Model Curriculum

NOS Name: IIOT Application in Predictive Maintenance (Manufacturing)

NOS Code: ASC/N6463

NOS Version: 1.0

NSQF Level: 5.5

Model Curriculum Version: 1.0

Automotive Skills Development Council | E 113, Okhla Industrial Area, Phase – III,
New Delhi – 110020

Table of Contents

A. Training Parameters

B. Program Overview

C. Training Outcomes

D. Compulsory Modules

E. Trainer Requirements

E. Assessor Requirements

F. Assessment Strategies

G. Reference

- Glossary
- Abbreviations & Acronyms

Training Parameters

Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Production Engineering
Country	India
NSQF Level	5.5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/2144.0801
Minimum Educational Qualification and Experience	UG Diploma in relevant field with 1.5 Years of Relevant experience OR 3rd year of UG Degree in relevant field OR Diploma after 10th in relevant field with 3 Years of Relevant experience
Pre-Requisite License or Training	NA
Minimum Job Entry Age	20 Years
Next Review Date	15/03/2027
NSQC Approval Date	15/03/2024
QP Version	1.0
Model Curriculum Creation Date	15/03/2024
Model Curriculum Valid Up to Date	15/03/2027

Model Curriculum Version	1.0
Minimum Duration of the Course	60 Hours
Maximum Duration of the Course	60 Hours

Program Overview

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

Training Outcomes:

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

Predictive Maintenance Fundamentals:

Learn the fundamentals of predictive maintenance, including the principles of condition monitoring, failure prediction algorithms, and reliability-centered maintenance (RCM) strategies. Understand the benefits of predictive maintenance in reducing downtime, optimizing maintenance schedules, and improving asset performance.

Sensor Selection and Deployment:

Acquire knowledge and skills in selecting and deploying sensors for monitoring key parameters such as temperature, vibration, pressure, and fluid levels in manufacturing equipment. Understand the criteria for sensor selection, placement, calibration, and maintenance to ensure accurate data collection.

Data Acquisition and Integration:

Learn how to collect, aggregate, and integrate data from diverse sources, including sensors, SCADA systems, ERP systems, and historical maintenance records. Understand the challenges associated with data interoperability, data quality, and data security in IIoT environments.

Data Analytics and Machine Learning:

Gain proficiency in data analytics techniques and machine learning algorithms for predictive maintenance applications. Learn how to preprocess sensor data, extract meaningful features, and train predictive models using supervised and unsupervised learning approaches.

Fault Detection and Diagnostics:

Develop skills in detecting abnormal equipment behavior and diagnosing potential faults or anomalies based on sensor data patterns. Explore techniques such as anomaly detection, pattern recognition, and root cause analysis to identify early indicators of equipment degradation or failure.

Sub-NOS Details	Theory Duration	Practical Duration	On-the-Job Training Duration	Total Duration
ASC/N6463- IIOT Application in Predictive Maintenance (Manufacturing) **NSQF Level- 5.5**	**15:00**	**45:00**		**60:00**
Module: 1: Introduction to IIOT Application in Predictive Maintenance (Manufacturing) Mapped to ASC/N6463	05:00	00:00		05:00
Module: 2- IIOT Application in Predictive Maintenance (Manufacturing) ,Mapped to ASC/N6463	10:00	45:00		55:00
Total Duration	**15:00**	**45:00**	**00:00**	**60:00**

Module Details

Module-1: Introduction to IIOT Application in Predictive Maintenance (Manufacturing). Mapped to ASC/N6463

Terminal Outcomes:

- Interpret the concept of data visualization and its role in IIoT applications in manufacturing.
- Investigate different types of reports generated from IIoT applications, such as equipment performance reports, maintenance reports, quality reports, and supply chain reports.

Duration: *<5:00>*	**Duration**: *<00:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Concept of IIoT and how it is transforming the manufacturing industry. • Different types of data that can be collected and analyzed through IIoT devices and sensors. • Methods to visualize and analyze this data using various tools and techniques. • Different IIoT platforms available in the market and their features, benefits, and limitations. • Challenges and limitations of IIoT applications, such as interoperability, standardization, and cybersecurity threats.	
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
IIOT Sensors, I/O Link, Communication Protocol Device, Edge Computing Device	

Module: 2 IIOT Application in Predictive Maintenance (Manufacturing).

Mapped to ASC/N6463

Terminal Outcomes:

Proficiency in IIoT Technologies: Participants should demonstrate a deep understanding of IIoT concepts, including sensor integration, data acquisition, communication protocols, and edge computing.

Comprehensive Understanding of Predictive Maintenance: Trainees should grasp the fundamentals of predictive maintenance, including condition monitoring techniques, failure prediction algorithms, and maintenance optimization strategies.

Ability to Select and Deploy Sensors: Participants should be capable of selecting appropriate sensors based on equipment requirements, deploying them effectively in manufacturing environments, and ensuring accurate data collection.

Integration with Manufacturing Systems: Trainees should demonstrate the ability to integrate IIoT applications with existing manufacturing systems, such as SCADA, PLCs, MES, and ERP systems, to collect and analyze data seamlessly.

Development of Predictive Maintenance Models: Trainees should be able to develop predictive maintenance models using historical data, sensor readings, and machine learning algorithms to predict equipment failures and maintenance requirements.

Implementation of Condition-Based Maintenance Strategies: Participants should demonstrate the ability to implement condition-based maintenance strategies based on real-time equipment health monitoring, including setting threshold levels, triggering maintenance alerts, and prioritizing maintenance tasks.

Duration: *<10:00>*	**Duration**: *<45:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Understanding of Predictive Maintenance Concepts: Gain a comprehensive understanding of predictive maintenance principles, including the goals, benefits, and challenges associated with implementing predictive maintenance programs in manufacturing environments. • • Knowledge of IIoT Technologies: Learn about the fundamentals of IIoT technologies, including sensors, actuators, communication protocols, edge computing, and cloud-based platforms. Understand how IIoT infrastructure can be integrated	• Understanding of IIoT Architecture: Gain a comprehensive understanding of the architecture of IIoT systems, including sensors, edge devices, gateways, communication protocols, cloud platforms, and analytics engines. Understand how these components interact to enable data collection, processing, and analysis for predictive maintenance. • Integration with Manufacturing Systems: Learn how to integrate IIoT applications with existing manufacturing systems, such as supervisory control and

with manufacturing systems to enable real-time data acquisition and analysis for predictive maintenance. • Sensor Selection and Deployment Strategies: Acquire knowledge and skills in selecting appropriate sensors and monitoring devices for capturing relevant data from manufacturing equipment and assets. Understand factors such as sensor accuracy, reliability, compatibility, and environmental considerations for effective sensor deployment. • Data Acquisition and Integration Techniques: Learn how to collect, aggregate, and integrate data from diverse sources within the manufacturing environment, including sensors, PLCs (Programmable Logic Controllers), SCADA (Supervisory Control and Data Acquisition) systems, and enterprise databases. Explore methods for data normalization, cleansing, and synchronization to ensure data quality and consistency. • Development of Predictive Maintenance Models: Learn how to develop and validate predictive maintenance models that leverage historical equipment data, maintenance records, and failure events. Explore techniques for model training, testing, and evaluation to ensure accuracy, reliability, and generalization across diverse manufacturing assets. • Real-Time Monitoring and Alerting Mechanisms: Understand the importance of real-time monitoring and alerting mechanisms for detecting potential equipment failures or anomalies. Learn how to configure threshold-based alerts, predictive analytics dashboards, and notification workflows to enable timely intervention and preventive maintenance	data acquisition (SCADA), programmable logic controllers (PLC), and manufacturing execution systems (MES). Understand the challenges and best practices for seamless integration of IIoT technologies into the manufacturing environment. • Sensor Selection and Deployment Strategies: Acquire knowledge and skills in selecting appropriate sensors for monitoring critical parameters of manufacturing equipment, such as temperature, pressure, vibration, and fluid levels. Learn about sensor placement, calibration, and maintenance procedures to ensure accurate and reliable data collection. • Data Acquisition and Preprocessing: Learn how to collect, preprocess, and filter sensor data from manufacturing equipment to remove noise, outliers, and irrelevant information. Understand the importance of data cleansing, normalization, and synchronization for accurate predictive maintenance analysis. • Real-time Monitoring and Alerting: Understand how IIoT applications enable real-time monitoring of equipment health and performance. Learn how to set up threshold-based alerts and notifications to trigger maintenance interventions when predefined conditions or anomalies are detected. • Development of Predictive Maintenance Models: Learn how to develop and deploy predictive maintenance models using tools and platforms such as Python, R, TensorFlow, and Apache Spark. Understand the trade-offs between model accuracy, complexity, and computational resources required for real-time deployment in manufacturing

actions.	environments.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
• IIOT Sensors, I/O Link, Communication Protocol Device, Edge Computing Device	

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
B.E/B.Tech	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	3	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	1	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
B.E/B.Tech	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	4	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	0	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
Diploma	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	5	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	1	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
Diploma	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	6	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	0	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA

Trainer Certification	
Domain Certification	**Platform Certification**
" IIOT Application in Predictive Maintenance (Manufacturing) ", NOS: "ASC/N6463", minimum accepted score is 80%	"Recommended that the trainer is certified for the job role "Trainer (VET and Skills)", Mapped to Qualification Pack: MEP/Q2601, V2.0" Minimum accepted score is 80%."

Assessor Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
B.E/B.Tech	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	3	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	1	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
B.E/B.Tech	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	4	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	0	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
Diploma	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	5	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	1	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA
Diploma	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	6	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	0	Mechanical/Automobile /Mechatronics/Electronics/Electrical/ Manufacturing	NA

Assessor Certification	
Domain Certification	**Platform Certification**
" IIOT Application in Predictive Maintenance (Manufacturing) ", NOS: "ASC/N6463", minimum accepted score is 80%	Recommended that the Accessor is certified for the job role "Assessor (VET and Skills)", Mapped to Qualification Pack: MEP/Q2701, V2.0" Minimum accepted score is 80%.

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Assessment Strategy

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
- Assessment agencies send the assessment confirmation to VTP/TC looping SSC
- Assessment agency deploys the ToA certified Assessor for executing the assessment
- SSC monitors the assessment process & records

2. Testing Environment:

- Confirm that the centre is available at the same address as mentioned on SDMS or SIP
- Check the duration of the training.
- Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
- If the batch size is more than 30, then there should be 2 Assessors.
- Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
- Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
- Confirm the number of TABs on the ground is correct to execute the Assessment smoothly.
- Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels / Framework:

- Question papers created by the Subject Matter Experts (SME)
- Question papers created by the SME verified by the other subject Matter Experts
- Questions are mapped with Semester-wise Curriculum.
- Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management
- Assessor must be ToA certified & trainer must be ToT Certified
- Assessment agency must follow the assessment guidelines to conduct the assessment

4. Types of evidence or evidence-gathering protocol:

- Time-stamped & geotagged reporting of the assessor from assessment location
- Centre photographs with signboards and scheme specific branding
- Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
- Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos

5. Method of verification or validation:

- Surprise visit to the assessment location
- Random audit of the batch
- Random audit of any candidate

6. Method for assessment documentation, archiving, and access

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

References

Glossary

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

Acronyms and Abbreviations

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
PPE	Personal Protective Equipment
IIOT	Industrial Internet of things
SCADA	Supervisory Control And Data Acquisition