Quiz 2, Power Electronics, Nov. 30, 2004, EE4001 – Answer all questions.

Name: **Student Number:**

1.   Express the Pole A duty ratio, d_A, in terms of the control voltage, $v_{c,A}$ and the peak of the triangular voltage, $V_{tri,pk}$.

2.   In a single pole converter of dc bus voltage V_d=150V and peak of the triangular voltage $V_{tri,pk}$.=5V, calculate the values of the control signal v_c, and the duty ratio d_A for an average output voltage V_{AN}=50V.

3.   In a two-quadrant single-pole converter of dc bus voltage V_d=100V, supplied by a generator of back emf E_a=75V and armature resistance R_a=0.5Ω, calculate the output pole voltage V_{AN} and the duty ratio d when generating and supplying an armature current I_a=5A.

4.   Calculate the peak-peak armature current ripple in the above motoring question when armature inductance L_a=10 mH and the triangular frequency f_{tri}=20 kHz?

5.   In a four-quadrant two-pole converter of dc bus voltage V_d=100V, supplying a motor of back emf E_a=-45V (spinning in reverse) and armature resistance R_a=0.25 Ω, calculate the output pole voltage V_{AB} and the duty ratio d when motoring and supplying an armature current I_{AB}=-20A.

6.   Calculate the peak-peak armature current ripple in the above motoring question when armature inductance La=10 mH and the triangular frequency f_{tri}=10 kHz?

7.   In the above motoring question calculate the pole A control voltage $v_{c,A}$ and the duty ratio d_A when using a peak triangular voltage $V_{tri,pk}$=5V.

8.   In the above motoring question calculate the pole B control voltage v_{cB} and the duty ratio d_B when using a peak triangular voltage $V_{tri,pk}$=5V.

9.   A buck converter, switching at 10 kHz, supplies a 200 V battery with 100 A from a 500 V dc generator. Calculate the inductance required to limit the current ripple to +/- 15 %.

10.   Calculate the capacitance required in the above converter to reduce the output voltage ripple to +/- 2 %.

11.   What is the rms current in the above capacitor?

12.   What is the rms current in the above inductor?

13.   What is the rms current in the controlled switch?

14.   In the power converter diagrammed below, plot i_a from zero to 80 μsec. The switch is going high at t = 0.

V_d = 150 V, e_a = 100 V, f_{sw} = 50 kHz, L = 2 mH, d = 0.5, $i_a(0)$ = 0.5 A
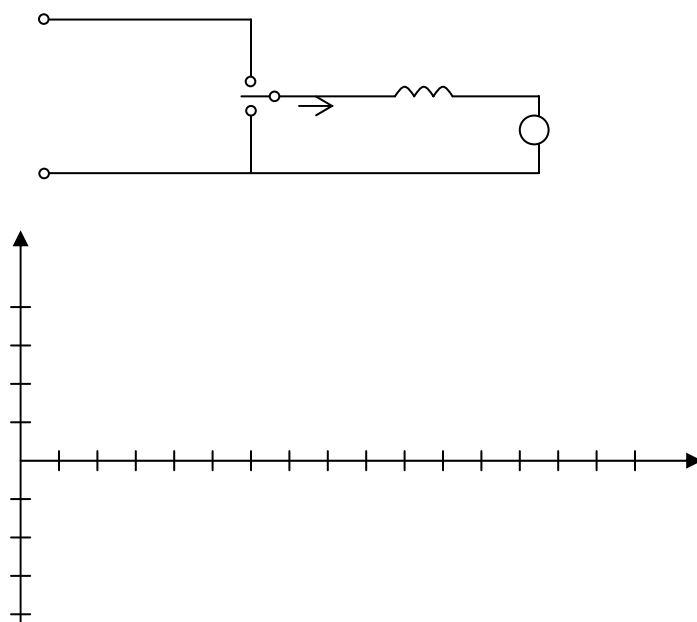
15.   Calculate the duty cycle d during steady state for the converter above.