

# EE 391 (All Sections)

## Midterm Examination

Friday, October 24, 2008

Time Allowed: 1.5 Hours

Materials allowed: Laboratory Notebooks, Design Reports, Calculators

### Instructions:

- Answer all questions in the space provided (use page backs for rough work if necessary)
- State your assumptions; show all relevant work. Box, circle or otherwise highlight your answers where appropriate. For multiple choice, circle the correct answer.
- *Put your name and student number on each page; (we may separate them for marking purposes)*
- Refer to the last page for relevant product data when required
- Weighting for each question is indicated in the left margin (Total marks: 120)

(Marker's use only.)

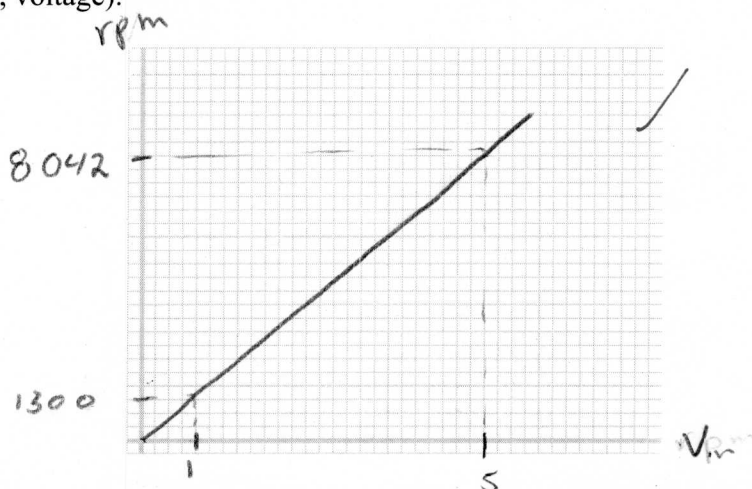
Governor	SPMS	Total
35 <del>34</del> /40	25 /40	60 /80

Design Lab II – Electronic Governor

Q1.1) Draw the speed vs. voltage curve for the DC motor you used in the electronic governor design. Label two points in the graph with your actual measurements, indicating their values (velocity/RPM, voltage).

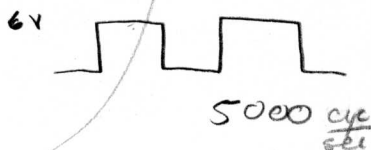
[3]

5



Q1.2) If a person wants to use 6 V PWM running at 5KHz to power the motor, what duty cycle (%) should be used to give an average DC voltage of 4 V?

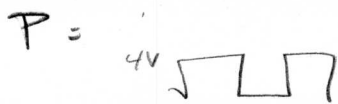
[5]



$$6V \times x = 4V$$

$$x = \frac{4V}{6V} = 0.667 = \boxed{66.7\%}$$

What duty cycle (%) would be required for the same power (i.e. Effective or RMS value) as 4VDC?



$$P = 1W = \frac{(1 - \delta)(4V)^2}{2}$$

$$\frac{2}{4} = 1 - \delta \Rightarrow \delta = 1 - 0.5 = 0.5 \quad \boxed{50\%}$$

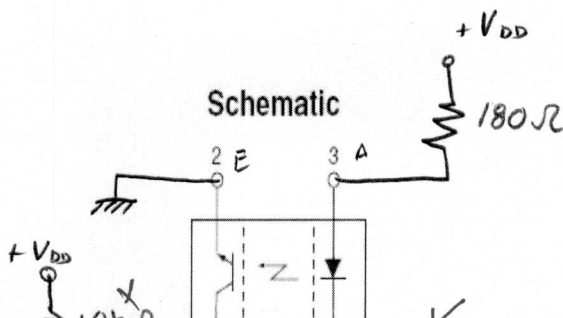
$$P_{out} = \frac{(1 - \delta)V_{cut} + I_{op}}{2}$$

$$P = \frac{(1 - 0.667) 6V}{2} = 1W$$

Q1.3) The QRD1113 Reflective Object Sensor was used to measure the speed of the motor. QRD1113 consists of an infra red LED and a photo transistor, which are optically coupled. The sensor characteristics are described by a line of specifications, that is, sensor current I<sub>c(ON)</sub> is min. 0.3mA when the forward LED current is 20mA and the reflector is placed at 0.05".

[4] Complete the schematic diagram (below) for using the sensor by showing all the connections you made to get a sensor output for input to Comparator 1 of the PIC16F668.

4/4



35

34/40

5  
3  
4  
4  
5  
5  
4  
5

