Model Curriculum

QP Name: Mechatronics Maintenance Specialist

QP Code: ELE/Q7105

QP Version: 3.0

NSQF Level: 5

Model Curriculum Version: 3.0

Electronics Sector Skills Council of India (ESSC!) ESC House, 2nd Floor ESC House, Okhla Industrial Area-Phase 1II NewDelhi-II0020

Table of Contents

Training Parameters

Sector	Electronics
Sub-Sector	Industrial Automation
Occupation	Engineering – I&A
Country	India
NSQF Level	5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7412.0101
Minimum Educational Qualification andExperience	Completed 2nd year of UG (UG Diploma) (Physics/ Electronics/Electrical/Mechanical) with 1.5 years of Relevant Experience OR Completed 3 year diploma after 10th (Electronics/ Electrical/Mechanical) with 3 Years of Relevant Experience OR Previous relevant Qualification of NSQF Level (4.5) with 1.5 years of Relevant Experience # Relevant Experience in Industrial Automation.
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	01.05.2025
Next Review Date	30.04.2028
NSQC Approval Date	08.05.2025
QP Version	3.0
Model Curriculum Creation Date	01.05.2025
Model Curriculum Valid Up to Date	30.04.2028
Model Curriculum Version	3.0
Minimum Duration of the Course	570 Hours
Maximum Duration of the Course	570 Hours

Program Overview

This section summarizes the end objectives of the program along with its duration.

Training Outcomes

At the end of the program, the learner should have acquired the listed knowledge and skills:

- Demonstrate the process of setting up circuits and electrical components in the mechatronics system.
- Demonstrate the process of installing, testing and using the sensors and actuators in the mechatronics system.
- Demonstrate the process of installing, testing and using microcontrollers in the mechatronics system.
- Explain the importance of following inclusive practices for all genders and PwD at work.
- Demonstrate the use of relevant health and safety equipment at work.

Compulsory Modules

The table lists the modules and their duration corresponding to the Compulsory NOS of the QP.

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Recommended)	On-the-Job Training Duration (Mandatory)	Total Duration
ELE/N7109: Set up circuits and electrical components in the mechatronics system	**66:00**	**54:00**	**00:00**	**90:00**	**210:00**
Module 1: Process of settingup circuits and electrical components in the mechatronics system	66:00	54:00	00:00	90:00	210:00
ELE/N7110: Install, test and use the sensors and actuators in the mechatronics system	**60:00**	**60:00**	**00:00**	**30:00**	**150:00**
Module 2: Process of installing, testing and using the sensors and actuators inthe mechatronics system	60:00	60:00	00:00	30:00	150:00
ELE/N7111: Install, test anduse microcontroller in the mechatronics system	**30:00**	**60:00**	**00:00**	**60:00**	**150:00**
Module 3: Process of installing, testing and using microcontroller in the mechatronics system	30:00	60:00	00:00	60:00	150:00
DGT/VSQ/N0102: Employability Skills (60 Hours)	**24:00**	**36:00**	**00:00**	**00:00**	**60:00**

Module 4: Employability Skills(60 Hours)	24:00	36:00	00:00	00:00	60:00
Total Duration	**180:00**	**210:00**	**00:00**	**180:00**	**570:00**

Module Details

Module 1: Process of setting up circuits and electrical components in themechatronics system

Mapped to ELE/N7109

Terminal Outcomes:

- Demonstrate the process of Setting up microcontrollers.
- Demonstrate the process of Setting up circuits, electrical components and pneumatic systems.

Duration: 66:00	Duration: 54:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the need and scope of the mechatronics system. • Explain the mechatronics system and its scope in the automation sector. • Explain the traditional vs. mechatronics approach. • Explain how to interpret the block diagram representation of a general mechatronics system showing various components with suitable examples. • Explain relevant control systems such as open and closed-loop systems, basic elements of the closed-loop system. • Explain the basic circuit concepts. • Explain the semiconductor circuit elements. • Explain different types of circuits used in mechatronic devices. • Explain how to interpret the pneumatic symbols in pneumatic systems. • Describe the function and operation of pneumatic valves. • Describe the logic functions used in the pneumatic system. • Describe the function of relays and their working in the pneumatic system. • Explain the need for the proximity sensor and its application in a pneumatic cylinder.	• Demonstrate the process of testing the mechatronics components to ensure they are functioning correctly. • Demonstrate the process of installing the mechatronics control system and the hardware interfacing units of microcontrollers. • Demonstrate the process of testing the microcontrollers for the correct functioning and carrying out troubleshooting for the issues identified. • **Demonstrate how to test the electrical components and circuits for correct functioning and compatibility with the mechatronics system.** • Demonstrate the process of performing sequence control and using the logic functions for operating the pneumatic system. • **Demonstrate how to use relays in the pneumatic system.** • Demonstrate how to monitor the pneumatic fluid by analysing the speed and pressure control sensors. • Demonstrate the process of carrying out troubleshooting for any issues encountered with the pneumatic system. • **Demonstrate how to design the cascade circuits.** • Demonstrate the process of installing the pneumatic power system.

• Explain the design of cascade circuits. • Describe the process of programming PLCs in the Ladder diagram. • Explain the principles of operation, characteristics and applications of power semiconductor devices. • Explain the characteristics of power semiconductor devices and circuits. • Explain the concept of fluid power. • Explain the relevant case studies for implementing the pneumatic system in the automatic production line.	• Demonstrate the process of carrying out maintenance of the circuits, electrical components and pneumatic system.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Align, Fit and Assemble Component Parts Using Hand Tools, Power Tools, Fixtures, Templates and Microscopes	

Module 2: Process of installing, testing and using the sensors and actuators in the mechatronics system

Mapped to ELE/N7110

Terminal Outcomes:

- Demonstrate the process of installing, testing and using the sensors and actuators.

Duration: 60:00	Duration: 60:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the use of contact and non-contact type sensors. • Explain the functions and application of Potentiometer Sensors, Strain Gauge Elements, Capacitive Elements, Eddy Current, Pressure Sensors, Pneumatic, Pyro Electrical, Piezoelectric Sensors etc. • Explain the criteria for selecting sensors for use. • Explain the classification, need and scope of different types of actuators. • Describe the process of pneumatic actuation, hydraulic actuation and double-acting. • Explain the use of different types of motors such as vane motors. • Explain the components of electrical actuation systems such as switching devices, keypads, electromechanical and solid-state relays, stepper motors etc. • Explain the criteria for the selection of different types of actuators. • Explain how to carry out repair and maintenance of sensors and actuators in a mechatronics system.	• Demonstrate the process of installing the selected sensors such as the potentiometer sensor following the standard procedure. • Demonstrate how to test the sensors for correct functioning after installation. • Demonstrate how to check the working of the strain gauge sensor and measure the torque applied by the motor. • Demonstrate the use of an eddy current sensor. • Demonstrate how to use the capacitive element by replacing the mechanical buttons. • Demonstrate how to use the inductive sensor to measure high precision measurements of displacement, distance, oscillation in harsh industrial environments. • Demonstrate the use of the pneumatic and pyro-electric and piezoelectric sensors. • Demonstrate the process of carrying out repair and maintenance of sensors. • Demonstrate the process of installing an actuator with the appropriate properties according to the need • Demonstrate how to use the appropriate interface circuitry to match the actuator to the system driving it. • Demonstrate how to test the actuator for correct functioning after

	installation. • Demonstrate the process of carrying out troubleshooting for any issues identified with the installed hydraulic and pneumatic actuator as per the sketches and block diagrams. • Demonstrate the process of install and using the vane motor as per the standard procedure. • Demonstrate how to control a high-powered circuit using a lower power signal through electro-mechanicaland solid-state relays. • Demonstrate how to use the stepper motor to convert electrical power into mechanical power. • Demonstrate how to create analytical design and development solutions for actuators for different applications. • Demonstrate the process of carrying out repair and maintenance of actuators.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Electromechanical Assemblies, Test Instruments Such as Oscilloscopes, Electronic Voltmeters and Bridges.	

Module 3: Process of installing, testing and using microcontroller in the mechatronics system

Mapped to ELE/N7111

Terminal Outcomes:

- Demonstrate the process of installing, testing and using the microcontroller.

Duration: 30:00	Duration: 60:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain different applications of mechatronic systems. • Explain the structure of different types of microcontrollers and their PIN configuration. • Explain the difference between a microprocessor and a microcontroller. • Explain the advantages, disadvantages and applications of microcontrollers. • Explain the interfacing of D/A converters and A/D converters with microcontrollers. • Explain the application of temperature control stepper motor control. • Describe the function of microcontroller structure in hardware interfacing units of the mechatronics system. • State the instruction sets and programming concepts of microprocessor and microcontroller. • State the programming concepts to interface the hardware units with microprocessor and microcontroller. • Explain the architecture of PIN configuration, ARM Processor. • Explain the criteria for selecting an appropriate microcontroller. • Describe the process of digital to analogue and vice versa conversion in a microcontroller. • Describe the process of controlling	• Demonstrate the process of installing the microcontroller as per the standard procedure and linking the function of the microcontroller structure in hardware interfacing units of the mechatronics system. • Demonstrate how to test the microcontroller after installation to ensure it functions as expected. • Demonstrate how to program the microcontroller to execute a specific set of instructions • Demonstrate the process of testing the functioning of the machine using the mechatronics system. • Demonstrate the process of carrying out interfacing of Analog-To-Digital (A/D) and Digital-To-Analog (D/A) converters using the appropriate type of microcontroller. • Demonstrate how to compose and program stepper motor using the appropriate type of microcontroller. • Demonstrate how to compose and program Advanced RISC Machine (ARM) and microprocessor with the stepper motor. • Demonstrate the process of carrying out repair and maintenance of microcontrollers.

the temperature with a temperature sensor using a microcontroller circuit. • Describe the process of interfacing experiments of A/D and D/A using the appropriate type of microprocessor. • Describe the process of interfacing and programming of Stepper motor using the appropriate type of microcontroller. • Describe the process of interfacing and programming of the ARM processor with a Stepper Motor. • Demonstrate how to carry out repair and maintenance of microcontrollers in the mechatronics system.	
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Common Hand and Power Tools, Such as Hammers, Hoists, Saws, Drills and Wrenches, to Precision Measuring Instruments and Electrical and Electronic Testing Device	

Module 4: Employability Skills (60 Hours)
Mapped to DGT/VSQ/N0102

Terminal Outcomes:

- Discuss about Employability Skills in meeting the job requirements
- Describe opportunities as an entrepreneur.
- Describe ways of preparing for apprenticeship & Jobs appropriately.

Duration: 24:00	Duration: 36:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain constitutional values, civic rights, responsibility towards society to become a responsible citizen • Discuss 21st century skills • Explain use of basic English phrases and sentences. • Demonstrate how to communicate in a well-behaved manner • Demonstrate how to work with others • Demonstrate how to operate digital devices • Discuss the significance of Internet and Computer/ Laptops • Discuss the need for identifying business opportunities • Discuss about types of customers. • Discuss on creation of biodata • Discuss about apprenticeship and opportunities related to it.	• List different learning and employability related GOI and private portals and their usage • Show how to practice different environmentally sustainable practices. • Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, etc. • Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone • Demonstrate how to communicate in a well-mannered way with others. • Demonstrate how to communicate effectively using verbal and nonverbal communication etiquette • Utilize virtual collaboration tools to work effectively • Demonstrate how to maintain hygiene and dressing appropriately. • Perform a mock interview
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer, UPS, Scanner, Computer Tables, LCD Projector, Computer Chairs, White Board OR Computer Lab	

Module 5: On-the-Job Training

Mapped to Mechatronics Maintenance Specialist

Mandatory Duration: 180:00	Recommended Duration: 00:00
Location: On-Site	

Terminal Outcomes

1. Explain the basics of the mechatronics system and its scope in the automation sector.
2. Explain the traditional vs. mechatronics approach.
3. Explain different types of circuits used in mechatronic devices.
4. Explain the logic functions used in the pneumatic system.
5. Set up circuits, electrical components and pneumatic system.
6. Carry out maintenance of the circuits, electrical components and pneumatic system.
7. Install, test and use the sensors and actuators.
8. Carry out repair and maintenance of sensors and actuators.
9. Install, test and use the microcontroller.
10. Carry out repair and maintenance of microcontrollers.
11. Maintain a healthy, safe and secure working environment.

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
Diploma/Degree/ Certified in relevant CITS	Electrical/ Electronics/ Mechanical Engineering	3	Mechatronics Maintenance Specialist	2	Electronics	

Trainer Certification	
Domain Certification	**Platform Certification**
"Mechatronics Maintenance Specialist", "ELE/Q7105, v3.0", Minimum accepted score is 80%	Recommended that the Trainer is certified for the **Mechatronics Maintenance Specialist** "Trainer (VET and Skills)", mapped to the Qualification Pack: "MEP/Q2601, V2.0", with minimum score of 80%

Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training/Assessment Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
Diploma/Degree/ Certified in relevant CITS	Electrical/ Electronics/ Mechanical Engineering	5	Mechatronics Maintenance Specialist	2	Electronics	

Assessor Certification	
Domain Certification	**Platform Certification**
"Mechatronics Maintenance Specialist", "ELE/Q7105, v3.0", Minimum accepted score is 80%	Recommended that the Assessor is certified for the **Mechatronics Maintenance Specialist** "Assessor (VET and Skills)", mapped to the Qualification Pack: "MEP/Q2701, V2.0", with minimum score of 80%

Assessment Strategy

1. Assessment System Overview:
    - Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
    - Assessment agencies send the assessment confirmation to VTP/TC looping SSC
    - The assessment agency deploys the ToA certified Assessor for executing the assessment
    - SSC monitors the assessment process & records
2. Testing Environment

    To ensure a conducive environment for conducting a test, the trainer will:
    - Confirm that the center is available at the same address as mentioned on SDMS or SIP
    - Check the duration of the training.
    - Check the Assessment Start and End time to be 10 a.m. and 5 p.m.
    - Ensure there are 2 assessors if the batch size is more than 30.
    - Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
    - Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
    - Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
    - Check the availability of the Lab Equipment for the particular Job Role.
3. Assessment Quality Assurance levels / Framework:
    - Question papers created by the Subject Matter Experts (SME)
    - Question papers created by the SME verified by the other subject Matter Experts
    - Questions are mapped with NOS and PC
    - Question papers are prepared considering that levels 1 to 3 are for the unskilled & semi-skilled individuals, and levels 4 and above are for the skilled, supervisor & higher management
    - The assessor must be ToA certified & the trainer must be ToT Certified
    - The assessment agency must follow the assessment guidelines to conduct the assessment
4. Types of evidence or evidence-gathering protocol:
    - Time-stamped & geotagged reporting of the assessor from assessment location
    - Centre photographs with signboards and scheme-specific branding
    - Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
    - Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos
5. Method of verification or validation:

    To verify the details submitted by the training center, the assessor will undertake:
    - A surprise visit to the assessment location
    - A random audit of the batch
    - A random audit of any candidate
6. Method for assessment documentation, archiving, and access

    To protect the assessment papers and information, the assessor will ensure:
    - Hard copies of the documents are stored

- Soft copies of the documents & photographs of the assessment are uploaded/ accessed from Cloud Storage
- Soft copies of the documents & photographs of the assessment are stored in the Hard drive

References

Glossary

Term	Description
Declarative knowledge	Declarative knowledge refers to facts, concepts and principles that need to be known and/or understood to accomplish a task or to solve a problem.
Key Learning	The key learning outcome is the statement of what a learner needs to know, understand and be able to do to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
OJT (M)	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on the site
OJT (R)	On-the-job training (Recommended); trainees are recommended the specified hours of training on the site
Procedural Knowledge	Procedural knowledge addresses how to do something, or how to perform a
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do **upon the completion of the training**.
Terminal Outcome	The terminal outcome is a statement of what a learner will know, understand and be able to do **upon the completion of a module.** A set of terminal outcomes help to achieve the training outcome.

Acronyms and Abbreviations

Term	Description
A/D	Analog-To-Digital
ARM	Advanced RISC Machine
CPR	Cardiopulmonary Resuscitation
D/A	Digital-To-Analog
NCO	National Occupational Standards
NOS	National Skills Qualification Committee
NSQF	National Skills Qualification Framework
OJT	On-the-Job Training
PC	Performance Criteria
PwD	Persons with Disabilities
QP	Qualification Pack
SaaS	Software-as-a-Service
SDMS	Skill Development & Management System
SIP	Skill India Portal
SME	Small and Medium Enterprises
SOP	Standard Operating Procedure
SSC	Sector Skill Council
TC	Trainer Certificate
ToA	Training of Assessors
ToT	Training of Trainers
TP	Training Provider