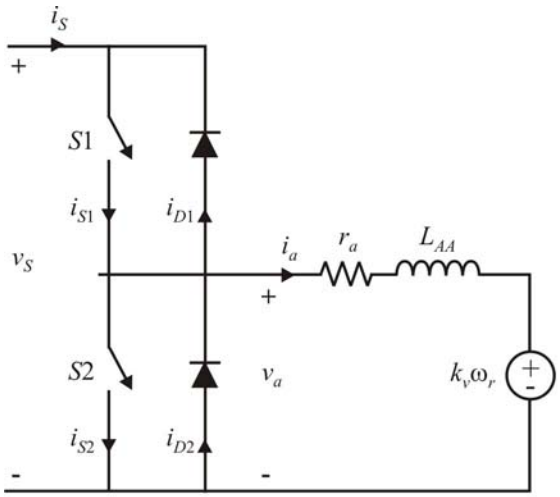
ECE 419/619, Electric Machines and Drives, Spring 2013
Quiz #2, March 7th, 4:30pm-4:45pm

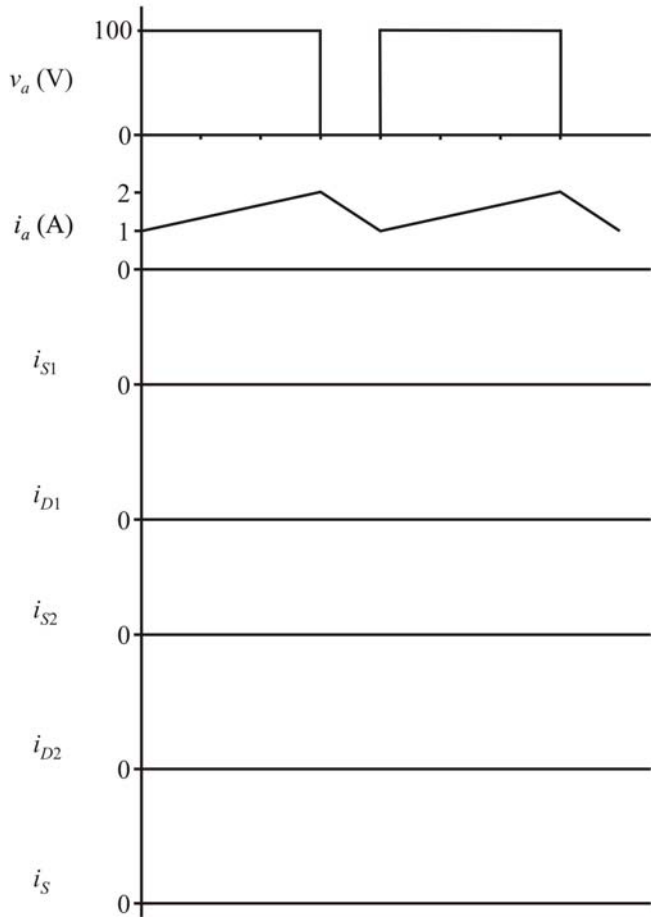
Name: _____

For the dc machine operating from a two-quadrant drive shown below, the parameters are

$r_a = 1\,\Omega$ $L_{AA} = 2\,\text{mH}$ $k_v = 0.5\,\frac{\text{V·s}}{\text{rad}}$

On the graph, sketch i_{S1}, i_{D1}, i_{S2}, i_{D2}, and i_S.





Determine:

- the duty cycle k
- the source voltage v_S
- the average armature current I_a
- the average armature voltage V_a
- the motor speed ω_r
- the average motor input power P_e
- the average source current I_S
- the average source power P_S

Quiz 2, PWM Dc Drives

$r_a := 1\cdot\Omega$ $L_{AA} := 2\cdot mH$ $k_v := 0.5\cdot V\cdot s$

from graphs

$k := 0.75$ $v_S := 100\cdot V$ $I_1 := 1\cdot A$ $I_2 := 2\cdot A$

steady-state calculations

$I_a := \frac{1}{2}\cdot(I_1 + I_2)$ $I_a = 1.5\,A$

$V_a := k\cdot v_S$ $V_a = 75\,V$

$\omega_r := \frac{V_a - r_a\cdot I_a}{k_v}$ $\omega_r = 147\,\frac{rad}{s}$

$P_e := V_a\cdot I_a$ $P_e = 112.5\,W$

$I_S := k\cdot I_a$ $I_S = 1.125\,A$

$P_S := v_S\cdot I_S$ $P_S = 112.5\,W$

plots

$i_{a\_A}(t) := I_1 + \frac{I_2 - I_1}{k\cdot T}\cdot t$

$i_{a\_B}(t) := I_2 + \frac{I_1 - I_2}{(1-k)\cdot T}\cdot(t - k\cdot T)$

$i_{a\_1}(t) := \text{if}(t < k\cdot T, i_{a\_A}(t), i_{a\_B}(t))$ $i_a(t) := i_{a\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$

$i_{S\_1}(t) := \text{if}(t < k\cdot T, i_a(t), 0)$ $i_S(t) := i_{S\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$

$v_{a\_1}(t) := \text{if}(t < k\cdot T, v_S, 0)$ $v_a(t) := v_{a\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$

Quiz 2, PWM Dc Drives

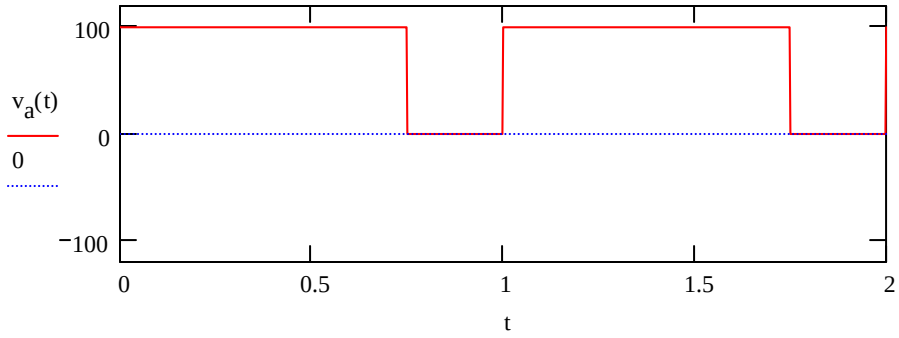
$$i_{S1\_1}(t) := \text{if}\left(t < k\cdot T, \text{if}\left(i_{a\_1}(t) > 0, i_{a\_1}(t), 0\right), 0\right) \qquad i_{S1}(t) := i_{S1\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$$

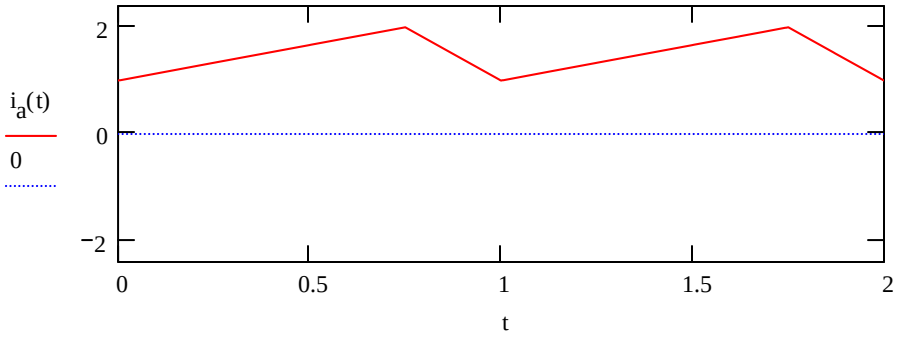
$$i_{D1\_1}(t) := \text{if}\left(t < k\cdot T, \text{if}\left(i_{a\_1}(t) < 0, -i_{a\_1}(t), 0\right), 0\right) \qquad i_{D1}(t) := i_{D1\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$$

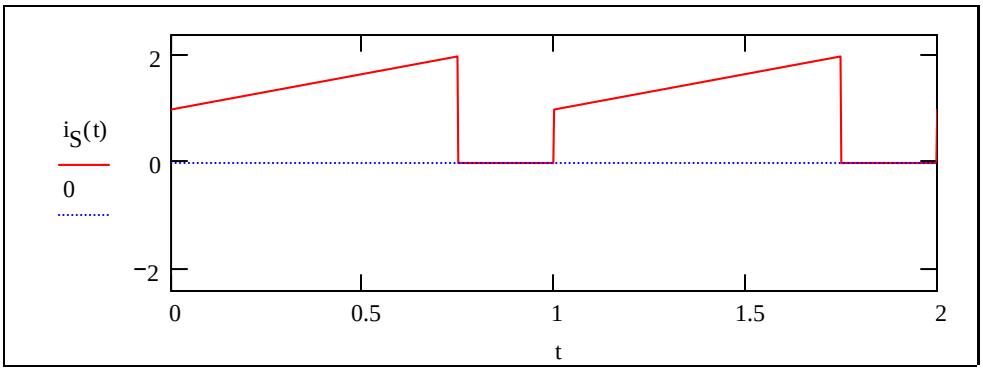
$$i_{S2\_1}(t) := \text{if}\left(t > k\cdot T, \text{if}\left(i_{a\_1}(t) < 0, -i_{a\_1}(t), 0\right), 0\right) \qquad i_{S2}(t) := i_{S2\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$$

$$i_{D2\_1}(t) := \text{if}\left(t > k\cdot T, \text{if}\left(i_{a\_1}(t) > 0, i_{a\_1}(t), 0\right), 0\right) \qquad i_{D2}(t) := i_{D2\_1}\left(t - \text{floor}\left(\frac{t}{T}\right)\cdot T\right)$$

armature voltage and current plots (positive currents)







10. Two-quadrant dc drive

switch and diode current plots (positive currents)