BIRZEIT UNIVERSITY

Electrical and Computer Engineering Department
ENEE5303, Exam 2
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1) A 230 V, 500 rpm, 90 A separately excited DC motor has the armature resistance and inductance of 0.115 Ω and 11 mH, respectively. The motor is fed by a four-quadrant chopper. The source voltage is 230 V and the frequency of operation is 400 Hz.
   i. If the motor operation is required in the fourth quadrant at the rated torque and 300 rpm, calculate the duty cycle.
   ii. What should be the value of the duty cycle if the motor is working in the third quadrant at 400 rpm and half of the rated torque?

2) A DC separately excited motor controlled by a two-quadrant chopper circuit consisting of two IGBTs and two diodes (shown in Fig.1). The motor current is controlled using hysteresis current controller:
   i. Show, perhaps with the aid of a sketch, the operation and implementation of the current controller to generate the gate drive signals for forward motoring?
   ii. Draw the control system required for driving the armature circuit of the motor in constant torque region.
   iii. Complete Table 1 which shows the truth table of current controller where the digital outputs of logic processors are the gate signals of IGBTs T_1, T_2, T_3 and T_4 (1 = high & 0 = low).
   iv. Derive the transfer function of the speed controller.

Table 1

$\omega_m > 0$	$i_a^* > 0$	$T_P > 0$	Quadrant of operation	Gate signal of IGBT T1	Gate signal of IGBT T2
1	1	1			
1	0	0			
1	0	1			
1	1	0			

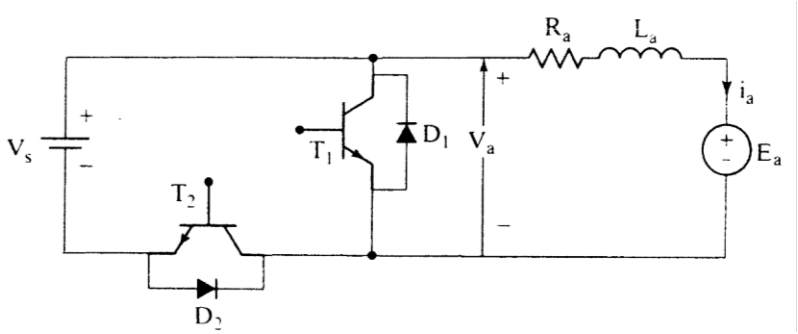

Fig. 1