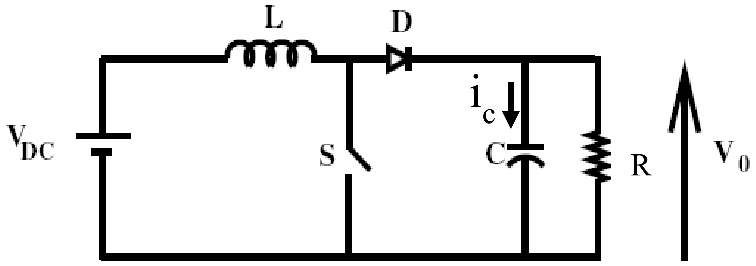
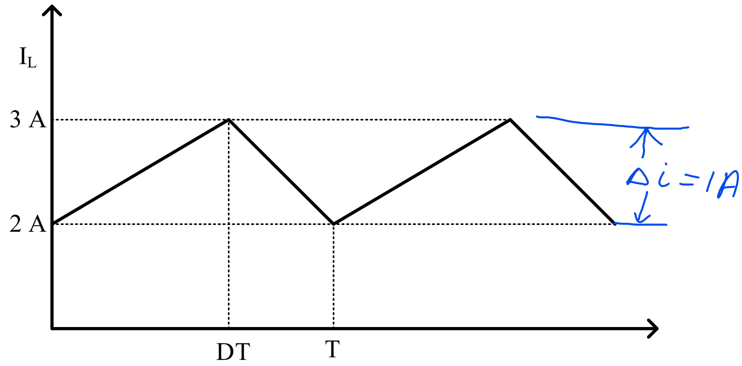
1. For the boost converter shown in figure V_{DC}=30 V V_O=60 V, switching frequency=100 kHz. Assume that V_O is held constant for a-b.



a) $V_o = \frac{V_{in}}{1-D}$

$\Rightarrow D = \frac{V_o - V_{in}}{V_o} = \underline{0.5}$



b) $L\frac{\Delta i}{\Delta t} = V_L$

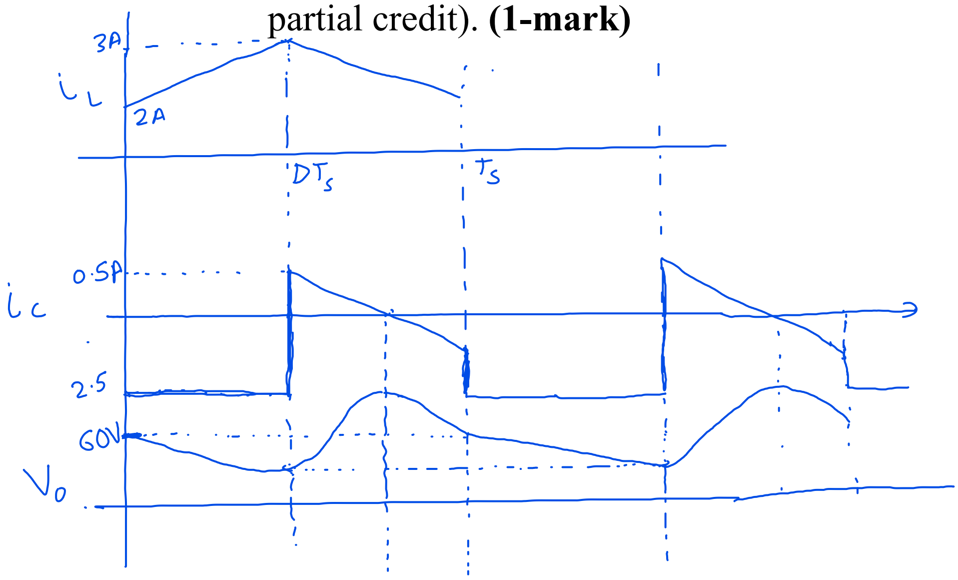
$\Rightarrow V_{in} = L \times \frac{\Delta i}{D T_s}$

$L = \frac{V_{in} D T_s}{\Delta i}$

$= \frac{30 \times 0.5 \times 10^{-5}}{1A}$

$= \underline{150 \mu H}$

a. Duty Cycle. **(0.5-mark)**
b. Value of L in µH. **(0.5-mark)**
c. Sketch the labelled waveform of current flowing through the capacitor assuming that charging current is +ve. (Credit will be given only if the waveform is correct. No partial credit). **(1-mark)**
d. Sketch the variation of V_O assuming that current through RL remains constant Note that nature of variation may not be important. (No partial credit). **(1-mark)**



2. A single phase full bridge VSI is feeding a purely inductive load as shown. Where T_1-T_4 are transistors and D_1-D_4 are feedback diodes. Also note that having turned on each pair of devices is maintained in that state for π radians. The frequency of the voltage applied to the load is 50 Hz.

$f_s = 50\,Hz$

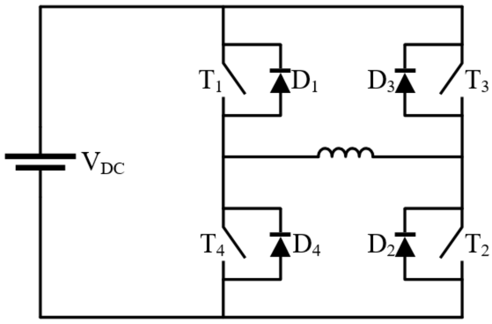
$\therefore T_s = \frac{1}{50} = 20\,msec$

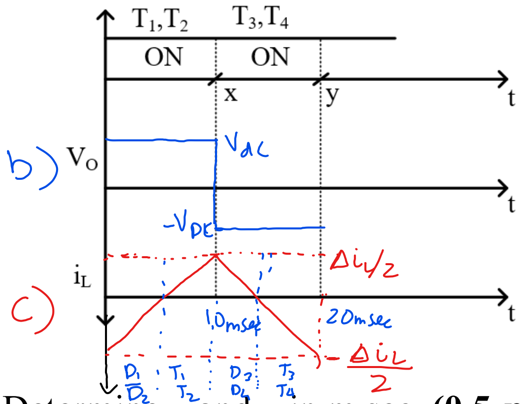
2π rad in one T_s.

$\therefore \pi$ rad is $\frac{T_s}{2} = 10\,msec$

$\therefore x = 10\,msec$

$y = 20\,msec$





$\Delta i_L = \frac{V_{DC} \times \Delta t}{L} = \frac{V_{DC} \times 10 \times 10^{-3}}{L}$

a. Determine x and y in m sec. **(0.5-mark)**

b. Draw the labelled waveform of voltage applied to the load. **(0.5-mark)**

c. Draw the labelled load current waveform, assuming that steady state is achieved and average value of load current is zero. **(1-mark)**

d. Determine the time duration (in m sec) of conduction of transistor T_1 and diode D_1. **(1-mark)**

both T_1 & D_1 will be conducting for 5 msec

$V_o = \frac{50}{1-0.5} = 100V \neq 150V$

∴ converter is operating in DCM

a) $V_{in} = L\frac{\Delta i}{\Delta t} = V_L$

$= L\frac{\Delta i}{D T_s}$

$50 = 10\times10^{-6}\frac{\Delta i}{0.5\times10^{-5}}$

$\Rightarrow \Delta i = 25A$

Also

$V_o - V_{in} = V_L = L\frac{\Delta i}{\Delta t}$

$150-50 = 10\times10^{-6}\times\frac{25}{(\beta-D)T_s}$

$100 = \frac{10^{-5}\times 25}{(\beta-0.5)10^{-5}}$

$(\beta-0.5) = 0.25$

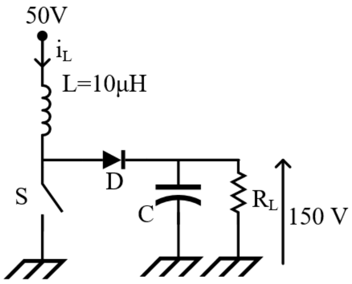
$\therefore \beta = 0.75$

∴ Diode will be conducting for $(\beta-D)T_s$ duration

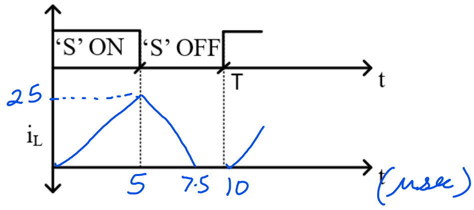
$= 0.25\times10^{-5}$

$= 2.5\,\mu sec$

3. The boost converter shown in figure operates with a duty cycle of 0.5 and switching frequency=100 kHz. Determine:
    a. The time in μsec for which diode D is conducting. **(1-mark)**
    b. Draw the labelled inductor current waveform. **(1-mark)**



b)



4. ~~Suggest a circuit for buck-boost converter which can transfer power in both the directions, i.e. power can flow from low-voltage side to high-voltage side, as well as from high-voltage side to low-voltage side. **(1-mark)**~~

5. ~~In one case, a regulated 5-volt supply is obtained using a linear regulator (e.g. LM7805 IC). In other case, a switching regulator is used to obtain regulated 5-volt supply. For both the cases, qualitatively plot the efficiency curve as a function of input voltage. **(1-mark)**~~

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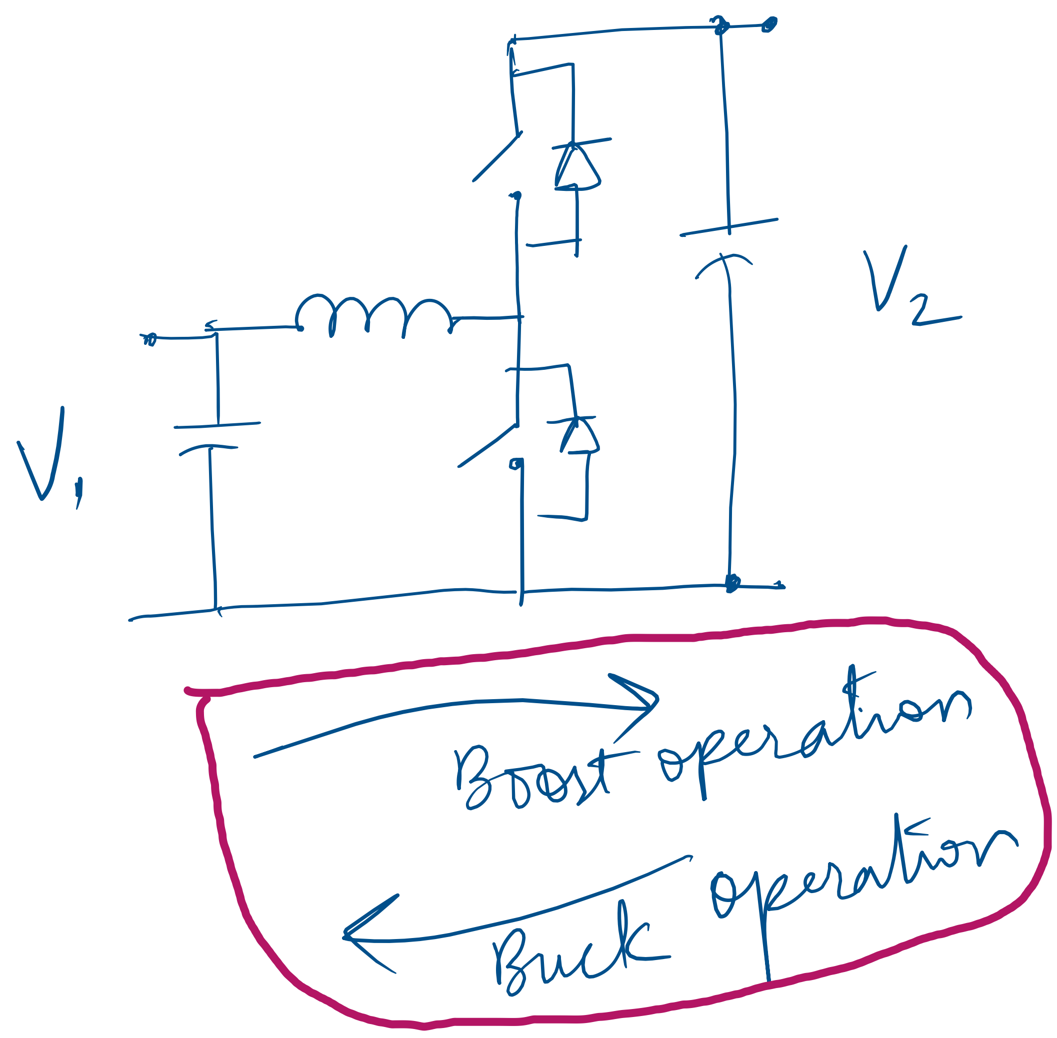

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