- Minimum control: **20 min**.
- Grades will be available on June, 13th
- Questions about the exam: Monday 11:00 - 13:00; Tuesday 15:00-19:00

VERY IMPORTANT: Draw a general schematic or plan, develop the exercise and justify the results always explaining what are you doing

Minimum 7 Designing a rotation speed meter (tachometer)

We want to build a tachometer to measure the speed of rotation of the electrical motor shown in Fig. 1 which revolves at a maximum speed of 1000 min^{-1} (or *rpm*: revolutions per minute). A geartooth joined to the motor axis turns while a magnetic sensor generates a digital pulse waveform[1]. The internal design of the magnetic sensor can be seen in Fig. 2. An alternative sensor, also very common but based on photodiodes and LED or optocouplers, can be seen in Fig. 3.
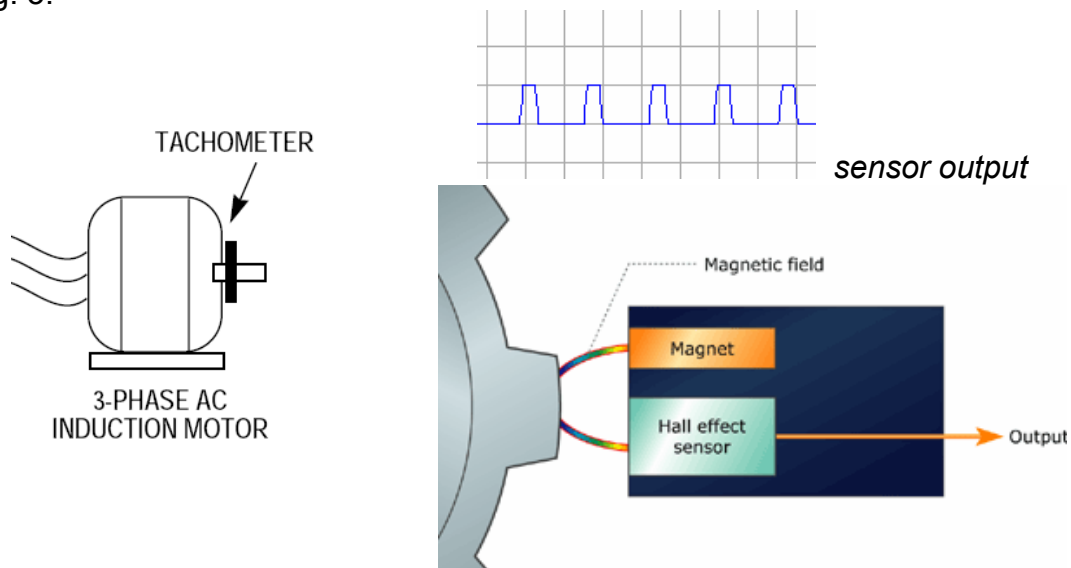

Fig. 1 Tachometer placement attached to the motor axis and detail of the magnetic Hall effect sensor

The metallic geartooth has 36 teeth and we to build a 3-digit 7-segment display to represent speeds up to 999 min^{-1} as sketched in Fig. 4.

---

[1] References for documenting the problem:
- http://archive.chipcenter.com/knowledge_centers/embedded/todays_feature/showArticle.jhtml?articleID=10817759
- http://www.freescale.com/files/microcontrollers/doc/app_note/AN1857.pdf
- http://www.cherrycorp.com/english/sensors/pdf/GS1012_Series.pdf
- http://dkc3.digikey.com/PDF/T072/P2115.pdf

a) Design the block diagram for the instrument
b) Design the 3-digit BCD counter and the output register using 74LS163 chips
c) Design the time base and the control unit (a FSM)
d) Verify your design in Proteus-VSM applying an square or a pulsed waveform to simulate the sensor output
e) Improve your instrument adding an overflow LED indicator which at the same time blank the digits when activated
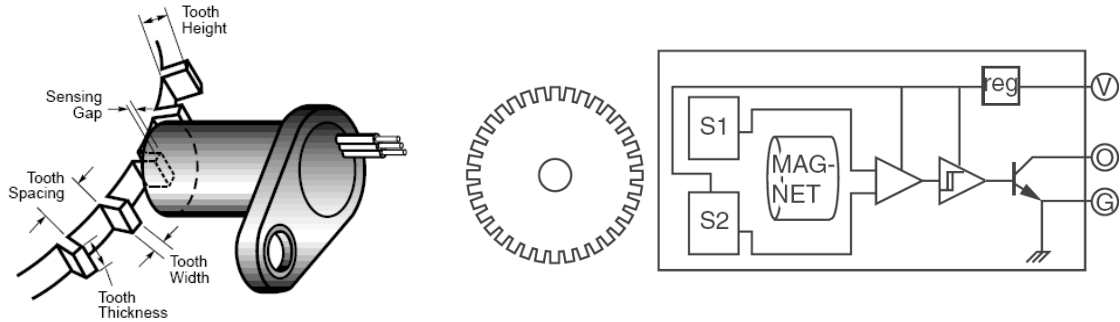

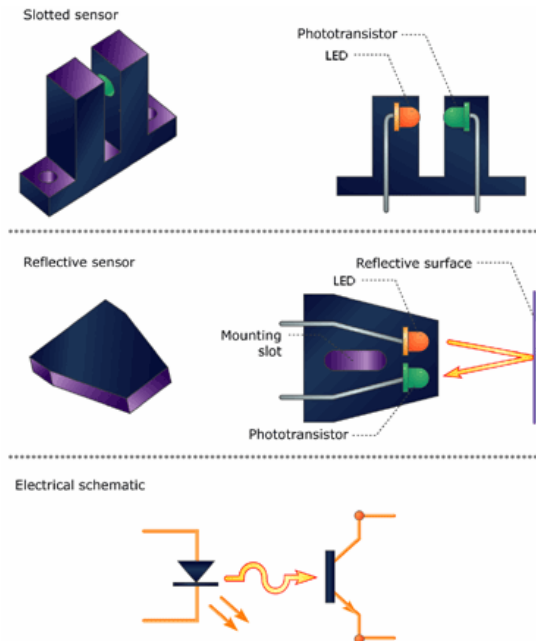*Fig. 2 Magnetic Hall effect sensor (SD1012 from www.cherrycorp.com)*
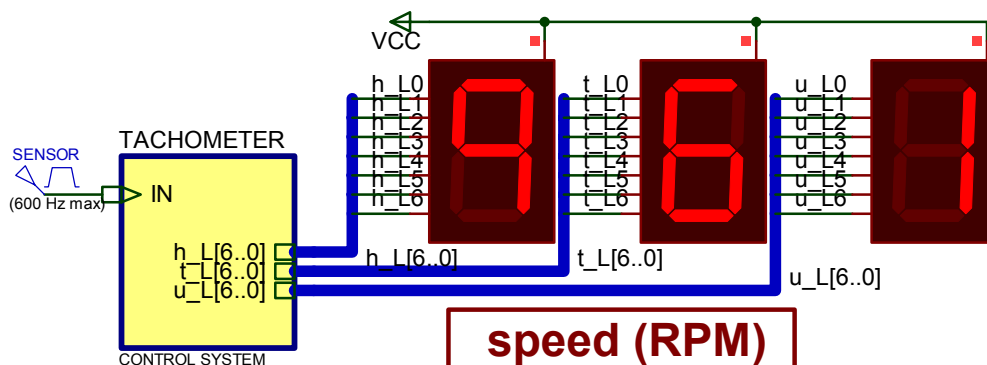

Fig. 3 Speed sensor based on optical sensor build using optocouplers

Fig. 4 3-digit speed sensor diagram