FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA SCHOOL OF ELECTRICAL ENGINEERING AND TECHNOLOGY DEPARTMENT OF MECHATRONICS ENGINEERING SECOND SEMESTER 2017/2018 B.Eng. DEGREE EXAMINATION COURSE: MCE 326: MECHATRONICS SYSTEMS DESIGN I

Instructions: attempt any four questions. TIME ALLOWED: 2 Hours

- Q1a). A mechatronics engineer is required to automate a packaging processing line.

 What will be the key elements of the packaging system?

 5Marks
 - b). A permanent magnet (PM) DC gear motor is used to lift a mass, as shown in the Figure 1. Develop a mathematical relationship between the voltage applied to the motor and the rotational displacement of the motor shaft which is also a measure of the linear displacement of the mass. Assume that the string is in extensible, and also neglect the friction between the string and the pulleys.

 10Marks

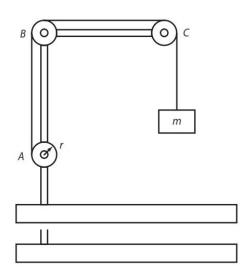


Figure 1:

- Q2a). A group of an undergraduate student of mechatronics engineering are designing an automatic fire extinguishing system. Recommend the categories of sensors required to actualize the project.

 5Marks.
 - b). State the relevant software that will be need to actualize the problem in Q2a above.

 3 Marks
 - c). Use a neat sketch to explain the working principle any two types of actuators.

8 Marks

Q3a). Differentiate between modeling and simulation.

3Marks

b). With the aid of a diagram explain the basic structure of a mechatronics system.

5Marks

- c). With the aid of a circuit diagram explain how a DC motor can be actuated. 7Marks
- Q4a). Explain briefly the terms in the mathematical models for electromechanical analogies for both transitional and torsional dynamics respectively.

8 Marks.

- b). Draw and label a simplified diagram of an automobile's shock absorber subsystem.

 3 Marks.
- c). Draw life curves for comparison purpose for a graduate engineer working in Nigeria and a counterpart working in Singapore.

 4 Marks.
- Q5. In a single transitional mass-spring-dash pot system, these values were used in an experiment; k = 15 N/m, m = 10 Kg, F = 60 N, and B = 30 N.s/m
 - (i) Draw the forces equilibrium diagram

3 Marks.

- (ii) Determine the displacement of the 10 Kg mass along a horizontal surface or axis. 8Marks.
- (iii) What do you understand reliability, and unreliability to mean? How are both related?

 4Marks