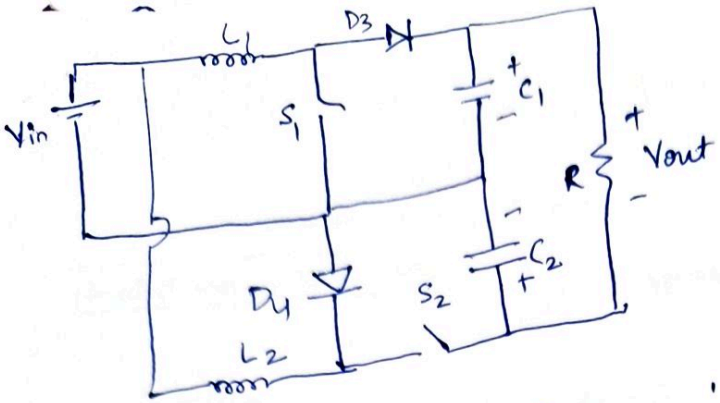
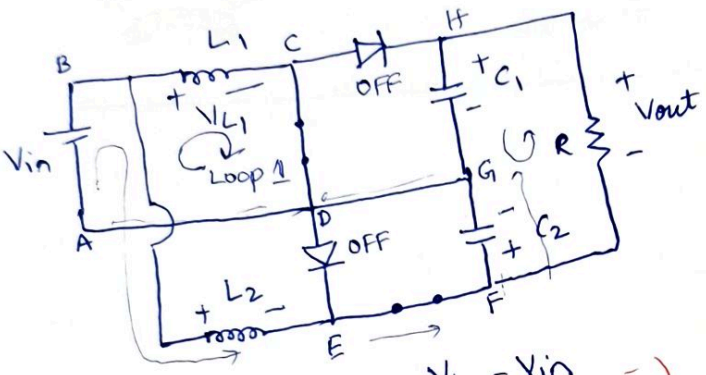


S_1, S_2 ON for $[0, DT_s]$



Loop 1: $V_{in} - V_{L_1} = 0 \Rightarrow V_{L_1} = V_{in}$ (0.5)

ABCDA

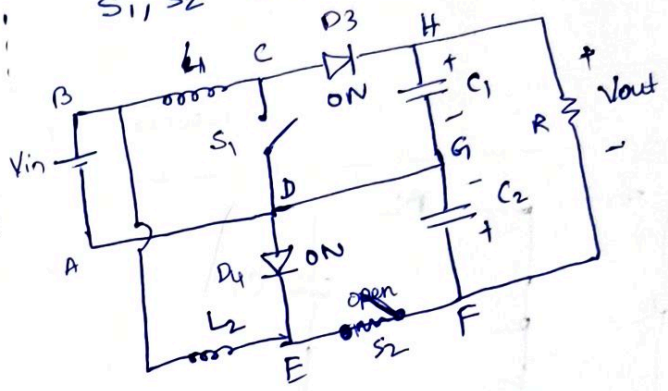
ABEFGDA: $V_{in} - V_{L_2} - V_{C_2} = 0$

$\Rightarrow V_{L_2} = V_{in} - V_{C_2}$ (0.5) — (1)

HGFH: $V_{out} - V_{C_1} + V_{C_2} = 0$

$V_{out} = V_{C_1} - V_{C_2}$

S_1, S_2 OFF for $[DT_s, T_s]$



ABCHGDA:

$V_{in} - V_{L_1} - V_{C_1} = 0$ (0.5)

$V_{L_1} = V_{in} - V_{C_1}$

ABEDA:

$V_{in} - V_{L_2} = 0$ (0.5) — (1)

$V_{L_2} = V_{in}$

$\langle V_{L_1} \rangle = 0$

$\Rightarrow V_{in} \times DT_s + (V_{in} - V_{C_1})(1-D)T_s = 0$

$V_{in} D + V_{in}(1-D) - V_{C_1}(1-D) = 0$

$V_{in} = V_{C_1}(1-D)$ — (1)

$$V_{C_1} = \frac{V_{in}}{1-D}$$

$\langle V_{L_2} \rangle = 0$

$(V_{in} - V_{C_2})DT_s + (V_{in})(1-D)T_s = 0$

$V_{in}D - V_{C_2}D + V_{in} - V_{in}D = 0$

$V_{in} = V_{C_2} D$

$$V_{C_2} = \frac{V_{in}}{D}$$ — (1)

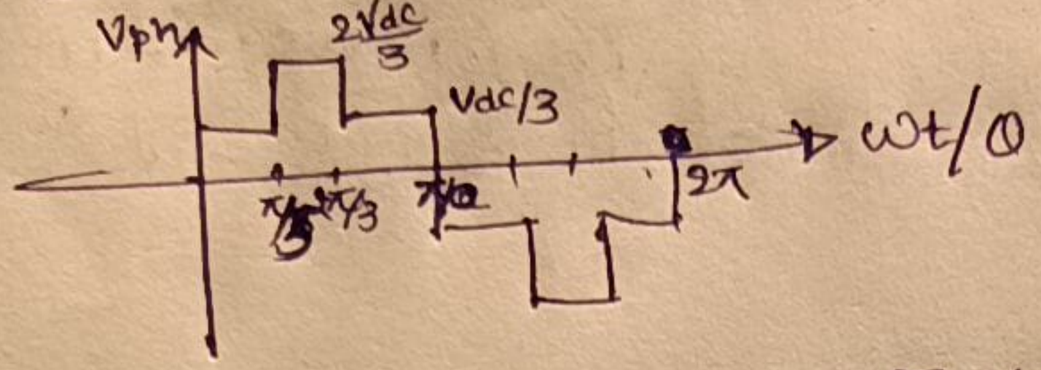
$V_{out} = V_{C_1} - V_{C_2}$

$= \frac{V_{in}}{1-D} - \frac{V_{in}}{D}$

$V_{out} = \frac{D-(1-D)}{D(1-D)} \times V_{in}$

$$\frac{V_{out}}{V_{in}} = \frac{2D-1}{D(1-D)}$$ — (1)

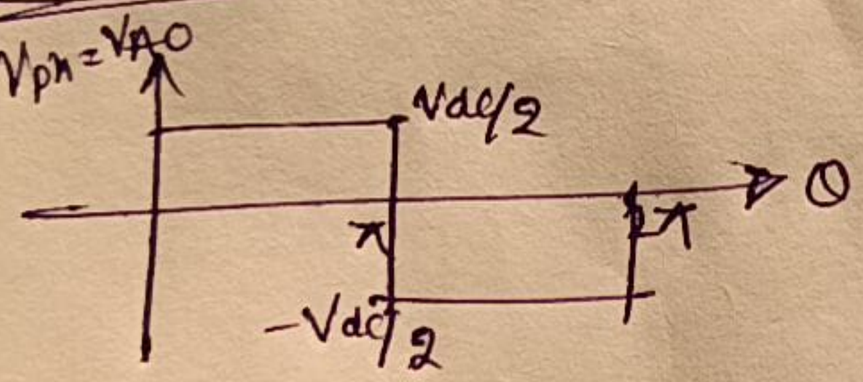
(1) 3-wire $V_{dc} = 100\ V$



→ 1.5

$$I_{rms} = \frac{V_{ph(rms)}}{R} = \frac{\sqrt{2}\ V_{dc}}{3\ R} = 4.71\ A$$ → (1)

(2) 4-wire $V_{dc} = 100$



→ 1.5

$$I_{rms} = \frac{V_{ph(rms)}}{R} = \frac{V_{dc}}{2R} = 5A$$ → (1)