



Fall 2019

Course Code: MCT 381

Time allowed: 2:00 Hrs.

Design of Mechatronics Systems (1) – Midterm Exam

The Exam Consists of Five Questions in One Page.

Maximum Marks: 25 Marks

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Question (1): (6 points)

- a- Draw the general overall mechatronics systems block diagram. Describe an example of the sensing and actuation stages. (2 Points)
- b- Compare between Full and Half step stepper motor (use sketches as required). (1 Point)
- c- Compare between Unipolar and Bipolar stepper motors from (No. of wires, Power requirements, Holding Torque, Applications). (1 Point)
- d- Mention in details how Pulse Width Modulation (PWM) works and its importance. (2 Point)

Question (2): [4 points]

In reference to the V-model:

- a- Mention an example where a product is verified but not validated. (1 Point)
- b- Mention another example where a product is validated but not verified. (1 Point)
- c- How can both cases be avoided? (2 Points)

Question (3): [4 points]

In reference to the Analysis of DC-motor:

- a- Describe in details the steps of what happens when sudden Un-loading of the motor occurs when it was initially rotating at a certain speed (v). (3 Points)
- b- Is the final speed lower or higher than the initial speed (v)? (1 Point)

Question (4): [4 points]

For a Linear-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. (4 Points)

Question (5): [7 marks]

For a 50-Kg mobile robot climbing down a hill with slope of 30 degrees. It is composed of 4-wheels. The two rear wheels are actuated, while the front two are not.

It is required to move this robot as follows: (1) start from rest, (2) accelerate in 10 seconds to its maximum linear velocity of 5 m/s, (3) move with this constant speed for 20 seconds, (4) finally decelerate to rest in 5 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 (density 2700 Kg/m³). [Assume any required data].

- a- Select the appropriate DC-motors to actuate this robot (assume that motors are directly coupled to the wheels). (5 Points)
- b- Suggest two different alternatives to keep the robot steady when it stops at the end of its motion on this inclined hill. (2 Points)

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Exam. Date : 08-10-2019