# Mechtron 3TB4: Embedded Systems Design II
# Tutorial 1 Practice Questions

Due: To be prepared before your first tutorial session. You will be quizzed on the content covered by these questions! Approximate marking scheme is provided after each question in square parentheses [].

Q.1 In class we discussed half-stepping sequence for a stepper motor with 2-poles on the rotor and 4-poles on the stator ref. figure 1.

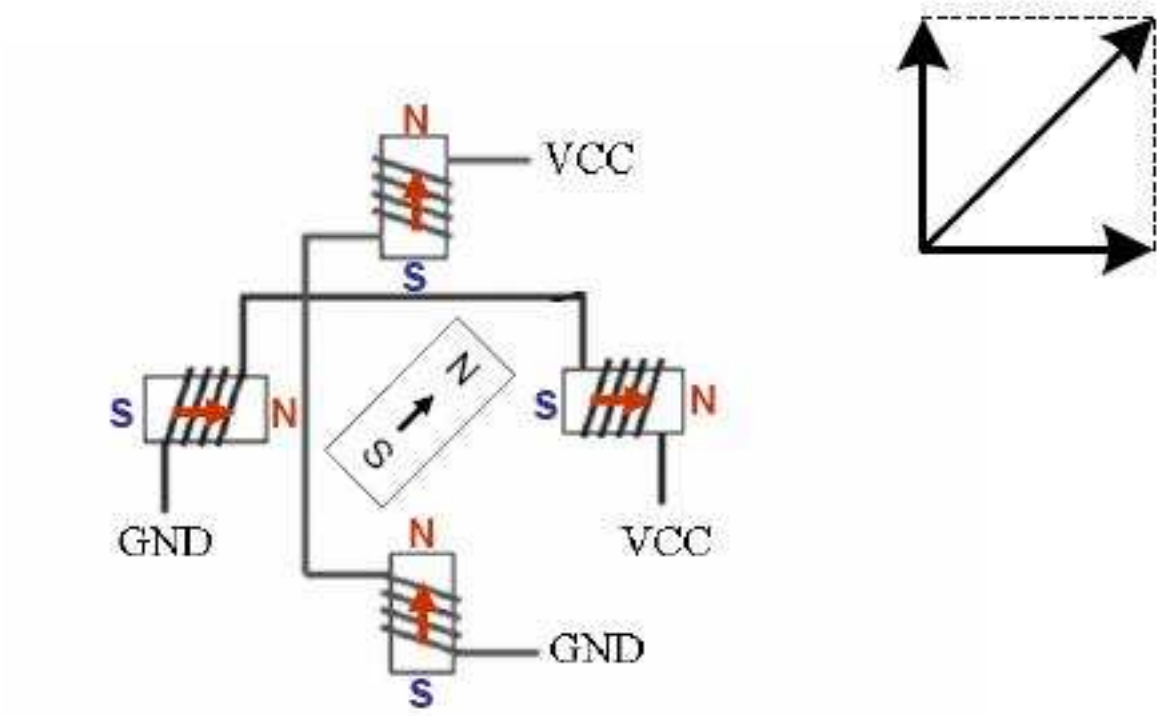


Figure 1:

a) Make a table showing sequences for all half steps required to rotate the motor 360 degrees in clockwise direction [5].

b) Make a table showing sequences for all half steps required to rotate the motor 360 degrees in counterclockwise direction [5].

Q.2 Consider a stepper motor with 2-bipolar windings on the stator and a 6-pole permanent magnet rotor ref. figure 2.

a) How many steps are requied by this motor to complete one revolution? [2]

b) What is the step resolution for this motor? [1]

c) Show the sequences for all steps required to rotate this motor by 75 degrees only [3].

Q.3 You are given a stepper motor shown in figure 3.

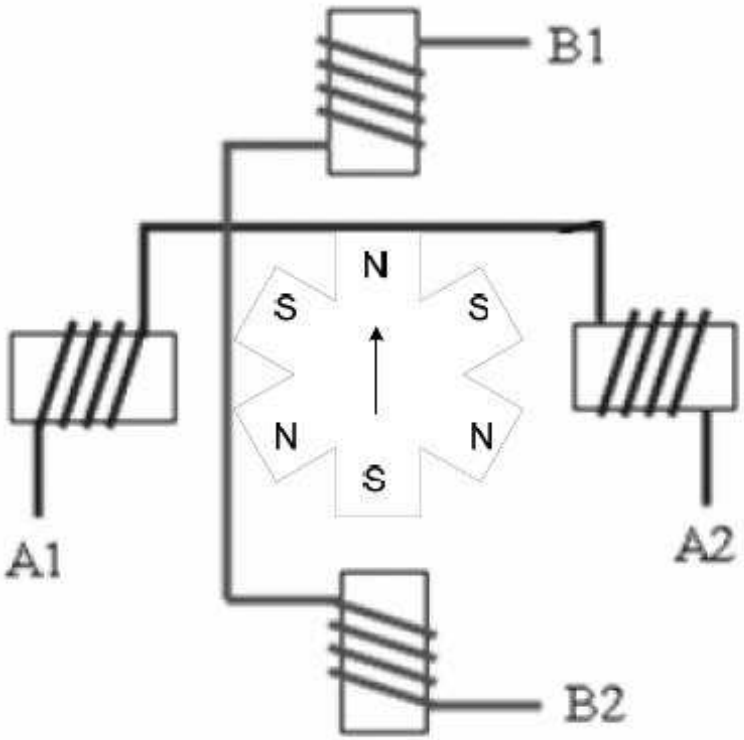


Figure 2:

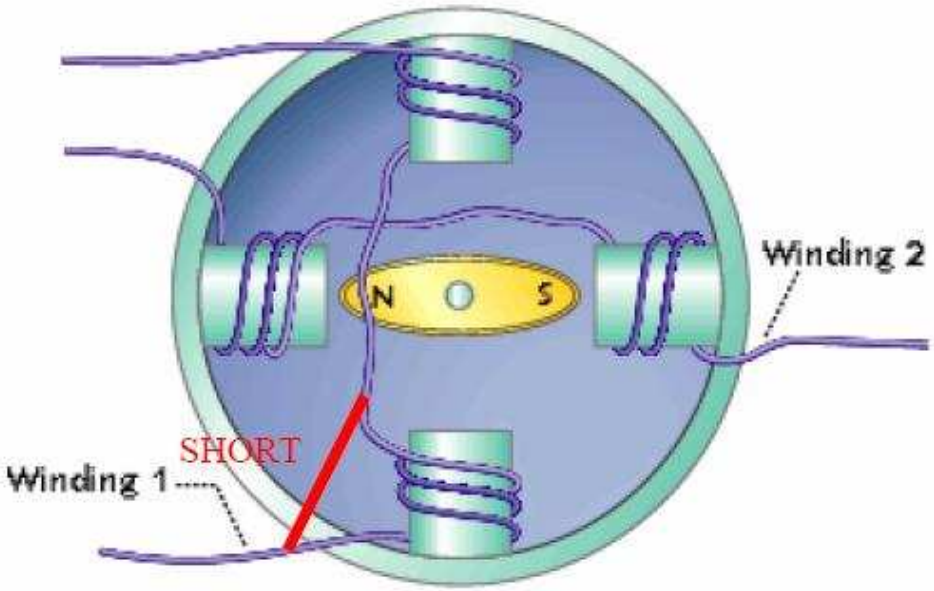


Figure 3:

Using ohmmeter in the lab, you determined that one of the windings was shorted, as indicated in the figure. Can you still use this motor to perform both full- and half-steps? How will the performance of the motor be affected?

Q4. Explain why nested interrupt support may be beneficial in an embedded system implementation? [2]

Q5. Your company is developing new microprocessor architecture. You are in charge of developing interrupt support hardware with the following characteristics:

- Only one instruction executes at any given time. Currently executing instruction is completed before servicing the interrupt, unless the instruction itself is the cause of the interrupt.
- On interrupt, only the return address is stored automatically. The address is stored to an auxiliary register.
- Addresses of ISRs are stored in a vector table.

a) What hardware components have to (i.e. are absolutely necessary) be added to the processor, if any, to support the interrupts as described? [2]

b) What hardware components have to (i.e. are absolutely necessary) be added to the devices, if any, to support the interrupts as described? [2]

c) What structures have to (i.e. are absolutely necessary) be added in memory, if any, to support the interrupts as described? [1]

Q6. Your company is developing a new software development system for AVR (ATmega324P). You are in charge of developing library functions. Among others, you are required to develop a library function with the following prototype:

```
void delay (unsigned int time);
```

The function does nothing for a specified amount of time, and returns after the time has expired. The library you are developing is targeting low power applications. You can use Timer0 for this purpose, and you can assume that no other part of the application uses Timer0.
Write C code that implements this function [10].