

EMTR-2019
Assignment #3 Reference Solutions

Q9.1

Q 9.1.

This can be considered as an SR flip flop switch circuit.

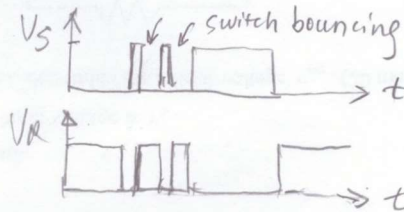
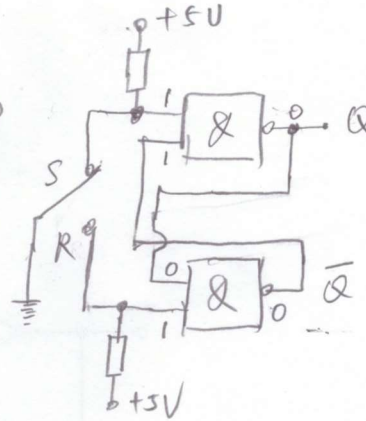
If the current switch state is $S=1, R=0$, and system output:

$$Q=1, (\bar{Q}=0)$$

If there is an unwanted input (bounce)

or $S=0, R=1$ over a short time period (e.g. 0.5 sec)

$$Q=1, \bar{Q}=0.$$

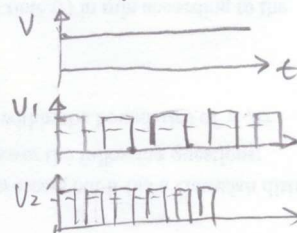
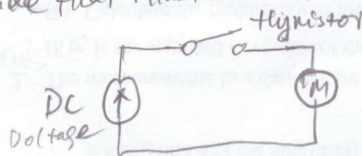


Similarly, if initial $Q=0, \bar{Q}=1$, same conclusion can be made

Q9.2

With a constant voltage supply, different thyristor switching freq produces different PWM average

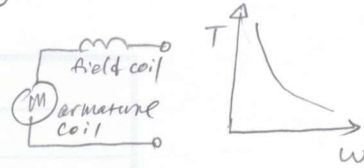
Like that illustration, $V_1 < V_2$,



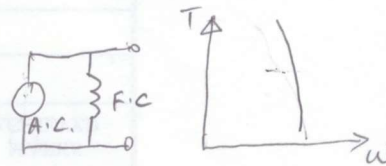
Q9.3

Q9.3

(a) If a DC motor is required to have high T at low ω , based on discussions in lectures, a series-wound DC motor can be used, which has properties shown in the graph.



(b) If the required T is almost constant, regardless of ω , then a shunt-wound DC motor can be used with properties shown in the graph.



Q9.5

Explanation can be based on analysis of Fig. 9.21, as well as the reference switching sequence table.

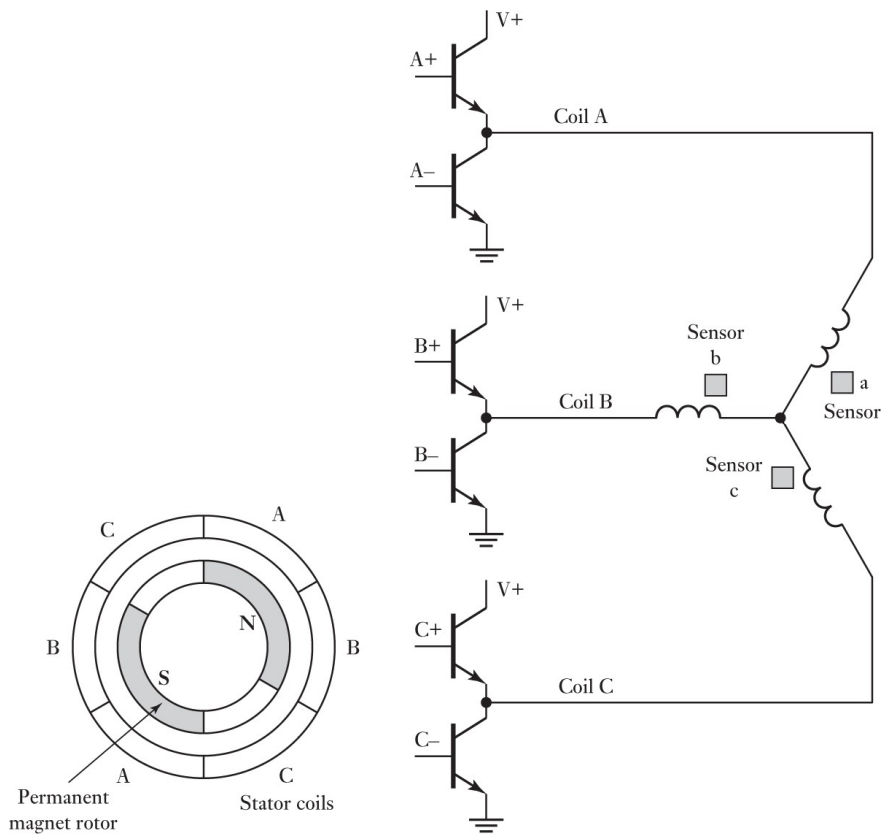


Figure 9.21: (a) Brushless permanent magnet motor, (b) transistor switching

Rotor position	Sensor signals			Transistors on	
	a	b	c		
0°	0	0	1	A+	B-
60°	0	1	1	A+	C-
120°	0	1	0	B+	C
180°	1	1	0	B+	A-
240°	1	0	0	C+	A-
360°	1	0	1	C+	B-

Q9.9

(a) the power input to the motor:

$$P_T = IV = 40 \times 120 = 4800 \text{ W}$$

(b) the power loss in the armature:

$$P_L = I^2 R = 40^2 \times 0.5 = 800 \text{ W}$$

(c) $\omega = 2\pi n = 2\pi \times 20 = 40\pi \text{ rad/s}$

The output power $P_o = P_T - P_L = 4800 - 800 = 4000 \text{ W}$

The torque generated:

$$P_o = T\omega, \quad T = \frac{P_o}{\omega} = \frac{4000 \text{ W}}{40\pi} = 31.831 \text{ N}\cdot\text{m}$$