

071606T4IMT

INDUSTRIAL MECHATRONICS TECHNOLOGY LEVEL 6

ENG/OS/IMT/CR/01/6

Design Electromechanical Systems

November/December 2025



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN ASSESSMENT

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INSTRUCTIONS TO CANDIDATE

1. The paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** questions in section **A**.
3. Answer question **TWELVE (12)** and **ANY OTHER TWO (2)** questions in section **B**
4. Marks for each question are indicated in the brackets.
5. Candidates are provided with a separate answer booklet.
6. Do not write on this question paper.

This paper consists of THREE (3) printed pages.

**Candidate should check the guide to ascertain that all the pages are printed as indicated
and that no questions or answers are missing.**

SECTION A (40 MARKS)

Answer ALL the questions in this section.

1. Specifications guide the design process by defining system requirements. State FOUR electromechanical system specifications that should be considered during design. (4 marks)
2. Patenting of a design is beneficial in many ways. List THREE importance of patenting an electromechanical design. (3 marks)
3. Mathematical modelling translates physical systems into equations for analysis. Identify TWO mathematical modelling approaches used in the design process. (2 marks)
4. Representing systems using mathematical modelling is essential when undertaking the design process. State FOUR advantages of using mathematical modelling. (4 marks)
5. Conceptual design and functional specification serve different purposes in the design process. Differentiate between conceptual design and functional specification. (4 marks)
6. Embedded systems use specialized software for controlling hardware. Identify THREE programming languages commonly applied in embedded software deployment. (3 marks)
7. Simulation software helps test systems re real prototypes. State FOUR simulation softwares used in electromechanical sy (4 marks)
8. Documentation ensures traceability an transfer. State FOUR technical documents required in electromechanical design documentation. (4 marks)
9. Optimization improves efficiency and reliability of systems. List FOUR methods of performing design optimization in electromechanical systems. (4 marks)
10. Sensors and actuators are essential for control and automation. Identify TWO differences between sensors and actuators. (4 marks)
11. Technical drawings are the universal language of engineering design. Give FOUR importance of using technical drawing in the design process. (4 marks)

SECTION A (60 MARKS)

ATTEMPT QUESTION 12 (COMPULSORY) and ANY OTHER TWO questions in this section.

12. A local commercial farmer growing temperature-sensitive orchids is facing inconsistent yields due to fluctuating daily temperatures and humidity levels. To solve this problem, an automated electromechanical system is required to maintain the greenhouse climate within optimal ranges. The system must be reliable, energy-efficient, and safe. You have been contracted as an industrial mechatronics technician to design the core electromechanical system for this project.
- Based on the scenario, identify the client's primary problem and the main goal of the proposed automated system. (4 marks)
 - Develop THREE key functional specifications for the system that the automated system must meet. (6 marks)
 - For the design of the system, describe the choice for the following components:
 - TWO sensors suitable for monitoring the greenhouse conditions. (4 marks)
 - TWO actuators appropriate for the climate. (4 marks)
 - ONE controller to coordinate the functions. (2 marks)
- 13.
- The design process is influenced by various factors which affect the final product. Explain FIVE factors to consider in the design of electromechanical systems. (10 marks)
 - Engineering projects involve multiple stages hence the need for keeping records. Discuss FIVE benefits of proper record-keeping in system design. (10 marks)
- 14.
- Product design involves a series of systematic steps to transform an idea into a functional product. Describe the first FIVE steps followed in product design process. (10 marks)
 - Safety design protects users and equipment from possible hazards. Describe FIVE aspects that should be addressed when designing for safety. (10 marks)
- 15.
- Electromechanical systems combine electrical and mechanical elements to perform tasks. Describe FIVE components used in electromechanical systems. (10 marks)
 - Simulation is crucial in mechatronics because it allows engineers to test designs virtually. Discuss FIVE challenges faced in the simulation of systems. (10 marks)