

# Sensing, Computing, Actuating

## Lecture 5 - Stepper Motors

This instruction exercise consists of three questions that show example questions related to the lectures on stepper motors. In preparation for the exam you should of course not only study these questions, but also the examples shown on the lecture slides.

### Exercise 1: Stepper motors

- (a) Draw a diagram that shows the physical construction of a three-phase four-pole permanent magnet step motor.
- (b) What is the full step angle of a three-phase four-pole permanent magnet step motor?
- (c) For an application it is important that the step motor remains in its position even when the motor is not energized. Can you use a variable reluctance step motor for this application? (Explain your answer)
- (d) Draw a disc that can be used in a absolute position encoder to encode angles of  $45^\circ$  in a 3-bit value?
- (e) A displacement can be sensed using a Hall effect sensor. Explain the operation of a Hall effect sensor. Clearly indicate in your answer how you can use the sensor to measure a displacement.
- (f) The internal resistance of a semiconductor-based Hall effect sensor has a PTC temperature coefficient. Can an NTC thermistor be used to compensate this temperature dependency in the Hall effect sensor. (Explain your answer and provide a circuit that shows how the two devices need to be connected.)