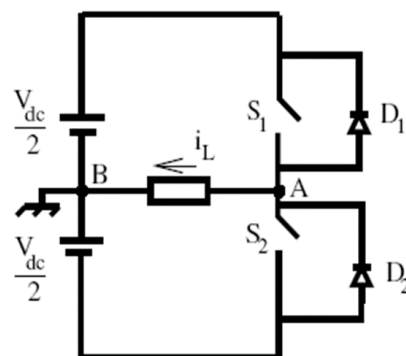
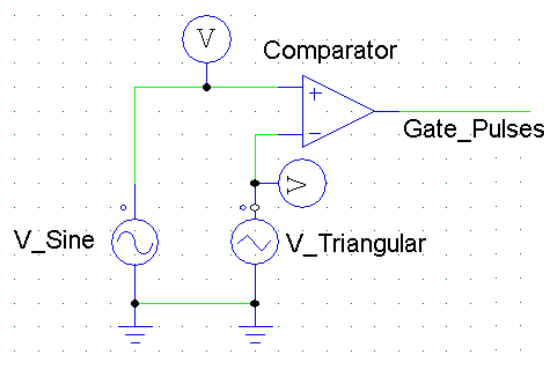
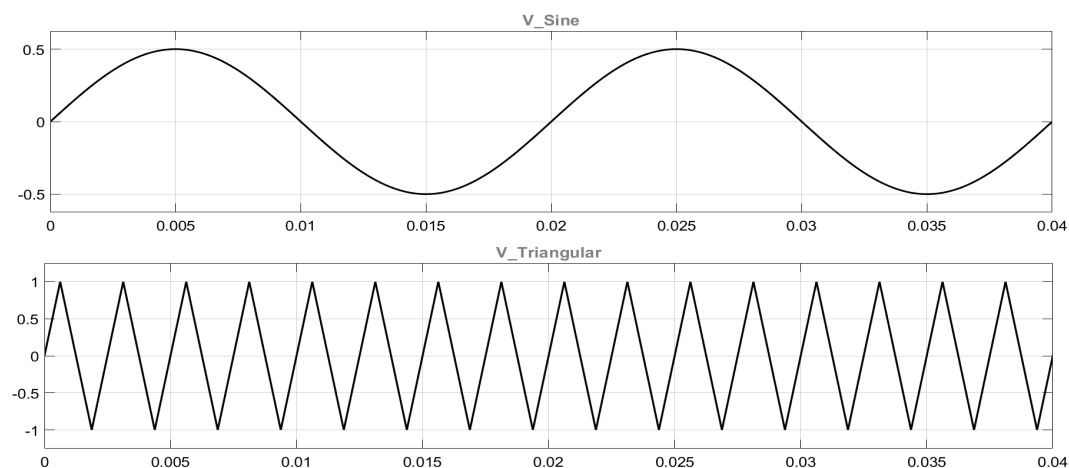
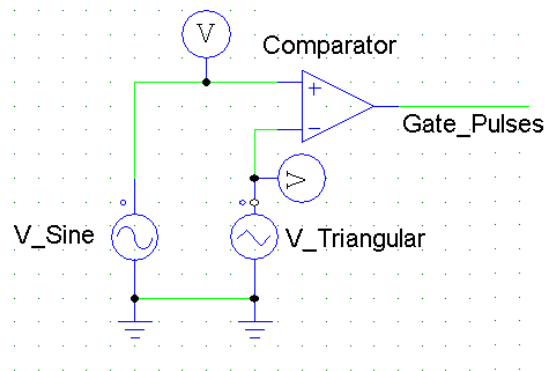


EE113 Tutorial 2: Energy Systems

1. A Buck converter is operating with input voltage 30 V and output voltage 12 V. A $2.4\ \Omega$ resistor is connected across the output terminals. The inductor value is $360\ \mu\text{H}$ and switching frequency is 10 kHz also assume the output voltage to be constant and circuit has reached steady state.
 - a. Calculate the required Duty Cycle.
 - b. Draw the inductor current waveform.(mark the relevant points on the waveform)
 - c. Now assume that the load resistor is replaced with another resistor of value $12\ \Omega$. Draw the inductor current waveform for this case. (mark the relevant points on the waveform)
 - d. If we further increase the load resistance beyond $12\ \Omega$, comment what would happen.
2. A Boost converter is operating with input voltage 12 V and output voltage 24 V. A $12\ \Omega$ resistor is connected across the output terminals. The inductor value is $300\ \mu\text{H}$ and switching frequency is 10 kHz also assume the output voltage to be constant and circuit has reached steady state.
 - a. Calculate the required Duty Cycle.
 - b. Draw the inductor current waveform.(mark the relevant points on the waveform)
 - c. Now assume that the load resistor is replaced with another resistor of value $48\ \Omega$. Draw the inductor current waveform for this case. (mark the relevant points on the waveform)
 - d. If we further increase the load resistance beyond $48\ \Omega$, comment what would happen.
3. Draw the output V_{AB} for the given circuit, which is shown below, given the wave forms of V_{Sine} and $V_{\text{Triangular}}$ are as follows. Given that $V_{\text{dc}}=200\text{V}$ and Gate_Pulses signal is given to S_1 . (mark the relevant points on the waveform)



4. A single-phase induction motor is being fed by an inverter which is implementing V/F control. Assuming the motor runs at its rated speed when the reference sine wave has an amplitude of 0.9 and frequency 50Hz. Draw the output waveform of the inverter when the motor is running at half its rated speed. Assume the V_Triangular signal has the amplitude of 1 and frequency of 500Hz.(mark the relevant points on the waveform)



5. A Boost converter is operating with input voltage of 10 V and output voltage of 20 V. The value of the inductor is $500\ \mu\text{H}$ and switching frequency is 10 kHz. A 10 ohm resistor is connected across the output terminals. Assume that the output voltage is constant.
- Determine the average current through the inductor, and peak-to-peak value of the inductor current.
 - For what value of load resistance, does the minimum value of inductor current becomes zero (current is just continuous)?
 - If the switching frequency is increased to 50 kHz, what is the peak-to-peak value of the inductor current? What conclusions can you make based on the results as compared to 10 kHz switching frequency?