Ain Shams University (ASU)
Faculty of Engineering
Credit Hours Education Program (CHEP)
Mechatronics and Automation Program (MCTA)

Fall Semester, September 2018   *Time: 2:00 Hrs..*

MCT381: Design of Mechatronics Systems (1)

This **Midterm** Exam Consists of **Five** Questions | **One** Page.   **15/11/2018**   **1/1**

Question (1): [12 marks]

1. **Draw** the overall mechatronics systems block diagram. **Describe** an example of the signal conditioning stage.
2. **Compare** between <u>Full</u> and <u>Half</u> step stepper motor (use sketches as required).
3. **Compare** between <u>Unipolar</u> and <u>Bipolar</u> stepper motors from (No. of wires, Power requirements, Holding Torque, Applications).
4. **Mention** in details how Micro-stepping works and its importance.

Question (2): [6 marks]

In reference to the V-model, **mention** an example where a product is verified but not validated. **Mention** another example where a product is validated but not verified. How can both cases be avoided?

Question (3): [7 marks]

In reference to the Analysis of DC-motor. **Describe** in details the steps of what happens when <u>sudden Un-loading</u> of the motor occurs when it was initially rotating at a certain speed (v). **Is** the final speed lower or higher than the initial speed (v)?

Question (4): [7 marks]

For a Quadratic-load Torque. **Describe** in details the steps of what happens when this load is attached to a DC-motor and both starts rotating from initial speed zero. **USE** Speed-Torque curve to show the steps of your solution.

Question (5): [18 marks]

For a 50-Kg mobile robot **climbing down** a hill with slope 1:10. It is composed of 4-wheels. The <u>two rear wheels are actuated</u>, while the front two are not!!

It is required to move this robot as follows: (1) start from rest, (2) accelerate in 5 seconds to its maximum linear velocity of 5m/s, (3) move with this constant speed for 30 seconds, (4) finally decelerate to rest in 7 seconds, and then stops.

Given that your ID is **15PABCD**, the radius of the wheel is (A+B+D) centimeters. While its width is (A+C) centimeters.

The wheels are from Aluminum with density 2700 Kg/m^3.

[Assume any required data].

a) **Select** the appropriate DC-motors to actuate this robot (assume that motors are directly coupled to the wheels).

b) **Suggest** two different alternatives to keep the robot steady when it stops at the end of its motion on this inclined hill.