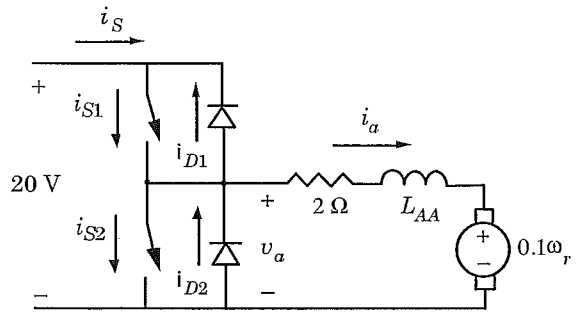
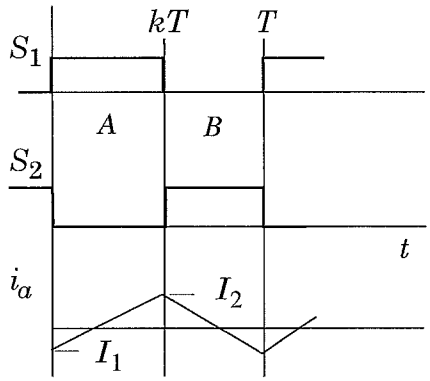
PE-3
August 2015 QE

(34) **1.** Consider the dc-to-dc converter.



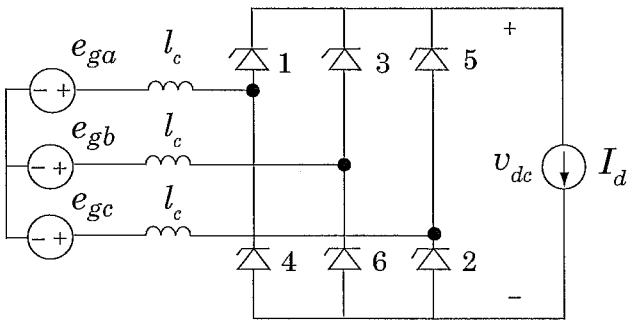


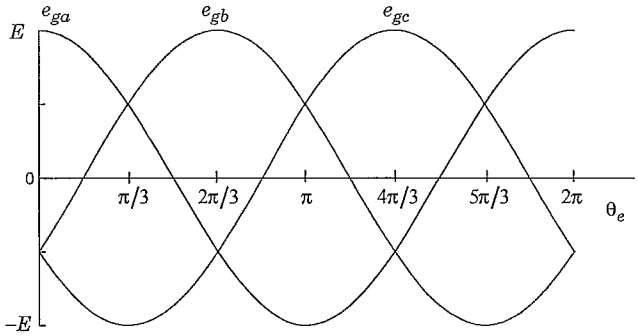
Assume ideal switches and diodes and $T \ll L_{AA}/r_a$.

(a) If $\omega_r = 100$ rad/s, $I_1 = -1$ A, and $I_2 = 3$ A, establish the duty cycle k.

(b) Sketch steady state i_{D1}, i_{S1}, and approximate their average values.

(34) **2.** Consider the three-phase full-bridge rectifier.



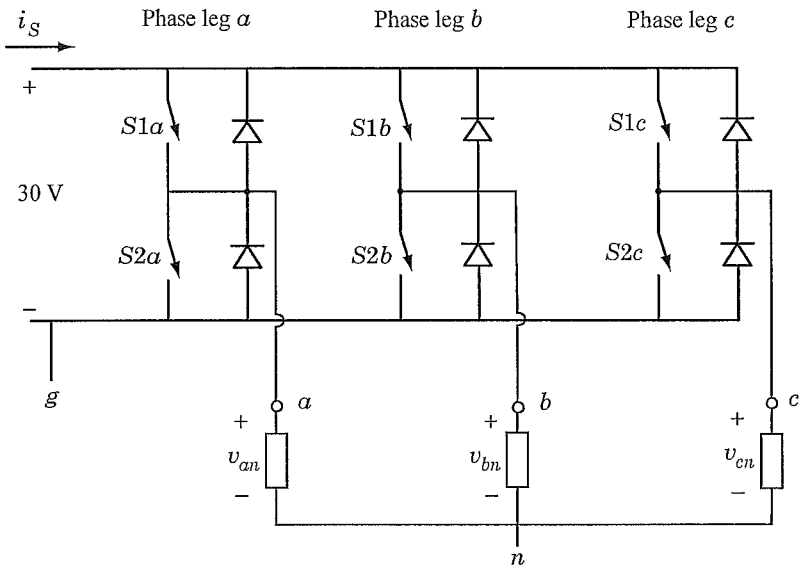


Suppose $e_{ga} = E\cos\theta_e$, $e_{gb} = E\cos(\theta_e - \frac{2\pi}{3})$, and $e_{gc} = E\cos(\theta_e + \frac{2\pi}{3})$ where $\theta_e = \omega_e t$.

(a) If $l_c = 0$, over what subinterval of $0 \le \theta_e \le 2\pi$ do Thyristors 2 and 3 conduct assuming the firing delay angle α is zero. Assume the dc current I_d is constant and positive. Sketch the simplified equivalent circuit of this interval.

(b) For the interval in (a), establish an expression for $v_{dc}(\theta_e)$ and evaluate its average value in terms of E.

(32) **3.** All switches and diodes are ideal. The load is a symmetrical ac motor. Assume complimentary switching ($S2a = \overline{S1a}$, $S2b = \overline{S1b}$, and $S2c = \overline{S1c}$).



Suppose $S1a$, $S1b$, and $S2c$ are closed.

(a) Establish v_{ng} (voltage from n to g) in V.

(b) Establish v_{bn} in V.

(c) If, instead, $S2a$, $S2b$, and $S2c$ are closed, what is the value of v_{bn}?

(d) If a conventional sine-triangle modulator is used (i.e. without third-harmonic injection), what is the maximum peak amplitude of $\hat{v}_{an}$ (fast average of v_{an}) if over-modulation is not allowed?

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