Qualification Pack

IIoT Industrial System Architecture Engineer

QP Code: CSC/Q0409

Version: 1.0

NSQF Level: 5.5

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Contents

Qualification Pack

CSC/Q0409: IIoT Industrial System Architecture Engineer

Brief Job Description

Industry 4.0 IIOT Specialist plays a vital role in new-age Smart e-factories to achieve desired user-friendly agile, flexible, and cost-effective, sustainable, self-reliance enterprise integrated horizontally and vertically - as well as with vendors, suppliers and consumers. IIOT Implements the system architecture, performs engineering tasks, reconfigurations, and upgrades. It evangelizes Industry 4.0 cultural ecosystems and helps relevant skill development thereby upskill and reskill.

Personal Attributes

This domain job requires the individual to be self-reliant and develop passion for the Industry 4.0 Industrial IOT and enable to extensively collaborate at all levels with different stakeholders. Unlearn and relearn new age disruptive technologies, simulation tools, system architectures, design aspects, controls and processes and thereby apply it to optimize benefits for the industry. The job role also teaches the spirit of entrepreneurship ecosystems as well.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. CSC/N0428: Assist in creating a smart e-Factory

2. CSC/N0429: Perform system analysis and assist in design, develop and maximize productivity of machinery

3. CSC/N0430: Execute Process Control automation to achieve improved productivity

4. CSC/N0431: Customize Industrial Internet of Things (IIOT) ecosystem for optimized performance

5. CSC/N0432: Collate data through Sensors and devices, and present it in relevant format for data analysis and data management

6. CSC/N0433: Assist to achieve the desired Product Life Cycle Management

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

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

Qualification Pack (QP) Parameters

Sector	Capital Goods

Qualification Pack

Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
Country	India
NSQF Level	5.5
Credits	20
Aligned to NCO/ISCO/ISIC Code	NCO/2015
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-02039-2024-V1-CGSC
NQR Version	1

CSC/N0428: Assist in creating a smart e-Factory

Description

This OS unit is about collaborating in creating modern smart factories with digital disruptive manufacturing technologies and processes to achieve an agile and flexible sustainable and self-reliant enterprise that can respond to the changing needs of markets and customers quickly to take the best advantage of national and global avenues. This requires ability to quickly change product designs, architecture, customizations, rapid deliveries, high quality and at reduced costs-without creating new facilities and shop-floor production lines.

Scope

The scope covers the following :

- Provide inputs for architecting and implementing Industry 4.0 ready factory
- Support and execute the intelligent implementation of the Industry 4.0 plan for the Industry
- Lead or participate in creating detailed engineering documentation
- Collectively Collaborate in Smart Planning, Design and Execution of manufacturing production plan
- Conduct one-to-one interactions with different stake holders of the organization with the pre-defined goals, roles and responsibilities
- Help the team understand the entrepreneurial spirit of Industry 4.0 and adopt the systems

Elements and Performance Criteria

Provide desired inputs for architecting and implementing Industry 4.0 disruptive ready smart factory

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

PC1. consolidate and provide the set of existing or planned processes to produce the desired end products

PC2. consolidate and provide the set of existing or planned sensors, devices, actuators, controllers, and related equipment (used or planned to be used), to monitor and control the processes in the smart factory

PC3. provide details of new-age technologies used or proposed, to implement the processes, with justifications

PC4. provide details of disruptive technologies used or proposed to implement the process control systems, with list of vendors and justifications

PC5. provide the current architecture of the processes and control systems, showing modularity, reuse, and extensibility

PC6. consolidate the list of products, sub-assemblies and components that will be produced in the factory together with volumes and the future road map

PC7. identify the list of sub-assemblies and components that will be sourced from vendors

PC8. identify the list of qualified vendors that can be potential partners, with details of their capabilities, capacities, technologies, and processes used by them

PC9. identify for each prospective vendor, the level of automation used, their main applications and interfaces exposed by them for integration and Cyber Security related standards, policies and tools used

PC10. identify the quality goals and the candidate quality management systems to be followed

PC11. identify the kind and the level of customization that will be offered to general and special category of customers for each end-product

PC12. identify the data that is expected from customers in different contexts, such as order, customization, schedule, quality, inspection, test reports, shipment, routing, payment, financing, contracts, etc.

PC13. identify volumes and expected response times of data from customers

PC14. identify the data that is expected to flow to and from vendors in different contexts

PC15. identify volumes and expected response times of data flow from vendors

PC16. identify all third-party services that will be required and the candidate interfaces

PC17. identify all human interfaces that are required in the target system

PC18. identify data/information flow for each human interface

PC19. identify locations of all facilities of the enterprise, their capabilities, capacities, installed systems, level of automation, workforce, warehouses, attached vendors and customers, logistics support and other relevant details

PC20. identify all data processing, analysis, forecasting and Cyber Security requirements for the target systems to meet the expected business volumes and profitability with the promised quality of service

Support and execute the intelligent implementation of the Industry 4.0 plan for the Industry

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

PC21. create collaboratively, a modular partition of whole system as a system-of-systems, and further drill down to sub-systems (to required depth of details)

PC22. derive functional specifications and performance parameters for each system and sub-system involved in the plan – considering the organization goals and KPIs

PC23. list technology options for each system and sub-system in the plan, identifying the already installed legacy systems, with their advantages and downsides

PC24. participate in collaborative finalization of the optimum technology mix – considering the overall business vision, costs, knowledge base, expertise and connected ecosystem

PC25. ensure that Cyber Security is built into each layer – device, connections, data, cloud, HMIs, controllers, applications, analytics, access control, physical security, partner connections and data sharing

PC26. include Cyber Security Risk Management Plan, together with Data Backup and Recovery, and Business Continuity Plan

PC27. get the finalized Blueprint of Industry 4.0 Plan for the organization, with clearly marked phases, timelines and capabilities added in each phase

Lead or participate in designing and developing detailed engineering support documentation for the smart plan

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

PC28. prepare detailed drawings and specifications of the system, drilling down to subsystems and components

PC29. prepare Bill of Materials (BOM) listing all equipment, controllers, drives, sensors, actuators, cables, accessories, and consumables

PC30. prepare process flow diagrams

PC31. prepare data flow diagrams and data structures

PC32. prepare list of vendors for different category of components

PC33. prepare list of third-party services for connectivity, messaging, data, and computing

PC34. prepare list of applications, software and Cyber Security tools needed

Collectively Collaborate in Smart Planning, Design and Execution of manufacturing production plan

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

PC35. participate in preparation of production plan following the organization goals and KPIs, using the organization specified application and tools. Ensure that all production facilities in a multifacility organization are involved in preparation of the plan

PC36. ensure that the plan includes Cyber Security and is consistent with the plant capacity and capability

PC37. ensure that customer inputs and requirements are included in the plan. Consult with customers if required

PC38. ensure that vendor capacities and capabilities are included in the plan

PC39. derive plan for each vendor and discuss with them to ensure viability

PC40. review plans and rework if required

PC41. confirm that the plan is adopted by the management and communicated to all concerned

PC42. ensure that the procurement plan is aligned with the production plan

PC43. participate in scheduling the production plan, using organization specified tools and applications

PC44. verify that the schedules generated for each line, system and equipment is consistent with their capacity

PC45. verify that the utilities and consumables are adequate for the product plan and schedule

PC46. verify that the workforce capacity and skills are adequate for the product plan and schedule

PC47. create Maintenance Plans (Predictive, Preventive) and Schedule for all critical systems and equipment

PC48. ensure availability of spares for critical systems and equipment

PC49. prepare skill development and training plan for the workforce to align with the production plan and available workforce

PC50. ensure adequate capacity for storage of in-process goods, finished goods, dispatch and logistics

PC51. ensure that the Quality Plan is consistent with the production plan

PC52. ensure that the Quality checks are built into the line and equipment schedules

PC53. ensure that Cyber Security checks are performed by experts and designed level of security is achieved

PC54. keep product design and PLM teams engaged in and provide feedback about the production and quality issues

Conduct one-to-one interactions with different stake holders of the organization with the pre-defined goals, roles and responsibilities

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

PC55. create daily, weekly, and periodic schedules of interaction with various teams that fall within the role definition in the organization as well as recommended by Industry 4.0 practices

PC56. respond to any query related to customer or vendor with priority

PC57. conduct regular rounds of production facility and ensure systems are running smoothly

PC58. watch for any signs of inefficiencies in equipment, operation or processes and identify possible causes

PC59. discuss issues with the production line with concerned people and find resolutions

PC60. review Cyber Security status and address issues, if any

Help the team understand the entrepreneurial spirit of Industry 4.0 and adopt the systems

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

PC61. keep the team engaged and ensure that they see the key features of Industry 4.0 and its value. Stress on utmost need for Cyber Security and their role in it

PC62. conduct regular talks, events, digital communications involving targeted / all workforce and management to highlight the success of Industry 4.0 adoption

PC63. identify any areas of the plant that are finding it difficult to adapt to Industry 4.0 culture and help to overcome it

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. industry 4.0 concepts and practices

KU2. global trends in manufacturing, especially relating to the target organization

KU3. digital manufacturing concepts and practices

KU4. architectures of digital factory

KU5. role of customers and vendors in a connected factory

KU6. importance of Cyber Security in Industry 4.0 and how it is implemented

KU7. workforce needed in Industry 4.0 organizations

KU8. vision and goals of the organization

KU9. products and services of the organization

KU10. production design methodology and product lifecycle

KU11. production planning methods and tools used in the organization

KU12. knowledge of tools and application relevant for digital manufacturing

KU13. technical skills relating to all the technologies relating to the organization

KU14. hands on skills in tools and applications used in digital manufacturing

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiatiate - with customers, vendors, across disciplines and roles

GS6. multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS8. be a technology evangelist

GS9. vigilate and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Provide desired inputs for architecting and implementing Industry 4.0 disruptive ready smart factory	**6**	**21**	**-**	**-**
PC1. consolidate and provide the set of existing or planned processes to produce the desired end products	-	1	-	-
PC2. consolidate and provide the set of existing or planned sensors, devices, actuators, controllers, and related equipment (used or planned to be used), to monitor and control the processes in the smart factory	-	1	-	-
PC3. provide details of new-age technologies used or proposed, to implement the processes, with justifications	1	1	-	-
PC4. provide details of disruptive technologies used or proposed to implement the process control systems, with list of vendors and justifications	1	1	-	-
PC5. provide the current architecture of the processes and control systems, showing modularity, reuse, and extensibility	1	1	-	-
PC6. consolidate the list of products, sub-assemblies and components that will be produced in the factory together with volumes and the future road map	-	1	-	-
PC7. identify the list of sub-assemblies and components that will be sourced from vendors	-	1	-	-
PC8. identify the list of qualified vendors that can be potential partners, with details of their capabilities, capacities, technologies, and processes used by them	-	1	-	-
PC9. identify for each prospective vendor, the level of automation used, their main applications and interfaces exposed by them for integration and Cyber Security related standards, policies and tools used	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. identify the quality goals and the candidate quality management systems to be followed	-	1	-	-
PC11. identify the kind and the level of customization that will be offered to general and special category of customers for each end-product	-	1	-	-
PC12. identify the data that is expected from customers in different contexts, such as order, customization, schedule, quality, inspection, test reports, shipment, routing, payment, financing, contracts, etc.	-	1	-	-
PC13. identify volumes and expected response times of data from customers	-	1	-	-
PC14. identify the data that is expected to flow to and from vendors in different contexts	-	1	-	-
PC15. identify volumes and expected response times of data flow from vendors	-	1	-	-
PC16. identify all third-party services that will be required and the candidate interfaces	-	1	-	-
PC17. identify all human interfaces that are required in the target system	1	1	-	-
PC18. identify data/information flow for each human interface	1	1	-	-
PC19. identify locations of all facilities of the enterprise, their capabilities, capacities, installed systems, level of automation, workforce, warehouses, attached vendors and customers, logistics support and other relevant details	-	1	-	-
PC20. identify all data processing, analysis, forecasting and Cyber Security requirements for the target systems to meet the expected business volumes and profitability with the promised quality of service	1	2	-	-
Support and execute the intelligent implementation of the Industry 4.0 plan for the Industry	**2**	**7**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC21. create collaboratively, a modular partition of whole system as a system-of-systems, and further drill down to sub-systems (to required depth of details)	1	1	-	-
PC22. derive functional specifications and performance parameters for each system and sub-system involved in the plan – considering the organization goals and KPIs	1	1	-	-
PC23. list technology options for each system and sub-system in the plan, identifying the already installed legacy systems, with their advantages and downsides	-	1	-	-
PC24. participate in collaborative finalization of the optimum technology mix – considering the overall business vision, costs, knowledge base, expertise and connected ecosystem	-	1	-	-
PC25. ensure that Cyber Security is built into each layer – device, connections, data, cloud, HMIs, controllers, applications, analytics, access control, physical security, partner connections and data sharing	-	1	-	-
PC26. include Cyber Security Risk Management Plan, together with Data Backup and Recovery, and Business Continuity Plan	-	1	-	-
PC27. get the finalized Blueprint of Industry 4.0 Plan for the organization, with clearly marked phases, timelines and capabilities added in each phase	-	1	-	-
Lead or participate in designing and developing detailed engineering support documentation for the smart plan	**4**	**7**	**-**	**-**
PC28. prepare detailed drawings and specifications of the system, drilling down to subsystems and components	1	1	-	-
PC29. prepare Bill of Materials (BOM) listing all equipment, controllers, drives, sensors, actuators, cables, accessories, and consumables	1	1	-	-
PC30. prepare process flow diagrams	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC31. prepare data flow diagrams and data structures	1	1	-	-
PC32. prepare list of vendors for different category of components	-	1	-	-
PC33. prepare list of third-party services for connectivity, messaging, data, and computing	-	1	-	-
PC34. prepare list of applications, software and Cyber Security tools needed	-	1	-	-
Collectively Collaborate in Smart Planning, Design and Execution of manufacturing production plan	**4**	**20**	**-**	**-**
PC35. participate in preparation of production plan following the organization goals and KPIs, using the organization specified application and tools. Ensure that all production facilities in a multifacility organization are involved in preparation of the plan	-	1	-	-
PC36. ensure that the plan includes Cyber Security and is consistent with the plant capacity and capability	-	1	-	-
PC37. ensure that customer inputs and requirements are included in the plan. Consult with customers if required	-	1	-	-
PC38. ensure that vendor capacities and capabilities are included in the plan	-	1	-	-
PC39. derive plan for each vendor and discuss with them to ensure viability	-	1	-	-
PC40. review plans and rework if required	-	1	-	-
PC41. confirm that the plan is adopted by the management and communicated to all concerned	-	1	-	-
PC42. ensure that the procurement plan is aligned with the production plan	-	1	-	-
PC43. participate in scheduling the production plan, using organization specified tools and applications	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC44. verify that the schedules generated for each line, system and equipment is consistent with their capacity	-	1	-	-
PC45. verify that the utilities and consumables are adequate for the product plan and schedule	-	1	-	-
PC46. verify that the workforce capacity and skills are adequate for the product plan and schedule	-	1	-	-
PC47. create Maintenance Plans (Predictive, Preventive) and Schedule for all critical systems and equipment	1	1	-	-
PC48. ensure availability of spares for critical systems and equipment	-	1	-	-
PC49. prepare skill development and training plan for the workforce to align with the production plan and available workforce	1	1	-	-
PC50. ensure adequate capacity for storage of in-process goods, finished goods, dispatch and logistics	-	1	-	-
PC51. ensure that the Quality Plan is consistent with the production plan	-	1	-	-
PC52. ensure that the Quality checks are built into the line and equipment schedules	-	1	-	-
PC53. ensure that Cyber Security checks are performed by experts and designed level of security is achieved	1	1	-	-
PC54. keep product design and PLM teams engaged in and provide feedback about the production and quality issues	-	1	-	-
Conduct one-to-one interactions with different stake holders of the organization with the pre-defined goals, roles and responsibilities	**2**	**6**	**-**	**-**
PC55. create daily, weekly, and periodic schedules of interaction with various teams that fall within the role definition in the organization as well as recommended by Industry 4.0 practices	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC56. respond to any query related to customer or vendor with priority	-	1	-	-
PC57. conduct regular rounds of production facility and ensure systems are running smoothly	-	1	-	-
PC58. watch for any signs of inefficiencies in equipment, operation or processes and identify possible causes	-	1	-	-
PC59. discuss issues with the production line with concerned people and find resolutions	-	1	-	-
PC60. review Cyber Security status and address issues, if any	1	1	-	-
Help the team understand the entrepreneurial spirit of Industry 4.0 and adopt the systems	**2**	**3**	**-**	**-**
PC61. keep the team engaged and ensure that they see the key features of Industry 4.0 and its value. Stress on utmost need for Cyber Security and their role in it	1	1	-	-
PC62. conduct regular talks, events, digital communications involving targeted / all workforce and management to highlight the success of Industry 4.0 adoption	1	1	-	-
PC63. identify any areas of the plant that are finding it difficult to adapt to Industry 4.0 culture and help to overcome it	-	1	-	-
NOS Total	**20**	**64**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0428
NOS Name	Assist in creating a smart e-Factory
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, Light Engineering Goods
Occupation	Design
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/N0429: Perform system analysis and assist in design, develop and maximize productivity of machinery

Description

This OS unit is about producing end products according to adopted technologies and processes - of which the individual is expected have adequate experience. The following activities are generic to most industries. The individual must be familiar with these and know how to adapt specific variations in the target company.

Scope

The scope covers the following :

- Contribute to Production Planning, Scheduling, Monitoring and Project Management
- Use appropriate tools and methods for Agile / Flexible / Lean manufacturing
- Contribute to Quality Management systems followed in the organization
- Perform Plant Health Monitoring and Management
- Optimize production performance utilizing Tool Room
- Perform optimal scheduling and programming of robotic tools and production line
- Respond to issues on production line and provide resolution involving stakeholders
- Proactively monitor production line for performance and early signs of failure using data analysis tools
- Communicate with stakeholders and seek inputs for production line performance
- Communicate deviations from plan to all concerned and help in restoring normalcy
- Identify areas for improvement and communicate with management for adoption

Elements and Performance Criteria

Contribute to Production Planning, Scheduling, Monitoring and Project Management
To be competent, the user/individual on the job must be able to:

PC1. perform the assigned role using organization specific production processes and tools

PC2. use approved and licensed applications and tools for Planning, Scheduling and Monitoring production - including existing ERP, SCM etc.

PC3. ensure that all required data is available and validated by data owners

PC4. ensure all stakeholders are involved in the process and have access to the applications and tools

PC5. ensure Cyber Security compliance and audit for all devices, data, connections, and applications - including connections and data shared with partners, vendors, and customers

PC6. explore Open Source platform and tools for adoption, in consultation with IT department

PC7. collaborate for creation of Production Plan aligned with the organization goals and KPIs

PC8. ensure that the plan conforms with the capacity of the plant and partners' capacity

PC9. ensure that the plan conforms with the capacity of the plant and partners' capacity

PC10. ensure that the production plan and schedule is synchronized with the Project Management tools and machine schedulers

PC11. ensure that the plan and schedule is communicated to all stakeholders, including vendor

PC12. ensure that appropriate Monitoring and Notifications Systems are in place and programmed with alerts so that any deviations are immediately communicated

Use appropriate tools and methods for Agile / Flexible / Lean manufacturing

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

PC13. apply Modular Product Design concept and tools for fast and easy variation

PC14. apply Information Technology to enable collaboration among planners, designers, procurers, and producers for fast response to orders and customizations

PC15. leverage Corporate Partners (sister organizations, vendors, strategic alliances with other companies) to improve time-to-market for key product areas

PC16. promote Knowledge Culture and employee training to facilitate rapid change and continuous adaptation

PC17. leverage use of Lean Processes – such as running small batches, customized one-offs using 3-D Printing, fast changeovers of models/versions, and a culture of continuous improvement rather than big-bang changes

Contribute to Quality Management systems followed in the organization

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

PC18. contribute to Quality Management systems and Standards such as ISO900X, Six Sigma, Lean Six Sigma, TQM, SPC, Kaizen etc. followed in the organization

PC19. participate in quality reviews and work with the teams on solving issues identified

PC20. ensure that quality systems are integrated in the production planning and monitoring plans

PC21. ensure that the quality system is integrated with those of vendors and partners

PC22. ensure that the organization has required visibility into the quality data and events generated by vendors' and partners' systems

Perform Plant Health Monitoring and Management

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

PC23. plan and schedule Preventive Maintenance of all equipment and lines

PC24. use captured data and data analysis tools to perform Predictive Maintenance

PC25. minimize impact of breakdown maintenance and unscheduled shutdowns by rescheduling and leveraging of unused machines and resources

PC26. explore use of Machine Learning tools to understand the failure mechanisms and dependencies

PC27. ensure that fire safety and personnel protection systems are in place and these systems are integrated into overall monitoring system

PC28. ensure that personnel safety barriers and interlocks are built into every area having automated machines, robotic systems, automated lines, and automated material handling systems

PC29. ensure that chemicals and gas handling and protection systems are in place and these systems are integrated into overall monitoring system

PC30. ensure that all regulatory requirements are complied

PC31. ensure that all regulatory inspections are performed timely and all certificates / licenses are current

PC32. ensure that all fire escapes and emergency exits are visibly marked and are unhindered

PC33. ensure that there is adequate marking of hazardous areas and there are audio visual alarms automatically triggered by any violations

PC34. ensure that events relating to fire, chemical hazards, and other disaster situations are immediately communicated to the concerned authorities inside and outside the organization

PC35. ensure that there are well known and understood SOPs for dealing with emergency situations

PC36. ensure that medical aid and emergency health services are planned and available at all hours when the plant runs

PC37. ensure adequate safety and health facilities for female employees

PC38. ensure adequate cleanliness, lighting, ventilation, temperature control, dust and other pollution, and acceptable noise levels throughout the plant

Optimize production performance utilizing Tool Room

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

PC39. plan Tool Room services to support the digital manufacturing lines and equipment, the maintenance, customization, and prototyping needs

PC40. get corporate approval and funds for the tool room plan and personnel

PC41. implement the tool room facilities

PC42. utilize tool room facilities to ensure performance of plant and equipment

PC43. utilize tool room to quickly turn around customized tools, jigs, fixtures, and accessories to enhance productivity

PC44. utilize tool room to quickly turn around emergency spare parts to minimize production downtimes

PC45. utilize tool room for rapid production of customized parts needed for customers

PC46. utilize tool room for rapid prototyping of new design ideas

Perform optimal scheduling and programming of robotic tools and production line

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

PC47. ensure that adequate numbers of trained workforce is available for programming, modifying and repurposing robotic tools

PC48. ensure that programming applications and tools are up-to-date and are linked to the scheduling system

PC49. include partner and vendor machines into scheduling algorithm, where applicable

PC50. prepare alternate schedules if partner or vendor machines become available

PC51. ensure that all scheduling constraints and conflicts are resolved

Respond to issues on production line and provide resolution involving stakeholders

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

PC52. consider if manual mode can be used safely to temporarily get around any inconsistencies on production lines and ensure it is disabled automatically by timeout or manually on completion of exception

PC53. ensure local manual override is disabled by default for safety, except in emergency condition

PC54. ensure all enable, disable, overrides and inconsistency events are logged and analyzed

PC55. reschedule machines and jobs in case of a breakdown of any robotic or automated machine, and include any unused resources to optimize disruption

PC56. resolve conflicts relating to parts availability, scheduling, quality, line blockage or breakdown by collaborating with all stakeholders

Proactively monitor production line for performance and early signs of failure using data analysis tools

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

PC57. collect real time machine data regarding parts processed, machine speed and other settings, processing times, setup times, environmental data, machine temperature, pressure, vibrations etc., consumables utilized, power consumption, and other relevant parameters

PC58. analyse the real time data to derive statistics about productivity, utilization, down times, power and utility consumption, and variation of these parameters with time and processing speeds

PC59. derive and compile data about performance, reliability, cost, and processing times of different machine for different parts, over the period

PC60. compare the observed performance of machines with specifications and understand the cause for any significant variations – resolve with vendor or take corrective action

PC61. use the compiled data to analyse and find patterns of performance degradation which can be linked to early signs of failure

PC62. use the results for Predictive Maintenance scheduling

PC63. create bench-mark parameter settings for each machine for optimal performance and minimized maintenance. Use this for machine scheduling

Communicate with stakeholders and seek inputs for production line performance

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

PC64. seek inputs proactively feedback on plant performance from operators, quality personnel, sales and marketing

PC65. communicate with stakeholders about plant health and performance and share specific actions taken to address any reported issues

PC66. seek inputs and feedback on product features and quality from customers and their voice - sales and marketing

PC67. analyse the inputs and categorize these for immediate and future considerations

PC68. determine the type of issue for inputs requiring immediate attention - quality, specifications, delivery, or support. Address in consultation with relevant groups and determine action plan and response

PC69. consult with design and PLM groups for inputs product features and customizations, and determine suitable action plan and response

PC70. maintain a log of all issues raised, change requests and action taken. Use this for finalizing product enhancement plans

Communicate deviations from plan to all concerned and help in restoring normalcy

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

PC71. analyse all deviations and perform root cause analysis (RCA) involving all groups

PC72. use data analysis to arrive at the origin of problem, time, and sequence of progression

PC73. determine the root cause being - machine design or specs, machine setting, machine operation, state of maintenance, programming fault, hardware fault, communication error, scheduling issue, other issue, or a combination

PC74. look for patterns of behaviour and event relationships

PC75. classify the patterns and determine the best approach for dealing with these situations

PC76. make required changes in machine usage, settings, programming, and scheduling to rectify the errors logged

PC77. verify that the changes work - and get concurrent of involved stakeholders. Finalize the changes as part of machine setup instructions or SOPs

PC78. document and communicate the action taken and recommendations for correct operation to all stakeholders

Identify areas for improvement and communicate with management for adoption

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

PC79. consolidate the observations and actions taken and determine if there are any candidates for follow-up as proposals for product enhancement, change, reconfiguration or for any change or upgrade of equipment or production line

PC80. create for each candidate proposal, a detailed report with analysis, impact, and business case and share with the management

PC81. follow-up on the proposals and provide additional inputs for decision making

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. industry 4.0 concepts and practices

KU2. digital manufacturing concepts and practices

KU3. tools and applications relevant for digital manufacturing

KU4. production Planning, Scheduling, Monitoring and Project Management

KU5. production processes and tools used in the organization

KU6. agile / Flexible/ Lean Manufacturing methods and tools

KU7. quality Management systems and Standards

KU8. plant Health Monitoring and Management

KU9. tool room planning, scheduling, and management

KU10. robotic tools for production line use

KU11. cloud computing

KU12. cyber security

KU13. technical skills relating to all the technologies relating to the organization

KU14. hands on skills in tools and applications used in digital manufacturing

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiate with customers, vendors, across disciplines and roles

GS6. Multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS8. be a technology evangelist

GS9. vigilante and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Contribute to Production Planning, Scheduling, Monitoring and Project Management	-	**12**	-	-
PC1. perform the assigned role using organization specific production processes and tools	-	1	-	-
PC2. use approved and licensed applications and tools for Planning, Scheduling and Monitoring production - including existing ERP, SCM etc.	-	1	-	-
PC3. ensure that all required data is available and validated by data owners	-	1	-	-
PC4. ensure all stakeholders are involved in the process and have access to the applications and tools	-	1	-	-
PC5. ensure Cyber Security compliance and audit for all devices, data, connections, and applications - including connections and data shared with partners, vendors, and customers	-	1	-	-
PC6. explore Open Source platform and tools for adoption, in consultation with IT department	-	1	-	-
PC7. collaborate for creation of Production Plan aligned with the organization goals and KPIs	-	1	-	-
PC8. ensure that the plan conforms with the capacity of the plant and partners' capacity	-	1	-	-
PC9. ensure that the plan conforms with the capacity of the plant and partners' capacity	-	1	-	-
PC10. ensure that the production plan and schedule is synchronized with the Project Management tools and machine schedulers	-	1	-	-
PC11. ensure that the plan and schedule is communicated to all stakeholders, including vendor	-	1	-	-
PC12. ensure that appropriate Monitoring and Notifications Systems are in place and programmed with alerts so that any deviations are immediately communicated	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Use appropriate tools and methods for Agile / Flexible / Lean manufacturing	**3**	**5**	**-**	**-**
PC13. apply Modular Product Design concept and tools for fast and easy variation	1	1	-	-
PC14. apply Information Technology to enable collaboration among planners, designers, procurers, and producers for fast response to orders and customizations	-	1	-	-
PC15. leverage Corporate Partners (sister organizations, vendors, strategic alliances with other companies) to improve time-to-market for key product areas	-	1	-	-
PC16. promote Knowledge Culture and employee training to facilitate rapid change and continuous adaptation	1	1	-	-
PC17. leverage use of Lean Processes – such as running small batches, customized one-offs using 3-D Printing, fast changeovers of models/versions, and a culture of continuous improvement rather than big-bang changes	1	1	-	-
Contribute to Quality Management systems followed in the organization	**1**	**7**	**-**	**-**
PC18. contribute to Quality Management systems and Standards such as ISO900X, Six Sigma, Lean Six Sigma, TQM, SPC, Kaizen etc. followed in the organization	1	3	-	-
PC19. participate in quality reviews and work with the teams on solving issues identified	-	1	-	-
PC20. ensure that quality systems are integrated in the production planning and monitoring plans	-	1	-	-
PC21. ensure that the quality system is integrated with those of vendors and partners	-	1	-	-
PC22. ensure that the organization has required visibility into the quality data and events generated by vendors' and partners' systems	-	1	-	-
Perform Plant Health Monitoring and Management	**9**	**18**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC23. plan and schedule Preventive Maintenance of all equipment and lines	1	3	-	-
PC24. use captured data and data analysis tools to perform Predictive Maintenance	-	1	-	-
PC25. minimize impact of breakdown maintenance and unscheduled shutdowns by rescheduling and leveraging of unused machines and resources	-	1	-	-
PC26. explore use of Machine Learning tools to understand the failure mechanisms and dependencies	-	1	-	-
PC27. ensure that fire safety and personnel protection systems are in place and these systems are integrated into overall monitoring system	1	1	-	-
PC28. ensure that personnel safety barriers and interlocks are built into every area having automated machines, robotic systems, automated lines, and automated material handling systems	1	1	-	-
PC29. ensure that chemicals and gas handling and protection systems are in place and these systems are integrated into overall monitoring system	1	1	-	-
PC30. ensure that all regulatory requirements are complied	-	1	-	-
PC31. ensure that all regulatory inspections are performed timely and all certificates / licenses are current	-	1	-	-
PC32. ensure that all fire escapes and emergency exits are visibly marked and are unhindered	1	1	-	-
PC33. ensure that there is adequate marking of hazardous areas and there are audio visual alarms automatically triggered by any violations	1	1	-	-
PC34. ensure that events relating to fire, chemical hazards, and other disaster situations are immediately communicated to the concerned authorities inside and outside the organization	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC35. ensure that there are well known and understood SOPs for dealing with emergency situations	1	1	-	-
PC36. ensure that medical aid and emergency health services are planned and available at all hours when the plant runs	1	1	-	-
PC37. ensure adequate safety and health facilities for female employees	-	1	-	-
PC38. ensure adequate cleanliness, lighting, ventilation, temperature control, dust and other pollution, and acceptable noise levels throughout the plant	1	1	-	-
Optimize production performance utilizing Tool Room	**5**	**17**	**-**	**-**
PC39. plan Tool Room services to support the digital manufacturing lines and equipment, the maintenance, customization, and prototyping needs	1	3	-	-
PC40. get corporate approval and funds for the tool room plan and personnel	-	1	-	-
PC41. implement the tool room facilities	-	1	-	-
PC42. utilize tool room facilities to ensure performance of plant and equipment	-	1	-	-
PC43. utilize tool room to quickly turn around customized tools, jigs, fixtures, and accessories to enhance productivity	1	2	-	-
PC44. utilize tool room to quickly turn around emergency spare parts to minimize production downtimes	1	1	-	-
PC45. utilize tool room for rapid production of customized parts needed for customers	1	3	-	-
PC46. utilize tool room for rapid prototyping of new design ideas	1	5	-	-
Perform optimal scheduling and programming of robotic tools and production line	**-**	**5**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC47. ensure that adequate numbers of trained workforce is available for programming, modifying and repurposing robotic tools	-	1	-	-
PC48. ensure that programming applications and tools are up-to-date and are linked to the scheduling system	-	1	-	-
PC49. include partner and vendor machines into scheduling algorithm, where applicable	-	1	-	-
PC50. prepare alternate schedules if partner or vendor machines become available	-	1	-	-
PC51. ensure that all scheduling constraints and conflicts are resolved	-	1	-	-
Respond to issues on production line and provide resolution involving stakeholders	**-**	**5**	**-**	**-**
PC52. consider if manual mode can be used safely to temporarily get around any inconsistencies on production lines and ensure it is disabled automatically by timeout or manually on completion of exception	-	1	-	-
PC53. ensure local manual override is disabled by default for safety, except in emergency condition	-	1	-	-
PC54. ensure all enable, disable, overrides and inconsistency events are logged and analyzed	-	1	-	-
PC55. reschedule machines and jobs in case of a breakdown of any robotic or automated machine, and include any unused resources to optimize disruption	-	1	-	-
PC56. resolve conflicts relating to parts availability, scheduling, quality, line blockage or breakdown by collaborating with all stakeholders	-	1	-	-
Proactively monitor production line for performance and early signs of failure using data analysis tools	**2**	**8**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC57. collect real time machine data regarding parts processed, machine speed and other settings, processing times, setup times, environmental data, machine temperature, pressure, vibrations etc., consumables utilized, power consumption, and other relevant parameters	-	1	-	-
PC58. analyse the real time data to derive statistics about productivity, utilization, down times, power and utility consumption, and variation of these parameters with time and processing speeds	-	1	-	-
PC59. derive and compile data about performance, reliability, cost, and processing times of different machine for different parts, over the period	-	1	-	-
PC60. compare the observed performance of machines with specifications and understand the cause for any significant variations – resolve with vendor or take corrective action	-	1	-	-
PC61. use the compiled data to analyse and find patterns of performance degradation which can be linked to early signs of failure	1	2	-	-
PC62. use the results for Predictive Maintenance scheduling	1	1	-	-
PC63. create bench-mark parameter settings for each machine for optimal performance and minimized maintenance. Use this for machine scheduling	-	1	-	-
Communicate with stakeholders and seek inputs for production line performance	**1**	**8**	**-**	**-**
PC64. seek inputs proactively feedback on plant performance from operators, quality personnel, sales and marketing	-	1	-	-
PC65. communicate with stakeholders about plant health and performance and share specific actions taken to address any reported issues	-	1	-	-
PC66. seek inputs and feedback on product features and quality from customers and their voice - sales and marketing	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC67. analyse the inputs and categorize these for immediate and future considerations	-	1	-	-
PC68. determine the type of issue for inputs requiring immediate attention - quality, specifications, delivery, or support. Address in consultation with relevant groups and determine action plan and response	-	1	-	-
PC69. consult with design and PLM groups for inputs product features and customizations, and determine suitable action plan and response	-	1	-	-
PC70. maintain a log of all issues raised, change requests and action taken. Use this for finalizing product enhancement plans	1	2	-	-
Communicate deviations from plan to all concerned and help in restoring normalcy	**3**	**8**	**-**	**-**
PC71. analyse all deviations and perform root cause analysis (RCA) involving all groups	-	1	-	-
PC72. use data analysis to arrive at the origin of problem, time, and sequence of progression	1	1	-	-
PC73. determine the root cause being - machine design or specs, machine setting, machine operation, state of maintenance, programming fault, hardware fault, communication error, scheduling issue, other issue, or a combination	-	1	-	-
PC74. look for patterns of behaviour and event relationships	1	1	-	-
PC75. classify the patterns and determine the best approach for dealing with these situations	1	1	-	-
PC76. make required changes in machine usage, settings, programming, and scheduling to rectify the errors logged	-	1	-	-
PC77. verify that the changes work - and get concurrent of involved stakeholders. Finalize the changes as part of machine setup instructions or SOPs	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC78. document and communicate the action taken and recommendations for correct operation to all stakeholders	-	1	-	-
Identify areas for improvement and communicate with management for adoption	**-**	**3**	**-**	**-**
PC79. consolidate the observations and actions taken and determine if there are any candidates for follow-up as proposals for product enhancement, change, reconfiguration or for any change or upgrade of equipment or production line	-	1	-	-
PC80. create for each candidate proposal, a detailed report with analysis, impact, and business case and share with the management	-	1	-	-
PC81. follow-up on the proposals and provide additional inputs for decision making	-	1	-	-
NOS Total	**24**	**96**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0429
NOS Name	Perform system analysis and assist in design, develop and maximize productivity of machinery
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, Light Engineering Goods, Defence Equipment
Occupation	Design
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/N0430: Execute Process Control automation to achieve improved productivity

Description

This OS unit is about automating manufacturing using programmable machines, with automated process flows, robot-based assembly, material handling and movement - controlled by distributed programs synchronized with production plans and schedules across the ecosystem.

Scope

The scope covers the following :

- Capture the distributed plant layout systems participating in the plant operation
- Architect the distributed plant operation and control system
- Implement plant control with PLC, HMI, SCADA, and other control systems
- Utilize different types of computer aided machining for achieving the planned outputs
- Integrate HVAC systems, ACCESS control systems, RFID based material movement systems in the plant
- Establish rapport with vendor ecosystems for responsive service

Elements and Performance Criteria

Capture the distributed plant layout of systems participating in the plant operation

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

PC1. capture the distributed plant layout and location of all systems and subsystems

PC2. capture details of other facilities and vendor systems participating in the operation

PC3. consider use of geotagging for locating resources and material flow

PC4. include provisions for implementing Cyber Security at all layers

Architect the distributed plant operation and control system

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

PC5. acquire complete documentation and history of existing installed systems and completely understand the design and the state of the plant and equipment

PC6. investigate and fill the gaps, in case of missing information

PC7. include provisions for Cyber Security at each layer

PC8. use appropriate Sensors, Signal Conditioners, Counters, Signal Transformers, and interface devices with digital, standard based interfaces - commonly known as 'Smart Sensors'

PC9. use appropriate Actuators for control elements - these can be of type pneumatic, hydraulic, vacuum, electromechanical, electromagnetic, mechanical or of a mixed type - to control the processes

PC10. use Digital Controllers (PLC etc.) with industry standard I/O interfaces and protocols to connect to sensors and actuators

PC11. use appropriate cables and cabling accessories (including fiberoptic devices and cables) and environmentally protected junction boxes with clearly legible markings, ferruling, and numbering

PC12. use appropriate power supplies and power control devices (such as PWM controller, Phase Angle Controller, VFD, PID Controllers etc.) to drive the control elements

PC13. use appropriate HMI devices for User Interaction

PC14. own the design and be responsible for its upkeep and upgradation

Implement plant control with PLC, HMI, SCADA, and other control systems

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

PC15. refer to the interconnection documentation and verify that all devices and controllers are connected using specified cables and following recommended interconnection practices

PC16. ensure all interlocks and emergency devices are connected

PC17. use appropriate signal levels, communication protocols and software stacks to connect devices with controllers

PC18. ensure cyber security requirements are setup

PC19. verify integrity of all wiring, interconnections, signal handling and ensure that all inputs/outputs are functional and comply with specified limits

PC20. identify all PID loops and other control loops in the system and mark their criticality, interdependence, priority, settings, and performance tuning procedures

PC21. capture all Motor Control loops as independent loops or part of larger loops

PC22. perform loop testing and confirm integrity

PC23. document all safety interlocks, emergency controls and ensure that these are programmed correctly

PC24. document and share start-up, shutdown, and emergency procedures. Ensure that these are visibly displayed at appropriate places

PC25. capture connections, control procedures and programming of all material handling and material movement systems

PC26. initiate performance tuning, involving processes personnel and other stakeholders. Frequently, the performance tuning request may originate from the process personnel

PC27. address all issues observed during the tuning process and resolve to closure involving all stakeholder

PC28. document the results of performance tuning and the settings of all devices, controllers, and actuators - along with the limits and alarms. Share this information with all stakeholders

PC29. test for Cyber Security, using recommended tools and involving experts. Document results along with complete configuration

Utilize different types of computer aided machining for achieving the planned outputs

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

PC30. utilize appropriate technologies such as - computer aided machining (CAM), computerized numerical control machining (CNC), 3-D Printing etc. to perform the necessary operations of the production process

PC31. identify and document different kinds of robots and automation tools used in the plant, their specifications and roles in manufacturing – for example Robotic Welding, Robotic Pick and Place, Robotic Assembly, Robotic Painting, Robotic Inspection etc.

PC32. leverage machines and manufacturing processes available in the vendors' plants

PC33. connect various CAM, CNC and other machines with the DCS or other controllers using appropriate cables and interfaces and verify correct handshake

PC34. identify the architecture and location of Data communication and Security devices and integrate securely the automation systems with the production management systems using specifies data flows, data formats, and protocols

PC35. identify the architecture and location of Data communication and Security devices and integrate securely the automation systems with the production management systems using specifies data flows, data formats, and protocols

PC36. train workforce in robot programming tools and processes. Ensure they know how to load programs, modify, and create new programs, test programs; decommission, relocate, and repurpose robots - following safety and Cyber Security norms

PC37. integrate and apply robotic and personnel safety systems, interlocks, and emergency procedures

Integrate HVAC systems, ACCESS control systems, RFID based material movement systems in the plant

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

PC38. integrate HVAC systems with the DCS and production management systems for maintaining the plant environment for optimal performance. Verify the climatic conditions and control actions

PC39. integrate RFID based material inflow / outflow systems in the plant with the DCS and production management systems

PC40. integrate all Access Control and Surveillance Systems and Attendance Systems with the DCS and production management systems and Cyber Security systems in the plant

PC41. test all integrated systems according to organization SOPs and document results

Establish rapport with vendor ecosystems for responsive service

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

PC42. prepare a list of all equipment vendors, their contact persons, warranty, and details of contracts with them. This includes plant and equipment vendors as well as material suppliers for product plans

PC43. establish contact with the representatives of the companies and ensure that they are familiar with the contracts and understand the part designs, schedules, quality, SLAs, and communication requirements

PC44. periodically connect with the vendors and ensure that there are no unknown factors or production issues at their ends - if not, address the issues on priority in consultation with other stakeholders

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. industry 4.0 concepts and practices

KU2. digital manufacturing concepts and practices

KU3. tools and applications relevant for digital manufacturing - CAD, CAM, CNC, 3D Printing

KU4. production Automation Systems and Tools

KU5. robotic tools for production line use

KU6. smart sensors, signal conditioners, counters, signal transformers, interface devices

KU7. PLC, DCS, SCADA, HMI, PID, VFD

KU8. Industrial signals and data protocols - 4-20mA, RS485, MODBUS, PROFIBUS, HART, FIELDBUS

KU9. Industrial cabling practices, Fiber optics

KU10. HVAC, Fire Alarms, Access Control, RFID, Surveillance Systems

KU11. Cloud Computing

KU12. Cyber Security

KU13. technical skills related to all the technologies relating to the organization

KU14. hands on skills in tools and applications used in digital manufacturing

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiate with customers, vendors, across disciplines and roles

GS6. multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS9. be a technology evangelist

GS9. vigilate and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Capture the distributed plant layout of systems participating in the plant operation	**2**	**4**	**-**	**-**
PC1. capture the distributed plant layout and location of all systems and subsystems	1	1	-	-
PC2. capture details of other facilities and vendor systems participating in the operation	-	1	-	-
PC3. consider use of geotagging for locating resources and material flow	1	1	-	-
PC4. include provisions for implementing Cyber Security at all layers	-	1	-	-
Architect the distributed plant operation and control system	**8**	**10**	**-**	**-**
PC5. acquire complete documentation and history of existing installed systems and completely understand the design and the state of the plant and equipment	1	1	-	-
PC6. investigate and fill the gaps, in case of missing information	1	1	-	-
PC7. include provisions for Cyber Security at each layer	1	1	-	-
PC8. use appropriate Sensors, Signal Conditioners, Counters, Signal Transformers, and interface devices with digital, standard based interfaces - commonly known as 'Smart Sensors'	1	1	-	-
PC9. use appropriate Actuators for control elements - these can be of type pneumatic, hydraulic, vacuum, electromechanical, electromagnetic, mechanical or of a mixed type - to control the processes	1	1	-	-
PC10. use Digital Controllers (PLC etc.) with industry standard I/O interfaces and protocols to connect to sensors and actuators	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. use appropriate cables and cabling accessories (including fiberoptic devices and cables) and environmentally protected junction boxes with clearly legible markings, ferruling, and numbering	-	1	-	-
PC12. use appropriate power supplies and power control devices (such as PWM controller, Phase Angle Controller, VFD, PID Controllers etc.) to drive the control elements	1	1	-	-
PC13. use appropriate HMI devices for User Interaction	1	1	-	-
PC14. own the design and be responsible for its upkeep and upgradation	-	1	-	-
Implement plant control with PLC, HMI, SCADA, and other control systems	**7**	**15**	**-**	**-**
PC15. refer to the interconnection documentation and verify that all devices and controllers are connected using specified cables and following recommended interconnection practices	-	1	-	-
PC16. ensure all interlocks and emergency devices are connected	-	1	-	-
PC17. use appropriate signal levels, communication protocols and software stacks to connect devices with controllers	1	1	-	-
PC18. ensure cyber security requirements are setup	1	1	-	-
PC19. verify integrity of all wiring, interconnections, signal handling and ensure that all inputs/outputs are functional and comply with specified limits	-	1	-	-
PC20. identify all PID loops and other control loops in the system and mark their criticality, interdependence, priority, settings, and performance tuning procedures	1	1	-	-
PC21. capture all Motor Control loops as independent loops or part of larger loops	1	1	-	-
PC22. perform loop testing and confirm integrity	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC23. document all safety interlocks, emergency controls and ensure that these are programmed correctly	-	1	-	-
PC24. document and share start-up, shutdown, and emergency procedures. Ensure that these are visibly displayed at appropriate places	-	1	-	-
PC25. capture connections, control procedures and programming of all material handling and material movement systems	-	1	-	-
PC26. initiate performance tuning, involving processes personnel and other stakeholders. Frequently, the performance tuning request may originate from the process personnel	1	1	-	-
PC27. address all issues observed during the tuning process and resolve to closure involving all stakeholder	-	1	-	-
PC28. document the results of performance tuning and the settings of all devices, controllers, and actuators - along with the limits and alarms. Share this information with all stakeholders	-	1	-	-
PC29. test for Cyber Security, using recommended tools and involving experts. Document results along with complete configuration	1	1	-	-
Utilize different types of computer aided machining for achieving the planned outputs	**6**	**8**	**-**	**-**
PC30. utilize appropriate technologies such as - computer aided machining (CAM), computerized numerical control machining (CNC), 3-D Printing etc. to perform the necessary operations of the production process	1	1	-	-
PC31. identify and document different kinds of robots and automation tools used in the plant, their specifications and roles in manufacturing – for example Robotic Welding, Robotic Pick and Place, Robotic Assembly, Robotic Painting, Robotic Inspection etc.	1	1	-	-
PC32. leverage machines and manufacturing processes available in the vendors' plants	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC33. connect various CAM, CNC and other machines with the DCS or other controllers using appropriate cables and interfaces and verify correct handshake	1	1	-	-
PC34. identify the architecture and location of Data communication and Security devices and integrate securely the automation systems with the production management systems using specifies data flows, data formats, and protocols	1	1	-	-
PC35. identify the architecture and location of Data communication and Security devices and integrate securely the automation systems with the production management systems using specifies data flows, data formats, and protocols	-	1	-	-
PC36. train workforce in robot programming tools and processes. Ensure they know how to load programs, modify, and create new programs, test programs; decommission, relocate, and repurpose robots - following safety and Cyber Security norms	1	1	-	-
PC37. integrate and apply robotic and personnel safety systems, interlocks, and emergency procedures	1	1	-	-
Integrate HVAC systems, ACCESS control systems, RFID based material movement systems in the plant	**4**	**3**	-	-
PC38. integrate HVAC systems with the DCS and production management systems for maintaining the plant environment for optimal performance. Verify the climatic conditions and control actions	1	1	-	-
PC39. integrate RFID based material inflow / outflow systems in the plant with the DCS and production management systems	1	1	-	-
PC40. integrate all Access Control and Surveillance Systems and Attendance Systems with the DCS and production management systems and Cyber Security systems in the plant	1	1	-	-
PC41. test all integrated systems according to organization SOPs and document results	1	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Establish rapport with vendor ecosystems for responsive service	-	3	-	-
PC42. prepare a list of all equipment vendors, their contact persons, warranty, and details of contracts with them. This includes plant and equipment vendors as well as material suppliers for product plans	-	1	-	-
PC43. establish contact with the representatives of the companies and ensure that they are familiar with the contracts and understand the part designs, schedules, quality, SLAs, and communication requirements	-	1	-	-
PC44. periodically connect with the vendors and ensure that there are no unknown factors or production issues at their ends - if not, address the issues on priority in consultation with other stakeholders	-	1	-	-
NOS Total	**27**	**43**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0430
NOS Name	Execute Process Control automation to achieve improved productivity
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, Light Engineering Goods, Defence Equipment, Fire-Fighting & Safety Equipment
Occupation	Design
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/N0431: Customize Industrial Internet of Things (IIOT) ecosystem for optimized performance

Description

This OS unit is about implementing IIoT that allows for a higher degree of automation by using cloud computing to refine and optimize the process controls. IIoT can coordinate disparate DCS systems in the enterprise across locations and factories including business partners.

Scope

The scope covers the following :

- Lead definition of scope of IIoT for the organization involving all stakeholders.
- Apply IIoT standards and practices for creating IIoT architecture of the organization.
- Design and implement IIoT realization collaboratively using appropriate devices, connections, protocols, services, applications, and Cyber Security standards
- Verify correct implementation of IIoT and validate data, processed information, and analysis for correctness.
- Verify Cyber Security compliance
- Respond to requests from stakeholders regarding production line performance, quality, customization, or scheduling issues

Elements and Performance Criteria

Take lead to discuss the scope of IIoT for the organization involving all stakeholders

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

PC1.   take the lead to discuss in the organization the role of IIoT in the industry and its relevance for the organization. Emphasize on the cultural and technological changes necessary, and the associated costs for adoption of IIoT and Industry 4.0 factory

PC2.   help evolve a consensus about the value proposition of IIoT for the organization and define its scope - in the short and long terms

PC3.   estimate the effort and cost of implementing IIoT with the defined scope and roadmap

PC4.   document the expectations and goals of IIoT and roadmap for implementation

PC5.   communicate this understanding across the organization so that there are common shared expectations from the system

PC6.   get management commitment for funds, people resources and support for the defined scope

Apply IIoT standards and practices for creating IIoT architecture of the organization

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

PC7.   evaluate IIoT standards such as XMPP, REST, MTQQ, Node-RED, OPC and others, as well as the Industrial Internet Consortium's (IIC) Industrial Internet Reference Architecture (IIRA)

PC8.   identify IIoT standards relevant for the organization and use these for creating the IIoT architecture

PC9.   investigate IIoT expertise of the DCS vendors and their support for IIoT in their offerings. Use this as selection criteria for DCS

PC10. design and document the Architecture, Layers (Content layer, Service layer, Network layer, Device layer) and contents of each layer with mapping to physical devices and systems. All required network and application services must be identified

PC11. ensure required infrastructure is available for the desired goals. The infrastructure includes physical devices, computers, network connections and services, cloud services and applications (including data mining, analytics and machine learning) running on the cloud and on the local computers (Cyber Physical Systems – CPS). The IT organization is likely to be the owner or subscriber of some of these resources

PC12. leverage DCS vendor's expertise in IIoT to implement the organization IIoT plan

PC13. define concrete IIoT Architecture involving appropriate sensors, connections, aggregators and controllers, connectivity devices and protocols such as Wi-Fi, WirelessHART, Bluetooth, BT-LE, Ethernet etc.

PC14. specify appropriate Edge and Cloud connectivity devices and services

PC15. define Cyber Security standards and implementations in all layers

PC16. identify the potential for exploiting analytics and machine learning to produce actionable outputs such as for Fault analysis and localization, Predictive Maintenance, Market Analysis and Predictive Scheduling etc.

PC17. explore if data or result validators can be designed to automatically check the data and analysis results - if yes, then define and design these

PC18. identify applications and tools to support data cleansing and normalization, data mining, data visualization, analytics, 'What-If' analysis and machine learning to support automatic tuning etc.

Design and implement IIoT realization collaboratively using appropriate devices, connections, protocols, services, applications, and Cyber Security standards

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

PC19. implement the IIoT Architecture using appropriate sensors, connections, controllers, connectivity devices, edge devices, cloud connectivity and services

PC20. use appropriate protocols such as Wi-Fi, WirelessHART, Bluetooth, BT-LE, Ethernet etc.

PC21. collaborate with IT organization to install, configure, connect, integrate, secure, manage and troubleshoot applications and services

PC22. implement any defined data validators using available software and applications

PC23. ensure all applications are configured to use appropriate data inputs and produce outputs in the desired formats

PC24. define if the analytics and machine learning applications will run in on-line or batch mode and design appropriate data feed, data extractors and aggregators, and batch processors

PC25. apply 'ZERO-TRUST' principle for security – meaning only authorized and authenticated users, devices and applications can access the system, for the purpose defined by their roles

PC26. define and design 'Trust' systems and the required infrastructure

PC27. apply Cyber Security standards at all layers and across all organizations connected to the system

Verify correct implementation of IIoT and validate data, processed information, and analysis for correctness

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

PC28. collaborate with IT to ensure that the devices, applications, and data sources are programmed to acquire and process the data correctly

PC29. verify the range, units, and conversion factors of raw data

PC30. verify that the frequency of data acquisition is appropriate

PC31. verify that the raw data is stable within the limits of process dynamics. If the data is inherently noisy, consider using hardware or software filtering before consumption

PC32. verify that statistical processing of raw data (averaging, minima, maxima, median, standard deviation etc.) are appropriate for each sensor - whether the processing is done within the device or elsewhere

PC33. verify that the limits and alarms for process parameters and variables use appropriate type of data - raw or processed

PC34. verify the latency of data at consumption points (for example in process loops and alarm processors) and ensure that its impact on control loops is within acceptable limits

PC35. test and verify the performance of validators using simulated data

PC36. verify that each data mining and analysis application receives correct data and produces correct outputs - which are validated by experts and by specifically designed validator programs

PC37. ensure that the processed data and analysis results are available to consuming applications and users online

PC38. validate with the users that the processed information and analysis they receive are correct and discuss any anomalies with stakeholders to resolve the issue

PC39. ensure that applications and users receive messages, alerts and alarms as programmed and that they respond to the communication in the correct manner

Verify Cyber Security compliance

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

PC40. set up the 'Trust' infrastructure for testing

PC41. test for 'ZERO-TRUST' compliance using defined scenarios and test cases and verify compliance

PC42. test Cyber Security compliance in all layers – using appropriate tools and experts and involving required stakeholders

PC43. collaborate with partners to set up and test for 'ZERO-TRUST' compliance of the connected system and verify compliance

PC44. reprogram the 'Trust' infrastructure for normal operation with organization roles, authorizations, and authentication mechanisms

PC45. verify that the user and applications access perform as designed and security is complied with

Respond to requests from stakeholders regarding production line performance, quality, customization, or scheduling issues

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

PC46. analyse requests from stakeholders (such as purchase, vendor management, service organizations, customers, and supply chain partners) regarding data quality and accessibility

PC47. check the trust system and organization data in case of any accessibility issues, to resolve any missing information or inconsistency – involving required stakeholders

PC48. confirm the key issue in case of any data quality related request, and verify the facts in the system at appropriate layer

PC49. identify for valid data quality request, the chain of components involved – from sensors to processing applications – and locate the sources of error. Rectify these involving stakeholders

PC50. perform validation at system level for issues relating to quality, customization, and scheduling - and further collaborate with the stakeholders to resolve the issue

PC51. consolidate all requests and analysis and utilize these for creating knowledgebase for production line and operations improvement

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. digital manufacturing concepts and practices relevant for the domain

KU2. programmable machines for processing, relevant for the domain

KU3. automated process flow

KU4. industrial robots, robot-based assembly, processing and material handling

KU5. distributed processing

KU6. Distributed Control Systems (DCS)

KU7. PLC, HMI, SCADA, PID Control and Programming

KU8. CAD, CAM, CNC machining

KU9. Additive Manufacturing, 3D Printing

KU10. Cyber Security

KU11. HVAC, Access Control, Industrial Surveillance Systems

KU12. Fire Alarm, Chemicals and Gas Monitoring and protection

KU13. RFID systems

KU14. technical skills relating to all the technologies relevant to the organization

KU15. tools and applications used in digital manufacturing, processes, and plant control

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiate with customers, vendors, across disciplines and roles

GS6. multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS9. be a technology evangelist

GS9. vigilate and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Take lead to discuss the scope of IIoT for the organization involving all stakeholders	**1**	**5**	**-**	**-**
PC1. take the lead to discuss in the organization the role of IIoT in the industry and its relevance for the organization. Emphasize on the cultural and technological changes necessary, and the associated costs for adoption of IIoT and Industry 4.0 factory	-	1	-	-
PC2. help evolve a consensus about the value proposition of IIoT for the organization and define its scope - in the short and long terms	-	1	-	-
PC3. estimate the effort and cost of implementing IIoT with the defined scope and roadmap	-	1	-	-
PC4. document the expectations and goals of IIoT and roadmap for implementation	1	-	-	-
PC5. communicate this understanding across the organization so that there are common shared expectations from the system	-	1	-	-
PC6. get management commitment for funds, people resources and support for the defined scope	-	1	-	-
Apply IIoT standards and practices for creating IIoT architecture of the organization	**9**	**23**	**-**	**-**
PC7. evaluate IIoT standards such as XMPP, REST, MTQQ, Node-RED, OPC and others, as well as the Industrial Internet Consortium's (IIC) Industrial Internet Reference Architecture (IIRA)	1	3	-	-
PC8. identify IIoT standards relevant for the organization and use these for creating the IIoT architecture	1	2	-	-
PC9. investigate IIoT expertise of the DCS vendors and their support for IIoT in their offerings. Use this as selection criteria for DCS	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. design and document the Architecture, Layers (Content layer, Service layer, Network layer, Device layer) and contents of each layer with mapping to physical devices and systems. All required network and application services must be identified	1	3	-	-
PC11. ensure required infrastructure is available for the desired goals. The infrastructure includes physical devices, computers, network connections and services, cloud services and applications (including data mining, analytics and machine learning) running on the cloud and on the local computers (Cyber Physical Systems – CPS). The IT organization is likely to be the owner or subscriber of some of these resources	-	1	-	-
PC12. leverage DCS vendor's expertise in IIoT to implement the organization IIoT plan	-	1	-	-
PC13. define concrete IIoT Architecture involving appropriate sensors, connections, aggregators and controllers, connectivity devices and protocols such as Wi-Fi, WirelessHART, Bluetooth, BT-LE, Ethernet etc.	1	3	-	-
PC14. specify appropriate Edge and Cloud connectivity devices and services	1	1	-	-
PC15. define Cyber Security standards and implementations in all layers	1	3	-	-
PC16. identify the potential for exploiting analytics and machine learning to produce actionable outputs such as for Fault analysis and localization, Predictive Maintenance, Market Analysis and Predictive Scheduling etc.	1	2	-	-
PC17. explore if data or result validators can be designed to automatically check the data and analysis results - if yes, then define and design these	-	1	-	-
PC18. identify applications and tools to support data cleansing and normalization, data mining, data visualization, analytics, 'What-If' analysis and machine learning to support automatic tuning etc.	1	2	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Design and implement IIoT realization collaboratively using appropriate devices, connections, protocols, services, applications, and Cyber Security standards	**5**	**14**	**-**	**-**
PC19. implement the IIoT Architecture using appropriate sensors, connections, controllers, connectivity devices, edge devices, cloud connectivity and services	1	3	-	-
PC20. use appropriate protocols such as Wi-Fi, WirelessHART, Bluetooth, BT-LE, Ethernet etc.	1	2	-	-
PC21. collaborate with IT organization to install, configure, connect, integrate, secure, manage and troubleshoot applications and services	1	2	-	-
PC22. implement any defined data validators using available software and applications	1	1	-	-
PC23. ensure all applications are configured to use appropriate data inputs and produce outputs in the desired formats	-	1	-	-
PC24. define if the analytics and machine learning applications will run in on-line or batch mode and design appropriate data feed, data extractors and aggregators, and batch processors	-	1	-	-
PC25. apply 'ZERO-TRUST' principle for security – meaning only authorized and authenticated users, devices and applications can access the system, for the purpose defined by their roles	-	1	-	-
PC26. define and design 'Trust' systems and the required infrastructure	1	2	-	-
PC27. apply Cyber Security standards at all layers and across all organizations connected to the system	-	1	-	-
Verify correct implementation of IIoT and validate data, processed information, and analysis for correctness	**12**	**12**	**-**	**-**
PC28. collaborate with IT to ensure that the devices, applications, and data sources are programmed to acquire and process the data correctly	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC29. verify the range, units, and conversion factors of raw data	1	1	-	-
PC30. verify that the frequency of data acquisition is appropriate	1	1	-	-
PC31. verify that the raw data is stable within the limits of process dynamics. If the data is inherently noisy, consider using hardware or software filtering before consumption	1	1	-	-
PC32. verify that statistical processing of raw data (averaging, minima, maxima, median, standard deviation etc.) are appropriate for each sensor - whether the processing is done within the device or elsewhere	1	1	-	-
PC33. verify that the limits and alarms for process parameters and variables use appropriate type of data - raw or processed	1	1	-	-
PC34. verify the latency of data at consumption points (for example in process loops and alarm processors) and ensure that its impact on control loops is within acceptable limits	1	1	-	-
PC35. test and verify the performance of validators using simulated data	1	1	-	-
PC36. verify that each data mining and analysis application receives correct data and produces correct outputs - which are validated by experts and by specifically designed validator programs	1	1	-	-
PC37. ensure that the processed data and analysis results are available to consuming applications and users online	1	1	-	-
PC38. validate with the users that the processed information and analysis they receive are correct and discuss any anomalies with stakeholders to resolve the issue	1	1	-	-
PC39. ensure that applications and users receive messages, alerts and alarms as programmed and that they respond to the communication in the correct manner	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Verify Cyber Security compliance	**6**	**6**	**-**	**-**
PC40. set up the 'Trust' infrastructure for testing	1	1	-	-
PC41. test for 'ZERO-TRUST' compliance using defined scenarios and test cases and verify compliance	1	1	-	-
PC42. test Cyber Security compliance in all layers – using appropriate tools and experts and involving required stakeholders	1	1	-	-
PC43. collaborate with partners to set up and test for 'ZERO-TRUST' compliance of the connected system and verify compliance	1	1	-	-
PC44. reprogram the 'Trust' infrastructure for normal operation with organization roles, authorizations, and authentication mechanisms	1	1	-	-
PC45. verify that the user and applications access perform as designed and security is complied with	1	1	-	-
Respond to requests from stakeholders regarding production line performance, quality, customization, or scheduling issues	**1**	**6**	**-**	**-**
PC46. analyse requests from stakeholders (such as purchase, vendor management, service organizations, customers, and supply chain partners) regarding data quality and accessibility	-	1	-	-
PC47. check the trust system and organization data in case of any accessibility issues, to resolve any missing information or inconsistency – involving required stakeholders	-	1	-	-
PC48. confirm the key issue in case of any data quality related request, and verify the facts in the system at appropriate layer	-	1	-	-
PC49. identify for valid data quality request, the chain of components involved – from sensors to processing applications – and locate the sources of error. Rectify these involving stakeholders	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC50. perform validation at system level for issues relating to quality, customization, and scheduling - and further collaborate with the stakeholders to resolve the issue	-	1	-	-
PC51. consolidate all requests and analysis and utilize these for creating knowledgebase for production line and operations improvement	1	1	-	-
NOS Total	**34**	**66**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0431
NOS Name	Customize Industrial Internet of Things (IIOT) ecosystem for optimized performance
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, Light Engineering Goods, Defence Equipment
Occupation	Design
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/N0432: Collate data through Sensors and devices, and present it in relevant format for data analysis and data management

Description

This OS unit is about supporting information driven decision making for faster response to market demands and supply chain changes. Extensive data capturing and appropriate use of big-data processing, analytics and AI software is necessary.

Scope

The scope covers the following :

- Capture information requirements at various decision-making points
- Determine capability and flexibility required in the analysis software
- Identify and implement suitable software for analysis and decision-making
- Test and verify correct processing and analysis of data
- Ensure utilization of analyzed information in visualization and decision making

Elements and Performance Criteria

Capture information requirements at various decision-making points

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

PC1. capture key information needed for decision making and identify what primary data is needed to support this

PC2. confirm that the data acquisition systems are designed to capture the required primary data

PC3. identify secondary information required and its sources - whether internal to the organization or external

PC4. capture all sources and destinations of digital data in the organization, their formats, and interfaces - such as sensors, devices, controllers, and software applications that produce raw data or processed information

PC5. identify formats, interfaces, volume, and latency of secondary data

PC6. identify data aggregation and pre-processing requirements for all data - primary and secondary -accounting for maximum latency of real time and critical data

PC7. capture the need for data processing to extract or develop the identified key information

PC8. capture all data/information consuming applications - software for plant control, production management and planning, predictive maintenance, data visualization, what-if analysis, pattern recognition and machine learning systems of the 'cognitive' nature

PC9. determine the volume of data, need for storage, type and location of storage

PC10. determine requirements for real-time, on-demand and offline/batch processing

PC11. include considerations of data security at all interfaces and in all processing and consuming applications

PC12. capture requirements for Disaster Management and Business Process Continuity to support the organization goals

Determine capability and flexibility required in the analysis software

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

PC13. capture detailed functionality of each analysis software and one or more datasets needed. Functionality must be governed by some organization KPIs to ensure its use and value

PC14. define the processing in terms of aggregations, filtering, transformations, interpolations, intermediate storage, combining and iterations to be performed on the datasets and the resultant outputs

PC15. determine if multilevel processing is needed on same or differing datasets with different values of computation variables and derived parameters

PC16. define if the processing logic required for each analytic function is fixed, flexible, customizable, or self-learning

PC17. define the functional variability, flexibility, or self-learning requirements clearly in detail, with examples if possible

PC18. create use cases and sample scenarios for discussion within and outside the organization

PC19. identify users and stakeholders for the analytic functions and get their inputs and concurrence for the defined and planned functions

Identify and implement suitable software for analysis and decision-making

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

PC20. explore the available open source and commercial software that match the functional requirements and use cases defined. Involve IT department and other experts in the organization

PC21. compare with practices in other industries in the domain and consult experts within and outside the organization - including partners and application vendors

PC22. brainstorm and estimate the time and effort needed to achieve the desired expertise using any proven open source software or platforms, with available experience in the organization, and its impact on time to market

PC23. create inhouse team for viable open source route, involving IT department and other experts in the organization to develop expertise in the platform and demonstrate the use cases defined

PC24. consider engaging professionals with expertise in the candidate open source platform for development and support

PC25. evaluate the performance of open source implementation and perform deep technical assessment of security, usability, accuracy, reliability, and supportability of the application – considering its potential use for critical decision making

PC26. prepare business case for acquisition of open source and commercial software applications and present to management

PC27. share the results of the open source evaluation, with value and risk assessment, to management and get their decision on open source vs commercial

PC28. get management approval for personnel and resources, and formalize the development team for approved open source platform, part of or complete solution

PC29. get approved software from vendors and schedule training program by the vendors

PC30. get hands on training in using the software, along with other users in the organization, in all aspects of the software – installation, configuration, programming, data import and export, visualization, validation, access control, cyber security, locks, advanced features, plug-ins etc.

PC31. perform development and implementation on the approved platforms and do pilot runs

Test and verify correct processing and analysis of data

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

PC32. disable any automatic actions based on analytics use in the testing phase

PC33. integrate the analysis software with the plant automation system and ensure that all devices, applications, and data sources are programmed to generate the required data feeds for analysis

PC34. perform test runs and visualize the results. Perform any reconfigurations and tuning needed to get the desired outputs

PC35. create variations in data streams by changing process variables if possible – otherwise let the analytics run normally for long enough period to experience data variations spanning the entire dynamic range of the control system – or a reasonable subset

PC36. observe and record the analytics outputs and validate its accuracy by manual analysis and experience of the process personnel. Specifically, validate if any control outputs recommended by the system are logical and correct

PC37. test the applications thoroughly, involving all stakeholders and to establish the required level of performance over extended time

PC38. perform Cyber Security audit and compliance

PC39. get approval of experts and stakeholders for use and possible on-line decision making

PC40. document benchmark data, configuration, and results for later use

Ensure utilization of analyzed information in visualization and decision making

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

PC41. monitor the performance of analytics and address any issues reported relating to interpretation, data errors, accuracy, or inconsistency

PC42. analyse the issue, involving the implementation team and determine the cause

PC43. perform any software reconfigurations or changes needed or address usage and interpretation issues through appropriate communication and training

PC44. ensure that the analytics results are used for decision making and the user are satisfied

PC45. seek inputs for further enhancements in analytics and feed these into development cycle

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Cyber Security

KU2. Statistical data processing

KU3. Time series analysis

KU4. Feature vector analysis and Pattern recognition

KU5. Correlations, Cross correlations

KU6. Multi-dimensional data visualization

KU7. software platforms such as Python, R etc.

KU8. matrix transformations

KU9. big-data processing and analytics

KU10. cloud computing

KU11. technical skills relating to all the technologies relevant to the organization

KU12. tools and applications used in digital manufacturing, processes, and plant control

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiate with customers, vendors, across disciplines and roles

GS6. multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS9. be a technology evangelist

GS9. vigilate and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Capture information requirements at various decision-making points	**12**	**12**	**-**	**-**
PC1. capture key information needed for decision making and identify what primary data is needed to support this	1	1	-	-
PC2. confirm that the data acquisition systems are designed to capture the required primary data	1	1	-	-
PC3. identify secondary information required and its sources - whether internal to the organization or external	1	1	-	-
PC4. capture all sources and destinations of digital data in the organization, their formats, and interfaces - such as sensors, devices, controllers, and software applications that produce raw data or processed information	1	1	-	-
PC5. identify formats, interfaces, volume, and latency of secondary data	1	1	-	-
PC6. identify data aggregation and pre-processing requirements for all data - primary and secondary - accounting for maximum latency of real time and critical data	1	1	-	-
PC7. capture the need for data processing to extract or develop the identified key information	1	1	-	-
PC8. capture all data/information consuming applications - software for plant control, production management and planning, predictive maintenance, data visualization, what-if analysis, pattern recognition and machine learning systems of the 'cognitive' nature	1	1	-	-
PC9. determine the volume of data, need for storage, type and location of storage	1	1	-	-
PC10. determine requirements for real-time, on-demand and offline/batch processing	1	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. include considerations of data security at all interfaces and in all processing and consuming applications	1	1	-	-
PC12. capture requirements for Disaster Management and Business Process Continuity to support the organization goals	1	1	-	-
Determine capability and flexibility required in the analysis software	**7**	**11**	**-**	**-**
PC13. capture detailed functionality of each analysis software and one or more datasets needed. Functionality must be governed by some organization KPIs to ensure its use and value	1	3	-	-
PC14. define the processing in terms of aggregations, filtering, transformations, interpolations, intermediate storage, combining and iterations to be performed on the datasets and the resultant outputs	1	2	-	-
PC15. determine if multilevel processing is needed on same or differing datasets with different values of computation variables and derived parameters	1	1	-	-
PC16. define if the processing logic required for each analytic function is fixed, flexible, customizable, or self-learning	1	1	-	-
PC17. define the functional variability, flexibility, or self-learning requirements clearly in detail, with examples if possible	1	1	-	-
PC18. create use cases and sample scenarios for discussion within and outside the organization	1	2	-	-
PC19. identify users and stakeholders for the analytic functions and get their inputs and concurrence for the defined and planned functions	1	1	-	-
Identify and implement suitable software for analysis and decision-making	**2**	**13**	**-**	**-**
PC20. explore the available open source and commercial software that match the functional requirements and use cases defined. Involve IT department and other experts in the organization	1	2	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC21. compare with practices in other industries in the domain and consult experts within and outside the organization - including partners and application vendors	-	1	-	-
PC22. brainstorm and estimate the time and effort needed to achieve the desired expertise using any proven open source software or platforms, with available experience in the organization, and its impact on time to market	-	1	-	-
PC23. create inhouse team for viable open source route, involving IT department and other experts in the organization to develop expertise in the platform and demonstrate the use cases defined	-	1	-	-
PC24. consider engaging professionals with expertise in the candidate open source platform for development and support	-	1	-	-
PC25. evaluate the performance of open source implementation and perform deep technical assessment of security, usability, accuracy, reliability, and supportability of the application – considering its potential use for critical decision making	-	1	-	-
PC26. prepare business case for acquisition of open source and commercial software applications and present to management	1	1	-	-
PC27. share the results of the open source evaluation, with value and risk assessment, to management and get their decision on open source vs commercial	-	1	-	-
PC28. get management approval for personnel and resources, and formalize the development team for approved open source platform, part of or complete solution	-	1	-	-
PC29. get approved software from vendors and schedule training program by the vendors	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC30. get hands on training in using the software, along with other users in the organization, in all aspects of the software – installation, configuration, programming, data import and export, visualization, validation, access control, cyber security, locks, advanced features, plug-ins etc.	-	1	-	-
PC31. perform development and implementation on the approved platforms and do pilot runs	-	1	-	-
Test and verify correct processing and analysis of data	**6**	**12**	**-**	**-**
PC32. disable any automatic actions based on analytics use in the testing phase	1	1	-	-
PC33. integrate the analysis software with the plant automation system and ensure that all devices, applications, and data sources are programmed to generate the required data feeds for analysis	1	3	-	-
PC34. perform test runs and visualize the results. Perform any reconfigurations and tuning needed to get the desired outputs	1	1	-	-
PC35. create variations in data streams by changing process variables if possible – otherwise let the analytics run normally for long enough period to experience data variations spanning the entire dynamic range of the control system – or a reasonable subset	1	1	-	-
PC36. observe and record the analytics outputs and validate its accuracy by manual analysis and experience of the process personnel. Specifically, validate if any control outputs recommended by the system are logical and correct	1	1	-	-
PC37. test the applications thoroughly, involving all stakeholders and to establish the required level of performance over extended time	-	1	-	-
PC38. perform Cyber Security audit and compliance	1	2	-	-
PC39. get approval of experts and stakeholders for use and possible on-line decision making	-	1	-	-
PC40. document benchmark data, configuration, and results for later use	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Ensure utilization of analyzed information in visualization and decision making	-	**5**	-	-
PC41. monitor the performance of analytics and address any issues reported relating to interpretation, data errors, accuracy, or inconsistency	-	1	-	-
PC42. analyse the issue, involving the implementation team and determine the cause	-	1	-	-
PC43. perform any software reconfigurations or changes needed or address usage and interpretation issues through appropriate communication and training	-	1	-	-
PC44. ensure that the analytics results are used for decision making and the user are satisfied	-	1	-	-
PC45. seek inputs for further enhancements in analytics and feed these into development cycle	-	1	-	-
NOS Total	**27**	**53**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0432
NOS Name	Collate data through Sensors and devices, and present it in relevant format for data analysis and data management
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, Light Engineering Goods, Defence Equipment
Occupation	Design
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/N0433: Assist to achieve the desired Product Life Cycle Management

Description

This OS unit is about Product Line Management (PLM) covering the entire lifecycle from concept to retirement. Industry 4.0 enables rapid prototyping, small volume production using additive manufacturing. Connected environment enables participation of customers and vendors in design and enhances product acceptance and component availability in time.

Scope

The scope covers the following :

- Capture the PLM design process and tools used in the organization
- Enable customer and vendor participation in the design loop
- Propose methods, tools, processes, and applications to improve product lifecycle efficiency
- Analyze and manage the impact of change requests on the manufacturing process and plans

Elements and Performance Criteria

Capture the PLM design process and tools used in the organization

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

PC1. document the PLM lifecycle processes followed in the organization and the level of maturity and automation at each stage

PC2. capture capability for development of smart products

PC3. help define the context of 'smartness' relevant for the organization – in terms of intelligence, adaptability for different markets and uses, personalization, connectivity, remote control, programmability, multifunctionality, upgradability, repurposing etc.

PC4. capture plan for creation of smart factory and current state of implementation

PC5. capture the level of integration and digital networking of processes in the ecosystem

PC6. capture capability for designing new business models, especially, new service offerings and paired products and services

PC7. document the standards used in the organization and connected ecosystem for designs, drawings, and related engineering activities

PC8. identify the set of tools and applications used in the PLM lifecycle, such as Modelling and Simulation, Computer Aided Design (CAD), Bills of Material, Computer Numerical Control (CNC) machining, Rapid Prototyping, 3-D Printing, 3-D master (drawing free production), Versioning, Change Management, ERP, SCM etc.

PC9. capture the current range of products and services and plans for new development, including release plans and roadmaps for product support and retirement

Enable customer and vendor participation in the design loop

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

PC10. enable customers to connect securely and participate in product planning and development process sharing their experience, expectations, use cases and usage plans

PC11. enable customers to be part of product previews and become early adopters

PC12. engage customers in design of new products – such as Smart Service which provides customers with added value as opposed to just the product

PC13. engage customers in product testing in real life environments to get actual data and insight into product behavior

PC14. engage customers in product testing in real life environments to get actual data and insight into product behavior

PC15. create satisfied customers by supporting their real needs, so that they can become the product champions and references

PC16. educate customers on the impact of customization or product change request on production process, schedule, and lifecycle support and possibility of using programmable features of existing products to satisfy their needs

PC17. enable vendors to connect securely and participate in product planning and development process sharing their experience, capabilities, and knowledge of the market

PC18. engage vendors to get their views on feasibility of design, manufacturability, lifecycle issues, cost, and alternative options

PC19. engage vendors to understand their production plans and synchronize these with organization plans

PC20. engage vendors to adopt the organization standards and tool sets to have a seamless exchange of information

PC21. ensure that qualified vendors have secure connections to the organization network to exchange authorized data relating to plan, schedule, status, and performance

PC22. leverage vendor connectivity to establish a reliable just-in-time inventory management system, and dynamic adjustment of schedules

PC23. enable excess inventory liquidation through vendors by enabling them to have a view of organization inventory

PC24. create a 'Trust' system to enable an open but secure channel of communication with vendors and customers, following Cyber Security norms

Propose methods, tools, processes, and applications to improve product lifecycle efficiency

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

PC25. assess capability gap in development of smart products and propose enhancements

PC26. assess gaps in the plan for creating a smart factory and propose enhancements

PC27. assess gaps in integration and digital networking of processes in the ecosystem and propose enhancements

PC28. identify and propose, with business case, new business models to increase profits and customer retention and reduce warranty costs

PC29. identify new service offerings connected with smart products

PC30. consider adopting 'After-sales PLM' which ensures integrated development of services and service processes during product development

PC31. enable Mobile online services to enhance lifecycle support experience and efficiency

PC32. establish Field-monitoring of products and utilize the Feedback from the service for development

Analyse and manage the impact of change requests on the manufacturing process

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

PC33. collaboratively define, communicate, and follow a process of initiating change requests and responding. Request may originate internally – a design or manufacturing flaw of high severity may be detected, or it may be reported from field

PC34. include classification of change requests based on their impact on customers, production line, schedule, safety, reliability, isolated or batch issue, regulatory requirement, good to have, and company reputation

PC35. ensure that all change requests are either approved with recommended action plan or rejected with reasons

PC36. define a cross cutting team of experts to analyse and decide action plan for management of high impact change requests. This will include stakeholders form design, production, quality, purchase, sales and marketing, service, and management. This team will examine the impact of change from all aspects and decide course of action

PC37. analyse a change request and validate its classification. Identify if there are multiple occurrences of the same fault reported from one or multiple locations

PC38. perform a root cause analysis from available data. Seek field samples if relevant. Analyse production line and Quality data and look for any deviations reported. Localise the fault to a batch, machine, operator, line, logistics, design, specifications, usage or unknown

PC39. perform a root cause analysis from available data. Seek field samples if relevant. Analyse production line and Quality data and look for any deviations reported. Localise the fault to a batch, machine, operator, line, logistics, design, specifications, usage or unknown

PC40. consider for medium / low impact changes suggesting a viable workaround, repair, retrofitting of affected parts, replacement with tighter performance band, upgrade to higher version etc.

PC41. include all approved change requests in a minor or major product version release plan – and incorporate necessary changes in Design, BOM, Procurement, Production plan and schedule, Quality documents and Test plans

PC42. discuss internally and plan a special version release to accommodate strategic customers and other situations

PC43. leverage agile manufacturing processes and product line customizations to provide a quick response to change requests – that is the promise of Industry 4.0

PC44. maintain adequate communications at appropriate levels with the affected customers and inform them of action plan

PC45. consider special service support and provision of stand-by or alternative product to help in mitigating customer distress and downtime

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Product Lifecycle Management (PLM)

KU2. Industry 4.0 technologies and practices

KU3. Modelling and Simulation

KU4. Computer Aided Design (CAD), Bills of Material

KU5. Computer Numerical Control (CNC) machining, Computer Aided Manufacturing (CAM)

KU6. Rapid Prototyping, 3-D Printing, 3-D master (drawing free production)

KU7. Product Versioning, Change Management

KU8. ERP, SCM

KU9. Cyber Security

KU10. big-data processing and analytics

KU11. cloud computing

KU12. technical skills relating to all the technologies relevant to the organization

KU13. tools and applications used in digital manufacturing, processes, and plant control

Generic Skills (GS)

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

GS1. communicate effectively in a global organization

GS2. collaborate extensively within the organization to achieve common goals

GS3. collaborate with customers to understand their needs and translating that into product specifications

GS4. collaborate with vendors to achieve the organization goals

GS5. negotiate with customers, vendors, across disciplines and roles

GS6. multitask in planning, management, execution, monitoring, coaching, evangelizing

GS7. mentor and coach

GS8. be a technology evangelist

GS9. vigilate and focus on security and safety

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Capture the PLM design process and tools used in the organization	**6**	**9**	**-**	**-**
PC1. document the PLM lifecycle processes followed in the organization and the level of maturity and automation at each stage	1	1	-	-
PC2. capture capability for development of smart products	1	1	-	-
PC3. help define the context of 'smartness' relevant for the organization – in terms of intelligence, adaptability for different markets and uses, personalization, connectivity, remote control, programmability, multifunctionality, upgradability, repurposing etc.	1	1	-	-
PC4. capture plan for creation of smart factory and current state of implementation	-	1	-	-
PC5. capture the level of integration and digital networking of processes in the ecosystem	1	1	-	-
PC6. capture capability for designing new business models, especially, new service offerings and paired products and services	-	1	-	-
PC7. document the standards used in the organization and connected ecosystem for designs, drawings, and related engineering activities	1	1	-	-
PC8. identify the set of tools and applications used in the PLM lifecycle, such as Modelling and Simulation, Computer Aided Design (CAD), Bills of Material, Computer Numerical Control (CNC) machining, Rapid Prototyping, 3-D Printing, 3-D master (drawing free production), Versioning, Change Management, ERP, SCM etc.	1	1	-	-
PC9. capture the current range of products and services and plans for new development, including release plans and roadmaps for product support and retirement	-	1	-	-
Enable customer and vendor participation in the design loop	**10**	**19**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. enable customers to connect securely and participate in product planning and development process sharing their experience, expectations, use cases and usage plans	1	1	-	-
PC11. enable customers to be part of product previews and become early adopters	-	1	-	-
PC12. engage customers in design of new products – such as Smart Service which provides customers with added value as opposed to just the product	1	-	-	-
PC13. engage customers in product testing in real life environments to get actual data and insight into product behavior	1	3	-	-
PC14. engage customers in product testing in real life environments to get actual data and insight into product behavior	1	2	-	-
PC15. create satisfied customers by supporting their real needs, so that they can become the product champions and references	1	1	-	-
PC16. educate customers on the impact of customization or product change request on production process, schedule, and lifecycle support and possibility of using programmable features of existing products to satisfy their needs	1	1	-	-
PC17. enable vendors to connect securely and participate in product planning and development process sharing their experience, capabilities, and knowledge of the market	1	1	-	-
PC18. engage vendors to get their views on feasibility of design, manufacturability, lifecycle issues, cost, and alternative options	1	2	-	-
PC19. engage vendors to understand their production plans and synchronize these with organization plans	1	1	-	-
PC20. engage vendors to adopt the organization standards and tool sets to have a seamless exchange of information	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC21. ensure that qualified vendors have secure connections to the organization network to exchange authorized data relating to plan, schedule, status, and performance	1	2	-	-
PC22. leverage vendor connectivity to establish a reliable just-in-time inventory management system, and dynamic adjustment of schedules	-	1	-	-
PC23. enable excess inventory liquidation through vendors by enabling them to have a view of organization inventory	-	1	-	-
PC24. create a 'Trust' system to enable an open but secure channel of communication with vendors and customers, following Cyber Security norms	-	1	-	-
Propose methods, tools, processes, and applications to improve product lifecycle efficiency	**2**	**8**	**-**	**-**
PC25. assess capability gap in development of smart products and propose enhancements	-	1	-	-
PC26. assess gaps in the plan for creating a smart factory and propose enhancements	1	1	-	-
PC27. assess gaps in integration and digital networking of processes in the ecosystem and propose enhancements	-	1	-	-
PC28. identify and propose, with business case, new business models to increase profits and customer retention and reduce warranty costs	1	1	-	-
PC29. identify new service offerings connected with smart products	-	1	-	-
PC30. consider adopting 'After-sales PLM' which ensures integrated development of services and service processes during product development	-	1	-	-
PC31. enable Mobile online services to enhance lifecycle support experience and efficiency	-	1	-	-
PC32. establish Field-monitoring of products and utilize the Feedback from the service for development	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Analyse and manage the impact of change requests on the manufacturing process	**6**	**15**	**-**	**-**
PC33. collaboratively define, communicate, and follow a process of initiating change requests and responding. Request may originate internally – a design or manufacturing flaw of high severity may be detected, or it may be reported from field	1	3	-	-
PC34. include classification of change requests based on their impact on customers, production line, schedule, safety, reliability, isolated or batch issue, regulatory requirement, good to have, and company reputation	1	1	-	-
PC35. ensure that all change requests are either approved with recommended action plan or rejected with reasons	1	1	-	-
PC36. define a cross cutting team of experts to analyse and decide action plan for management of high impact change requests. This will include stakeholders form design, production, quality, purchase, sales and marketing, service, and management. This team will examine the impact of change from all aspects and decide course of action	1	1	-	-
PC37. analyse a change request and validate its classification. Identify if there are multiple occurrences of the same fault reported from one or multiple locations	1	-	-	-
PC38. perform a root cause analysis from available data. Seek field samples if relevant. Analyse production line and Quality data and look for any deviations reported. Localise the fault to a batch, machine, operator, line, logistics, design, specifications, usage or unknown	1	2	-	-
PC39. perform a root cause analysis from available data. Seek field samples if relevant. Analyse production line and Quality data and look for any deviations reported. Localise the fault to a batch, machine, operator, line, logistics, design, specifications, usage or unknown	-	1	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC40. consider for medium / low impact changes suggesting a viable workaround, repair, retrofitting of affected parts, replacement with tighter performance band, upgrade to higher version etc.	-	1	-	-
PC41. include all approved change requests in a minor or major product version release plan – and incorporate necessary changes in Design, BOM, Procurement, Production plan and schedule, Quality documents and Test plans	-	1	-	-
PC42. discuss internally and plan a special version release to accommodate strategic customers and other situations	-	1	-	-
PC43. leverage agile manufacturing processes and product line customizations to provide a quick response to change requests – that is the promise of Industry 4.0	-	1	-	-
PC44. maintain adequate communications at appropriate levels with the affected customers and inform them of action plan	-	1	-	-
PC45. consider special service support and provision of stand-by or alternative product to help in mitigating customer distress and downtime	-	1	-	-
NOS Total	**24**	**51**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0433
NOS Name	Assist to achieve the desired Product Life Cycle Management
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, Light Engineering Goods, Defence Equipment
Occupation	Design
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/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**	**-**	**-**

Qualification Pack

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. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.

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

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

6. To pass the Qualification Pack assessment, every trainee should score a minimum of 70% of % aggregate marks to successfully clear the assessment.

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/N0428.Assist in creating a smart e-Factory	20	64	-	-	84	15
CSC/N0429.Perform system analysis and assist in design, develop and maximize productivity of machinery	24	96	-	-	120	15
CSC/N0430.Execute Process Control automation to achieve improved productivity	27	43	-	-	70	15
CSC/N0431.Customize Industrial Internet of Things (IIOT) ecosystem for optimized performance	34	66	-	-	100	15
CSC/N0432.Collate data through Sensors and devices, and present it in relevant format for data analysis and data management	27	53	-	-	80	10
CSC/N0433.Assist to achieve the desired Product Life Cycle Management	24	51	-	-	75	10
CSC/N0505.Follow health, safety and environment guidelines at workplace	15	20	-	-	35	10

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
DGT/VSQ/N0102.Employability Skills (60 Hours)	20	30	-	-	50	10
Total	**191**	**423**	**-**	**-**	**614**	**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.