Qualification Pack

Manufacturing and Mechatronics Lead Technician

Semester 5: Automation/ Semester 5: Robot Maintenance/ Semester 6: Advance Robotics/ Semester 6: Technical Troubleshooting and Problem Solving/ Semester 6:Artificial Intelligence in Automotive Manufacturing

QP Code: ASC/Q6424

Version: 1.0

NSQF Level: 4.5

Qualification Pack

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Contents

Qualification Pack

ASC/Q6424: Manufacturing and Mechatronics Lead Technician

Brief Job Description

The individual at this job is responsible for overseeing the manufacturing process and leading a team of technicians in the assembly, maintenance, and troubleshooting of mechatronic systems used in production

Personal Attributes

The person should be organized, team-oriented and have the ability to work independently for long hours. He should be result-oriented, keen observer and have an eye for detail and quality. The individual should also be able to demonstrate skills for information order, imagination, oral expression, analytical approach, deductive reasoning and comprehension.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. ASC/N8382: Hydraulics and Pneumatics
2. ASC/N3549: Lubrication & Mechanical Drives
3. ASC/N8383: PLC and Electrical Drives
4. ASC/N9841: Best Industrial Practices
5. ASC/N8386: Sensors & Actuators
6. ASC/N8387: SCADA & Industrial Automation
7. ASC/N8388: I 4.0 Technologies
8. ASC/N9843: Environmental Studies
9. DGT/VSQ/N0104: Employability Skills (120 Hours)

Options*(Not mandatory):*

Option 1: Semester 5: Automation

1. ASC/N8384: Automation

Option 2: Semester 5: Robot Maintenance

1. ASC/N8385: Robot Maintenance

Option 3: Semester 6: Advance Robotics

1. ASC/N8389: Advance Robotics

Option 4: Semester 6: Technical Troubleshooting and Problem Solving

1. ASC/N8390: Technical Troubleshooting and Problem Solving

Option 5: Semester 6:Artificial Intelligence in Automotive Manufacturing

1. ASC/N8391: Artificial Intelligence in Automotive Manufacturing

Qualification Pack (QP) Parameters

Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
Country	India
NSQF Level	4.5
Credits	40
Aligned to NCO/ISCO/ISIC Code	NCO-2015/3122.4702
Minimum Educational Qualification & Experience	Certificate-NSQF (Fabrication and Service Technician, Level 4)
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	NA
Next Review Date	30/11/2026

Qualification Pack

NSQC Approval Date	30/11/2023
Version	1.0
Reference code on NQR	QG-4.5-AU-01362-2023-V1-ASDC
NQR Version	1

Remarks:

Mandatory: It is Mandatory to select at least one optional NOS in every semester to meet the 40 credits requirement in a year for diploma progression (As per NCVET Diploma guidelines)

ASC/N8382: Hydraulics and Pneumatics

Description

This NOS unit is about to Analyze and design Pneumatic & hydraulic circuits in Manufacturing Operations.

Scope

The scope covers the following :

- Analyze the existing pneumatic or hydraulic circuit to identify any potential issues.
- Utilize advanced design techniques and software tools to optimize the pneumatic or hydraulic circuit's design.
- Perform simulations of the designed circuit using specialized software to evaluate its performance.

Elements and Performance Criteria

Analyze the existing pneumatic or hydraulic circuit to identify any potential issues.

To be competent, the user/individual on the job must be able to:

PC1. Assess the overall performance of the pneumatic or hydraulic circuit, focusing on factors like pressure control, flow rates, response times, and energy efficiency.

PC2. Visually inspect the pneumatic or hydraulic components, such as valves, cylinders, pumps, and sensors, for signs of wear, damage, or malfunction.

PC3. Measure the pressure and flow rates at various points within the pneumatic or hydraulic circuit to identify any inconsistencies or deviations from the expected values.

PC4. Maintain detailed records of the analysis process, including observations, findings, and potential causes of the identified issues.

Utilize advanced design techniques and software tools to optimize the pneumatic or hydraulic circuit's design.

To be competent, the user/individual on the job must be able to:

PC5. Identify and select appropriate software tools and design techniques that cater to the specific requirements of the pneumatic or hydraulic circuit.

PC6. Develop an accurate model of the pneumatic or hydraulic circuit using the selected software tools.

PC7. Analyze the performance of the circuit model under various operating conditions, such as different flow rates, pressures, and temperatures.

PC8. Apply optimization techniques, such as genetic algorithms or gradient-based methods, to fine-tune the circuit design for improved performance, energy efficiency, and component sizing.

Perform simulations of the designed circuit using specialized software to evaluate its performance.

To be competent, the user/individual on the job must be able to:

PC9. Develop a detailed model of the designed circuit within the simulation software.

PC10. Configure the simulation settings, such as the time step, simulation duration, and output data format.

PC11. Analyze the simulation results, focusing on key performance metrics such as pressure, flow, temperature, and energy consumption.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. organisation procedures for health, safety and security, individual role and responsibilities in this context

KU2. the organisation's emergency procedures for different emergency situations and the importance of following the same

KU3. evacuation procedures for workers and visitors

KU4. how and when to report hazards as well as the limits of responsibility for dealing with hazards

KU5. potential hazards, risks and threats based on the nature of work

KU6. various types of fire extinguisher

KU7. various types of safety signs and their meaning

KU8. • Fundamentals of Pneumatics and Hydraulics:
• A strong understanding of the principles governing pneumatic and hydraulic systems is essential. This includes knowledge of fluid mechanics, gas dynamics, and the behavior of fluids under pressure. Familiarity with the components used in these systems, such as valves, actuators, cylinders, and pumps, is also crucial.

KU9. • Circuit Design and Analysis:
• Understanding the process of designing and analyzing pneumatic and hydraulic circuits is vital. This includes the ability to create schematics, calculate flow rates, pressure drops, and power consumption. Knowledge of various circuit configurations, such as series, parallel, and combination circuits, is also necessary.

KU10. • Manufacturing Operations and Automation:
• A good understanding of manufacturing processes and automation is essential for designing circuits that cater to specific industrial applications. This includes knowledge of different types of machines and equipment used in manufacturing, as well as the automation techniques employed to control and monitor these processes.

KU11. • Fundamentals of Pneumatics and Hydraulics:
• A strong understanding of the principles governing pneumatic and hydraulic systems is essential. This includes knowledge of fluid mechanics, gas dynamics, and the behavior of fluids under pressure. Familiarity with the components used in these systems, such as valves, actuators, cylinders, and pumps, is also crucial.

KU12. • Circuit Design and Analysis:
• Understanding the process of designing and analyzing pneumatic and hydraulic circuits is vital. This includes the ability to create schematics, calculate flow rates, pressure drops, and power consumption. Knowledge of various circuit configurations, such as series, parallel, and combination circuits, is also necessary.

KU13. • Manufacturing Operations and Automation:
• A good understanding of manufacturing processes and automation is essential for designing circuits that cater to specific industrial applications. This includes knowledge of different types of machines and equipment used in manufacturing, as well as the automation techniques employed to control and monitor these processes.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read safety instructions/guidelines
GS2. modify work practices to improve them
GS3. work with supervisors/team members to carry out work related tasks
GS4. complete tasks efficiently and accurately within stipulated time
GS5. inform/report to concerned person in case of any problem
GS6. make timely decisions for efficient utilization of resources
GS7. write reports such as accident report, in at least English/regional language

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Analyze the existing pneumatic or hydraulic circuit to identify any potential issues.	**10**	**20**	**20**	**-**
PC1. Assess the overall performance of the pneumatic or hydraulic circuit, focusing on factors like pressure control, flow rates, response times, and energy efficiency.	3	5	5	-
PC2. Visually inspect the pneumatic or hydraulic components, such as valves, cylinders, pumps, and sensors, for signs of wear, damage, or malfunction.	3	5	5	-
PC3. Measure the pressure and flow rates at various points within the pneumatic or hydraulic circuit to identify any inconsistencies or deviations from the expected values.	2	5	5	-
PC4. Maintain detailed records of the analysis process, including observations, findings, and potential causes of the identified issues.	2	5	5	-
Utilize advanced design techniques and software tools to optimize the pneumatic or hydraulic circuit's design.	**5**	**10**	**10**	**-**
PC5. Identify and select appropriate software tools and design techniques that cater to the specific requirements of the pneumatic or hydraulic circuit.	1	2	2	-
PC6. Develop an accurate model of the pneumatic or hydraulic circuit using the selected software tools.	2	3	3	-
PC7. Analyze the performance of the circuit model under various operating conditions, such as different flow rates, pressures, and temperatures.	1	2	2	-
PC8. Apply optimization techniques, such as genetic algorithms or gradient-based methods, to fine-tune the circuit design for improved performance, energy efficiency, and component sizing.	1	3	3	-
Perform simulations of the designed circuit using specialized software to evaluate its performance.	**5**	**10**	**10**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Develop a detailed model of the designed circuit within the simulation software.	2	4	4	-
PC10. Configure the simulation settings, such as the time step, simulation duration, and output data format.	2	3	3	-
PC11. Analyze the simulation results, focusing on key performance metrics such as pressure, flow, temperature, and energy consumption.	1	3	3	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8382
NOS Name	Hydraulics and Pneumatics
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N3549: Lubrication & Mechanical Drives

Description

This NOS unit is about to Identify and categorize Lubrication & Mechanical Drives as per Requirement.

Scope

The scope covers the following :

- Identify the types of lubrication and mechanical drives involved in the process.
- Categorize the mechanical drives used in the manufacturing.
- Assess the performance of the identified lubrication and mechanical drive systems,

Elements and Performance Criteria

Identify the types of lubrication and mechanical drives involved in the process

To be competent, the user/individual on the job must be able to:

PC1. Examine relevant documentation, such as process flow diagrams, equipment manuals, and maintenance records, to gather information about the lubrication and mechanical drive systems currently in use

PC2. Determine the types of lubrication systems used in the manufacturing process, such as oil-based, grease-based, or water-based systems

PC3. Identify the mechanical drives used in the manufacturing process, such as belt drives, chain drives, gear drives, and direct drives.

PC4. Evaluate the performance of the identified lubrication and mechanical drive systems, focusing on factors such as efficiency, reliability, and maintenance requirements.

PC5. Compile the information gathered during the documentation review, on-site inspection, and performance assessment into a comprehensive report.

Categorize the mechanical drives used in the manufacturing

To be competent, the user/individual on the job must be able to:

PC6. Collect information about the mechanical drives present in the specific manufacturing process you are categorizing.

PC7. Identify the primary categories of mechanical drives, such as belt drives, chain drives, gear drives, and direct drives.

PC8. Evaluate the performance of each mechanical drive in terms of efficiency, reliability, and maintenance requirements.

PC9. Create a comprehensive report or spreadsheet that lists all the mechanical drives identified in the manufacturing process.

Assess the performance of the identified lubrication and mechanical drive systems

To be competent, the user/individual on the job must be able to:

PC10. Analyze the collected data to assess the performance of the lubrication and mechanical drive systems against the established performance indicators.

PC11. Investigate any issues or anomalies identified during the performance evaluation.

PC12. Perform tests on the lubrication and mechanical drive systems to evaluate their performance under various operating conditions

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant organisational standards such as work standard, Standard Operating Procedure, quality process, maintenance standards etc. followed in the company

KU2. importance of cycle-time and required output as per work order and work instructions

KU3. drawing standards used by the company

KU4. Technical Knowledge: A strong foundation in engineering principles, particularly in mechanical, electrical, and industrial engineering. This knowledge helps in understanding the working mechanisms, components, and functions of various lubrication systems and mechanical drives used in manufacturing processes.

KU5. Lubrication Systems Understanding: Familiarity with different types of lubrication systems such as splash, forced feed, and bath lubrication, as well as knowledge about lubricants, their properties, and applications.

KU6. Mechanical Drives Awareness: Knowledge about various types of mechanical drives like belt drives, chain drives, gear drives, and couplings, along with their working principles, advantages, and limitations.

KU7. Manufacturing Processes Familiarity: Understanding the various manufacturing processes, such as assembly, forging, casting, and welding, and how lubrication and mechanical drives play a role in these processes.

KU8. Material Science Knowledge: Familiarity with materials used in manufacturing, such as metals, plastics, and composites, and their properties, which can impact the choice of lubrication and mechanical drives.

KU9. Maintenance and Reliability Concepts: Knowledge of preventive maintenance practices and reliability engineering principles to ensure optimal performance and longevity of lubrication and mechanical drives systems in manufacturing.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret workplace related drawing

GS2. communicate the changes and requirements to supervisor by using relevant drawing terms and nomenclature

GS3. attentively listen and comprehend the information given by the supervisor/team members

GS4. write in English/regional language

GS5. recognise problem in drawing and take suitable action

GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Identify the types of lubrication and mechanical drives involved in the process	**10**	**20**	**20**	**-**
PC1. Examine relevant documentation, such as process flow diagrams, equipment manuals, and maintenance records, to gather information about the lubrication and mechanical drive systems currently in use	2	4	4	-
PC2. Determine the types of lubrication systems used in the manufacturing process, such as oil-based, grease-based, or water-based systems	2	4	4	-
PC3. Identify the mechanical drives used in the manufacturing process, such as belt drives, chain drives, gear drives, and direct drives.	2	4	4	-
PC4. Evaluate the performance of the identified lubrication and mechanical drive systems, focusing on factors such as efficiency, reliability, and maintenance requirements.	2	4	4	-
PC5. Compile the information gathered during the documentation review, on-site inspection, and performance assessment into a comprehensive report.	2	4	4	-
Categorize the mechanical drives used in the manufacturing	**5**	**10**	**10**	**-**
PC6. Collect information about the mechanical drives present in the specific manufacturing process you are categorizing.	2	2	2	-
PC7. Identify the primary categories of mechanical drives, such as belt drives, chain drives, gear drives, and direct drives.	1	3	3	-
PC8. Evaluate the performance of each mechanical drive in terms of efficiency, reliability, and maintenance requirements.	1	3	3	-
PC9. Create a comprehensive report or spreadsheet that lists all the mechanical drives identified in the manufacturing process.	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Assess the performance of the identified lubrication and mechanical drive systems	**5**	**10**	**10**	**-**
PC10. Analyze the collected data to assess the performance of the lubrication and mechanical drive systems against the established performance indicators.	1	3	3	-
PC11. Investigate any issues or anomalies identified during the performance evaluation.	2	4	4	-
PC12. Perform tests on the lubrication and mechanical drive systems to evaluate their performance under various operating conditions	2	3	3	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N3549
NOS Name	Lubrication & Mechanical Drives
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Machining Operation
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8383: PLC and Electrical Drives

Description

This NOS unit is about to Develop proficiency in Programming, Controlling, and diagnosing of PLC & Drives.

Scope

The scope covers the following :

- Choose the appropriate PLC and drive systems based on the requirements.
- Install the selected PLC and drive hardware components and configure.
- Integrate the PLC and drive systems with the manufacturing process.

Elements and Performance Criteria

Choose the appropriate PLC and drive systems based on the requirements.

To be competent, the user/individual on the job must be able to:

PC1. Identify the number and types of input and output signals required for the process

PC2. Assess the communication requirements between the PLC, drive systems, and other connected devices.

PC3. Evaluate the control functions required for the manufacturing process, such as PID control, sequential control, or safety functions.

PC4. Determine the power requirements for the PLC and drive systems, considering factors such as the number of connected devices, power consumption, and voltage/frequency specifications

PC5. Ensure that the selected PLC and drive systems are compatible with the necessary software tools and programming languages, such as Ladder Logic, Structured Text, or Function Block Diagram.

Install the selected PLC and drive hardware components and configure.

To be competent, the user/individual on the job must be able to:

PC6. Choose an appropriate location for installing the PLC and drive hardware components, considering factors such as accessibility, space requirements, and environmental conditions

PC7. Securely mount the PLC enclosure on a suitable surface, following the manufacturer's guidelines.

PC8. Install the required Input/Output (I/O) modules in the PLC enclosure, following the manufacturer's instructions.

PC9. Configure the communication interfaces (e.g., Ethernet, serial, or wireless) on the PLC, as per the requirements of the manufacturing process and the connected devices.

Integrate the PLC and drive systems with the manufacturing process.

To be competent, the user/individual on the job must be able to:

PC10. Configure the communication protocols between the PLC and drive systems and the other components of the manufacturing process.

PC11. Perform thorough testing of the integrated PLC and drive systems to ensure they are functioning as intended.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant organisational standards such as work standard, Standard Operating Procedure, quality process, maintenance standards etc. followed in the company

KU2. importance of cycle-time and required output as per work order and work instructions

KU3. drawing standards used by the company

KU4. Fundamentals of Electrical and Electronics: Understanding electrical and electronic principles is crucial for working with PLCs and drives. This includes topics like Ohm's Law, Kirchhoff's Laws, and electronic components.

KU5. PLC Hardware and Architecture: Familiarize yourself with the various PLC components, their functions, and how they interact within the system. This includes understanding the CPU, power supply, communication ports, and I/O modules.

KU6. PLC Programming Languages: Learn different PLC programming languages, such as Ladder Logic (LAD), Functional Block Diagram (FBD), Structured Text (ST), and Sequential Function Charts (SFC).

KU7. Logic and Timing: Understand how to create and implement logical operations, timing sequences, and timing circuits in PLC programming.

KU8. PLC Communication Protocols: Learn about communication protocols like Modbus, Ethernet/IP, and PROFIBUS, which are commonly used in PLC systems.

KU9. Industrial Automation and Manufacturing Processes: Gain knowledge about various manufacturing processes and how PLCs and drives are used to control and automate them.

KU10. Drive Systems: Understand the principles of drive systems, including AC and DC drives, frequency converters, and motor control.

KU11. Troubleshooting and Diagnostics: Learn how to identify and resolve common issues in PLC and drive systems, including hardware and software faults.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret workplace related drawing

GS2. communicate the changes and requirements to supervisor by using relevant drawing terms and nomenclature

GS3. attentively listen and comprehend the information given by the supervisor/team members

GS4. write in English/regional language

GS5. recognise problem in drawing and take suitable action

GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Choose the appropriate PLC and drive systems based on the requirements.	**10**	**20**	**20**	**-**
PC1. Identify the number and types of input and output signals required for the process	2	4	4	-
PC2. Assess the communication requirements between the PLC, drive systems, and other connected devices.	2	4	4	-
PC3. Evaluate the control functions required for the manufacturing process, such as PID control, sequential control, or safety functions.	2	4	4	-
PC4. Determine the power requirements for the PLC and drive systems, considering factors such as the number of connected devices, power consumption, and voltage/frequency specifications	2	4	4	-
PC5. Ensure that the selected PLC and drive systems are compatible with the necessary software tools and programming languages, such as Ladder Logic, Structured Text, or Function Block Diagram.	2	4	4	-
Install the selected PLC and drive hardware components and configure.	**5**	**10**	**10**	**-**
PC6. Choose an appropriate location for installing the PLC and drive hardware components, considering factors such as accessibility, space requirements, and environmental conditions	1	2	2	-
PC7. Securely mount the PLC enclosure on a suitable surface, following the manufacturer's guidelines.	1	2	2	-
PC8. Install the required Input/Output (I/O) modules in the PLC enclosure, following the manufacturer's instructions.	1	3	3	-
PC9. Configure the communication interfaces (e.g., Ethernet, serial, or wireless) on the PLC, as per the requirements of the manufacturing process and the connected devices.	2	3	3	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Integrate the PLC and drive systems with the manufacturing process.	**5**	**10**	**10**	**-**
PC10. Configure the communication protocols between the PLC and drive systems and the other components of the manufacturing process.	2	4	4	-
PC11. Perform thorough testing of the integrated PLC and drive systems to ensure they are functioning as intended.	3	6	6	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8383
NOS Name	PLC and Electrical Drives
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N9841: Best Industrial Practices

Description

This NOS is about to Maintain an organized and clean workshop, ensuring Best Industrial Practices.

Scope

The scope covers the following :

- Conduct regular inspections of the workshop to identify potential issues.
- Implement safety measures in the workshop.
- Develop a waste management plan

Elements and Performance Criteria

Conduct regular inspections of the workshop to identify potential issues

To be competent, the user/individual on the job must be able to:

PC1. Create a regular inspection schedule that outlines the frequency and tasks for inspecting various areas of the workshop

PC2. Identify specific areas and checkpoints within the workshop that require regular inspection, such as equipment, tools, storage areas, and safety equipment.

PC3. Create a comprehensive checklist that covers all aspects of the workshop, including equipment functionality, cleanliness, safety measures, and potential hazards

PC4. Perform the scheduled inspections, following the established checklist and paying close attention to any signs of potential issues, such as equipment malfunctions, hazardous conditions, or clutter.

Implement safety measures in the workshop

To be competent, the user/individual on the job must be able to:

PC5. Identify potential hazards in the workshop by conducting a thorough risk assessment.

PC6. Create a comprehensive safety policy that outlines the expectations and procedures for maintaining a safe workshop environment

PC7. Establish a policy for the use of personal protective equipment, such as gloves, goggles, hard hats, and safety shoes. Ensure that appropriate PPE is readily available and that employees are trained in its proper use.

PC8. Develop and communicate emergency response procedures, including evacuation plans, fire safety measures, and first aid protocols.

Develop a waste management plan

To be competent, the user/individual on the job must be able to:

PC9. Establish specific, measurable, achievable, relevant, and time-bound (SMART) goals for reducing waste generation.

PC10. Categorize the different types of waste generated, such as paper, plastics, metals, glass, hazardous materials, and organic waste

PC11. Collaborate with waste management service providers, recycling companies, and other organizations to facilitate the efficient handling and disposal of waste.

PC12. Regularly monitor and evaluate the effectiveness of the waste management plan by tracking waste generation, recycling rates, and other relevant metrics.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant manufacturing, quality and maintenance standards and procedures followed in the organisation

KU2. functional processes like Procurement, Store management, inventory management, quality management and key contact points for query resolution

KU3. requirement of raw materials, tools and equipment on the shift/line

KU4. Workshop Organization: Understand the importance of a well-organized workspace, including proper storage, labeling, and arrangement of tools and equipment. Know how to categorize and group items based on their frequency of use, type, and size

KU5. Safety Protocols: Have a thorough understanding of safety guidelines and protocols in the workshop, such as using personal protective equipment (PPE), maintaining proper ventilation, and following fire safety procedures.

KU6. Cleanliness and Hygiene: Know the importance of maintaining cleanliness in the workshop to prevent accidents, contamination, and the spread of germs. Understand proper cleaning techniques and the use of appropriate cleaning materials.

KU7. Industrial Practices: Be well-versed in best industrial practices related to workshop maintenance, such as regular equipment maintenance, proper disposal of hazardous waste, and adherence to environmental guidelines.

KU8. Time Management: Develop an understanding of efficient time management techniques to ensure tasks are completed in a timely manner, minimizing disruptions and downtime in the workshop.

KU9. Communication Skills: Understand the importance of clear communication among team members to ensure everyone is on the same page regarding workshop organization, cleanliness, and safety protocols.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret work instructions, reports and process documents

GS2. communicate the production requirements and issues to the seniors and other departments

GS3. attentively listen and comprehend the information given by the master technician/team members

GS4. write reports related to production process in English/regional language

GS5. recognise a workplace problem and take suitable action

GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS7. plan and organise work according to the work requirements

GS8. report to the supervisor or deal with a colleague individually, depending on the type of concern

GS9. complete the assigned tasks with minimum supervision

GS10. explore new approach of doing things to resolve issues

GS11. suggest improvements (if any) in current ways of working

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Conduct regular inspections of the workshop to identify potential issues	**5**	**10**	**10**	**-**
PC1. Create a regular inspection schedule that outlines the frequency and tasks for inspecting various areas of the workshop	2	3	3	-
PC2. Identify specific areas and checkpoints within the workshop that require regular inspection, such as equipment, tools, storage areas, and safety equipment.	1	3	3	-
PC3. Create a comprehensive checklist that covers all aspects of the workshop, including equipment functionality, cleanliness, safety measures, and potential hazards	1	2	2	-
PC4. Perform the scheduled inspections, following the established checklist and paying close attention to any signs of potential issues, such as equipment malfunctions, hazardous conditions, or clutter.	1	2	2	-
Implement safety measures in the workshop	**5**	**10**	**10**	**-**
PC5. Identify potential hazards in the workshop by conducting a thorough risk assessment.	1	3	3	-
PC6. Create a comprehensive safety policy that outlines the expectations and procedures for maintaining a safe workshop environment	2	3	3	-
PC7. Establish a policy for the use of personal protective equipment, such as gloves, goggles, hard hats, and safety shoes. Ensure that appropriate PPE is readily available and that employees are trained in its proper use.	1	2	2	-
PC8. Develop and communicate emergency response procedures, including evacuation plans, fire safety measures, and first aid protocols.	1	2	2	-
Develop a waste management plan	**5**	**10**	**10**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Establish specific, measurable, achievable, relevant, and time-bound (SMART) goals for reducing waste generation.	2	3	3	-
PC10. Categorize the different types of waste generated, such as paper, plastics, metals, glass, hazardous materials, and organic waste	1	2	2	-
PC11. Collaborate with waste management service providers, recycling companies, and other organizations to facilitate the efficient handling and disposal of waste.	1	3	3	-
PC12. Regularly monitor and evaluate the effectiveness of the waste management plan by tracking waste generation, recycling rates, and other relevant metrics.	1	2	2	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N9841
NOS Name	Best Industrial Practices
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Generic
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8386: Sensors & Actuators

Description

This NOS is about to Collect data from the environment provide crucial feedback for closed-loop control systems using Sensors & Actuators.

Scope

The scope covers the following :

- Identify key environmental parameters to be Addressed.
- Install the selected sensors at strategic locations.
- Calibrate the sensors to ensure accurate readings.
- Perform routine maintenance on the sensors, actuators, and control system.

Elements and Performance Criteria

Identify key environmental parameters to be Addressed

To be competent, the user/individual on the job must be able to:

PC1. List any known issues or hazards that may arise within the industrial process.

PC2. Determine how each identified environmental factor may impact the industrial process, equipment, or worker safety

PC3. prioritize the environmental parameters that should be monitored and controlled using industrial sensors

PC4. Install the sensors and integrate them into the industrial process, ensuring that they are properly calibrated and functioning as expected

install the selected sensors at strategic locations

To be competent, the user/individual on the job must be able to:

PC5. Assemble the required tools and materials for sensor installation, such as mounting hardware, wiring, and any additional components specified by the sensor manufacturer

PC6. Connect the sensors to the data acquisition system or control system using the appropriate wiring and connectors

PC7. Perform a calibration check to ensure that the sensors are providing accurate readings. Test the sensors under various conditions to verify their performance and responsiveness.

PC8. Conduct a thorough inspection of the installed sensors to verify that they are securely mounted, properly connected, and functioning correctly.

Calibrate the sensors to ensure accurate readings

To be competent, the user/individual on the job must be able to:

PC9. Assemble the required equipment and tools for calibration, such as calibration standards, calibration fixtures, test instruments, and adjustment tools

PC10. Use reference standards or calibration equipment that provide accurate and traceable measurement values.

PC11. Evaluate the calibration results to determine if the sensor is within its specified tolerance limits

Perform routine maintenance on the sensors, actuators, and control system

To be competent, the user/individual on the job must be able to:

PC12. Establish a maintenance schedule that outlines the frequency and scope of maintenance activities for each component.

PC13. Test the actuators to verify that they are responding correctly to control signals from the system. Inspect the actuators for signs of wear, damage, or malfunction. Replace or repair any faulty actuators to ensure they can perform their intended functions

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant manufacturing, quality and maintenance standards and procedures followed in the organisation

KU2. functional processes like Procurement, Store management, inventory management, quality management and key contact points for query resolution

KU3. requirement of raw materials, tools and equipment on the shift/line

KU4. how to prepare shift roster and maintain performance information of the team

KU5. use of ERP system for maintaining and updating production line data

KU6. documents and reports related to production process

KU7. various process improvement techniques like Kaizen, 5S, Poka Yoke, TQM etc

KU8. how to audit gaps and issues in production process and their analysis

KU9. Sensor Technology: Understanding various types of sensors, their working principles, and applications is crucial. This includes knowledge about different sensor modalities like temperature, pressure, humidity, and other environmental parameters

KU10. Actuator Technology: Familiarity with actuator types (e.g., electromechanical, pneumatic, or hydraulic) and their functions in controlling and manipulating the environment is necessary.

KU11. Data Acquisition Systems: Knowledge about data acquisition hardware and software is vital for interfacing sensors and actuators with the control system. This includes understanding data sampling rates, signal conditioning, and data transmission protocols

KU12. Signal Processing: An understanding of signal processing techniques, such as filtering, amplification, and noise reduction, is important for obtaining accurate and reliable data from sensors

KU13. Control Theory: Familiarity with control theory concepts like feedback loops, gain, and transfer functions is essential for designing and implementing closed-loop control systems

KU14. Programming and Scripting: Proficiency in programming languages (e.g., Python, or MATLAB) and scripting tools for data analysis, visualization, and control system implementation is crucial.

KU15. Mathematics and Statistics: Strong mathematical and statistical skills are necessary for data analysis, modeling, and optimization in closed-loop control systems.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret work instructions, reports and process documents

GS2. communicate the production requirements and issues to the seniors and other departments

GS3. attentively listen and comprehend the information given by the master technician/team members

GS4. write reports related to production process in English/regional language

GS5. recognise a workplace problem and take suitable action

GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS7. plan and organise work according to the work requirements

GS8. report to the supervisor or deal with a colleague individually, depending on the type of concern

GS9. complete the assigned tasks with minimum supervision

GS10. explore new approach of doing things to resolve issues

GS11. suggest improvements (if any) in current ways of working

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Identify key environmental parameters to be Addressed	**5**	**20**	**20**	**-**
PC1. List any known issues or hazards that may arise within the industrial process.	1	5	5	-
PC2. Determine how each identified environmental factor may impact the industrial process, equipment, or worker safety	1	5	5	-
PC3. prioritize the environmental parameters that should be monitored and controlled using industrial sensors	1	5	5	-
PC4. Install the sensors and integrate them into the industrial process, ensuring that they are properly calibrated and functioning as expected	2	5	5	-
install the selected sensors at strategic locations	**5**	**5**	**5**	**-**
PC5. Assemble the required tools and materials for sensor installation, such as mounting hardware, wiring, and any additional components specified by the sensor manufacturer	2	1	1	-
PC6. Connect the sensors to the data acquisition system or control system using the appropriate wiring and connectors	1	1	1	-
PC7. Perform a calibration check to ensure that the sensors are providing accurate readings. Test the sensors under various conditions to verify their performance and responsiveness.	1	1	1	-
PC8. Conduct a thorough inspection of the installed sensors to verify that they are securely mounted, properly connected, and functioning correctly.	1	2	2	-
Calibrate the sensors to ensure accurate readings	**5**	**8**	**8**	**-**
PC9. Assemble the required equipment and tools for calibration, such as calibration standards, calibration fixtures, test instruments, and adjustment tools	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. Use reference standards or calibration equipment that provide accurate and traceable measurement values.	2	3	3	-
PC11. Evaluate the calibration results to determine if the sensor is within its specified tolerance limits	2	3	3	-
Perform routine maintenance on the sensors, actuators, and control system	**5**	**7**	**7**	**-**
PC12. Establish a maintenance schedule that outlines the frequency and scope of maintenance activities for each component.	2	3	3	-
PC13. Test the actuators to verify that they are responding correctly to control signals from the system. Inspect the actuators for signs of wear, damage, or malfunction. Replace or repair any faulty actuators to ensure they can perform their intended functions	3	4	4	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8386
NOS Name	Sensors & Actuators
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8387: SCADA & Industrial Automation

Description

This NOS is about to Monitor, control, and manage various processes and systems using SCADA & Industrial Automation.

Scope

The scope covers the following :

- Develop a system architecture that integrates sensors, actuators, and control algorithms.
- Perform commissioning and testing to verify that the SCADA and automation systems.
- Regularly maintain the hardware and software components of the SCADA and automation systems

Elements and Performance Criteria

Develop a system architecture that integrates sensors, actuators, and control algorithms

To be competent, the user/individual on the job must be able to:

PC1. Identify the process requirements that need to be monitored and controlled, such as temperature, pressure, flow rate, or other critical parameters.

PC2. Determine the necessary sensors, actuators, and control devices required to monitor and control the process parameters.

PC3. Develop control algorithms and logic to manage the interactions between sensors, actuators, and the process

PC4. Design the network infrastructure required to connect the sensors, actuators, and control system components.

PC5. Configure the selected components and devices to work together within the designed system architecture.

Perform commissioning and testing to verify that the SCADA and automation systems

To be competent, the user/individual on the job must be able to:

PC6. Create a detailed plan outlining the testing procedures, test cases, and acceptance criteria for the SCADA and automation systems.

PC7. Set up a suitable test environment that closely resembles the actual operating conditions of the process.

PC8. Perform functional testing to verify that the SCADA and automation systems can perform their intended functions correctly

PC9. Test the integration between the SCADA and automation systems and other components of the process, such as sensors, actuators, and control devices.

PC10. Test the accuracy and reliability of data acquisition and processing by comparing the data collected by the SCADA system with known reference values or expected results

PC11. Verify that the user interfaces and reporting features of the SCADA system are functioning correctly and providing the required information to the users.

PC12. Review the test results and identify any issues, errors, or areas for improvement. Document the findings and create a prioritized list of actions to address the issues

Regularly maintain the hardware and software components of the SCADA and automation systems

To be competent, the user/individual on the job must be able to:

PC13. Periodically calibrate the sensors and actuators to ensure they are providing accurate readings.

PC14. inspect the hardware components, such as control devices, communication equipment, and power supplies, for any signs of damage, corrosion, or loose connections. Address any issues promptly to prevent potential system failures.

PC15. Regularly review system logs and alerts for any indications of malfunctioning components, unusual activity, or potential issues.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. fundamentals of the CNC/conventional machine

KU2. various types of machining processes such as drilling, boring, turning etc.

KU3. SOP recommended by the manufacturer for using tools, jigs, fixtures, measuring instruments etc., during the machining processes.

KU4. how to select and modify the CNC machining program

KU5. Familiarity with SCADA Systems: A strong understanding of SCADA systems, their components, and how they function is crucial. This includes knowledge of HMI (Human-Machine Interface), PLCs (Programmable Logic Controllers), and communication protocols like Modbus, DNP3, and OPC

KU6. Industrial Automation Concepts: Understanding automation principles, control loops, and process control systems is essential. Familiarity with PID (Proportional-Integral-Derivative) control, sensors, and actuators is also vital

KU7. Programming Languages: Proficiency in programming languages commonly used in SCADA and Industrial Automation, such as Ladder Logic, Structured Text, Function Block Diagram, is necessary.

KU8. Networking and Communication: Knowledge of industrial networking protocols, such as Ethernet, PROFINET, and Ethernet/IP, as well as familiarity with network topologies and security measures, is essential

KU9. Database Management: Ability to handle and manage data collected by SCADA systems using databases like SQL or Oracle is important for efficient analysis and decision-making

KU10. Process Optimization: Understanding the principles of process optimization, such as Six Sigma and Lean Manufacturing, can help in improving system efficiency and reducing downtime

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret work instructions, machine drawings, reports and process documents

GS2. communicate the machining requirements to the seniors and other departments

GS3. communicate issues to the supervisor that occur during machining process

GS4. attentively listen and comprehend the information given by the master technician/team members

GS5. write reports related to production process in English/regional language

GS6. recognise a workplace problem and take suitable action

GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS8. plan and organise work according to the work requirements

GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

GS10. complete the assigned tasks with minimum supervision

GS11. suggest improvements (if any) in current ways of working

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Develop a system architecture that integrates sensors, actuators, and control algorithms	**10**	**20**	**20**	**-**
PC1. Identify the process requirements that need to be monitored and controlled, such as temperature, pressure, flow rate, or other critical parameters.	2	4	4	-
PC2. Determine the necessary sensors, actuators, and control devices required to monitor and control the process parameters.	2	4	4	-
PC3. Develop control algorithms and logic to manage the interactions between sensors, actuators, and the process	2	4	4	-
PC4. Design the network infrastructure required to connect the sensors, actuators, and control system components.	2	4	4	-
PC5. Configure the selected components and devices to work together within the designed system architecture.	2	4	4	-
Perform commissioning and testing to verify that the SCADA and automation systems	**5**	**10**	**10**	**-**
PC6. Create a detailed plan outlining the testing procedures, test cases, and acceptance criteria for the SCADA and automation systems.	1	1	1	-
PC7. Set up a suitable test environment that closely resembles the actual operating conditions of the process.	1	2	2	-
PC8. Perform functional testing to verify that the SCADA and automation systems can perform their intended functions correctly	1	1	1	-
PC9. Test the integration between the SCADA and automation systems and other components of the process, such as sensors, actuators, and control devices.	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. Test the accuracy and reliability of data acquisition and processing by comparing the data collected by the SCADA system with known reference values or expected results	-	1	1	-
PC11. Verify that the user interfaces and reporting features of the SCADA system are functioning correctly and providing the required information to the users.	-	1	1	-
PC12. Review the test results and identify any issues, errors, or areas for improvement. Document the findings and create a prioritized list of actions to address the issues	1	2	2	-
Regularly maintain the hardware and software components of the SCADA and automation systems	**5**	**10**	**10**	**-**
PC13. Periodically calibrate the sensors and actuators to ensure they are providing accurate readings.	1	3	3	-
PC14. inspect the hardware components, such as control devices, communication equipment, and power supplies, for any signs of damage, corrosion, or loose connections. Address any issues promptly to prevent potential system failures.	2	3	3	-
PC15. Regularly review system logs and alerts for any indications of malfunctioning components, unusual activity, or potential issues.	2	4	4	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8387
NOS Name	SCADA & Industrial Automation
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8388: I 4.0 Technologies

Description

This NOS is about to Perform Integration of different components, systems, and processes of Smart Manufacturing using Industry 4.0 Technologies.

Scope

The scope covers the following :

- Determine the specific integration requirements for the smart manufacturing.
- Design the overall architecture for the integrated smart manufacturing.
- Integrate the different components, systems, and processes using Industry 4.0 technologies.

Elements and Performance Criteria

Determine the specific integration requirements for the smart manufacturing.

To be competent, the user/individual on the job must be able to:

PC1. Determine the types of data that need to be exchanged between the different components and systems, such as process data, sensor data, and control commands.

PC2. Evaluate the communication protocols currently used by the different components and systems to ensure they are compatible with each other

PC3. Determine the process control requirements for the integrated smart manufacturing system, including the need for real-time control, adaptive control, or predictive control

PC4. Create specific use cases that demonstrate how the different components, systems, and processes will be integrated and how they will work together to achieve the desired outcomes

PC5. Compile all the gathered information into a comprehensive document that outlines the specific integration requirements for the smart manufacturing initiative

Design the overall architecture for the integrated smart manufacturing

To be competent, the user/individual on the job must be able to:

PC6. Conduct a thorough analysis of the existing systems and processes to be integrated.

PC7. Identify the specific integration requirements for the smart manufacturing systems, including data exchange, process control, and communication protocols

PC8. Design the architecture in a modular fashion, allowing for flexibility and scalability

PC9. Develop a comprehensive cybersecurity framework to protect the integrated smart manufacturing system from potential threats, such as unauthorized access, data breaches, or cyber-attacks.

Integrate the different components, systems, and processes using Industry 4.0 technologies

To be competent, the user/individual on the job must be able to:

PC10. Determine the specific integration requirements for the smart manufacturing systems, including data exchange, process control, and communication protocols.

PC11. Create a comprehensive integration plan that outlines the steps, timelines, and resources required for the integration process

PC12. Integrate the overall architecture for the integrated smart manufacturing system, including the hardware and software components, communication protocols, and data flow

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. fundamentals of the conventional machine

KU2. various types of machining processes such as drilling, boring, turning etc.

KU3. SOP recommended by the manufacturer for using tools, jigs, fixtures, measuring instruments etc., during the machining processes.

KU4. how to select and modify the Robot program

KU5. SOP recommended by the organisation for operating Robot and conventional machine

KU6. Robotics Fundamentals: A strong understanding of robotics principles such as mechanics, electronics, control systems, and programming is essential

KU7. Programming Languages: Proficiency in programming languages commonly used in robotics, such as C++, Python, and Robot Operating System (ROS), is crucial.

KU8. Robotics Software: Familiarity with robotics software like simulation tools (e.g., Gazebo, V-Rep), path planning algorithms, and motion planning software is vital

KU9. Technical Knowledge: A strong foundation in engineering, computer science, and related disciplines is essential to understand the various components, systems, and processes involved in smart manufacturing.

KU10. Familiarity with Industry 4.0 Technologies: A thorough understanding of the latest Industry 4.0 technologies, such as IoT, AI, machine learning, big data analytics, cloud computing, and cyber-physical systems, is crucial for effective integration

KU11. Systems Thinking: The ability to view the entire manufacturing process as a complex, interconnected system is vital for identifying potential areas of improvement and integration opportunities

KU12. Interoperability and Standardization Knowledge: Understanding industry standards and protocols for data exchange, communication, and interoperability between different components and systems is essential for seamless integration.

KU13. Project Management Skills: Effective project management skills, including planning, scheduling, resource allocation, and risk management, are necessary to ensure the successful implementation and integration of various components and systems.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret work instructions, machine drawings, reports and process documents

GS2. communicate the machining requirements to the seniors and other departments

GS3. communicate issues to the supervisor that occur during machining process

GS4. attentively listen and comprehend the information given by the master technician/team members

GS5. write reports related to production process in English/regional language

GS6. recognise a workplace problem and take suitable action

GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS8. plan and organise work according to the work requirements

GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

GS10. complete the assigned tasks with minimum supervision

GS11. suggest improvements (if any) in current ways of working

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Determine the specific integration requirements for the smart manufacturing.	**10**	**20**	**20**	**-**
PC1. Determine the types of data that need to be exchanged between the different components and systems, such as process data, sensor data, and control commands.	2	4	4	-
PC2. Evaluate the communication protocols currently used by the different components and systems to ensure they are compatible with each other	2	4	4	-
PC3. Determine the process control requirements for the integrated smart manufacturing system, including the need for real-time control, adaptive control, or predictive control	2	4	4	-
PC4. Create specific use cases that demonstrate how the different components, systems, and processes will be integrated and how they will work together to achieve the desired outcomes	2	4	4	-
PC5. Compile all the gathered information into a comprehensive document that outlines the specific integration requirements for the smart manufacturing initiative	2	4	4	-
Design the overall architecture for the integrated smart manufacturing	**5**	**10**	**10**	**-**
PC6. Conduct a thorough analysis of the existing systems and processes to be integrated.	1	3	3	-
PC7. Identify the specific integration requirements for the smart manufacturing systems, including data exchange, process control, and communication protocols	1	2	2	-
PC8. Design the architecture in a modular fashion, allowing for flexibility and scalability	1	3	3	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Develop a comprehensive cybersecurity framework to protect the integrated smart manufacturing system from potential threats, such as unauthorized access, data breaches, or cyber-attacks.	2	2	2	-
Integrate the different components, systems, and processes using Industry 4.0 technologies	**5**	**10**	**10**	**-**
PC10. Determine the specific integration requirements for the smart manufacturing systems, including data exchange, process control, and communication protocols.	1	2	2	-
PC11. Create a comprehensive integration plan that outlines the steps, timelines, and resources required for the integration process	2	4	4	-
PC12. Integrate the overall architecture for the integrated smart manufacturing system, including the hardware and software components, communication protocols, and data flow	2	4	4	-
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8388
NOS Name	I 4.0 Technologies
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N9843: Environmental Studies

Description

This NOS is about to Interpret Environmental Studies in conducting field studies, including data collection, observation, sampling, and recording relevant environmental data.

Scope

The scope covers the following :

- Develop a plan for collecting environmental data.
- Analyze the collected data using appropriate statistical or analytical techniques.
- Interpret the analyzed data in the context of environmental.

Elements and Performance Criteria

Develop a plan for collecting environmental data

To be competent, the user/individual on the job must be able to:

PC1. Determine the types of environmental data required to address the study objectives.

PC2. Choose appropriate study sites based on the objectives of the study and the environmental factors being investigated.

PC3. develop a sampling strategy that ensures representative and reliable data collection.

PC4. Determine the necessary resources required for the data collection, including personnel, equipment, funding, and logistical support

Analyze the collected data using appropriate statistical or analytical techniques

To be competent, the user/individual on the job must be able to:

PC5. Clean and preprocess the collected data to ensure its quality and suitability for analysis.

PC6. Explore the structure and characteristics of the data through descriptive statistics, visualizations, or summary tables.

PC7. Perform the chosen analytical techniques on the preprocessed data, following the appropriate methodology and procedures.

PC8. Validate and verify the results of the analysis by cross-checking them with other data sources, performing sensitivity analyses, or using alternative analytical techniques.

Interpret the analyzed data in the context of environmental.

To be competent, the user/individual on the job must be able to:

PC9. Examine the analyzed data to identify patterns, trends, or relationships that may provide insights into the environmental system being studied.

PC10. Assess the importance and relevance of the study's findings in the context of the broader environmental field

PC11. Compare the study's findings with existing environmental knowledge, theories, or models to determine whether the results support, challenge, or extend current understanding.

PC12. Continuously review and refine the interpretation of the analyzed data as new information becomes available or as the environmental field evolves.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. fundamentals of the Fabrication Process

KU2. various types of machining processes such as drilling, boring, turning etc.

KU3. SOP recommended by the manufacturer for using tools, jigs, fixtures, measuring instruments etc., during the machining processes.

KU4. how to select and modify the CNC machining program

KU5. Environmental Science Knowledge: A strong foundation in environmental science, including ecology, geology, atmospheric science, and hydrology, is crucial for understanding the complexities of the natural environment.

KU6. Research Methods: Familiarity with various research methodologies, including quantitative and qualitative approaches, is vital for designing and executing field studies.

KU7. Data Collection Techniques: Proficiency in using different tools and techniques for data collection, such as field instruments, remote sensing, and GIS technology, is essential for accurate and reliable data acquisition.

KU8. Observation Skills: The ability to observe and document changes in the environment, both natural and human-induced, is crucial for understanding the dynamics of ecosystems and their responses to external factors.

KU9. Sampling Techniques: Knowledge of appropriate sampling methods, such as random, stratified, or systematic sampling, helps ensure that the data collected is representative and statistically valid.

KU10. Data Analysis: Understanding statistical analysis techniques, such as regression analysis, hypothesis testing, and data visualization, is necessary for interpreting and drawing meaningful conclusions from the collected data.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret work instructions, machine drawings, reports and process documents

GS2. communicate the machining requirements to the seniors and other departments

GS3. communicate issues to the supervisor that occur during machining process

GS4. attentively listen and comprehend the information given by the master technician/team members

GS5. write reports related to production process in English/regional language

GS6. recognise a workplace problem and take suitable action

GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS8. plan and organise work according to the work requirements

GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

GS10. complete the assigned tasks with minimum supervision

GS11. suggest improvements (if any) in current ways of working

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Develop a plan for collecting environmental data	**5**	**10**	**10**	**-**
PC1. Determine the types of environmental data required to address the study objectives.	1	2	2	-
PC2. Choose appropriate study sites based on the objectives of the study and the environmental factors being investigated.	2	3	3	-
PC3. develop a sampling strategy that ensures representative and reliable data collection.	1	3	3	-
PC4. Determine the necessary resources required for the data collection, including personnel, equipment, funding, and logistical support	1	2	2	-
Analyze the collected data using appropriate statistical or analytical techniques	**5**	**10**	**10**	**-**
PC5. Clean and preprocess the collected data to ensure its quality and suitability for analysis.	1	3	3	-
PC6. Explore the structure and characteristics of the data through descriptive statistics, visualizations, or summary tables.	1	2	2	-
PC7. Perform the chosen analytical techniques on the preprocessed data, following the appropriate methodology and procedures.	1	3	3	-
PC8. Validate and verify the results of the analysis by cross-checking them with other data sources, performing sensitivity analyses, or using alternative analytical techniques.	2	2	2	-
Interpret the analyzed data in the context of environmental.	**5**	**10**	**10**	**-**
PC9. Examine the analyzed data to identify patterns, trends, or relationships that may provide insights into the environmental system being studied.	1	2	2	-
PC10. Assess the importance and relevance of the study's findings in the context of the broader environmental field	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. Compare the study's findings with existing environmental knowledge, theories, or models to determine whether the results support, challenge, or extend current understanding.	1	3	3	-
PC12. Continuously review and refine the interpretation of the analyzed data as new information becomes available or as the environmental field evolves.	2	3	3	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N9843
NOS Name	Environmental Studies
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Generic
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

DGT/VSQ/N0104: Employability Skills (120 Hours)

Description

This unit is about employability skills, Constitutional values, becoming a professional in the 21st Century, digital, financial, and legal literacy, diversity and Inclusion, English and communication skills, customer service, entrepreneurship, and apprenticeship, getting ready for jobs and career development.

Scope

The scope covers the following :

- Introduction to Employability Skills
- Constitutional values - Citizenship
- Becoming a Professional in the 21st Century
- Basic English Skills
- Career Development & Goal Setting
- Communication Skills
- Diversity & Inclusion
- Financial and Legal Literacy
- Essential Digital Skills
- Entrepreneurship
- Customer Service
- Getting ready for Apprenticeship & Jobs

Elements and Performance Criteria

Introduction to Employability Skills

To be competent, the user/individual on the job must be able to:

PC1. understand the significance of employability skills in meeting the current job market requirement and future of work

PC2. identify and explore learning and employability relevant portals

PC3. research about the different industries, job market trends, latest skills required and the available opportunities

Constitutional values – Citizenship

To be competent, the user/individual on the job must be able to:

PC4. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. for personal growth and the nation's progress

PC5. follow personal values and ethics such as honesty, integrity, caring and respecting others, etc.

PC6. follow and promote environmentally sustainable practices

Becoming a Professional in the 21st Century

To be competent, the user/individual on the job must be able to:

PC7. recognize the significance of 21st Century Skills for employment

PC8. practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life

PC9. adopt a continuous learning mindset for personal and professional development

Basic English Skills

To be competent, the user/individual on the job must be able to:

PC10. use English as a medium of formal and informal communication while dealing with topics of everyday conversation in different contexts

PC11. speak over the phone in English, in an audible manner, using appropriate greetings, opening, and closing statements both on personal and work front

PC12. read and understand routine information, notes, instructions, mails, letters etc. written in English

PC13. write short messages, notes, letters, e-mails etc., using accurate English

Career Development & Goal Setting

To be competent, the user/individual on the job must be able to:

PC14. identify career goals based on the skills, interests, knowledge, and personal attributes

PC15. prepare a career development plan with short- and long-term goals

Communication Skills

To be competent, the user/individual on the job must be able to:

PC16. follow verbal and non-verbal communication etiquette while communicating in professional and public settings

PC17. use active listening techniques for effective communication

PC18. communicate in writing using appropriate style and format based on formal or informal requirements

PC19. work collaboratively with others in a team

Diversity & Inclusion

To be competent, the user/individual on the job must be able to:

PC20. • ensure personal behaviour, conduct, and use appropriate communication by taking gender into • consideration

PC21. empathize with a PwD and aid a PwD, if asked

PC22. escalate any issues related to sexual harassment at the workplace in accordance with the POSH Act

Financial and Legal Literacy

To be competent, the user/individual on the job must be able to:

PC23. identify and select reliable institutions for various financial products and services such as bank account, debit and credit cards, loans, insurance etc.

PC24. carry out offline and online financial transactions, safely and securely, using various methods and check the entries in the passbook

PC25. identify common components of salary and compute income, expenses, taxes, investments etc

PC26. identify relevant rights and laws and use legal aids to fight against legal exploitation

Essential Digital Skills

To be competent, the user/individual on the job must be able to:

PC27. operate digital devices and use their features and applications securely and safely

PC28. carry out basic internet operations by connecting to the internet safely and securely, using the mobile data or other available networks through Bluetooth, Wi-Fi, etc.

PC29. display responsible online behaviour while using various social media platforms

PC30. create a personal email account, send and process received messages as per requirement

PC31. carry out basic procedures in documents, spreadsheets and presentations using respective and appropriate applications

PC32. utilize virtual collaboration tools to work effectively

Entrepreneurship

To be competent, the user/individual on the job must be able to:

PC33. identify different types of Entrepreneurship and Enterprises

PC34. use research and networking skills to identify and assess opportunities for potential business

PC35. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion

PC36. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity

Customer Service

To be competent, the user/individual on the job must be able to:

PC37. identify different types of customers

PC38. identify and respond to customer requests and needs in a professional manner

PC39. use appropriate tools to collect customer feedback

PC40. follow appropriate hygiene and grooming standards

Getting ready for apprenticeship & Jobs

To be competent, the user/individual on the job must be able to:

PC41. create a professional Curriculum vitae (Résumé)

PC42. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively

PC43. apply to identified job openings using offline /online methods as per requirement

PC44. answer questions politely, with clarity and confidence, during recruitment and selection

PC45. identify apprenticeship opportunities and register for it as per guidelines and requirements

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. need for employability skills

KU2. different learning and employability related portals

KU3. various constitutional and personal values

KU4. different environmentally sustainable practices and their importance

KU5. Twenty first (21st) century skills and their importance

KU6. how to use English language for effective verbal (face to face and telephonic) and written communication in formal and informal set up

KU7. importance of career development and setting long- and short-term goals

KU8. Do's and don'ts of effective communication

KU9. POSH Act

KU10. inclusivity and its importance

KU11. different types of disabilities and appropriate verbal and non-verbal communication and behaviour towards PwD

KU12. different types of financial institutes, products, and services

KU13. components of salary and how to compute income and expenditure

KU14. importance of maintaining safety and security in offline and online financial transactions

KU15. different legal rights and laws

KU16. different types of digital devices and the procedure to operate them safely and securely

KU17. how to create and operate an e- mail account

KU18. use applications such as word processors, spreadsheets etc.

KU19. different types of Enterprises and ways to identify business opportunities

KU20. types and needs of customers

KU21. how to apply for a job and prepare for an interview

KU22. apprenticeship scheme and the process of registering on apprenticeship portal

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and write different types of documents/instructions/correspondence in English and other languages

GS2. communicate effectively using appropriate language in formal and informal settings

GS3. behave politely and appropriately with all to maintain effective work relationship

GS4. how to work in a virtual mode, using various technological platforms

GS5. perform calculations efficiently

GS6. solve problems effectively

GS7. pay attention to details

GS8. manage time efficiently

GS9. maintain hygiene and sanitization to avoid infection

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Introduction to Employability Skills	**1**	**1**	**-**	**-**
PC1. understand the significance of employability skills in meeting the current job market requirement and future of work	-	-	-	-
PC2. identify and explore learning and employability relevant portals	-	-	-	-
PC3. research about the different industries, job market trends, latest skills required and the available opportunities	-	-	-	-
Constitutional values – Citizenship	**2**	**1**	**-**	**-**
PC4. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. for personal growth and the nation's progress	-	-	-	-
PC5. follow personal values and ethics such as honesty, integrity, caring and respecting others, etc.	-	-	-	-
PC6. follow and promote environmentally sustainable practices	-	-	-	-
Becoming a Professional in the 21st Century	**2**	**3**	**-**	**-**
PC7. recognize the significance of 21st Century Skills for employment	-	-	-	-
PC8. practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life	-	-	-	-
PC9. adopt a continuous learning mindset for personal and professional development	-	-	-	-
Basic English Skills	**2**	**3**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. use English as a medium of formal and informal communication while dealing with topics of everyday conversation in different contexts	-	-	-	-
PC11. speak over the phone in English, in an audible manner, using appropriate greetings, opening, and closing statements both on personal and work front	-	-	-	-
PC12. read and understand routine information, notes, instructions, mails, letters etc. written in English	-	-	-	-
PC13. write short messages, notes, letters, e-mails etc., using accurate English	-	-	-	-
Career Development & Goal Setting	**1**	**2**	**-**	**-**
PC14. identify career goals based on the skills, interests, knowledge, and personal attributes	-	-	-	-
PC15. prepare a career development plan with short- and long-term goals	-	-	-	-
Communication Skills	**2**	**3**	**-**	**-**
PC16. follow verbal and non-verbal communication etiquette while communicating in professional and public settings	-	-	-	-
PC17. use active listening techniques for effective communication	-	-	-	-
PC18. communicate in writing using appropriate style and format based on formal or informal requirements	-	-	-	-
PC19. work collaboratively with others in a team	-	-	-	-
Diversity & Inclusion	**1**	**2**	**-**	**-**
PC20. • ensure personal behaviour, conduct, and use appropriate communication by taking gender into • consideration	-	-	-	-
PC21. empathize with a PwD and aid a PwD, if asked	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC22. escalate any issues related to sexual harassment at the workplace in accordance with the POSH Act	-	-	-	-
Financial and Legal Literacy	**2**	**3**	**-**	**-**
PC23. identify and select reliable institutions for various financial products and services such as bank account, debit and credit cards, loans, insurance etc.	-	-	-	-
PC24. carry out offline and online financial transactions, safely and securely, using various methods and check the entries in the passbook	-	-	-	-
PC25. identify common components of salary and compute income, expenses, taxes, investments etc	-	-	-	-
PC26. identify relevant rights and laws and use legal aids to fight against legal exploitation	-	-	-	-
Essential Digital Skills	**2**	**3**	**-**	**-**
PC27. operate digital devices and use their features and applications securely and safely	-	-	-	-
PC28. carry out basic internet operations by connecting to the internet safely and securely, using the mobile data or other available networks through Bluetooth, Wi-Fi, etc.	-	-	-	-
PC29. display responsible online behaviour while using various social media platforms	-	-	-	-
PC30. create a personal email account, send and process received messages as per requirement	-	-	-	-
PC31. carry out basic procedures in documents, spreadsheets and presentations using respective and appropriate applications	-	-	-	-
PC32. utilize virtual collaboration tools to work effectively	-	-	-	-
Entrepreneurship	**2**	**3**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC33. identify different types of Entrepreneurship and Enterprises	-	-	-	-
PC34. use research and networking skills to identify and assess opportunities for potential business	-	-	-	-
PC35. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion	-	-	-	-
PC36. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity	-	-	-	-
Customer Service	**1**	**2**	**-**	**-**
PC37. identify different types of customers	-	-	-	-
PC38. identify and respond to customer requests and needs in a professional manner	-	-	-	-
PC39. use appropriate tools to collect customer feedback	-	-	-	-
PC40. follow appropriate hygiene and grooming standards	-	-	-	-
Getting ready for apprenticeship & Jobs	**2**	**4**	**-**	**-**
PC41. create a professional Curriculum vitae (Résumé)	-	-	-	-
PC42. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively	-	-	-	-
PC43. apply to identified job openings using offline /online methods as per requirement	-	-	-	-
PC44. answer questions politely, with clarity and confidence, during recruitment and selection	-	-	-	-
PC45. identify apprenticeship opportunities and register for it as per guidelines and requirements	-	-	-	-
NOS Total	**20**	**30**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	DGT/VSQ/N0104
NOS Name	Employability Skills (120 Hours)
Sector	Cross Sectoral
Sub-Sector	Professional Skills
Occupation	Employability
NSQF Level	6
Credits	4
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8384: Automation

Description

This NOS unit is about to Identify, select, and apply appropriate sensors and actuators for monitoring and controlling processes in automation systems.

Scope

The scope covers the following :

- Develop/interpret e-plan, layout and drawings
- Perform installation and integration of the automation system
- Carry out maintenance of automation system
- Perform post-installation activities.

Elements and Performance Criteria

Develop/Interpret e-plan, layout and drawings

To be competent, the user/individual on the job must be able to:

PC1. prepare/interpret the project design by obtaining information from mechanical drawings and layout diagram

PC2. prepare design of electrical wiring, schematic diagram and project documentation as per organizational SOP and guidelines

PC3. prepare the e-plan consists of layout, mechanical drawings and project execution phases as per work instructions

PC4. identify and select the automation elements in align with electrical, mechanical and environmental parameters like power, response time, inbuilt protections, dimension, weight package, thermal characteristics etc. as per the e-plan and required specifications

PC5. decide on the core and auxiliary support process as per specifications & drawings

PC6. plan and administer automation project as per the e-plan

Perform installation and integration of the automation system

To be competent, the user/individual on the job must be able to:

PC7. mount and place the electrical and mechanical components safely as per design and project document

PC8. route electrical wires, make wiring connections etc. as per the wiring diagram and SOP

PC9. perform assembly of the system components like D.C. valve, cylinder assembly etc. as per the mechanical drawings and SOP

PC10. perform the pre-commissioning to ensure proper functionality of installed automation components

PC11. carry out the various integration activities like programming, wiring with external elements etc. as per design document and SOP

PC12. develop HMI screen for system monitoring controls like process, alarm and maintenance of automation system

PC13. do the necessary parameter setting to drive conveyor motor with VFD

PC14. start the automation system, look for any warnings/errors in it and rectify the same as per organizational guidelines

PC15. perform all necessary tests and procedures required as per industry standards

PC16. perform dry-run of the automation system with the existing manufacturing process

Carry out maintenance of automation system

To be competent, the user/individual on the job must be able to:

PC17. prepare maintenance schedule and checklist for conducting the preventive, predictive and breakdown maintenance of the automation system

PC18. generate the fallback action plan for failures of critical activities

PC19. identify the critical spares with the help of supplier, maintenance team and plan for their availability

PC20. develop the maintenance manual with the help of supplier and maintenance team

Perform post-installation activities

To be competent, the user/individual on the job must be able to:

PC21. conduct the trials of automation system as per the e-plan to align it with existing or new manufacturing process

PC22. handover the system to production team & train them on it as per organizational guidelines and procedures

PC23. prepare documents and records such as experience under development, TGW /TGR faced during process trials etc. as a reference for future development

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. product portfolio of organization

KU2. company manufacturing processes

KU3. Standard operation procedures recommended by manufacturer for using equipment/machinery in use

KU4. how to read wiring diagrams, mechanical drawings and floor layout

KU5. how to select electrical and mechanical automation elements based on specification

KU6. classification of the automation elements as power and safety elements (electrical incomer, circuit breakers, compressed air, hydraulic power pack, FRL, pressure relief valve etc.), input elements (proximity sensors, push buttons, limit switches, reed switches), control elements (relay, contactors, VFD, HMI, pneumatic and hydraulic solenoid valves) and output elements (indicators, buzzer, induction motors, pneumatic and hydraulic actuators)

KU7. types of control system used in the automation system

KU8. installation process includes mounting, wiring standards, routing, element assembly

KU9. programming of PLC and simulation tools from different makers along with integration of automation elements

KU10. HMI screen development process consists of process control, alarm and maintenance of automation system

KU11. device and control parameters to drive conveyor motor with VFD

KU12. APQP procedures, TGW TGR and knowledge management protocol

KU13. industry standards like safety device rating, wire and cable size capacity, connector types etc.

KU14. possible failures of automation elements and its replacement

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. communicate effectively at the workplace

GS2. attentively listen and comprehend the information given by the process managers

GS3. write observations and any work-related information in English/regional language

GS4. recognise a workplace problem and take suitable action

GS5. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS6. complete the assigned tasks in a timely and efficient manner

GS7. coordinate with shop floor workers and team for installing the new systems efficiently

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Develop/Interpret e-plan, layout and drawings	**3**	**8**	**11**	**-**
PC1. prepare/interpret the project design by obtaining information from mechanical drawings and layout diagram	1	1	2	-
PC2. prepare design of electrical wiring, schematic diagram and project documentation as per organizational SOP and guidelines	1	1	2	-
PC3. prepare the e-plan consists of layout, mechanical drawings and project execution phases as per work instructions	-	2	2	-
PC4. identify and select the automation elements in align with electrical, mechanical and environmental parameters like power, response time, inbuilt protections, dimension, weight package, thermal characteristics etc. as per the e-plan and required specifications	1	2	2	-
PC5. decide on the core and auxiliary support process as per specifications & drawings	-	1	2	-
PC6. plan and administer automation project as per the e-plan	-	1	1	-
Perform installation and integration of the automation system	**8**	**13**	**11**	**-**
PC7. mount and place the electrical and mechanical components safely as per design and project document	1	2	2	-
PC8. route electrical wires, make wiring connections etc. as per the wiring diagram and SOP	1	1	1	-
PC9. perform assembly of the system components like D.C. valve, cylinder assembly etc. as per the mechanical drawings and SOP	1	1	1	-
PC10. perform the pre-commissioning to ensure proper functionality of installed automation components	1	1	1	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. carry out the various integration activities like programming, wiring with external elements etc. as per design document and SOP	1	1	1	-
PC12. develop HMI screen for system monitoring controls like process, alarm and maintenance of automation system	1	1	1	-
PC13. do the necessary parameter setting to drive conveyor motor with VFD	1	2	1	-
PC14. start the automation system, look for any warnings/errors in it and rectify the same as per organizational guidelines	1	1	1	-
PC15. perform all necessary tests and procedures required as per industry standards	-	1	1	-
PC16. perform dry-run of the automation system with the existing manufacturing process	-	2	1	-
Carry out maintenance of automation system	**2**	**6**	**5**	**-**
PC17. prepare maintenance schedule and checklist for conducting the preventive, predictive and breakdown maintenance of the automation system	-	1	2	-
PC18. generate the fallback action plan for failures of critical activities	1	1	1	-
PC19. identify the critical spares with the help of supplier, maintenance team and plan for their availability	1	2	1	-
PC20. develop the maintenance manual with the help of supplier and maintenance team	-	2	1	-
Perform post-installation activities	**2**	**3**	**3**	**-**
PC21. conduct the trials of automation system as per the e-plan to align it with existing or new manufacturing process	1	1	1	-
PC22. handover the system to production team & train them on it as per organizational guidelines and procedures	-	1	1	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC23. prepare documents and records such as experience under development, TGW /TGR faced during process trials etc. as a reference for future development	1	1	1	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8384
NOS Name	Automation
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8385: Robot Maintenance

Description

This NOS unit is about Perform Commissioning and alignment procedures to maintain the accuracy and precision of Industrial robotic movements.

Scope

The scope covers the following :

- Select the industrial robot as per e-plan requirement
- Perform installation and commissioning of robot
- Carry out maintenance of industrial robot
- Perform post-installation activities

Elements and Performance Criteria

Select the Industrial Robot as per E Plan Requirement

To be competent, the user/individual on the job must be able to:

PC1. prepare/interpret the project document to obtain information regarding robots and automation system requirements

PC2. select the industrial robot based on mobility, application and robot types like Cylindrical, SCARA, Delta and Articulated

PC3. select the robot based on technical parameters like payload, reach limit, speed, repeatability etc.

PC4. select the suitable end effector like grippers, handling device, spot, sealer and spray gun for the robot to align it with the application.

Perform installation and commissioning of robot

To be competent, the user/individual on the job must be able to:

PC5. prepare the suitable mounting design like floor, ceiling, pedestal etc. as per e-plan, layout diagram and robot manual.

PC6. position the robot and controller on the designated installation area

PC7. connect all cables, wire harness, safety peripherals, tooling etc. as per e-plan, layout diagram and robot manual.

PC8. perform the pre-commissioning to ensure proper functionality of safety elements like operator station controls (E-stop, cycle start, reset), safety peripherals such as light curtains, gate plug connections, tooling and teach pendant controls.

PC9. turn on the power of robot, look for any warnings/errors in it and rectify the same as per organisational guidelines.

PC10. set the initial settings like robot jogging, mastering and axis limits in a standalone environment as per guidelines and robot manual

PC11. program the robot as per the path required for using point to point control system with necessary instructions.

PC12. integrate the robot with automation elements like proximity sensors, motor conveyor with VFD, pneumatic fixtures, indexing table etc. as per SOP and design document.

Carry out maintenance of industrial robot

To be competent, the user/individual on the job must be able to:

PC13. prepare maintenance schedule and checklist for conducting the preventive, predictive and breakdown maintenance of the robot.

PC14. generate the fallback action plan for failures of critical activities

PC15. identify critical spares like encoder, encoder battery, dedicated fuse etc. with the help of supplier, maintenance team and plan for their availability.

PC16. develop the maintenance manual with the help of supplier and maintenance team

Perform post-installation activities

To be competent, the user/individual on the job must be able to:

PC17. conduct the trials of robot as per the e-plan to align it with existing or new manufacturing process

PC18. fine tune the robot program with required cycle time

PC19. perform the backup processes like teach pendant programs, parameters, mastering data using different backup devices as per organisational guidelines.

PC20. handover the system to production team & train them on it as per organisational guidelines and procedures

PC21. prepare documents and records such as experience under development, TGW /TGR faced during process trials etc. as a reference for future development.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. product portfolio of organisation

KU2. company manufacturing processes

KU3. Standard Operation Procedures (SOP) recommended by manufacturer for using equipment/machinery in use

KU4. how to select industrial robots based on specifications like applications, robot types, technical parameters

KU5. types of end effector and their selection criteria

KU6. installation process includes robot mounting, wiring standards, routing, safety peripherals and tool integration

KU7. robot integration with automation elements like electro pneumatics and hydraulics, electrical components like circuit breakers, push buttons, sensors, relay, contactor, indicators, buzzer, motor conveyor, PLC, VFD, HMI

KU8. robot mastering, types and different conditions to do mastering

KU9. teach pendant controls and displays

KU10. robot programming methods, instructions using teach pendant and simulation tools

KU11. APQP procedures, TGW TGR and knowledge management protocol

KU12. industry standards like safety device and its rating, wire and cable size capacity, connector types

KU13. possible failures of automation elements and their replacement
KU14. robot maintenance which includes robot arm, controller and peripheral elements
KU15. robot backup procedures during maintenance
KU16. process cycle time calculation

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. communicate effectively at the workplace
GS2. attentively listen and comprehend the information given by the process managers
GS3. write observations and any work-related information in English/regional language
GS4. recognise a workplace problem and take suitable action
GS5. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently
GS6. complete the assigned tasks in a timely and efficient manner
GS7. coordinate with shop floor workers and team for installing the new systems efficiently

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Select the Industrial Robot as per E Plan Requirement	**4**	**5**	**11**	**-**
PC1. prepare/interpret the project document to obtain information regarding robots and automation system requirements	1	1	2	-
PC2. select the industrial robot based on mobility, application and robot types like Cylindrical, SCARA, Delta and Articulated	1	1	3	-
PC3. select the robot based on technical parameters like payload, reach limit, speed, repeatability etc.	1	2	3	-
PC4. select the suitable end effector like grippers, handling device, spot, sealer and spray gun for the robot to align it with the application.	1	1	3	-
Perform installation and commissioning of robot	**8**	**21**	**17**	**-**
PC5. prepare the suitable mounting design like floor, ceiling, pedestal etc. as per e-plan, layout diagram and robot manual.	1	3	2	-
PC6. position the robot and controller on the designated installation area	-	2	1	-
PC7. connect all cables, wire harness, safety peripherals, tooling etc. as per e-plan, layout diagram and robot manual.	1	3	2	-
PC8. perform the pre-commissioning to ensure proper functionality of safety elements like operator station controls (E-stop, cycle start, reset), safety peripherals such as light curtains, gate plug connections, tooling and teach pendant controls.	2	3	3	-
PC9. turn on the power of robot, look for any warnings/errors in it and rectify the same as per organisational guidelines.	1	2	2	-
PC10. set the initial settings like robot jogging, mastering and axis limits in a standalone environment as per guidelines and robot manual	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. program the robot as per the path required for using point to point control system with necessary instructions.	1	3	3	-
PC12. integrate the robot with automation elements like proximity sensors, motor conveyor with VFD, pneumatic fixtures, indexing table etc. as per SOP and design document.	1	3	2	-
Carry out maintenance of industrial robot	**3**	**7**	**6**	**-**
PC13. prepare maintenance schedule and checklist for conducting the preventive, predictive and breakdown maintenance of the robot.	1	2	3	-
PC14. generate the fallback action plan for failures of critical activities	1	1	1	-
PC15. identify critical spares like encoder, encoder battery, dedicated fuse etc. with the help of supplier, maintenance team and plan for their availability.	1	2	1	-
PC16. develop the maintenance manual with the help of supplier and maintenance team	-	2	1	-
Perform post-installation activities	**5**	**7**	**6**	**-**
PC17. conduct the trials of robot as per the e-plan to align it with existing or new manufacturing process	1	2	1	-
PC18. fine tune the robot program with required cycle time	1	2	1	-
PC19. perform the backup processes like teach pendant programs, parameters, mastering data using different backup devices as per organisational guidelines.	1	2	2	-
PC20. handover the system to production team & train them on it as per organisational guidelines and procedures	1	-	1	-
PC21. prepare documents and records such as experience under development, TGW /TGR faced during process trials etc. as a reference for future development.	1	1	1	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
NOS Total	**20**	**40**	**40**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8385
NOS Name	Robot Maintenance
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8389: Advance Robotics

Description

This NOS is about to Enhance Proficiency in designing complex robotic systems using Advanced Robotics

Scope

The scope covers the following :

- Design the overall structure and organization of the Advance robotic system.
- Develop detailed designs for each subsystem within the robotic system.
- Build and test individual components of the robotic system.
- Implement the control algorithms that govern the behaviour of the robotic system.

Elements and Performance Criteria

Design the overall structure and organization of the Advance robotic system

To be competent, the user/individual on the job must be able to:

PC1. Choose an appropriate architecture for the robotic system based on the identified requirements.

PC2. Identify the necessary hardware components for the robotic system, such as sensors, actuators, power sources, and communication devices.

PC3. Design the system to be scalable and modular, allowing for easy expansion or modification in the future.

Develop detailed designs for each subsystem within the robotic system

To be competent, the user/individual on the job must be able to:

PC4. Conduct research on existing solutions, technologies, and methodologies relevant to the design of the subsystem

PC5. Develop a set of technical specifications for the subsystem, outlining its functional requirements, performance metrics, and any constraints or limitations

PC6. Evaluate different design options for the subsystem, considering factors such as cost, performance, reliability, and complexity.

PC7. Validate the detailed design through simulations, analyses, or other methods to ensure it meets the specified requirements and performs as intended

Build and test individual components of the robotic system

To be competent, the user/individual on the job must be able to:

PC8. Develop detailed designs for the individual components, considering factors such as size, weight, power consumption, and performance requirements. This may involve creating technical specifications, schematics, or 3D models.

PC9. Perform various tests on the individual components to verify their functionality, performance, and compliance with the design specifications

PC10. Identify and resolve any issues or discrepancies found during testing and optimize the component's performance to meet the project requirements.

PC11. Maintain detailed documentation of the component design, fabrication, testing, and optimization processes

Implement the control algorithms that govern the behavior of the robotic system

To be competent, the user/individual on the job must be able to:

PC12. Create detailed specifications for the control algorithms, outlining their functionality, input/output requirements, and performance metrics

PC13. Design the overall structure and organization of the control algorithms, including the decision-making processes, feedback loops, and communication between different components.

PC14. Test the control algorithms and the overall robotic system under various conditions and scenarios to ensure they function as intended and meet the desired performance metrics

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant standards and procedures followed in the company.

KU2. various components and systems of an Electric vehicle

KU3. various assembly operations and methods

KU4. Robotics Fundamentals: A strong foundation in robotics principles such as kinematics, dynamics, control systems, and sensor technologies.

KU5. Programming Languages: Proficiency in programming languages like C, Python, and MATLAB, which are widely used in robotics development.

KU6. Robot Operating System (ROS): Familiarity with ROS, an open-source robotics middleware that helps in creating and integrating robotic systems.

KU7. Artificial Intelligence and Machine Learning: Understanding of AI and ML concepts, algorithms, and techniques to enable intelligent decision-making and problem-solving in robots.

KU8. Computer Vision: Knowledge of computer vision techniques and algorithms to enable robots to perceive and understand their environment.

KU9. Mechanical Design and Manufacturing: Ability to design and fabricate mechanical components, assemblies, and structures for robots.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret drawings, work instructions, equipment manuals and process documents

GS2. communicate the assembly process requirements to the lead technician and co-workers

GS3. communicate issues to the supervisor that occur during assembling process

GS4. attentively listen and comprehend the information given by the lead technician/team members

GS5. write any work related information in English/regional language

GS6. recognise a workplace problem and take suitable action

GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS8. plan and organise work according to the principles of 5S

GS9. complete the assigned tasks with minimum supervision

GS10. report to the supervisor or deal with a colleague individually, depending on the type of concern

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Design the overall structure and organization of the Advance robotic system	**3**	**6**	**6**	**-**
PC1. Choose an appropriate architecture for the robotic system based on the identified requirements.	1	2	2	-
PC2. Identify the necessary hardware components for the robotic system, such as sensors, actuators, power sources, and communication devices.	1	2	2	-
PC3. Design the system to be scalable and modular, allowing for easy expansion or modification in the future.	1	2	2	-
Develop detailed designs for each subsystem within the robotic system	**5**	**12**	**12**	**-**
PC4. Conduct research on existing solutions, technologies, and methodologies relevant to the design of the subsystem	1	3	3	-
PC5. Develop a set of technical specifications for the subsystem, outlining its functional requirements, performance metrics, and any constraints or limitations	1	3	3	-
PC6. Evaluate different design options for the subsystem, considering factors such as cost, performance, reliability, and complexity.	1	3	3	-
PC7. Validate the detailed design through simulations, analyses, or other methods to ensure it meets the specified requirements and performs as intended	2	3	3	-
Build and test individual components of the robotic system	**5**	**8**	**8**	**-**
PC8. Develop detailed designs for the individual components, considering factors such as size, weight, power consumption, and performance requirements. This may involve creating technical specifications, schematics, or 3D models.	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Perform various tests on the individual components to verify their functionality, performance, and compliance with the design specifications	2	2	2	-
PC10. Identify and resolve any issues or discrepancies found during testing and optimize the component's performance to meet the project requirements.	1	2	2	-
PC11. Maintain detailed documentation of the component design, fabrication, testing, and optimization processes	1	2	2	-
Implement the control algorithms that govern the behavior of the robotic system	**2**	**4**	**4**	**-**
PC12. Create detailed specifications for the control algorithms, outlining their functionality, input/output requirements, and performance metrics	1	2	2	-
PC13. Design the overall structure and organization of the control algorithms, including the decision-making processes, feedback loops, and communication between different components.	1	1	1	-
PC14. Test the control algorithms and the overall robotic system under various conditions and scenarios to ensure they function as intended and meet the desired performance metrics	-	1	1	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8389
NOS Name	Advance Robotics
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

Qualification Pack

ASC/N8390: Technical Troubleshooting and Problem Solving

Description

This NOS is about to Perform technical troubleshooting and problem-solving in a Manufacturing Process

Scope

The scope covers the following :

- Collect relevant data and information about the manufacturing process.
- Analyze the symptoms and effects of the issue to determine the root cause.
- Implement appropriate corrective actions to address the issue.

Elements and Performance Criteria

Collect relevant data and information about the manufacturing process

To be competent, the user/individual on the job must be able to:

PC1. Identify the various sources from which data can be collected, such as equipment sensors, production records, quality control reports, and employee feedback.

PC2. Organize and store the collected data in a structured and accessible manner, ensuring that it can be easily retrieved and analyzed when needed.

PC3. Analyze the collected data to identify trends, patterns, and areas for improvement in the manufacturing process.

Analyze the symptoms and effects of the issue to determine the root cause

To be competent, the user/individual on the job must be able to:

PC4. Examine historical production data, including process parameters, equipment logs, and quality control records, to identify any patterns, trends, or anomalies that may be related to the issue.

PC5. Perform targeted tests or simulations to replicate the observed symptoms and effects of the issue.

PC6. Perform additional tests or experiments to confirm or refute the hypothesis.

PC7. Create detailed documentation of the root cause analysis, including the symptoms and effects observed, the data and information analyzed, and the developed hypothesis

Implement appropriate corrective actions to address the issue

To be competent, the user/individual on the job must be able to:

PC8. analyze the issue to understand its root cause and identify the specific aspects of the manufacturing process that require improvement.

PC9. Assess the potential effectiveness of each corrective action by considering factors such as the likelihood of resolving the issue, potential benefits, and potential drawbacks

PC10. Execute the action plan by carrying out the chosen corrective actions. This may involve adjusting equipment settings, modifying work instructions, or reorganizing the production line.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant standards and procedures followed in the company.
KU2. various components and systems of a Manufacturing Process
KU3. various assembly operations and methods
KU4. the process flow of the assembly operations
KU5. Technical Knowledge: A strong understanding of the manufacturing process, equipment, and machinery is crucial. This includes familiarity with the various components, their functions, and how they interact within the overall process.
KU6. Process Understanding: It is essential to have a deep understanding of the manufacturing process, including its various stages, workflows, and interdependencies. This knowledge helps in identifying potential problem areas and devising effective solutions
KU7. Analytical Skills: The ability to analyze data, identify patterns, and draw logical conclusions is vital for troubleshooting and problem-solving. This involves breaking down complex issues into smaller, more manageable components and examining each aspect in detail.
KU8. Troubleshooting Methodology: Proficiency in using systematic troubleshooting methodologies, such as the 5 Whys or the Fishbone Diagram, can help identify root causes of problems quickly and effectively.
KU9. Problem-Solving Techniques: Being adept at various problem-solving techniques, such as brainstorming, root cause analysis, or SWOT analysis, can help in devising and implementing effective solutions

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret drawings, work instructions, equipment manuals and process documents
GS2. communicate the assembly process requirements to the lead technician and co-workers
GS3. communicate issues to the supervisor that occur during assembling process
GS4. attentively listen and comprehend the information given by the lead technician/team members
GS5. write any work related information in English/regional language
GS6. recognise a workplace problem and take suitable action
GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently
GS8. plan and organise work according to the principles of 5S
GS9. complete the assigned tasks with minimum supervision
GS10. report to the supervisor or deal with a colleague individually, depending on the type of concern

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Collect relevant data and information about the manufacturing process	**5**	**10**	**10**	**-**
PC1. Identify the various sources from which data can be collected, such as equipment sensors, production records, quality control reports, and employee feedback.	1	2	2	-
PC2. Organize and store the collected data in a structured and accessible manner, ensuring that it can be easily retrieved and analyzed when needed.	2	4	4	-
PC3. Analyze the collected data to identify trends, patterns, and areas for improvement in the manufacturing process.	2	4	4	-
Analyze the symptoms and effects of the issue to determine the root cause	**5**	**10**	**10**	**-**
PC4. Examine historical production data, including process parameters, equipment logs, and quality control records, to identify any patterns, trends, or anomalies that may be related to the issue.	1	2	2	-
PC5. Perform targeted tests or simulations to replicate the observed symptoms and effects of the issue.	2	3	3	-
PC6. Perform additional tests or experiments to confirm or refute the hypothesis.	1	2	2	-
PC7. Create detailed documentation of the root cause analysis, including the symptoms and effects observed, the data and information analyzed, and the developed hypothesis	1	3	3	-
Implement appropriate corrective actions to address the issue	**5**	**10**	**10**	**-**
PC8. analyze the issue to understand its root cause and identify the specific aspects of the manufacturing process that require improvement.	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Assess the potential effectiveness of each corrective action by considering factors such as the likelihood of resolving the issue, potential benefits, and potential drawbacks	2	4	4	-
PC10. Execute the action plan by carrying out the chosen corrective actions. This may involve adjusting equipment settings, modifying work instructions, or reorganizing the production line.	2	4	4	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8390
NOS Name	Technical Troubleshooting and Problem Solving
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

ASC/N8391: Artificial Intelligence in Automotive Manufacturing

Description

This NOS is about to Deploy AI-powered vision systems and algorithms to detect defects in real-time during the manufacturing process.

Scope

The scope covers the following :

- Implement a pilot project to test the AI-powered vision systems and algorithms in a Manufacturing Process.
- Provide the AI models with relevant data and train them to recognize defects.
- Conduct thorough testing and validation of the AI-powered vision systems and algorithms.

Elements and Performance Criteria

Implement a pilot project to test the AI-powered vision systems and algorithms in a Manufacturing Process.

To be competent, the user/individual on the job must be able to:

PC1. Set up a controlled test environment that closely resembles the actual manufacturing process, including relevant equipment, materials, and production conditions

PC2. Use the collected data to train the AI models and fine-tune their performance. This may involve adjusting the model's parameters, using supervised or unsupervised learning techniques, and validating the model's accuracy.

PC3. Conduct thorough testing and validation of the AI-powered vision systems and algorithms to ensure their accuracy, reliability, and performance under real-world manufacturing conditions.

Provide the AI models with relevant data and train them to recognize defects

To be competent, the user/individual on the job must be able to:

PC4. Gather a large and diverse dataset of images and videos that represent various types of defects and anomalies in the manufacturing process

PC5. Use the labeled dataset to train the selected AI algorithms, adjusting the model parameters and hyperparameters to optimize its performance in detecting defects.

PC6. Evaluate the performance of the trained AI models using a separate validation dataset to assess their accuracy, precision, and recall in detecting defects

PC7. Test the AI models in a real-world manufacturing environment to assess their performance under actual production conditions.

Conduct thorough testing and validation of the AI-powered vision systems and algorithms

To be competent, the user/individual on the job must be able to:

PC8. Establish clear testing criteria and objectives for evaluating the performance of the AI-powered vision systems and algorithms.

PC9. Create a comprehensive set of test cases and scenarios that cover various aspects of the manufacturing process, including different types of products, production line configurations, and potential defects

PC10. Compare the results generated by the AI-powered vision systems and algorithms with the ground truth, which is the actual presence or absence of defects in the manufacturing process.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant standards and procedures followed in the company.

KU2. various components and systems of Manufacturing Process.

KU3. various assembly operations and methods

KU4. the process flow of the assembly operations

KU5. Computer Vision: Understanding of computer vision principles, techniques, and algorithms for object recognition, image segmentation, and feature extraction

KU6. Machine Learning: Proficiency in machine learning algorithms, such as supervised and unsupervised learning, deep learning, and neural networks, for training and optimizing the vision systems.

KU7. Data Processing and Analysis: Familiarity with data preprocessing, data cleaning, and data analysis techniques to prepare and enhance the quality of data for training and testing the AI models.

KU8. Programming Languages: Expertise in programming languages like Python, C, or Java for developing and implementing the vision systems and algorithms.

KU9. Hardware Integration: Knowledge of integrating AI models with hardware components, such as cameras, sensors, and other peripherals, to create an end-to-end solution.

KU10. Manufacturing Process Knowledge: Understanding of the manufacturing process and the types of defects that can occur, as well as the ability to identify relevant features and patterns for defect detection.

KU11. Quality Control and Assurance: Familiarity with quality control principles and practices to ensure the AI-powered vision systems meet the desired accuracy and efficiency standards.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and interpret drawings, work instructions, equipment manuals and process documents

GS2. communicate the assembly process requirements to the lead technician and co-workers

GS3. communicate issues to the supervisor that occur during assembling process

GS4. attentively listen and comprehend the information given by the lead technician/team members

GS5. write any work related information in English/regional language

GS6. recognise a workplace problem and take suitable action

GS7. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently

GS8. plan and organise work according to the principles of 5S

GS9. complete the assigned tasks with minimum supervision

GS10. report to the supervisor or deal with a colleague individually, depending on the type of concern

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Implement a pilot project to test the AI-powered vision systems and algorithms in a Manufacturing Process.	**5**	**10**	**10**	**-**
PC1. Set up a controlled test environment that closely resembles the actual manufacturing process, including relevant equipment, materials, and production conditions	1	2	2	-
PC2. Use the collected data to train the AI models and fine-tune their performance. This may involve adjusting the model's parameters, using supervised or unsupervised learning techniques, and validating the model's accuracy.	2	4	4	-
PC3. Conduct thorough testing and validation of the AI-powered vision systems and algorithms to ensure their accuracy, reliability, and performance under real-world manufacturing conditions.	2	4	4	-
Provide the AI models with relevant data and train them to recognize defects	**5**	**10**	**10**	**-**
PC4. Gather a large and diverse dataset of images and videos that represent various types of defects and anomalies in the manufacturing process	1	2	2	-
PC5. Use the labeled dataset to train the selected AI algorithms, adjusting the model parameters and hyperparameters to optimize its performance in detecting defects.	2	3	3	-
PC6. Evaluate the performance of the trained AI models using a separate validation dataset to assess their accuracy, precision, and recall in detecting defects	1	2	2	-
PC7. Test the AI models in a real-world manufacturing environment to assess their performance under actual production conditions.	1	3	3	-
Conduct thorough testing and validation of the AI-powered vision systems and algorithms	**5**	**10**	**10**	**-**
PC8. Establish clear testing criteria and objectives for evaluating the performance of the AI-powered vision systems and algorithms.	1	2	2	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. Create a comprehensive set of test cases and scenarios that cover various aspects of the manufacturing process, including different types of products, production line configurations, and potential defects	2	4	4	-
PC10. Compare the results generated by the AI-powered vision systems and algorithms with the ground truth, which is the actual presence or absence of defects in the manufacturing process.	2	4	4	-
NOS Total	**15**	**30**	**30**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	ASC/N8391
NOS Name	Artificial Intelligence in Automotive Manufacturing
Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Automotive Product Development
NSQF Level	4.5
Credits	3
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

Assessment Plan:

1. Components of Assessment: - Each subject will be assessed in three components: Theory (20% weightage), Practical (40% weightage), and On-job Training (OJT, 40% weightage).

2. Passing Parameters: - To pass the semester, students must meet both the assessment parameters given below.

Parameter 1 - Weighted Semester Score: - Students must achieve a minimum of 60% in the weighted average score across all three components (Theory, Practical, and OJT) for each subject.

Parameter 2 - Individual Component Score: - Students need to score at least 40% in each individual component (Theory, Practical, and OJT) of every subject.

Mandatory Note: This qualification can be offered as part of a Diploma program, in line with the 39th NSQC, ASDC Diploma (Diploma in Manufacturing Technology) approval. However, achieving 40 credits in a year is mandatory for progression within the Diploma course. Therefore, it is required to select at least one

optional NOS in every semester to meet this requirement.

Minimum Aggregate Passing % at QP Level : 40

(**Please note**: Every Trainee should score a minimum aggregate passing percentage as specified above, to successfully clear the Qualification Pack assessment.)

Assessment Weightage

Compulsory NOS

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8382.Hydraulics and Pneumatics	20	40	40	-	100	15
ASC/N3549.Lubrication & Mechanical Drives	20	40	40	-	100	15
ASC/N8383.PLC and Electrical Drives	20	40	40	-	100	15
ASC/N9841.Best Industrial Practices	15	30	30	-	75	5
ASC/N8386.Sensors & Actuators	20	40	40	-	100	15
ASC/N8387.SCADA & Industrial Automation	20	40	40	-	100	15
ASC/N8388.I 4.0 Technologies	20	40	40	-	100	10
ASC/N9843.Environmental Studies	15	30	30	-	75	5
DGT/VSQ/N0104.Employability Skills (120 Hours)	20	30	-	-	50	5
Total	**170**	**330**	**300**	**-**	**800**	**100**

Optional: 1 Semester 5: Automation

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8384.Automation	15	30	30	-	75	10
Total	**15**	**30**	**30**	**-**	**75**	**10**

Optional: 2 Semester 5: Robot Maintenance

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8385.Robot Maintenance	20	40	40	-	100	10
Total	**20**	**40**	**40**	**-**	**100**	**10**

Optional: 3 Semester 6: Advance Robotics

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8389.Advance Robotics	15	30	30	-	75	10
Total	**15**	**30**	**30**	**-**	**75**	**10**

Optional: 4 Semester 6: Technical Troubleshooting and Problem Solving

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8390.Technical Troubleshooting and Problem Solving	15	30	30	-	75	10
Total	**15**	**30**	**30**	**-**	**75**	**10**

Optional: 5 Semester 6:Artificial Intelligence in Automotive Manufacturing

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ASC/N8391.Artificial Intelligence in Automotive Manufacturing	15	30	30	-	75	10
Total	**15**	**30**	**30**	**-**	**75**	**10**

Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training

Glossary

Sector	Sector is a conglomeration of different business operations having similar business and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
Occupation	Occupation is a set of job roles, which perform similar/ related set of functions in an industry.
Job role	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
Occupational Standards (OS)	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the Knowledge and Understanding (KU) they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria (PC)	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
National Occupational Standards (NOS)	NOS are occupational standards which apply uniquely in the Indian context.
Qualifications Pack (QP)	QP comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A QP is assigned a unique qualifications pack code.
Unit Code	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
Unit Title	Unit title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on quality of performance required.

Knowledge and Understanding (KU)	Knowledge and Understanding (KU) are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.
Organisational Context	Organisational context includes the way the organisation is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Technical Knowledge	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills/ Generic Skills (GS)	Core skills or Generic Skills (GS) are a group of skills that are the key to learning and working in today's world. These skills are typically needed in any work environment in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.
Electives	Electives are NOS/set of NOS that are identified by the sector as contributive to specialization in a job role. There may be multiple electives within a QP for each specialized job role. Trainees must select at least one elective for the successful completion of a QP with Electives.
Options	Options are NOS/set of NOS that are identified by the sector as additional skills. There may be multiple options within a QP. It is not mandatory to select any of the options to complete a QP with Options.