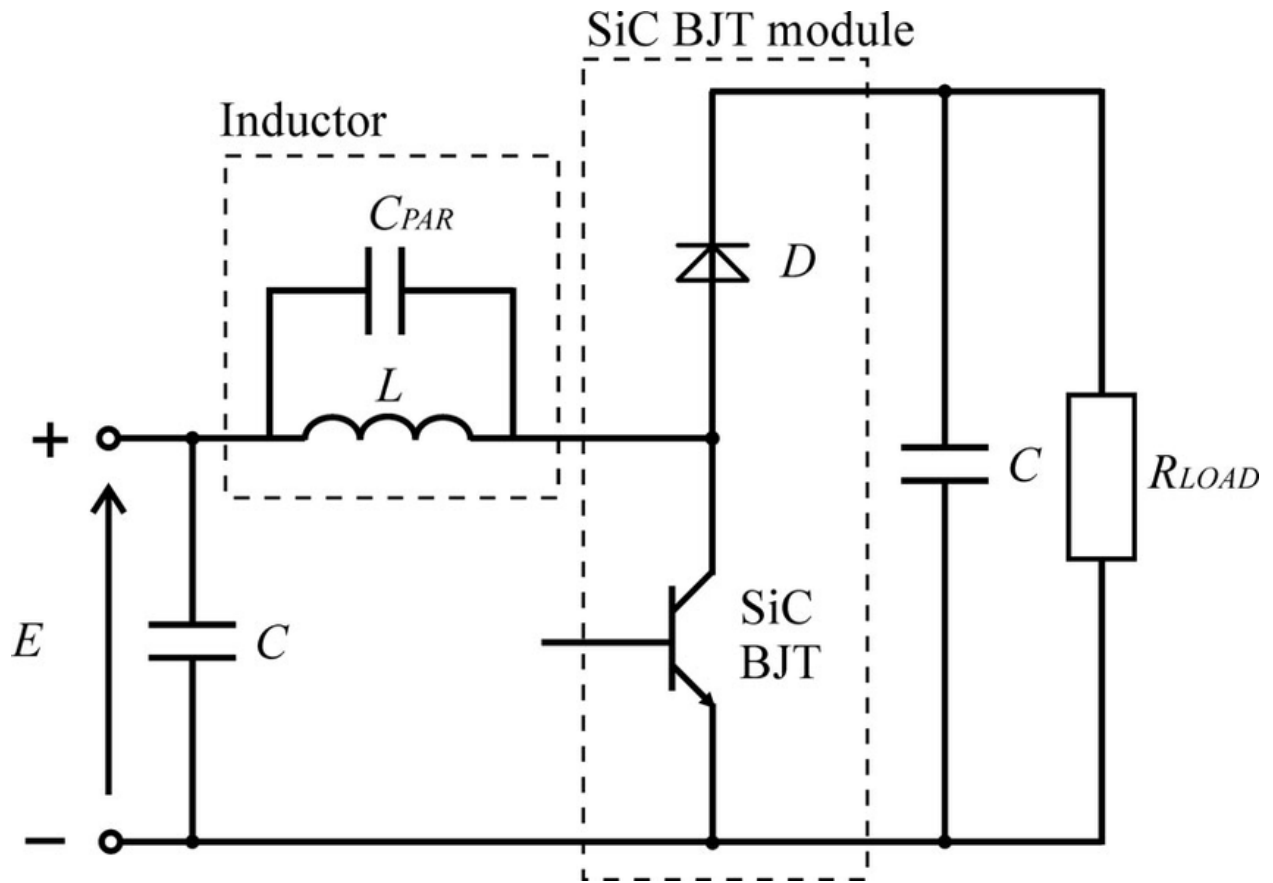
7. What are the parameters of your circuit (input and output power, current and voltage)

Ans.)

- Inductor
- Capacitor
- Sic bjt
- resistor
- diode

8. State the equations used for deriving the values of the components. Mathematically derive each value of your component.

Explain in q 4

9. Using Multisim or Matlab simulate your circuit. Show and explain the results of your simulation.

<u>**Simulation on software**</u>

<u>**Online circuit lab**</u>

10. Write your conclusion about the project.

DC-DC boost converters are switched periodically in order to maintain the output voltage constant with lower ripple content at the output. DC-DC boost converters are the best choice for renewable energy applications; since it steps up the varying input voltage to the required level.

Templet

1. All text should be in Times New Roman font.
2. Headings should be **bold** and in **14** size.
3. Sub-heading should be **bold** in **12** size.
4. Rest of the text should be normal in 12 size.
5. Labelling of figures and tables should be *Italic* in *11* size.
6. Use proper referencing.

Do not write the complete questions. Only give its designated number and main heading

Do not copy paste the figures, tables and graphs. Redraw the figures. Remake the table and graphs from the data available in the papers.

Plagiarism should not be more than **20%. You have to submit plagiarism report with the task**.

Engr. Shayan Tariq Jan
Course Instructor