

**FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**  
**DEPARTMENT OF MECHTRONICS ENGINEERING**  
**SECOND SEMESTER EXAMINATION 2018/2019 SESSION**  
Course Code: MCE 326 Time : 2hr.

**Instructions: attempt Any four questions.**

**Question One**

- a) A mechatronics engineer is required to automate a packaging processing line. What will be the key elements of the packaging system. 5 Marks
- 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 inextensible, and also neglect the friction between the string and the pulleys. 10 Marks

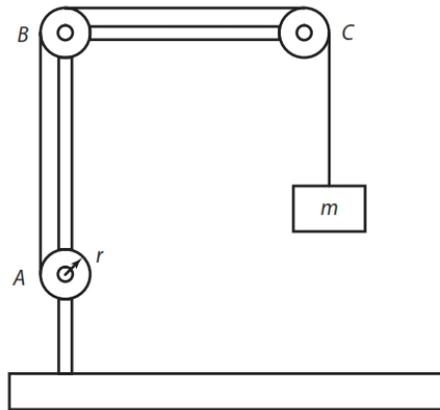


Figure 1:

**Question Two**

- a) 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. 5 Marks.
- 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

**Question Three**

- a). Differentiate between modeling and simulation. 3 Marks
- b). With the aid of a diagram explain the basic structure of a mechatronics system. 5 Marks
- c). With the aid of a circuit diagram explain how a DC motor can be actuated.

**Question Four**

- . (a) Explain briefly the terms in the mathematical models for electromechanical analogies for both translational 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).

**Question five**

Q5. In a single translational mass-spring-dashpot system, these values were used in an experiment;  $k = 15 \text{ N/m}$ ,  $m = 10 \text{ Kg}$ ,  $F = 60 \text{ N}$ , and  $B = 30 \text{ N.s/m}$

- (i) Draw the forces equilibrium diagram (3 Marks).
- (ii) Determine the displacement of the 10 Kg mass along an horizontal surface or axis (8 Marks).
- (iii) What do you understand reliability, and unreliability to mean? How are both related? (4 Marks)