Predictive Maintenance Engineer

QP Code: CSC/Q0902

Version: 1.0

NSQF Level: 5.5

Capital Goods & Strategic Skill Council || 1st Floor, L-29, Outer Circle, Connaught Place New Delhi – 110001 || email:technicaladvisors@cgsc.in

Contents

CSC/Q0902: Predictive Maintenance Engineer

Brief Job Description

A Predictive Maintenance Engineer predicts the future failure point of a machine component and takes corrective action based on a plan, just before it fails.

Personal Attributes

The incumbent requires excellent quantitative abilities and advanced communication skills. The ability to plan and organize work and identify and solve problems in the course of working are essential attributes. The ability to work with complexity and high environmental awareness is critical for the job.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. CSC/N0902: Conduct regular inspection of machinery and equipment to identify potential issues

2. CSC/N0909: Assist in Design, Development and Implementation of predictive maintenance system

3. CSC/N0910: Perform Data acquisition, and prepare for the process and analysis of acquired data

4. CSC/N0911: Maintain accurate records for Diagnosis and Prognosis based on condition-based monitoring

5. CSC/N0912: Determine and Initiate Preventive Maintenance Action

6. CSC/N0913: Review the Predictive Maintenance Program

7. CSC/N1342: Collaboratively work with the team

8. CSC/N0505: Follow health, safety and environment guidelines at workplace

9. DGT/VSQ/N0102: Employability Skills (60 Hours)

Qualification Pack (QP) Parameters

Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods

Occupation	Maintenance
Country	India
NSQF Level	5.5
Credits	20
Aligned to NCO/ISCO/ISIC Code	NCO-2015/NIL
Minimum Educational Qualification & Experience	UG in relevant field (UG Degree in relevant field + 3 years of relevant experience or 3 Years UG Degree in Science and Technology (B.Sc / BCA) / 4 years BE, B.Tech (Electrical, Electronics, Mechanical, Mechatronics, Instrumentation and Control)* or 10th grade pass +3 years Diploma in relevant field + 4 year of relevant experience or Previous NSQC level 5 + 1.5 years of relevant experience *Subject to being offered as 6 months internship/ project)
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	24 Years
Last Reviewed On	NA
Next Review Date	31/01/2027
NSQC Approval Date	31/01/2024
Version	1.0
Reference code on NQR	QG-5.5-CG-02042-2024-V1-CGSC
NQR Version	1

CSC/N0902: Conduct regular inspection of machinery and equipment to identify potential issues

Description

Conducting regular inspections of machinery and equipment involves systematically examining them to identify potential safety and performance issues. This includes following inspection checklists and guidelines to ensure thorough assessments. The role requires documenting inspection findings and communicating them to relevant stakeholders. It also involves taking corrective actions to address identified issues and prevent future problems

Scope

The scope covers the following :

- The scope of this NOS includes conducting regular inspections of machinery and equipment in industrial settings to identify potential safety and performance issues. This involves following inspection checklists and guidelines, documenting findings, and communicating them to relevant stakeholders. The role requires taking corrective actions to address identified issues and prevent future problems.

Elements and Performance Criteria

Conduct regular inspection of machinery and equipment

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

PC1. Conduct inspections according to a predetermined schedule (e.g., weekly, monthly, quarterly) to ensure comprehensive coverage of machinery and equipment.

PC2. Ensure that all scheduled inspections are completed within the specified timeframe to maintain consistency and reliability in identifying potential issues.

PC3. Verify that inspections are conducted meticulously, covering all critical components, parts, and subsystems of machinery and equipment.

PC4. Ensure adherence to established inspection protocols and checklists to minimize oversight.

PC5. Demonstrate the ability to accurately identify potential issues, anomalies, or deviations from normal operating conditions during inspections.

PC6. Document and report identified issues promptly to facilitate timely intervention and preventive measures.

PC7. Evaluate the accuracy of assessments made during inspections, including the severity and likelihood of identified issues.

PC8. Utilize appropriate diagnostic tools and techniques to enhance the precision of assessments.

PC9. Report inspection findings promptly to relevant stakeholders, including maintenance teams, supervisors, and management.

PC10. Ensure that reports are delivered within established timeframes to facilitate timely decision-making and action.

PC11. Maintain detailed and accurate records of inspection findings, including observations, measurements, and recommended actions.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

KU4. own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities

KU5. reporting structure, inter-dependent functions, lines and procedures in the work area

KU6. relevant people and their responsibilities within the work area

KU7. escalation matrix and procedures for reporting work and employment related issues

KU8. documentation and related procedures applicable in the context of employment and work

KU9. importance and purpose of documentation in the context of employment and work

KU10. types of industrial processes and equipment in a manufacturing facility

KU11. type of predictive maintenance to performed based on failure histories, associated root causes and relevant testing methods

KU12. how to interpret information sources for predictive maintenance

KU13. how to compile and organise data sources for efficient workflow

KU14. tools, technologies, parts, and components used in predictive maintenance

KU15. how to analyse the data for predictive maintenance

KU16. how to evaluate relevant key variables and performance factors

KU17. how to perform lifecycle analysis of the industrial equipment

KU18. how to visually inspect the industrial equipment for fault finding

KU19. importance of periodic instrument inspections for predictive maintenance

KU20. how to perform real-time monitoring for industrial equipment and machinery

KU21. how to identify failure modes and outcomes for the manufacturing industry

KU22. circumstances or events that indicate a sign of failure within the equipment

KU23. importance of ensuring the required availability of data for predictive maintenance

KU24. importance of preparing reports for recording significant findings

KU25. importance of recording the readings, key findings, and variance from normal operational standards

KU26. importance of complying with relevant legislation, standards, policies and procedures

Generic Skills (GS)

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

GS1. fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/ or local language

GS2. undertake arithmetic operations, and calculations/ formulae Arithmetic operations: e.g. addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages

GS3. produce representations and make calculations in a plane and solid geometry

GS4. use appropriate measuring techniques and units of measurement

GS5. use appropriate units and number systems to express the degree of accuracy Units and number systems representing the degree of accuracy: decimals places, significant figures, fractions as a decimal quantity

GS6. interpret and express tolerance in terms of limits on dimensions

GS7. identify the correct order for performing mathematical operations and solve equations that contain multiple operations

GS8. use basic algebra to solve for the unknown

GS9. convert between various angular units such as degrees, minutes, seconds, grads, radians, etc.

GS10. interpret tables and graphs to determine intermediate and extrapolated values

GS11. use elementary statistics and laws of probability (mean, median and standard deviation)

GS12. calculate the slope, intercept, and linearity of data sets, and interpret graphs and plots that illustrate these aspects of data

GS13. convert various units of measurement between English and metric units, including length, area, volume, capacity, and weight

GS14. describe and define the seven base units: meter, kilogram, second, ampere, kelvin, candela, and mole

GS15. identify fundamental constants C (velocity or speed of light in a vacuum), G (gravitational constant), and R (universal gas constant), their standard symbols, and their common applications

GS16. translate practical problems into useful mathematical expressions

GS17. write in a manner appropriate for business

GS18. read and correctly assimilate information from manufacturer manuals and guides

GS19. read technical drawings and schematics to correctly extract relevant information

GS20. convey and share technical information clearly using appropriate language

GS21. express information to individuals or groups taking into account the nature of audience and the information

GS22. receive, attend to, correctly interpret and respond to verbal messages and other cues

GS23. apply active listening skills using reflection, restatement, questioning and clarification

GS24. take proper and effective action when necessary without having all the facts at hand

GS25. adapt plans, goals, actions and priorities in response to unpredictable or unexpected events

GS26. plan, prioritize and sequence work operations as per job requirement

GS27. organize and analyze information relevant to work

GS28. allocate resources and time effectively

GS29. identify customer requirements and address key concerns related to the machine/equipment

GS30. identify problems with work planning, procedures, output and behavior and their implications

GS31. prioritize and plan for problem solving

GS32. communicate problems appropriately to others

GS33. identify sources of information and support for problem solving

GS34. seek assistance and support from other sources to solve problems

GS35. identify effective resolution techniques

GS36. select and apply resolution techniques

GS37. seek evidence for problem resolution

GS38. undertake and express new ideas and initiatives to others

GS39. participate in improvement procedures including process, quality and internal/external customer/ supplier relationships

GS40. enhance one's competencies in new and different situations and contexts to achieve more

GS41. distinguish fact from opinion

GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Conduct regular inspection of machinery and equipment	**30**	**70**	**-**	**-**
PC1. Conduct inspections according to a predetermined schedule (e.g., weekly, monthly, quarterly) to ensure comprehensive coverage of machinery and equipment.	-	-	-	-
PC2. Ensure that all scheduled inspections are completed within the specified timeframe to maintain consistency and reliability in identifying potential issues.	-	-	-	-
PC3. Verify that inspections are conducted meticulously, covering all critical components, parts, and subsystems of machinery and equipment.	-	-	-	-
PC4. Ensure adherence to established inspection protocols and checklists to minimize oversight.	-	-	-	-
PC5. Demonstrate the ability to accurately identify potential issues, anomalies, or deviations from normal operating conditions during inspections.	-	-	-	-
PC6. Document and report identified issues promptly to facilitate timely intervention and preventive measures.	-	-	-	-
PC7. Evaluate the accuracy of assessments made during inspections, including the severity and likelihood of identified issues.	-	-	-	-
PC8. Utilize appropriate diagnostic tools and techniques to enhance the precision of assessments.	-	-	-	-
PC9. Report inspection findings promptly to relevant stakeholders, including maintenance teams, supervisors, and management.	-	-	-	-
PC10. Ensure that reports are delivered within established timeframes to facilitate timely decision-making and action.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. Maintain detailed and accurate records of inspection findings, including observations, measurements, and recommended actions.	-	-	-	-
NOS Total	**30**	**70**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0902
NOS Name	Conduct regular inspection of machinery and equipment to identify potential issues
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	3
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0909: Assist in Design, Development and Implementation of predictive maintenance system

Description

Design, develop, and implement a predictive maintenance system for industrial equipment. This system will use machine learning algorithms to analyze sensor data and predict when maintenance is required, helping to reduce downtime and maintenance costs. The system will also include a user-friendly interface for monitoring equipment health and scheduling maintenance tasks.

Scope

The scope covers the following :

- The scope of this NOS includes designing, developing, and implementing a predictive maintenance system for industrial equipment. It involves analyzing sensor data, using machine learning algorithms to predict maintenance needs, and providing a user interface for monitoring and scheduling maintenance tasks. The system aims to reduce downtime and maintenance costs while improving equipment reliability and operational efficiency.

Elements and Performance Criteria

Assist in Design, Development and Implemention of predictive maintenance system

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

PC1. Ensure that the acquired data is accurate and reliable to avoid misleading analysis.

PC2. Measure accuracy through comparison with known standards or manual inspections where applicable.

PC3. Acquire all necessary data required for predictive maintenance analysis.

PC4. Verify that all relevant parameters and variables are included in the dataset.

PC5. Ensure consistency in data format, units, and timestamps across all acquired datasets.

PC6. Resolve any discrepancies or inconsistencies found during the acquisition process.

PC7. Acquire data in a timely manner to ensure that it reflects the current state of the equipment or system.

PC8. Minimize delays between data acquisition and analysis to enable timely decision-making.

PC9. Acquire data that is directly relevant to the predictive maintenance objectives.

PC10. Filter out irrelevant data to streamline analysis and improve efficiency.

PC11. Implement measures to protect the confidentiality, integrity, and availability of acquired data.

PC12. Adhere to relevant data privacy regulations and organizational policies.

PC13. Perform data quality checks and validation procedures to identify and correct errors or anomalies.

PC14. Implement automated quality control measures where possible to ensure consistent data quality.

PC15. PC15. Optimize data acquisition processes to minimize resource utilization and maximize efficiency

PC16. Optimize data acquisition processes to minimize resource utilization and maximize efficiency.

PC17. Utilize automated data acquisition systems where appropriate to reduce manual effort and human error.

PC18. Implement data management practices to organize, catalog, and archive acquired datasets effectively

PC19. Maintain comprehensive documentation of data acquisition processes, including metadata such as sensor configurations and sampling rates.

PC20. Ensure that acquired data is well-documented and annotated to facilitate analysis and interpretation.

PC21. Design data acquisition systems and processes to accommodate future scalability and evolving maintenance requirements.

PC22. Ensure flexibility to adapt to changes in equipment configurations or monitoring objectives.

PC23. Ensure compatibility and interoperability between data acquisition systems and analysis tools.

PC24. Facilitate seamless integration of acquired data with existing predictive maintenance workflows and platforms.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

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GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Assist in Design, Development and Implemention of predictive maintenance system	**50**	**100**	**-**	**-**
PC1. Ensure that the acquired data is accurate and reliable to avoid misleading analysis.	-	-	-	-
PC2. Measure accuracy through comparison with known standards or manual inspections where applicable.	-	-	-	-
PC3. Acquire all necessary data required for predictive maintenance analysis.	-	-	-	-
PC4. Verify that all relevant parameters and variables are included in the dataset.	-	-	-	-
PC5. Ensure consistency in data format, units, and timestamps across all acquired datasets.	-	-	-	-
PC6. Resolve any discrepancies or inconsistencies found during the acquisition process.	-	-	-	-
PC7. Acquire data in a timely manner to ensure that it reflects the current state of the equipment or system.	-	-	-	-
PC8. Minimize delays between data acquisition and analysis to enable timely decision-making.	-	-	-	-
PC9. Acquire data that is directly relevant to the predictive maintenance objectives.	-	-	-	-
PC10. Filter out irrelevant data to streamline analysis and improve efficiency.	-	-	-	-
PC11. Implement measures to protect the confidentiality, integrity, and availability of acquired data.	-	-	-	-
PC12. Adhere to relevant data privacy regulations and organizational policies.	-	-	-	-
PC13. Perform data quality checks and validation procedures to identify and correct errors or anomalies.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC14. Implement automated quality control measures where possible to ensure consistent data quality.	-	-	-	-
PC15. PC15. Optimize data acquisition processes to minimize resource utilization and maximize efficiency	-	-	-	-
PC16. Optimize data acquisition processes to minimize resource utilization and maximize efficiency.	-	-	-	-
PC17. Utilize automated data acquisition systems where appropriate to reduce manual effort and human error.	-	-	-	-
PC18. Implement data management practices to organize, catalog, and archive acquired datasets effectively	-	-	-	-
PC19. Maintain comprehensive documentation of data acquisition processes, including metadata such as sensor configurations and sampling rates.	-	-	-	-
PC20. Ensure that acquired data is well-documented and annotated to facilitate analysis and interpretation.	-	-	-	-
PC21. Design data acquisition systems and processes to accommodate future scalability and evolving maintenance requirements.	-	-	-	-
PC22. Ensure flexibility to adapt to changes in equipment configurations or monitoring objectives.	-	-	-	-
PC23. Ensure compatibility and interoperability between data acquisition systems and analysis tools.	-	-	-	-
PC24. Facilitate seamless integration of acquired data with existing predictive maintenance workflows and platforms.	-	-	-	-
NOS Total	**50**	**100**	**-**	**-**

Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0909
NOS Name	Assist in Design, Development and Implementation of predictive maintenance system
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	3
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0910: Perform Data acquisition, and prepare for the process and analysis of acquired data

Description

Perform data acquisition and preparation for the process and analysis of acquired data for industrial applications. This includes identifying relevant data sources, collecting data from sensors and other sources, ensuring data quality and integrity, and preprocessing the data for analysis. The process involves selecting appropriate data acquisition methods and tools, establishing data collection protocols, and ensuring compliance with data privacy and security regulations.

Scope

The scope covers the following :

- The scope of this NOS includes performing data acquisition and preparation activities specifically tailored for industrial applications. This involves identifying and accessing relevant data sources, which may include sensors, databases, and other data repositories. It encompasses the selection and configuration of data acquisition tools and methods, as well as the implementation of data collection protocols to ensure data quality and integrity.

Elements and Performance Criteria

Measurement of condition data

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

PC1. take measurements (using appropriate tools/techniques/technologies) of various parameters for condition monitoring for each equipment in the predetermined route

PC2. establish, in specific cases, the quality of the measurements by elimination of the common causes of poor measurements (e.g. poor mounting of the transducer, transducer fault)

PC3. take measurements/note down values of other relevant parameters of the equipment (e.g. process data/operation data like pressure, temperature, flow)

PC4. record the conditions in which the measurements were taken (e.g. operating speed, equipment load, ambient temperature)

PC5. observe and note down any specific physical conditions of the equipment (e.g. leakage, low level, looseness, wear and tear)

PC6. download the measured data into the related data storage and analysis software system, as applicable for further analysis

Process the data and perform analysis by trending

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

PC7. acquire the raw-data, filter out unwanted noise and/or other non-related signals, and format the measured signals in the form required for further analysis and diagnosis

PC8. compare the measured values to historical trends (e.g. overall values like vibration velocity in rms, temperature, current)

PC9. compare the measured values to baseline data (e.g. baseline readings taken during commissioning of the equipment)

PC10. compare the measured values to representative data for the same or similar equipment

PC11. evaluate data as per criteria for the severity of the parameter (e.g. vibration severity based on the vibration magnitude at rated speed under steady operation conditions and significant changes, in either direction, in the magnitude of the vibration, including the rate of change); look for any other anomaly in the data

Compare measurement to alerts/alarm criteria for the equipment

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

PC12. check whether the measured values are acceptable compared to the alert/alarm criteria for the equipment (e.g. measured bearing temperature and the alarm limit) and determine if operation of the equipment may continue for a period till the time investigations are carried out to identify the reason for the change in the measured parameter and define any remedial action

PC13. determine the need for any immediate action on the equipment (e.g. reduction of load, greasing of the bearing), as necessary, other than to record the value and observations and to continue to monitor the equipment

PC14. decide on the need for any additional measurements and monitoring (e.g. at more/different locations)

PC15. determine the need for any short-term change in frequency of the condition monitoring (e.g. once every two weeks to week or weekly to daily) till the time the equipment behaviour is normal

PC16. • initiate the diagnosis process in case the measured values are not acceptable compared to the alert/alarm criteria for the equipment
• note: consider the need for diagnosis even on other occasions when no anomalies are suspected or detected (e.g. condition assessment of an equipment before a major shutdown to determine the need for any maintenance action or when other symptoms like noise, smell are detected outside of condition monitoring, e.g. operator surveillance)

PC17. consider the basic approaches (e.g. the time domain and the frequency domain analysis) when analyzing certain signals like vibration, current (e.g. time waveform and spectrum)

Document key findings

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

PC18. data measured on the equipment at various locations and directions (e.g. condition data, related process/operation data and other data like load, startup/shutdown); other physical conditions/observations on the equipment

PC19. in case of any issues in the quality of the measurements, cause/s for the same and corrective action (e.g. replace/calibrate the transducer or the cable)

PC20. findings based on preliminary evaluation of data (trends, magnitude, rate of change, correlation with any other parameter)

PC21. decisions based on the analysis (e.g. additional data collection, changes to condition monitoring frequency, time domain and frequency domain analysis)

PC22. recommendations based on the analysis (equipment load/speed reduction, lubrication, shutdown in case of exceeding the trip value/s)

PC23. need for diagnosis for identification of the issue/s

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

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KU5. reporting structure, inter-dependent functions, lines and procedures in the work area

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Generic Skills (GS)

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

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GS7. identify the correct order for performing mathematical operations and solve equations that contain multiple operations

GS8. use basic algebra to solve for the unknown

GS9. convert between various angular units such as degrees, minutes, seconds, grads, radians, etc.

GS10. interpret tables and graphs to determine intermediate and extrapolated values

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GS12. calculate the slope, intercept, and linearity of data sets, and interpret graphs and plots that illustrate these aspects of data

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GS14. describe and define the seven base units: meter, kilogram, second, ampere, kelvin, candela, and mole

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GS19. read technical drawings and schematics to correctly extract relevant information

GS20. convey and share technical information clearly using appropriate language

GS21. express information to individuals or groups taking into account the nature of audience and the information

GS22. receive, attend to, correctly interpret and respond to verbal messages and other cues

GS23. apply active listening skills using reflection, restatement, questioning and clarification

GS24. take proper and effective action when necessary without having all the facts at hand

GS25. adapt plans, goals, actions and priorities in response to unpredictable or unexpected events

GS26. plan, prioritize and sequence work operations as per job requirement

GS27. organize and analyze information relevant to work

GS28. allocate resources and time effectively

GS29. identify customer requirements and address key concerns related to the machine/equipment

GS30. identify problems with work planning, procedures, output and behavior and their implications

GS31. prioritize and plan for problem solving

GS32. communicate problems appropriately to others

GS33. identify sources of information and support for problem solving

GS34. seek assistance and support from other sources to solve problems

GS35. identify effective resolution techniques

GS36. select and apply resolution techniques

GS37. seek evidence for problem resolution

GS38. undertake and express new ideas and initiatives to others

GS39. participate in improvement procedures including process, quality and internal/external customer/ supplier relationships

GS40. enhance one's competencies in new and different situations and contexts to achieve more

GS41. distinguish fact from opinion

GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Measurement of condition data	**20**	**40**	**-**	**-**
PC1. take measurements (using appropriate tools/techniques/technologies) of various parameters for condition monitoring for each equipment in the predetermined route	-	-	-	-
PC2. establish, in specific cases, the quality of the measurements by elimination of the common causes of poor measurements (e.g. poor mounting of the transducer, transducer fault)	-	-	-	-
PC3. take measurements/note down values of other relevant parameters of the equipment (e.g. process data/operation data like pressure, temperature, flow)	-	-	-	-
PC4. record the conditions in which the measurements were taken (e.g. operating speed, equipment load, ambient temperature)	-	-	-	-
PC5. observe and note down any specific physical conditions of the equipment (e.g. leakage, low level, looseness, wear and tear)	-	-	-	-
PC6. download the measured data into the related data storage and analysis software system, as applicable for further analysis	-	-	-	-
Process the data and perform analysis by trending	**-**	**-**	**-**	**-**
PC7. acquire the raw-data, filter out unwanted noise and/or other non-related signals, and format the measured signals in the form required for further analysis and diagnosis	-	-	-	-
PC8. compare the measured values to historical trends (e.g. overall values like vibration velocity in rms, temperature, current)	-	-	-	-
PC9. compare the measured values to baseline data (e.g. baseline readings taken during commissioning of the equipment)	-	-	-	-
PC10. compare the measured values to representative data for the same or similar equipment	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. evaluate data as per criteria for the severity of the parameter (e.g. vibration severity based on the vibration magnitude at rated speed under steady operation conditions and significant changes, in either direction, in the magnitude of the vibration, including the rate of change); look for any other anomaly in the data	-	-	-	-
Compare measurement to alerts/alarm criteria for the equipment	**-**	**-**	**-**	**-**
PC12. check whether the measured values are acceptable compared to the alert/alarm criteria for the equipment (e.g. measured bearing temperature and the alarm limit) and determine if operation of the equipment may continue for a period till the time investigations are carried out to identify the reason for the change in the measured parameter and define any remedial action	-	-	-	-
PC13. determine the need for any immediate action on the equipment (e.g. reduction of load, greasing of the bearing), as necessary, other than to record the value and observations and to continue to monitor the equipment	-	-	-	-
PC14. decide on the need for any additional measurements and monitoring (e.g. at more/different locations)	-	-	-	-
PC15. determine the need for any short-term change in frequency of the condition monitoring (e.g. once every two weeks to week or weekly to daily) till the time the equipment behaviour is normal	-	-	-	-
PC16. • initiate the diagnosis process in case the measured values are not acceptable compared to the alert/alarm criteria for the equipment • note: consider the need for diagnosis even on other occasions when no anomalies are suspected or detected (e.g. condition assessment of an equipment before a major shutdown to determine the need for any maintenance action or when other symptoms like noise, smell are detected outside of condition monitoring, e.g. operator surveillance)	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC17. consider the basic approaches (e.g. the time domain and the frequency domain analysis) when analyzing certain signals like vibration, current (e.g. time waveform and spectrum)	-	-	-	-
Document key findings	**-**	**-**	**-**	**-**
PC18. data measured on the equipment at various locations and directions (e.g. condition data, related process/operation data and other data like load, startup/shutdown); other physical conditions/observations on the equipment	-	-	-	-
PC19. in case of any issues in the quality of the measurements, cause/s for the same and corrective action (e.g. replace/calibrate the transducer or the cable)	-	-	-	-
PC20. findings based on preliminary evaluation of data (trends, magnitude, rate of change, correlation with any other parameter)	-	-	-	-
PC21. decisions based on the analysis (e.g. additional data collection, changes to condition monitoring frequency, time domain and frequency domain analysis)	-	-	-	-
PC22. recommendations based on the analysis (equipment load/speed reduction, lubrication, shutdown in case of exceeding the trip value/s)	-	-	-	-
PC23. need for diagnosis for identification of the issue/s	-	-	-	-
NOS Total	**20**	**40**	**-**	**-**

Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0910
NOS Name	Perform Data acquisition, and prepare for the process and analysis of acquired data
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	3
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0911: Maintain accurate records for Diagnosis and Prognosis based on condition-based monitoring

Description

Maintain accurate records for diagnosis and prognosis based on condition-based monitoring (CBM) in industrial settings. This involves documenting equipment health data, maintenance activities, and diagnostic results to track the condition of machinery over time. The process includes recording sensor data, maintenance logs, and diagnostic reports in a structured format.

Scope

The scope covers the following :

- The scope of this NOS includes the accurate maintenance of records for diagnosis and prognosis based on condition-based monitoring in industrial environments. This involves documenting equipment health data, maintenance activities, and diagnostic results to track machinery condition over time. The scope encompasses the use of structured record-keeping methods to store sensor data, maintenance logs, and diagnostic reports.

Elements and Performance Criteria

Establish diagnostic requirements for the condition monitoring setup

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

PC1. understand the essential role of diagnostics in decision making for appropriate operation or maintenance tasks based on condition data analysis

PC2. be able to set up diagnostic procedures according to the faults that can occur in the equipment

PC3. carry out preliminary study when preparing the requirements for condition monitoring and diagnostics of equipment (for appropriate condition data necessary for diagnosis, diagnostic techniques)

PC4. understand the various steps generally applied to the diagnostic study and the application of Failure Mode and Effect Analysis (FMEA)/ Failure Mode and Effect Criticality Analysis (FMECA) and Failure Mode Symptoms Analysis (FMSA)

PC5. prepare diagnostics requirements report, clearly identifying the equipment faults that are not covered by condition monitoring and hence are not diagnosable (e.g. information about the equipment; failure modes/symptoms analysis)

PC6. re-evaluate, on an ongoing basis, the value of adding more capability (e.g. diagnostic tools and techniques, related condition data measurements) to detect specific equipment faults not covered initially

PC7. • understand the condition monitoring data in terms of
• a) measurements,
• b) descriptors,
• c) symptoms,
• d) fault,
• e) operational parameters (used for establishing descriptors or establishing operating conditions)

PC8. • understand machine data, e.g.
- a) for vibrations – speed, number of gear teeth, rolling element bearing fault frequencies
- b) for oil analysis – oil flow, metal composition, filter ratings
- c) for current analysis – no. of stator bars, no. of rotor slots

PC9. understand the machine history in terms of fault history, operational history and maintenance history

Decide on the diagnostic approach

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

PC10. understand the triggers for the diagnosis (e.g. detection of an anomaly during routine monitoring of the equipment)

PC11. detect anomaly (e.g. by appropriate methods like making a comparison between the present descriptors of the equipment or comparison with similar equipment) in the equipment that warrants the need for diagnosis

PC12. identify the change in one or more of the measured or derived parameters from the baseline values that are indicative of potential fault

PC13. understand the various considerations for selection of appropriate diagnostic approach/es (e.g. application of the equipment, monitoring technique, data availability)

PC14. • determine the best possible approach (in the legacy environment) for diagnosing the condition of an equipment
- 1. data-driven approach (e.g. simple trending, histograms)
- 2. knowledge-based approach (e.g. fault models)
- note: In many cases the use of both the approaches may be necessary

PC15. • decide on the knowledge-based approach to be used for legacy environment
- 1. the faults/symptoms approach and
- 2. the causal approach (for in-depth knowledge of the mechanism of the initiation and fault propagation)

PC16. estimate the confidence in the accuracy of the diagnosis based on the consideration for various elements (e.g. maintenance history with experience of same fault on similar machines, analysis technique)

PC17. decide on further verification as required based on the confidence in the diagnosis

PC18. carryout the necessary actions to increase the confidence in the diagnosis (e.g. retaking measurements, additional measurements, more sophisticated diagnostic process or measurement technique)

Decide on the prognosis and prognostic approaches

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

PC19. based on the diagnosis and the expected progression of existing and future faults, estimate the need for prognosis

PC20. decide on the need for fault prognosis based on the diagnosis based on foreknowledge of the probable failure modes, future duties to which the machine will or might be subjected, and a thorough understanding of the relationships between failure modes and operating conditions

PC21. understand the requirement of various data for prognosis

PC22. understand the basics of a prognosis process (preprocessing to post-action prognosis)

PC23. understand the influence factors (parameters that affect the deterioration rate of a failure mode and hence impacts the time to failure)

PC24. determine the need to establish the estimated time to failure (ETTF)

PC25. understand the requirements of a prognosis report

PC26. perform fault prognosis to estimate the time to failure

PC27. carryout the necessary actions to increase the confidence in the prognosis (e.g. retaking measurements, additional measurements, more sophisticated diagnostic process or measurement technique)

Document key findings

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

PC28. prepare diagnostics requirements report

PC29. prepare diagnosis report

PC30. take actions to increase the confidence in the diagnosis

PC31. prepare prognosis report

PC32. take actions to increase the confidence in the prognosis

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

KU4. own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities

KU5. reporting structure, inter-dependent functions, lines and procedures in the work area

KU6. relevant people and their responsibilities within the work area

KU7. escalation matrix and procedures for reporting work and employment related issues

KU8. documentation and related procedures applicable in the context of employment and work

KU9. importance and purpose of documentation in the context of employment and work

KU10. types of industrial processes and equipment in a manufacturing facility

KU11. type of predictive maintenance to performed based on failure histories, associated root causes and relevant testing methods

KU12. how to interpret information sources for predictive maintenance

KU13. how to compile and organise data sources for efficient workflow

KU14. tools, technologies, parts, and components used in predictive maintenance

KU15. how to analyse the data for predictive maintenance

KU16. how to evaluate relevant key variables and performance factors

KU17. how to perform lifecycle analysis of the industrial equipment

KU18. how to visually inspect the industrial equipment for fault finding

KU19. importance of periodic instrument inspections for predictive maintenance

KU20. how to perform real-time monitoring for industrial equipment and machinery

KU21. how to identify failure modes and outcomes for the manufacturing industry

KU22. circumstances or events that indicate a sign of failure within the equipment

KU23. importance of ensuring the required availability of data for predictive maintenance

KU24. importance of preparing reports for recording significant findings

KU25. importance of recording the readings, key findings, and variance from normal operational standards

KU26. importance of complying with relevant legislation, standards, policies and procedures

Generic Skills (GS)

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

GS1. fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/ or local language

GS2. undertake arithmetic operations, and calculations/ formulae Arithmetic operations: e.g. addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages

GS3. produce representations and make calculations in a plane and solid geometry

GS4. use appropriate measuring techniques and units of measurement

GS5. use appropriate units and number systems to express the degree of accuracy Units and number systems representing the degree of accuracy: decimals places, significant figures, fractions as a decimal quantity

GS6. interpret and express tolerance in terms of limits on dimensions

GS7. identify the correct order for performing mathematical operations and solve equations that contain multiple operations

GS8. use basic algebra to solve for the unknown

GS9. convert between various angular units such as degrees, minutes, seconds, grads, radians, etc.

GS10. interpret tables and graphs to determine intermediate and extrapolated values

GS11. use elementary statistics and laws of probability (mean, median and standard deviation)

GS12. calculate the slope, intercept, and linearity of data sets, and interpret graphs and plots that illustrate these aspects of data

GS13. convert various units of measurement between English and metric units, including length, area, volume, capacity, and weight

GS14. describe and define the seven base units: meter, kilogram, second, ampere, kelvin, candela, and mole

GS15. identify fundamental constants C (velocity or speed of light in a vacuum), G (gravitational constant), and R (universal gas constant), their standard symbols, and their common applications

GS16. translate practical problems into useful mathematical expressions

GS17. write in a manner appropriate for business

GS18. read and correctly assimilate information from manufacturer manuals and guides

GS19. read technical drawings and schematics to correctly extract relevant information

GS20. convey and share technical information clearly using appropriate language

GS21. express information to individuals or groups taking into account the nature of audience and the information

GS22. receive, attend to, correctly interpret and respond to verbal messages and other cues

GS23. apply active listening skills using reflection, restatement, questioning and clarification

GS24. take proper and effective action when necessary without having all the facts at hand

GS25. adapt plans, goals, actions and priorities in response to unpredictable or unexpected events

GS26. plan, prioritize and sequence work operations as per job requirement

GS27. organize and analyze information relevant to work

GS28. allocate resources and time effectively

GS29. identify customer requirements and address key concerns related to the machine/equipment

GS30. identify problems with work planning, procedures, output and behavior and their implications

GS31. prioritize and plan for problem solving

GS32. communicate problems appropriately to others

GS33. identify sources of information and support for problem solving

GS34. seek assistance and support from other sources to solve problems

GS35. identify effective resolution techniques

GS36. select and apply resolution techniques

GS37. seek evidence for problem resolution

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GS39. participate in improvement procedures including process, quality and internal/external customer/ supplier relationships

GS40. enhance one's competencies in new and different situations and contexts to achieve more

GS41. distinguish fact from opinion

GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Establish diagnostic requirements for the condition monitoring setup	**40**	**80**	**-**	**-**
PC1. understand the essential role of diagnostics in decision making for appropriate operation or maintenance tasks based on condition data analysis	-	-	-	-
PC2. be able to set up diagnostic procedures according to the faults that can occur in the equipment	-	-	-	-
PC3. carry out preliminary study when preparing the requirements for condition monitoring and diagnostics of equipment (for appropriate condition data necessary for diagnosis, diagnostic techniques)	-	-	-	-
PC4. understand the various steps generally applied to the diagnostic study and the application of Failure Mode and Effect Analysis (FMEA)/ Failure Mode and Effect Criticality Analysis (FMECA) and Failure Mode Symptoms Analysis (FMSA)	-	-	-	-
PC5. prepare diagnostics requirements report, clearly identifying the equipment faults that are not covered by condition monitoring and hence are not diagnosable (e.g. information about the equipment; failure modes/symptoms analysis)	-	-	-	-
PC6. re-evaluate, on an ongoing basis, the value of adding more capability (e.g. diagnostic tools and techniques, related condition data measurements) to detect specific equipment faults not covered initially	-	-	-	-
PC7. • understand the condition monitoring data in terms of • a) measurements, • b) descriptors, • c) symptoms, • d) fault, • e) operational parameters (used for establishing descriptors or establishing operating conditions)	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC8. • understand machine data, e.g. • a) for vibrations – speed, number of gear teeth, rolling element bearing fault frequencies • b) for oil analysis – oil flow, metal composition, filter ratings • c) for current analysis – no. of stator bars, no. of rotor slots	-	-	-	-
PC9. understand the machine history in terms of fault history, operational history and maintenance history	-	-	-	-
Decide on the diagnostic approach	**-**	**-**	**-**	**-**
PC10. understand the triggers for the diagnosis (e.g. detection of an anomaly during routine monitoring of the equipment)	-	-	-	-
PC11. detect anomaly (e.g. by appropriate methods like making a comparison between the present descriptors of the equipment or comparison with similar equipment) in the equipment that warrants the need for diagnosis	-	-	-	-
PC12. identify the change in one or more of the measured or derived parameters from the baseline values that are indicative of potential fault	-	-	-	-
PC13. understand the various considerations for selection of appropriate diagnostic approach/es (e.g. application of the equipment, monitoring technique, data availability)	-	-	-	-
PC14. • determine the best possible approach (in the legacy environment) for diagnosing the condition of an equipment • 1. data-driven approach (e.g. simple trending, histograms) • 2. knowledge-based approach (e.g. fault models) • note: In many cases the use of both the approaches may be necessary	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC15. • decide on the knowledge-based approach to be used for legacy environment • 1. the faults/symptoms approach and • 2. the causal approach (for in-depth knowledge of the mechanism of the initiation and fault propagation)	-	-	-	-
PC16. estimate the confidence in the accuracy of the diagnosis based on the consideration for various elements (e.g. maintenance history with experience of same fault on similar machines, analysis technique)	-	-	-	-
PC17. decide on further verification as required based on the confidence in the diagnosis	-	-	-	-
PC18. carryout the necessary actions to increase the confidence in the diagnosis (e.g. retaking measurements, additional measurements, more sophisticated diagnostic process or measurement technique)	-	-	-	-
Decide on the prognosis and prognostic approaches	**-**	**-**	**-**	**-**
PC19. based on the diagnosis and the expected progression of existing and future faults, estimate the need for prognosis	-	-	-	-
PC20. decide on the need for fault prognosis based on the diagnosis based on foreknowledge of the probable failure modes, future duties to which the machine will or might be subjected, and a thorough understanding of the relationships between failure modes and operating conditions	-	-	-	-
PC21. understand the requirement of various data for prognosis	-	-	-	-
PC22. understand the basics of a prognosis process (preprocessing to post-action prognosis)	-	-	-	-
PC23. understand the influence factors (parameters that affect the deterioration rate of a failure mode and hence impacts the time to failure)	-	-	-	-
PC24. determine the need to establish the estimated time to failure (ETTF)	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC25. understand the requirements of a prognosis report	-	-	-	-
PC26. perform fault prognosis to estimate the time to failure	-	-	-	-
PC27. carryout the necessary actions to increase the confidence in the prognosis (e.g. retaking measurements, additional measurements, more sophisticated diagnostic process or measurement technique)	-	-	-	-
Document key findings	**-**	**-**	**-**	**-**
PC28. prepare diagnostics requirements report	-	-	-	-
PC29. prepare diagnosis report	-	-	-	-
PC30. take actions to increase the confidence in the diagnosis	-	-	-	-
PC31. prepare prognosis report	-	-	-	-
PC32. take actions to increase the confidence in the prognosis	-	-	-	-
NOS Total	**40**	**80**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0911
NOS Name	Maintain accurate records for Diagnosis and Prognosis based on condition-based monitoring
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	3
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0912: Determine and Initiate Preventive Maintenance Action

Description

Determine and initiate preventive maintenance actions based on equipment condition assessments and maintenance schedules in industrial settings. This NOS involves analyzing equipment performance data, conducting inspections, and evaluating predictive maintenance results to identify potential issues. It includes developing preventive maintenance plans, scheduling maintenance activities, and coordinating with relevant stakeholders. The process aims to minimize unplanned downtime, reduce maintenance costs, and ensure equipment reliability and availability.

Scope

The scope covers the following :

- The scope of this NOS includes determining and initiating preventive maintenance actions based on equipment condition assessments and maintenance schedules in industrial settings. This involves analyzing equipment performance data, conducting inspections, and evaluating predictive maintenance results to identify potential issues. The scope encompasses developing preventive maintenance plans, scheduling maintenance activities, and coordinating with relevant stakeholders.

Elements and Performance Criteria

Determine the need for maintenance action

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

PC1. determine the action/s to be taken on the equipment (e.g. no action, increase or decrease the equipment load/speed/throughput)

PC2. determine the need for an immediate shutdown of the equipment based on severity of the fault conditions (e.g. based on alert/alarm limits for the measured parameter)

PC3. determine the need for maintenance action (e.g. inspection of the equipment or corrective maintenance work) based on the level of confidence in the fault diagnosis and prognosis

Initiate the maintenance action

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

PC4. recommend the maintenance action to the equipment owner operator and/or maintenance team (e.g. email or verbal communication or portal)

PC5. create a Maintenance Work Request/Notification in the CMMS/EAM System if the organization's business processes support such an action

Record maintenance activities performed and the equipment condition post maintenance

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

PC6. record the details of maintenance action performed on the equipment including inspection findings, spares used, other faults discovered during inspection/restoration of the equipment

PC7. record the changes to the equipment condition, post maintenance action (e.g. reduction in vibration post alignment of the driven and driver equipment, reduction in temperature post greasing of the bearing)

PC8. validate the recommendations given post analysis, diagnosis and prognosis for their effectiveness by inspection of the component/s (e.g. bearing condition, misalignment)

PC9. capture all the maintenance work and the equipment condition in the equipment history record for reference in future diagnosis and prognosis, review of effectiveness of the predictive maintenance program

PC10. where appropriate (e.g. repetitive failures of an equipment), support review and optimization of the maintenance strategy for the equipment (e.g. introduction of new condition monitoring technique, additional maintenance tasks for PM, design-out maintenance as necessary)

Document key findings

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

PC11. prepare documentation on recommendations for the action to be taken

PC12. prepare documentation on recommendation for maintenance of the equipment

PC13. prepare documentation on work request/maintenance notification initiated for maintenance interventions

PC14. prepare documentation on maintenance work carried out including physical observations, findings

PC15. prepare documentation on changes to the equipment condition, post maintenance action

PC16. prepare documentation on changes to the equipment maintenance strategy

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

KU4. own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities

KU5. reporting structure, inter-dependent functions, lines and procedures in the work area

KU6. relevant people and their responsibilities within the work area

KU7. escalation matrix and procedures for reporting work and employment related issues

KU8. documentation and related procedures applicable in the context of employment and work

KU9. importance and purpose of documentation in the context of employment and work

KU10. types of industrial processes and equipment in a manufacturing facility

KU11. type of predictive maintenance to performed based on failure histories, associated root causes and relevant testing methods

KU12. how to interpret information sources for predictive maintenance

KU13. how to compile and organise data sources for efficient workflow

KU14. tools, technologies, parts, and components used in predictive maintenance

KU15. how to analyse the data for predictive maintenance

KU16. how to evaluate relevant key variables and performance factors

KU17. how to perform lifecycle analysis of the industrial equipment

KU18. how to visually inspect the industrial equipment for fault finding

KU19. importance of periodic instrument inspections for predictive maintenance

KU20. how to perform real-time monitoring for industrial equipment and machinery

KU21. how to identify failure modes and outcomes for the manufacturing industry

KU22. circumstances or events that indicate a sign of failure within the equipment

KU23. importance of ensuring the required availability of data for predictive maintenance

KU24. importance of preparing reports for recording significant findings

KU25. importance of recording the readings, key findings, and variance from normal operational standards

KU26. importance of complying with relevant legislation, standards, policies and procedures

Generic Skills (GS)

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

GS1. fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/ or local language

GS2. undertake arithmetic operations, and calculations/ formulae Arithmetic operations: e.g. addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages

GS3. produce representations and make calculations in a plane and solid geometry

GS4. use appropriate measuring techniques and units of measurement

GS5. use appropriate units and number systems to express the degree of accuracy Units and number systems representing the degree of accuracy: decimals places, significant figures, fractions as a decimal quantity

GS6. interpret and express tolerance in terms of limits on dimensions

GS7. identify the correct order for performing mathematical operations and solve equations that contain multiple operations

GS8. use basic algebra to solve for the unknown

GS9. convert between various angular units such as degrees, minutes, seconds, grads, radians, etc.

GS10. interpret tables and graphs to determine intermediate and extrapolated values

GS11. use elementary statistics and laws of probability (mean, median and standard deviation)

GS12. calculate the slope, intercept, and linearity of data sets, and interpret graphs and plots that illustrate these aspects of data

GS13. convert various units of measurement between English and metric units, including length, area, volume, capacity, and weight

GS14. describe and define the seven base units: meter, kilogram, second, ampere, kelvin, candela, and mole

GS15. identify fundamental constants C (velocity or speed of light in a vacuum), G (gravitational constant), and R (universal gas constant), their standard symbols, and their common applications

GS16. translate practical problems into useful mathematical expressions

GS17. write in a manner appropriate for business

GS18. read and correctly assimilate information from manufacturer manuals and guides

GS19. read technical drawings and schematics to correctly extract relevant information

GS20. convey and share technical information clearly using appropriate language

GS21. express information to individuals or groups taking into account the nature of audience and the information

GS22. receive, attend to, correctly interpret and respond to verbal messages and other cues

GS23. apply active listening skills using reflection, restatement, questioning and clarification

GS24. take proper and effective action when necessary without having all the facts at hand

GS25. adapt plans, goals, actions and priorities in response to unpredictable or unexpected events

GS26. plan, prioritize and sequence work operations as per job requirement

GS27. organize and analyze information relevant to work

GS28. allocate resources and time effectively

GS29. identify customer requirements and address key concerns related to the machine/equipment

GS30. identify problems with work planning, procedures, output and behavior and their implications

GS31. prioritize and plan for problem solving

GS32. communicate problems appropriately to others

GS33. identify sources of information and support for problem solving

GS34. seek assistance and support from other sources to solve problems

GS35. identify effective resolution techniques

GS36. select and apply resolution techniques

GS37. seek evidence for problem resolution

GS38. undertake and express new ideas and initiatives to others

GS39. participate in improvement procedures including process, quality and internal/external customer/ supplier relationships

GS40. enhance one's competencies in new and different situations and contexts to achieve more

GS41. distinguish fact from opinion

GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Determine the need for maintenance action	**15**	**30**	**-**	**-**
PC1. determine the action/s to be taken on the equipment (e.g. no action, increase or decrease the equipment load/speed/throughput)	-	-	-	-
PC2. determine the need for an immediate shutdown of the equipment based on severity of the fault conditions (e.g. based on alert/alarm limits for the measured parameter)	-	-	-	-
PC3. determine the need for maintenance action (e.g. inspection of the equipment or corrective maintenance work) based on the level of confidence in the fault diagnosis and prognosis	-	-	-	-
Initiate the maintenance action	-	-	-	-
PC4. recommend the maintenance action to the equipment owner operator and/or maintenance team (e.g. email or verbal communication or portal)	-	-	-	-
PC5. create a Maintenance Work Request/Notification in the CMMS/EAM System if the organization's business processes support such an action	-	-	-	-
Record maintenance activities performed and the equipment condition post maintenance	-	-	-	-
PC6. record the details of maintenance action performed on the equipment including inspection findings, spares used, other faults discovered during inspection/restoration of the equipment	-	-	-	-
PC7. record the changes to the equipment condition, post maintenance action (e.g. reduction in vibration post alignment of the driven and driver equipment, reduction in temperature post greasing of the bearing)	-	-	-	-
PC8. validate the recommendations given post analysis, diagnosis and prognosis for their effectiveness by inspection of the component/s (e.g. bearing condition, misalignment)	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC9. capture all the maintenance work and the equipment condition in the equipment history record for reference in future diagnosis and prognosis, review of effectiveness of the predictive maintenance program	-	-	-	-
PC10. where appropriate (e.g. repetitive failures of an equipment), support review and optimization of the maintenance strategy for the equipment (e.g. introduction of new condition monitoring technique, additional maintenance tasks for PM, design-out maintenance as necessary)	-	-	-	-
Document key findings	**-**	**-**	**-**	**-**
PC11. prepare documentation on recommendations for the action to be taken	-	-	-	-
PC12. prepare documentation on recommendation for maintenance of the equipment	-	-	-	-
PC13. prepare documentation on work request/maintenance notification initiated for maintenance interventions	-	-	-	-
PC14. prepare documentation on maintenance work carried out including physical observations, findings	-	-	-	-
PC15. prepare documentation on changes to the equipment condition, post maintenance action	-	-	-	-
PC16. prepare documentation on changes to the equipment maintenance strategy	-	-	-	-
NOS Total	**15**	**30**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0912
NOS Name	Determine and Initiate Preventive Maintenance Action
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	2
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0913: Review the Predictive Maintenance Program

Description

Review the predictive maintenance program to assess its effectiveness and make recommendations for improvement in industrial settings. This NOS involves evaluating the program's objectives, methodologies, and outcomes to determine if they align with organizational goals and industry best practices. It includes analyzing maintenance data, performance metrics, and feedback from stakeholders to identify strengths, weaknesses, and areas for improvement.

Scope

The scope covers the following :

- The scope of this NOS includes reviewing the predictive maintenance program in industrial settings to assess its effectiveness and recommend improvements. This involves evaluating the program's objectives, methodologies, and outcomes to ensure alignment with organizational goals and industry best practices. The scope encompasses analyzing maintenance data, performance metrics, and stakeholder feedback to identify strengths, weaknesses, and improvement areas.

Elements and Performance Criteria

Periodical review of the condition monitoring/predictive maintenance program

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

PC1. review the condition monitoring/predictive maintenance program on a periodical basis, for various aspects (e.g. feasibility of adopting condition monitoring techniques not implemented earlier, effectiveness of condition monitoring and diagnostic techniques currently implemented)

PC2. revise alert/alarm criteria due to changes in the equipment being monitored considering the various aspects (e.g. progressive wear of the components, ageing, operation/duty cycle changes)

PC3. re-establish baselines where required (e.g. post-equipment overhaul/modification/rerating)

PC4. modify rule-based diagnostics where applicable (e.g. changes to the components, limits of the parameters)

Initiate the maintenance action

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

PC5. issue of condition monitoring and diagnostic reports within the timeline/agreed time window

PC6. regularly back up all data in a secure manner

PC7. review, update and revise data bases (e.g. different, disparate condition monitoring systems/solutions) at pre-determined intervals

PC8. review alarm settings at regular intervals

Document key findings

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

PC9. prepare documentation on report of the periodical review of the predictive maintenance program including the recommendations

PC10. prepare documentation on revisions to the alarm and shutdown/trip values for the equipment

PC11. prepare documentation on re-establish baselines for specific equipment

PC12. prepare documentation on modifications done in rule-based diagnostics

PC13. prepare documentation on exception report (periodical) based on the tracking of adherence to timelines for issue of various reports

PC14. prepare documentation on secure back up of all data carried out on periodical basis

PC15. prepare documentation on review/update/revisions carried out for various data bases and software

PC16. review and revisions carried out to alarm settings at regular intervals

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions

KU2. relevant health and safety requirements applicable in the workplace

KU3. importance of working in a clean and safe environment

KU4. own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities

KU5. reporting structure, inter-dependent functions, lines and procedures in the work area

KU6. relevant people and their responsibilities within the work area

KU7. escalation matrix and procedures for reporting work and employment related issues

KU8. documentation and related procedures applicable in the context of employment and work

KU9. importance and purpose of documentation in the context of employment and work

KU10. types of industrial processes and equipment in a manufacturing facility

KU11. type of predictive maintenance to performed based on failure histories, associated root causes and relevant testing methods

KU12. how to interpret information sources for predictive maintenance

KU13. how to compile and organise data sources for efficient workflow

KU14. tools, technologies, parts, and components used in predictive maintenance

KU15. how to analyse the data for predictive maintenance

KU16. how to evaluate relevant key variables and performance factors

KU17. how to perform lifecycle analysis of the industrial equipment

KU18. how to visually inspect the industrial equipment for fault finding

KU19. importance of periodic instrument inspections for predictive maintenance

KU20. how to perform real-time monitoring for industrial equipment and machinery

KU21. how to identify failure modes and outcomes for the manufacturing industry

KU22. circumstances or events that indicate a sign of failure within the equipment

KU23. importance of ensuring the required availability of data for predictive maintenance

KU24. importance of preparing reports for recording significant findings

KU25. importance of recording the readings, key findings, and variance from normal operational standards

KU26. importance of complying with relevant legislation, standards, policies and procedures

Generic Skills (GS)

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

GS1. fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/ or local language

GS2. undertake arithmetic operations, and calculations/ formulae Arithmetic operations: e.g. addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages

GS3. produce representations and make calculations in a plane and solid geometry

GS4. use appropriate measuring techniques and units of measurement

GS5. use appropriate units and number systems to express the degree of accuracy Units and number systems representing the degree of accuracy: decimals places, significant figures, fractions as a decimal quantity

GS6. interpret and express tolerance in terms of limits on dimensions

GS7. identify the correct order for performing mathematical operations and solve equations that contain multiple operations

GS8. use basic algebra to solve for the unknown

GS9. convert between various angular units such as degrees, minutes, seconds, grads, radians, etc.

GS10. interpret tables and graphs to determine intermediate and extrapolated values

GS11. use elementary statistics and laws of probability (mean, median and standard deviation)

GS12. calculate the slope, intercept, and linearity of data sets, and interpret graphs and plots that illustrate these aspects of data

GS13. convert various units of measurement between English and metric units, including length, area, volume, capacity, and weight

GS14. describe and define the seven base units: meter, kilogram, second, ampere, kelvin, candela, and mole

GS15. identify fundamental constants C (velocity or speed of light in a vacuum), G (gravitational constant), and R (universal gas constant), their standard symbols, and their common applications

GS16. translate practical problems into useful mathematical expressions

GS17. write in a manner appropriate for business

GS18. read and correctly assimilate information from manufacturer manuals and guides

GS19. read technical drawings and schematics to correctly extract relevant information

GS20. convey and share technical information clearly using appropriate language

GS21. express information to individuals or groups taking into account the nature of audience and the information

GS22. receive, attend to, correctly interpret and respond to verbal messages and other cues

GS23. apply active listening skills using reflection, restatement, questioning and clarification

GS24. take proper and effective action when necessary without having all the facts at hand

GS25. adapt plans, goals, actions and priorities in response to unpredictable or unexpected events

GS26. plan, prioritize and sequence work operations as per job requirement

GS27. organize and analyze information relevant to work

GS28. allocate resources and time effectively

GS29. identify customer requirements and address key concerns related to the machine/equipment

GS30. identify problems with work planning, procedures, output and behavior and their implications

GS31. prioritize and plan for problem solving

GS32. communicate problems appropriately to others

GS33. identify sources of information and support for problem solving

GS34. seek assistance and support from other sources to solve problems

GS35. identify effective resolution techniques

GS36. select and apply resolution techniques

GS37. seek evidence for problem resolution

GS38. undertake and express new ideas and initiatives to others

GS39. participate in improvement procedures including process, quality and internal/external customer/ supplier relationships

GS40. enhance one's competencies in new and different situations and contexts to achieve more

GS41. distinguish fact from opinion

GS42. evaluate the reliability of information sourced from suppliers and vendors

GS43. balance priorities with constraints in order to propose viable recommendations

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Periodical review of the condition monitoring/predictive maintenance program	15	30	-	-
PC1. review the condition monitoring/predictive maintenance program on a periodical basis, for various aspects (e.g. feasibility of adopting condition monitoring techniques not implemented earlier, effectiveness of condition monitoring and diagnostic techniques currently implemented)	-	-	-	-
PC2. revise alert/alarm criteria due to changes in the equipment being monitored considering the various aspects (e.g. progressive wear of the components, ageing, operation/duty cycle changes)	-	-	-	-
PC3. re-establish baselines where required (e.g. post-equipment overhaul/modification/rerating)	-	-	-	-
PC4. modify rule-based diagnostics where applicable (e.g. changes to the components, limits of the parameters)	-	-	-	-
Initiate the maintenance action	-	-	-	-
PC5. issue of condition monitoring and diagnostic reports within the timeline/agreed time window	-	-	-	-
PC6. regularly back up all data in a secure manner	-	-	-	-
PC7. review, update and revise data bases (e.g. different, disparate condition monitoring systems/solutions) at pre-determined intervals	-	-	-	-
PC8. review alarm settings at regular intervals	-	-	-	-
Document key findings	-	-	-	-
PC9. prepare documentation on report of the periodical review of the predictive maintenance program including the recommendations	-	-	-	-
PC10. prepare documentation on revisions to the alarm and shutdown/trip values for the equipment	-	-	-	-
PC11. prepare documentation on re-establish baselines for specific equipment	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC12. prepare documentation on modifications done in rule-based diagnostics	-	-	-	-
PC13. prepare documentation on exception report (periodical) based on the tracking of adherence to timelines for issue of various reports	-	-	-	-
PC14. prepare documentation on secure back up of all data carried out on periodical basis	-	-	-	-
PC15. prepare documentation on review/update/revisions carried out for various data bases and software	-	-	-	-
PC16. review and revisions carried out to alarm settings at regular intervals	-	-	-	-
NOS Total	**15**	**30**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0913
NOS Name	Review the Predictive Maintenance Program
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Maintenance
NSQF Level	5.5
Credits	2
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N1342: Collaboratively work with the team

Description

This OS unit is about building relationships and working with people and groups inside and outside the organization, using skills and habits, to achieve the team goals and objectives

Scope

The scope covers the following :

- This unit/task covers the following:
- Creating team environment
- Communicating - giving and receiving
- Working cooperatively
- Participating in team decision making
- Demonstrating Sense of Responsibility
- Showing respect for opinions, customs, and preferences

Elements and Performance Criteria

Creating team environment

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

PC1. test and maintain these systems regularly to guarantee their effectiveness in case of emergencies

PC2. get to know team members by name and greet them appropriately and respond to their greetings

PC3. get to know the roles and responsibilities of team members. Ensure others know about you and your role in the team

PC4. learn about the culture and preferences of team members – especially if they belong to other organizations or nationalities

PC5. follow organization's policies and procedures for working with team members within and outside the organization – especially relating to privacy, confidentiality, and security

PC6. create an environment of trust and mutual respect

Communicating - giving and receiving

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

PC7. use appropriate mode of communication – verbal, written, mail, phone or text and clearly articulate your message to ensure that the recipient understands the message

PC8. listen to team members and try to understand what they are wanting to say. Seek or provide clarifications if you see any gap in understanding

PC9. communicate professionally and follow organization protocols. Do not overload the team members with unnecessary and unsolicited information

PC10. share important information with the team timely

PC11. respond to communications promptly

Working cooperatively

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

PC12. perform own role and produce output in time for other team members to consume

PC13. receive inputs from others and work upon it per role requirement

PC14. adjust within the permissible rules so that work flows smoothly

PC15. help team members to perform their role effectively and provide any clarifications and support they need

PC16. share tools and common resources fairly, taking cognizance of others' needs and schedules

PC17. resolve any contentious issues amicably, involving the team lead or the supervisor if needed

PC18. • let team members know in good time if you cannot carry out your commitments, explaining the reasons and alternate solutions, if any. Let the
• team lead know about this

Participating in team decision making

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

PC19. think positively and make constructive suggestions to meet the goals

PC20. accept and give suggestions with open mind

PC21. take initiatives and volunteer to contribute

PC22. help team members with facts and figures to arrive at workable decisions

PC23. accept decisions professionally and support these, even if these do not match your suggestions and personal views

PC24. act in the interest of the team and the organization to ensure that things do not 'fall through the gap' and team goals are achieved

PC25. take initiative to correct the situation if something seems to be going wrong

PC26. seek help or escalate if the situation demands

Showing respect for opinions, customs, and preferences

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

PC27. follow organization's and statutory guidelines about making references or comments to social customs or preferences

PC28. refrain from making any comments to hurt sentiments

PC29. accommodate team members' preferences to the extent feasible. If these come in the way of fulfilling team goals, discuss with the supervisor/ team leader

PC30. seek information and clarifications from others if you do not understand any customs

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the organisation's policies and procedures for working with colleagues, roles and responsibilities

KU2. the importance of effective communication and establishing good working relationships with colleagues

KU3. different methods of communication and the circumstances in which it is appropriate to use these

KU4. the importance of creating an environment of trust and mutual respect

KU5. the implications of own work on the work and schedule of others

KU6. different types of information that colleagues might need and the importance of providing this information when it is required

KU7. the importance of helping colleagues with problems, to meet quality and time standards as a team

Generic Skills (GS)

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

GS1. read and write instructions, guidelines, procedures, messages, emails, and other media in language of the workplace

GS2. communicate in common and technical terms in language of the workplace

GS3. listen effectively and orally communicate information

GS4. be punctual, do work scheduling and reporting

GS5. comply with workplace practices and ethics

GS6. maintain cleanliness and healthy environment

GS7. be customer friendly - understand real needs of the customer and suggest most appropriate solution

GS8. be safety conscious and avoid risk

GS9. be observant, vigilant, and security consciousness

GS10. respond, handle problem, and escalate as necessary

GS11. ask for clarification and advice from concerned persons

GS12. make decisions on a suitable course of action or response keeping in view resource utilization while meeting commitments

GS13. plan and organize work to achieve targets and deadlines

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Creating team environment	**6**	**15**	**-**	**-**
PC1. test and maintain these systems regularly to guarantee their effectiveness in case of emergencies	-	-	-	-
PC2. get to know team members by name and greet them appropriately and respond to their greetings	-	-	-	-
PC3. get to know the roles and responsibilities of team members. Ensure others know about you and your role in the team	-	-	-	-
PC4. learn about the culture and preferences of team members – especially if they belong to other organizations or nationalities	-	-	-	-
PC5. follow organization's policies and procedures for working with team members within and outside the organization – especially relating to privacy, confidentiality, and security	-	-	-	-
PC6. create an environment of trust and mutual respect	-	-	-	-
Communicating - giving and receiving	**6**	**15**	**-**	**-**
PC7. use appropriate mode of communication – verbal, written, mail, phone or text and clearly articulate your message to ensure that the recipient understands the message	-	-	-	-
PC8. listen to team members and try to understand what they are wanting to say. Seek or provide clarifications if you see any gap in understanding	-	-	-	-
PC9. communicate professionally and follow organization protocols. Do not overload the team members with unnecessary and unsolicited information	-	-	-	-
PC10. share important information with the team timely	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. respond to communications promptly	-	-	-	-
Working cooperatively	**6**	**15**	**-**	**-**
PC12. perform own role and produce output in time for other team members to consume	-	-	-	-
PC13. receive inputs from others and work upon it per role requirement	-	-	-	-
PC14. adjust within the permissible rules so that work flows smoothly	-	-	-	-
PC15. help team members to perform their role effectively and provide any clarifications and support they need	-	-	-	-
PC16. share tools and common resources fairly, taking cognizance of others' needs and schedules	-	-	-	-
PC17. resolve any contentious issues amicably, involving the team lead or the supervisor if needed	-	-	-	-
PC18. • let team members know in good time if you cannot carry out your commitments, explaining the reasons and alternate solutions, if any. Let the • team lead know about this	-	-	-	-
Participating in team decision making	**6**	**15**	**-**	**-**
PC19. think positively and make constructive suggestions to meet the goals	-	-	-	-
PC20. accept and give suggestions with open mind	-	-	-	-
PC21. take initiatives and volunteer to contribute	-	-	-	-
PC22. help team members with facts and figures to arrive at workable decisions	-	-	-	-
PC23. accept decisions professionally and support these, even if these do not match your suggestions and personal views	-	-	-	-
PC24. act in the interest of the team and the organization to ensure that things do not 'fall through the gap' and team goals are achieved	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC25. take initiative to correct the situation if something seems to be going wrong	-	-	-	-
PC26. seek help or escalate if the situation demands	-	-	-	-
Showing respect for opinions, customs, and preferences	**6**	**10**	-	-
PC27. follow organization's and statutory guidelines about making references or comments to social customs or preferences	-	-	-	-
PC28. refrain from making any comments to hurt sentiments	-	-	-	-
PC29. accommodate team members' preferences to the extent feasible. If these come in the way of fulfilling team goals, discuss with the supervisor/ team leader	-	-	-	-
PC30. seek information and clarifications from others if you do not understand any customs	-	-	-	-
NOS Total	**30**	**70**	-	-

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1342
NOS Name	Collaboratively work with the team
Sector	Capital Goods
Sub-Sector	Generic
Occupation	Generic
NSQF Level	5
Credits	1
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

CSC/N0505: Follow health, safety and environment guidelines at workplace

Description

This OS unit is about following adequate safety procedures to make work environment healthy and safe

Scope

The scope covers the following :

- This unit/task covers the following:
- Adhere to standard safety procedures of the company
- Follow healthy practices and posture
- Practice waste management and recycling
- Conserve material and resources

Elements and Performance Criteria

Adhere to standard safety procedures of the organisation

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

PC1. comply with general safety procedures and those for handling equipment, tools, chemicals, and hazardous material, as prescribed and followed in the organisation

PC2. remove finger rings or any other metal objects likely to interfere with the work

PC3. ensure that identification badge or any other object worn around the neck or on the clothing does not get caught in any rotating machine, or otherwise interfere with the work

PC4. use appropriate safety devices such as goggles, gloves, ear plugs, caps, ESD pins, covers, shoes, helmets etc. recommended for the work being performed

PC5. inform, escalate, or raise alarm about any suspicions, unaccounted hazardous material, devices, or other objects found in the premises

PC6. inform, escalate, or raise alarm about any breach of safety or security procedure in the organisation

PC7. help achieve zero accidents goals at work

PC8. avoid damage to sensitive electronic components due to negligence of ESD procedures

PC9. participate regularly in fire drills or other safety related workshops organised by the organisation

PC10. follow strictly all access control and perimeter safety procedures in designated factory areas such as robotic work stations, automated production lines, automated material movement and other potentially risky operations

PC11. ensure that other people follow all access control and perimeter safety procedures in designated factory areas and help avoid accidents

PC12. use emergency switches or other mechanisms of stopping a machine immediately in case any emergency situation has developed or about to happen

PC13. ensure that electrical equipment are properly grounded

PC14. follow Cyber Security guidelines and be vigilant at workplace

PC15. proceed to designated safe assembly area immediately on hearing fire alarm

Follow healthy practices and posture

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

PC16. wash hands and use sanitizers as recommended to prevent spread of diseases

PC17. follow common personal hygiene practices

PC18. maintain appropriate posture, especially in long hours of sitting or standing position and in handling heavy materials

PC19. participate in company organised health sessions such as exercises, games, yoga, physiotherapy, and other activities

PC20. handle heavy and hazardous materials with care, while maintaining appropriate posture, using suitable tools, and handling equipment such as trolleys, jacks, and ladders

PC21. learn and apply first aid devices available in the workplace

PC22. learn and apply safety and handling procedures for electrical shock and electrocution

PC23. learn and apply emergency medical help services

PC24. follow workplace decorum and avoid emotional outbursts or inappropriate language

PC25. prevent any harassment at workplace

Practice waste management and recycling

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

PC26. identify recyclable, non-recyclable, and hazardous waste generated in the workplace and comply with their disposal procedures

PC27. dispose non-recyclable waste and hazardous waste following recommended processes

PC28. deposit recyclable and reusable material at identified locations

PC29. support education and compliance of waste management processes

Conserve material and resources

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

PC30. identify ways to optimize usage of material and resources such as water, electricity, energy in various tasks, activities, and processes

PC31. check for spills and leakages of material in various tasks, activities, and processes and plug them

PC32. escalate the leakage issue to appropriate authority if needed

PC33. carry out routine cleaning of tools, machines, and equipment and maintain them in good working condition to optimize efficiency and wastage

PC34. check if the equipment is functioning normally before commencing work and rectify or report any malfunctioning to the responsible agency

PC35. check for any odour, sparks, fumes, emission, unusual vibration, noise, or any other objectionable presence in the environment and take immediate corrective action followed by report to responsible agency

PC36. ensure electrical equipment are properly connected for use and are switched off when not in use

PC37. support education and compliance of resource conservation processes

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. company policies on workplace, environment, and personnel management
KU2. company policy on occupational safety and health
KU3. professional hazards related to nature of work and how to deal with them
KU4. how to maintain the work area safe and secure
KU5. how to handle hazardous materials, tools, and equipment
KU6. emergency procedures for fire, electrocution, physical injury, wounds, etc.
KU7. need for proper body posture and use of appropriate handling equipment
KU8. understand electrical grounding practices
KU9. common sources of pollution and ways to minimize it
KU10. waste management - categorisation, colour coding, handling, and disposal procedure
KU11. organisation policies and procedures for minimizing waste
KU12. efficient use of electricity, material, and water in processes
KU13. organization policies regarding network usage and security
KU14. norms for professional behaviour at workplace and dealing with deviations

Generic Skills (GS)

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

GS1. communicating in the language of the workplace
GS2. reading and interpreting documents, drawings, symbols, and instructions
GS3. operating computer and common office equipment and diagnosing common electrical and interconnection problems
GS4. writing notes, reports, observations, emails
GS5. using personnel protective devices
GS6. maintaining clean and healthy work environment
GS7. using and operating safety devices and equipment
GS8. conducting work following workplace security processes and rules
GS9. responding to emergency situations pertaining to workplace
GS10. understanding people and collaborating to create a healthy workplace

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Adhere to standard safety procedures of the organisation	**7**	**10**	**-**	**-**
PC1. comply with general safety procedures and those for handling equipment, tools, chemicals, and hazardous material, as prescribed and followed in the organisation	-	-	-	-
PC2. remove finger rings or any other metal objects likely to interfere with the work	-	-	-	-
PC3. ensure that identification badge or any other object worn around the neck or on the clothing does not get caught in any rotating machine, or otherwise interfere with the work	-	-	-	-
PC4. use appropriate safety devices such as goggles, gloves, ear plugs, caps, ESD pins, covers, shoes, helmets etc. recommended for the work being performed	-	-	-	-
PC5. inform, escalate, or raise alarm about any suspicions, unaccounted hazardous material, devices, or other objects found in the premises	-	-	-	-
PC6. inform, escalate, or raise alarm about any breach of safety or security procedure in the organisation	-	-	-	-
PC7. help achieve zero accidents goals at work	-	-	-	-
PC8. avoid damage to sensitive electronic components due to negligence of ESD procedures	-	-	-	-
PC9. participate regularly in fire drills or other safety related workshops organised by the organisation	-	-	-	-
PC10. follow strictly all access control and perimeter safety procedures in designated factory areas such as robotic work stations, automated production lines, automated material movement and other potentially risky operations	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. ensure that other people follow all access control and perimeter safety procedures in designated factory areas and help avoid accidents	-	-	-	-
PC12. use emergency switches or other mechanisms of stopping a machine immediately in case any emergency situation has developed or about to happen	-	-	-	-
PC13. ensure that electrical equipment are properly grounded	-	-	-	-
PC14. follow Cyber Security guidelines and be vigilant at workplace	-	-	-	-
PC15. proceed to designated safe assembly area immediately on hearing fire alarm	-	-	-	-
Follow healthy practices and posture	**8**	**10**	**-**	**-**
PC16. wash hands and use sanitizers as recommended to prevent spread of diseases	-	-	-	-
PC17. follow common personal hygiene practices	-	-	-	-
PC18. maintain appropriate posture, especially in long hours of sitting or standing position and in handling heavy materials	-	-	-	-
PC19. participate in company organised health sessions such as exercises, games, yoga, physiotherapy, and other activities	-	-	-	-
PC20. handle heavy and hazardous materials with care, while maintaining appropriate posture, using suitable tools, and handling equipment such as trolleys, jacks, and ladders	-	-	-	-
PC21. learn and apply first aid devices available in the workplace	-	-	-	-
PC22. learn and apply safety and handling procedures for electrical shock and electrocution	-	-	-	-
PC23. learn and apply emergency medical help services	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC24. follow workplace decorum and avoid emotional outbursts or inappropriate language	-	-	-	-
PC25. prevent any harassment at workplace	-	-	-	-
Practice waste management and recycling	**-**	**-**	**-**	**-**
PC26. identify recyclable, non-recyclable, and hazardous waste generated in the workplace and comply with their disposal procedures	-	-	-	-
PC27. dispose non-recyclable waste and hazardous waste following recommended processes	-	-	-	-
PC28. deposit recyclable and reusable material at identified locations	-	-	-	-
PC29. support education and compliance of waste management processes	-	-	-	-
Conserve material and resources	**-**	**-**	**-**	**-**
PC30. identify ways to optimize usage of material and resources such as water, electricity, energy in various tasks, activities, and processes	-	-	-	-
PC31. check for spills and leakages of material in various tasks, activities, and processes and plug them	-	-	-	-
PC32. escalate the leakage issue to appropriate authority if needed	-	-	-	-
PC33. carry out routine cleaning of tools, machines, and equipment and maintain them in good working condition to optimize efficiency and wastage	-	-	-	-
PC34. check if the equipment is functioning normally before commencing work and rectify or report any malfunctioning to the responsible agency	-	-	-	-
PC35. check for any odour, sparks, fumes, emission, unusual vibration, noise, or any other objectionable presence in the environment and take immediate corrective action followed by report to responsible agency	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC36. ensure electrical equipment are properly connected for use and are switched off when not in use	-	-	-	-
PC37. support education and compliance of resource conservation processes	-	-	-	-
NOS Total	15	20	-	-

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0505
NOS Name	Follow health, safety and environment guidelines at workplace
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Defence Equipment, Fire-Fighting & Safety Equipment, Homeland Security
Occupation	Service
NSQF Level	5
Credits	1
Version	1.0
Last Reviewed Date	31/01/2024
Next Review Date	31/01/2027
NSQC Clearance Date	31/01/2024

DGT/VSQ/N0102: Employability Skills (60 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. identify employability skills required for jobs in various industries

PC2. identify and explore learning and employability portals

Constitutional values – Citizenship

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

PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.

PC4. follow environmentally sustainable practices

Becoming a Professional in the 21st Century

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

PC5. recognize the significance of 21st Century Skills for employment

PC6. 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

Basic English Skills

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

PC7. use basic English for everyday conversation in different contexts, in person and over the telephone

PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English

PC9. write short messages, notes, letters, e-mails etc. in English

Career Development & Goal Setting

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

PC10. understand the difference between job and career

PC11. prepare a career development plan with short- and long-term goals, based on aptitude

Communication Skills

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

PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings

PC13. work collaboratively with others in a team

Diversity & Inclusion

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

PC14. communicate and behave appropriately with all genders and PwD

PC15. escalate any issues related to sexual harassment at workplace according to POSH Act

Financial and Legal Literacy

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

PC16. select financial institutions, products and services as per requirement

PC17. carry out offline and online financial transactions, safely and securely

PC18. identify common components of salary and compute income, expenses, taxes, investments etc

PC19. 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:

PC20. operate digital devices and carry out basic internet operations securely and safely

PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively

PC22. use basic features of word processor, spreadsheets, and presentations

Entrepreneurship

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

PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research

PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion

PC25. 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:

PC26. identify different types of customers

PC27. identify and respond to customer requests and needs in a professional manner.

PC28. follow appropriate hygiene and grooming standards

Getting ready for apprenticeship & Jobs

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

PC29. create a professional Curriculum vitae (Résumé)

PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively

PC31. apply to identified job openings using offline /online methods as per requirement

PC32. answer questions politely, with clarity and confidence, during recruitment and selection

PC33. 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 and different learning and employability related portals

KU2. various constitutional and personal values

KU3. different environmentally sustainable practices and their importance

KU4. Twenty first (21st) century skills and their importance

KU5. how to use English language for effective verbal (face to face and telephonic) and written communication in formal and informal set up

KU6. importance of career development and setting long- and short-term goals

KU7. about effective communication

KU8. POSH Act

KU9. Gender sensitivity and inclusivity

KU10. different types of financial institutes, products, and services

KU11. how to compute income and expenditure

KU12. importance of maintaining safety and security in offline and online financial transactions

KU13. different legal rights and laws

KU14. different types of digital devices and the procedure to operate them safely and securely

KU15. how to create and operate an e- mail account and use applications such as word processors, spreadsheets etc.

KU16. how to identify business opportunities

KU17. types and needs of customers

KU18. how to apply for a job and prepare for an interview

KU19. 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

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

GS3. behave politely and appropriately with all

GS4. how to work in a virtual mode

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. identify employability skills required for jobs in various industries	-	-	-	-
PC2. identify and explore learning and employability portals	-	-	-	-
Constitutional values – Citizenship	1	1	-	-
PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.	-	-	-	-
PC4. follow environmentally sustainable practices	-	-	-	-
Becoming a Professional in the 21st Century	2	4	-	-
PC5. recognize the significance of 21st Century Skills for employment	-	-	-	-
PC6. 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	-	-	-	-
Basic English Skills	2	3	-	-
PC7. use basic English for everyday conversation in different contexts, in person and over the telephone	-	-	-	-
PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English	-	-	-	-
PC9. write short messages, notes, letters, e-mails etc. in English	-	-	-	-
Career Development & Goal Setting	1	2	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. understand the difference between job and career	-	-	-	-
PC11. prepare a career development plan with short- and long-term goals, based on aptitude	-	-	-	-
Communication Skills	**2**	**2**	**-**	**-**
PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings	-	-	-	-
PC13. work collaboratively with others in a team	-	-	-	-
Diversity & Inclusion	**1**	**2**	**-**	**-**
PC14. communicate and behave appropriately with all genders and PwD	-	-	-	-
PC15. escalate any issues related to sexual harassment at workplace according to POSH Act	-	-	-	-
Financial and Legal Literacy	**2**	**3**	**-**	**-**
PC16. select financial institutions, products and services as per requirement	-	-	-	-
PC17. carry out offline and online financial transactions, safely and securely	-	-	-	-
PC18. identify common components of salary and compute income, expenses, taxes, investments etc	-	-	-	-
PC19. identify relevant rights and laws and use legal aids to fight against legal exploitation	-	-	-	-
Essential Digital Skills	**3**	**4**	**-**	**-**
PC20. operate digital devices and carry out basic internet operations securely and safely	-	-	-	-
PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively	-	-	-	-
PC22. use basic features of word processor, spreadsheets, and presentations	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Entrepreneurship	**2**	**3**	-	-
PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research	-	-	-	-
PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion	-	-	-	-
PC25. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity	-	-	-	-
Customer Service	**1**	**2**	-	-
PC26. identify different types of customers	-	-	-	-
PC27. identify and respond to customer requests and needs in a professional manner.	-	-	-	-
PC28. follow appropriate hygiene and grooming standards	-	-	-	-
Getting ready for apprenticeship & Jobs	**2**	**3**	-	-
PC29. create a professional Curriculum vitae (Résumé)	-	-	-	-
PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively	-	-	-	-
PC31. apply to identified job openings using offline /online methods as per requirement	-	-	-	-
PC32. answer questions politely, with clarity and confidence, during recruitment and selection	-	-	-	-
PC33. 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/N0102
NOS Name	Employability Skills (60 Hours)
Sector	Cross Sectoral
Sub-Sector	Professional Skills
Occupation	Employability
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	29/11/2026
NSQC Clearance Date	30/11/2023

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down the proportion of marks for Theory and Skills Practical for each PC.

2. The assessment for the theory part will be based on the knowledge bank of questions created by the SSC.

3. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below.)

4. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/ training center based on these criteria.

5. To pass the Qualification Pack, every trainee should score a minimum of 70% in every NOS.

6. In case of successfully passing only a certain number of NOSs, the trainee is eligible to take the subsequent assessment on the balance NOS's to pass the Qualification Pack.

7. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.

Minimum Aggregate Passing % at QP Level : 70

(**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
CSC/N0902.Conduct regular inspection of machinery and equipment to identify potential issues	30	70	-	-	100	15
CSC/N0909.Assist in Design, Development and Implementation of predictive maintenance system	50	100	-	-	150	15
CSC/N0910.Perform Data acquisition, and prepare for the process and analysis of acquired data	20	40	-	-	60	15
CSC/N0911.Maintain accurate records for Diagnosis and Prognosis based on condition-based monitoring	40	80	-	-	120	15
CSC/N0912.Determine and Initiate Preventive Maintenance Action	15	30	-	-	45	10
CSC/N0913.Review the Predictive Maintenance Program	15	30	-	-	45	10
CSC/N1342.Collaboratively work with the team	30	70	-	-	100	10
CSC/N0505.Follow health, safety and environment guidelines at workplace	15	20	-	-	35	5

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
DGT/VSQ/N0102.Employability Skills (60 Hours)	20	30	-	-	50	5
Total	**235**	**470**	**-**	**-**	**705**	**100**

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.