

**FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA**  
**SCHOOL OF ELECTRICAL ENGINEERING AND TECHNOLOGY**  
**DEPARTMENT OF MECHATRONICS ENGINEERING**  
**FIRST SEMESTER 2018/2019 B.Eng. DEGREE EXAMINATION**  
**COURSE: MCE 412: Mechatronics Laboratory III**  
**INSTRUCTION: Attempt ALL QUESTIONS.**  
**TIME ALLOWED: 3 Hours**

**Question One (25 Marks).**

- a). The Management has approved the installation of traffic light systems at strategic locations within the university, hence you have been awarded the design contract for the traffic light system. The Traffic Light system is to be designed using Timers and Counters and the operation is such that the RED signal light comes ON after **10** seconds and goes OFF, thereafter the AMBER comes ON for another **10** seconds. The GREEN light stays ON for **50** seconds after AMBER. The RED depicts STOP, AMBER depicts READY and GREEN means GO. You are required to design this system using the PLC. Your design should include the PLC ladder diagram and program codes as applicable. **(15 Marks)**
- b). Identify and discuss four areas of application of PLC. **(5 Marks)**
- c). Discuss the advantages of PLC based systems over Relay based systems. **(5 Marks)**
- d). List three different brands of PLC and two type each for each brand. **(5 Marks)**

**Question Two (20 Marks).**

- a). In a metal recycling plant, the waste cans are often compressed by the metal crusher to form large square before been conveyed for further processing. The metal crusher compresses the metals by applying extreme force on the waste cans.
- i. What actuation system would recommend for the metallic crusher? Justify the reasons for the selection. **(4 Marks)**
- ii. Compare and Contrast between Hydraulic and pneumatic Actuators. **(4 Marks)**
- b). Identify three areas of applications of the Hydraulic; Pneumatic and Electric Actuators. **(4 Marks)**
- c). Compare and Contrast between Stepper and Servo motors. **(4 Marks)**
- d). Discuss the characteristic advantages of Electric actuation systems over the Pneumatic and Hydraulic systems. **(4 Marks)**

**Question Three (10 Marks).**

Potholes and bumps are responsible for large number of accidents and loss of lives and properties on Nigerian roads. Developing proactive and early detection measures will be an effective approach for reducing accidents, and a source of information for ensuring timely road maintenance activities. Consequently, you are expected to design a cost-effective road defect detection system using sensor, microcontroller and other relevant electronic components to detect potholes, bumps and an alert system. Block diagram, Flow chart, pseudo code and explanation of detailed procedures will be required for full points.

**(10 Marks)**

**Question Four (5 Marks).**

The University is currently faced with the challenge of poor of electric energy management; thus, you have been contacted to help design a switching system to help turn on and off lighting points within the university facility using a simple AND & OR Gates. Use appropriate block diagram/ schematic diagram where necessary to justify your design.

**(5 Marks)**