Model Curriculum

QP Name: Additive Manufacturing Design and Application Engineer

QP Code: CSC/Q0412

Version: 1.0

NSQF Level: 5.5

Model Curriculum Version: 1.0

Capital Goods and Strategic Skill Council
39,1st Floor, Samyak Tower, Pusa Rd, Block 9A, WEA, Karol Bagh, New Delhi, Delhi, 110005

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Training Parameters

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, FireFighting & Safety Equipment
Occupation	Design
Country	India
NSQF Level	5.5
Aligned to NCO/ISCO/ISIC Code	2144.0401, 2144.0201
Minimum Educational Qualification and Experience	UG Degree in relevant field + 2 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 + 5 year of relevant experience or Previous NSQC level 5 + 1.5 years of relevant experience *Subject to being offered as 6 months internship/ project
Pre-Requisite License or Training	NA
Minimum Job Entry Age	24 Years
Last Reviewed On	31st January 2024
Next Review Date	31st January 2027
NSQC Approval Date	31st January 2024

QP Version	1.0
Model Curriculum Creation Date	31st January 2024
Model Curriculum Valid Up to Date	30 January 2027
Model Curriculum Version	1.0
Minimum Duration of the Course	570 Hours
Maximum Duration of the Course	570 Hours

Program Overview

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

Training Outcomes

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

- Describe various additive manufacturing technologies, including stereolithography (SLA), selective laser sintering (SLS), fused deposition modeling (FDM), and metal additive manufacturing processes.
- Use advanced CAD software for creating detailed and intricate designs suitable for additive manufacturing.
- Select appropriate materials for additive manufacturing based on the intended application and performance requirements.
- Optimize the printing parameters and post-processing steps to enhance the mechanical properties and overall quality of the manufactured parts.

Compulsory Modules

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

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
CSC/N0435: Design 3D model of the components in CAD software. **NOS Version- 1.0** **NSQF Level- 5.5**	**20:00**	**40:00**	**0:00**	**00:00**	**60:00**
Module 1: Introduction to the role of an Additive Manufacturing design and application engineer	02:00	00:00	0:00	00:00	02:00
Module 2: Design 3D model of the components in a CAD software.	18:00	40:00	0:00	00:00	58:00
CSC/N0436: Identify the printing Process & Select the additive material which can be used. **NOS Version-1.0** **NSQF Level- 5.5**	**15:00**	**15:00**	**0:00**	**00:00**	**30:00**
Module 3: Identify the					

printing Process & Select the additive material which can be used	15:00	15:00	0:00	00:00	30:00
CSC/N0437: Write Process instructions, and collate data for RCA- root cause analysis **NOS Version-1.0** **NSQF Level- 5.5**	**20:00**	**40:00**	**30:00**	**00:00**	**90:00**
Module 4: Write Process instructions, and collate data for RCA- root cause analysis	20:00	40:00	0:00	00:00	60:00
CSC/N0438:Developing prototypes of new products using 3D printers or other computer-controlled equipment **NOS Version-1.0** **NSQF Level- 5.5**	**30:00**	**30:00**	**0:00**	**00:00**	**60:00**
Module 5: Develop prototypes of new products using 3D printers or other computer-controlled equipment	30:00	30:00	0:00	00:00	60:00
CSC/N0439 : **Implement corrective actions for process and quality issues/ Perform Quality Assurance and Testing** **NOS Version-1.0** **NSQF Level- 5.5**	**15:00**	**15:00**	**30:00**	**00:00**	**60:00**
Module 6: Implement corrective actions for process and quality issues/ Perform Quality Assurance and Testing	15:00	15:00	30:00	00:00	60:00
CSC/N0440: Interface with design engineers to ensure manufacturability of new designs. **NOS Version-1.0** **NSQF Level- 5.5**	**20:00**	**40:00**	**30:00**	**00:00**	**90:00**
Module 7: Interact with design engineers to ensure manufacturability of new designs which adheres to DFM -Design for	20:00	40:00	0:00	00:00	60:00

manufacturing and DFX-Design for excellence principles.					
CSC/N1339: **Collaboratively coordinate with the team** **NOS Version- 1.0** **NSQF Level- 5**	**30:00**	**60:00**	**0:00**	**00:00**	**90:00**
Module 9: Collaboratively coordinate with the team	20:00	40:00	0:00	00:00	60:00
CSC/N0530 Health, Safety and Environment at workplace **NOS Version- 1.0** **NSQF Level- 5**	**10:00**	**20:00**	**00:00**	**00:00**	**30:00**
Module 10: Health, Safety and Environment at workplace	10:00	20:00	00:00	00:00	30:00
DGT/VSQ/N0102 - Employability Skills (60 hours) **NOS Version No. – 1.0** **NSQF Level – 4**	**20:00**	**40:00**	**00:00**	**00:00**	**60:00**
Module 11: Introduction to Employability Skills	20:00	40:00	00:00	00:00	60:00
Total Duration	**180:00**	**300:00**	**00:00**	**90:00**	**570:00**

Module Details

Module 1: Introduction to the role of an Additive Manufacturing Design and Application engineer

Bridge Module, mapped to CSC/N0435 v1.0

Terminal Outcomes:

- Discuss the job role of an Additive Manufacturing Design and Application engineer

Duration: 02:00	Duration: 0:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Describe the size and scope of the capital good industry and its sub-sectors. • Discuss the role and responsibilities of an Additive Manufacturing Design and Application engineer. • Identify various employment opportunities for an Additive Manufacturing Design and Application engineer.	
Classroom Aids	
Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films	
Tools, Equipment and Other Requirements	
NA	

- ## Module 2: Design 3D model of the components in a CAD software

Bridge module, Mapped to CSC/N0435 v1.0

Terminal Outcomes:

- Represent the specifications and dimensions of metal part prototypes using 3D computer modeling techniques, ensuring precision and compatibility with additive manufacturing processes.
- Demonstrate the ability to evaluate designs for suitability with additive manufacturing processes, optimizing factors such as overhangs, support structures, and material usage efficiency to enhance manufacturability and minimize production challenges.
- Select appropriate metal materials for prototypes based on thorough consideration of mechanical properties, durability, and suitability for additive manufacturing techniques, ensuring optimal performance and manufacturability of the final product.

Duration: 18:00	**Duration**: 40:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the principles of additive manufacturing (AM) processes and their applicability in prototyping metal parts. • Discuss the requirements for designing metal parts compatible with additive manufacturing techniques. • Evaluate various metal materials used in additive manufacturing based on their mechanical properties, durability, and suitability for specific applications. • Describe industry standards, regulations, and safety requirements relevant to designing and producing metal parts using additive manufacturing. • Discuss techniques for optimizing designs to enhance manufacturability, minimize production costs, and reduce lead times. • Discuss methods for validating the structural integrity of metal part designs through simulation and analysis. • Explore strategies for achieving desired surface finishes on metal parts produced via additive manufacturing. • Discuss the importance of	• Apply CAD software skills to accurately represent specifications and dimensions of metal part prototypes. • Utilize design evaluation tools to assess the suitability of designs for additive manufacturing processes, considering factors such as overhangs and support structures. • Select appropriate metal materials for prototypes based on mechanical properties and manufacturability requirements. • Employ simulation and analysis software to validate the structural integrity of designs and ensure they meet performance requirements. • Optimize design processes to minimize production time and costs while maintaining quality standards. • Implement surface finishing techniques to achieve desired functional and aesthetic properties on metal parts. • Engage in effective communication with stakeholders to gather feedback and ensure alignment throughout the design and production process. • Demonstrate ways to ensure compliance with industry standards, regulations, and safety requirements throughout the design and production phases.

investigating advancements in additive manufacturing technologies, materials, and design methodologies to stay updated with industry trends. • Discuss the need and importance of maintaining comprehensive documentation to facilitate traceability, analysis, and continuous improvement in additive manufacturing processes.	• Stay updated with advancements in additive manufacturing technologies, materials, and design methodologies through continuous learning and research. • Maintain detailed documentation of the design and production process to facilitate traceability, analysis, and future improvements.
Classroom Aids	
Computer, Projection Equipment, PowerPoint Presentation and Software, Facilitator's Guide, Participant's Handbook.	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

- ## Module 3: Identify the Process & Select the additive material to be used

Bridge module, Mapped to NOS CSC/N0436 v1.0

Terminal Outcomes:

- Identify additive manufacturing processes and selecting appropriate materials for various applications.
- Manage costs effectively, mitigate risks, and maintain compliance with industry standards.
- Demonstrate the skills to continuously improve material selection processes and outcomes through feedback and innovation, contributing to the overall success of additive manufacturing projects as Design and Application Engineers.

Duration: 15:00	**Duration: 15:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Describe various additive manufacturing processes, including Fused Deposition Modeling (FDM), Stereolithography (SLA), Selective Laser Sintering (SLS), among others. • Explain the strengths, weaknesses, and applications of each additive manufacturing process to make informed decisions. • Discuss the need to research and evaluate new additive materials in the market for potential applications, staying abreast of industry advancements. • Analyze job requirements, including part geometry, function, environment, and regulatory compliance, to determine the most suitable additive manufacturing process and material. • Discuss the process of conducting material testing and validation to verify performance characteristics and suitability for the intended application. • Describe the importance of managing costs associated with additive material selection, procurement, processing, and post-processing requirements. • Discuss opportunities to improve additive material selection processes through the adoption of new technologies, materials, or methodologies. • Describe potential risks associated	• Apply theoretical knowledge to real-world scenarios, effectively selecting additive materials and processes for specific applications. • Demonstrate proficiency in conducting material testing and validation, ensuring that selected materials meet performance requirements. • Manage costs associated with additive material selection by optimizing usage and considering procurement, processing, and post-processing expenses. • Identify and mitigate risks associated with additive material selection through proactive planning and implementation of contingency measures. • Utilize feedback from manufacturing operations to continually improve material selection processes and outcomes. • Maintain accurate records and documentation of material selection processes and outcomes for future reference and analysis. • Prepare and deliver comprehensive reports and presentations to communicate material selection decisions and outcomes to stakeholders effectively. • Ensure compliance with industry standards and best practices in additive material selection, handling,

with additive material selection, including material compatibility issues, regulatory compliance challenges, or supply chain disruptions. • Describe contingency plans to address unforeseen issues that may arise during material selection or processing. • Discuss industry standards and best practices related to additive material selection, handling, and processing.	and processing in all aspects of work.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

- **Module 4: Write Process instructions, and collate data for RCA- root cause analysis**

Bridge module ,Mapped to NOS CSC/N0437 v1.0

Terminal Outcomes:

- Produce concise and effective instructions, avoiding unnecessary complexity.
- Utilize visual aids such as diagrams, illustrations, or videos to enhance understanding and provide visual guidance.
- Incorporate safety instructions and precautions effectively to minimize the risk of accidents or injuries during manufacturing.
- Define problems or issues encountered in the additive manufacturing process accurately.
- Generate and evaluate potential solutions to address identified root causes, considering short-term fixes and long-term preventive measures.

Duration: 20:00	**Duration: 40:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the principles of writing clear and concise process instructions tailored for technicians and operators involved in the manufacturing process. • Describe the importance of accuracy in documenting steps, measurements, tolerances, and materials required for the manufacturing process. • Explain the significance of consistency in instructions to maintain uniformity across the manufacturing process. • Discuss the necessity of updating instructions to incorporate process improvements, new technologies, or material changes. • Explain the importance of avoiding unnecessary complexity in instructions to ensure clarity and effectiveness. • Describe the value of incorporating visual aids such as diagrams, illustrations, or videos to enhance understanding and provide visual guidance. • Explain the importance of including safety instructions and precautions to minimize the risk of accidents or injuries during manufacturing. • Discuss the importance of establishing a feedback system to identify ambiguities or areas for improvement in instructions. • Understand the process of evaluating	• Demonstrate the ability to write clear and easily understandable instructions tailored for technicians and operators involved in the manufacturing process. • Demonstrate the ability to accurately document steps, measurements, tolerances, and materials required for the manufacturing process. • Demonstrate the ability to maintain consistency across all instructions to ensure uniformity in the manufacturing process. • Demonstrate the ability to update instructions to incorporate process improvements, new technologies, or changes in materials. • Demonstrate the ability to avoid unnecessary complexity in instructions to ensure clarity and effectiveness. • Demonstrate the ability to incorporate diagrams, illustrations, or videos to enhance understanding and provide visual guidance. • Demonstrate the ability to include safety instructions and precautions to minimize the risk of accidents or injuries during manufacturing. • Demonstrate the ability to establish a feedback system to identify ambiguities or areas for improvement in instructions. • Demonstrate the ability to evaluate

manufacturing process efficiency by monitoring adherence to instructions and identifying areas for optimization. • Define problems or issues encountered in the additive manufacturing process accurately. •	manufacturing process efficiency by monitoring adherence to instructions and identifying areas for optimization. • Identify problems or issues encountered in the additive manufacturing process accurately. • Collect relevant data related to the identified problems, including process parameters, material properties, and equipment performance. • Prioritize significant contributing factors for corrective action based on their impact on the manufacturing process and product quality. • Generate and evaluate potential solutions to address identified root causes, considering short-term fixes and long-term preventive measures. • Implement selected solutions efficiently, making necessary adjustments to process parameters, material specifications, or equipment maintenance procedures. • Monitor the additive manufacturing process rigorously to assess the effectiveness of implemented solutions and prevent issue recurrence. • Document the RCA process thoroughly, including findings, actions taken, and outcomes, for future reference and continuous improvement efforts. • Utilize insights gained from the RCA process to drive continuous improvement in additive manufacturing processes, technologies, and workflows effectively.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

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- ## Module 5: Develop prototypes of new products using 3D printers or other computer-controlled equipment

Bridge module, Mapped to NOS CSC/N0438 v1.0

Terminal Outcomes:

- Develop prototypes that accurately represent design specifications and functional requirements provided by stakeholders.
- Choose appropriate materials for prototyping based on intended use, durability, and desired properties of the final product.
- Implement design optimizations to leverage the capabilities of additive manufacturing technologies.

Duration: 30:00	**Duration: 30:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Discuss the importance of prototyping principles, including design specifications interpretation, functional requirements analysis, and stakeholder communication. • Describe CAD Modeling and Blueprint Interpretation. • Discuss the importance of material properties and selection criteria for prototyping, considering factors such as intended use, durability, and desired final product properties. • Describe various additive manufacturing technologies, including 3D printing, and their capabilities, limitations, and application in prototyping. • Discuss techniques for achieving high-quality prints with minimal defects, including dimensional accuracy standards, surface finish optimization, and print parameter adjustments. • Describe strategies for optimizing prototyping timeframes and costs, balancing speed with quality considerations. • Explain iterative design processes, collaborating with design teams to iterate on prototypes based on feedback and revisions. • Discuss Troubleshooting and Issue Resolution related to printing processes, materials, or design compatibility to maintain project timelines.	• Demonstrate hands-on experience with CAD software to create and modify designs for prototyping. • Demonstrate practical skills in operating 3D printers or other computer-controlled equipment for prototype production. • Use proper material handling and preparation techniques for different prototyping materials. • Demonstrate printer calibration procedures and perform routine maintenance to ensure optimal printing performance. • Practice adjusting print parameters such as layer height, infill density, and print speed to optimize print quality and efficiency. • Show proficiency in post-processing techniques such as sanding, painting, or surface treatments to enhance prototype aesthetics and functionality. • Work collaboratively with design teams to iterate on prototypes based on feedback and design revisions. • Develop problem-solving skills to diagnose and resolve issues related to printing processes, materials, or design compatibility. • Show how to maintain detailed records of prototyping activities and provide clear and concise progress reports to project stakeholders. • Practice conducting thorough

• Discuss the need to maintain detailed records of prototyping activities and provide regular progress reports to project stakeholders.	inspections and tests to verify prototype functionality, structural integrity, and compliance with design requirements. • Adhere to safety protocols and industry regulations governing the use of additive manufacturing equipment and materials to maintain a safe working environment.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

- **Module 6: Implement corrective actions for process and quality issues/ Perform Quality Assurance and Testing**

Bridge module ,Mapped to NOS CSC/N0439 v1.0

Terminal Outcomes:

- Describe the principles and methodologies involved in implementing corrective actions for process and quality issues in additive manufacturing processes.
- Apply various techniques and tools to identify, analyze, and rectify deviations from expected outcomes and ensure product quality in additive manufacturing.

Duration: 15:00	**Duration: 15:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Discuss how to document deviations from expected outcomes in additive manufacturing processes. • Identify quality issues in manufactured parts through inspection, testing, and analysis. • Describe data analytics and statistical methods to identify trends and patterns indicative of process or quality issues. • Discuss the need to conduct thorough root cause analysis to determine the underlying reasons for process deviations and quality issues. • Explain techniques such as fishbone diagrams, 5 Whys, or fault tree analysis to identify contributing factors. • Discuss how to collaborate with cross-functional teams to gather relevant information and insights for comprehensive analysis. • Describe why corrective actions are aligned with industry standards, regulatory requirements, and best practices in additive manufacturing. • Discuss the importance of coordinating with relevant stakeholders, including production teams, engineers, and quality assurance personnel, to ensure timely and effective implementation. • Discuss how to develop and execute quality assurance testing protocols for additive manufacturing processes and products. • Discuss the utilization of a variety of	• Apply theoretical knowledge to identify and document deviations from expected outcomes in additive manufacturing processes. • Utilize inspection, testing, and analysis techniques to identify and address quality issues in manufactured parts. • Interpret data analytics and statistical methods to recognize trends and patterns indicative of process or quality issues. • Conduct root cause analysis effectively to determine underlying reasons for process deviations and quality issues. • Apply various techniques such as fishbone diagrams, 5 Whys, or fault tree analysis to identify contributing factors to issues. • Collaborate with cross-functional teams to gather relevant information and insights for comprehensive analysis and problem-solving. • Formulate actionable corrective plans based on root cause analysis findings, considering industry standards and best practices. • Prioritize corrective actions based on their potential impact on process stability and product quality. • Lead or support the implementation of corrective actions within additive manufacturing processes. • Coordinate with relevant stakeholders to ensure timely and effective implementation of corrective actions. • Monitor progress and adjust implementation strategies as

testing methods, including dimensional inspection, material analysis, mechanical testing, and non-destructive testing, to assess product quality.	necessary to achieve desired outcomes. • Develop and execute quality assurance testing protocols for additive manufacturing processes and products. • Utilize a variety of testing methods to assess product quality, ensuring adherence to relevant industry standards and specifications. • Analyze testing data to evaluate conformance to quality standards and specifications. • Document test results comprehensively, including any deviations or non-conformities. • Generate reports summarizing testing activities, findings, and recommendations for improvement. • Drive continuous improvement initiatives to enhance process efficiency and product quality. • Identify opportunities for optimization and innovation through collaboration with internal teams and external partners. • Participate in lessons learned sessions to capture insights from corrective actions and quality assurance activities for future reference. • Show how to ensure compliance with relevant regulations, standards, and certifications governing additive manufacturing processes and products. • Stay updated on industry developments and regulatory changes to ensure adherence to the latest requirements. • Collaborate with regulatory affairs teams to address compliance issues or concerns effectively.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

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Additive Manufacturing Design and Application engineer

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Additive Manufacturing Design and Application engineer

- **Module 7: Interface with design engineers to ensure manufacturability of new designs**

Bridge module ,Mapped to NOS CSC/N0440 v1.0

Terminal Outcomes:

- Establish effective communication channels and collaboration between design engineers and manufacturing teams leads to the creation of additive manufacturing (AM)-friendly designs.
- Interact closely with design engineers, AM-specific design guidelines and best practices are developed and implemented.
- Reduce manufacturing Errors and Costs by identifying potential manufacturability issues during the design phase.

Duration: 20:00	**Duration: 40:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Discuss various design requirements • Collaboration and Problem-Solving: Working closely with design engineers to identify potential manufacturability issues early in the design phase and finding solutions that balance design intent with manufacturing feasibility. • Describe additive manufacturing processes, materials, and limitations to provide informed feedback to design engineers regarding design features, material selection, tolerances, and part orientation for optimal manufacturability. • Explain design geometries and providing guidance on optimizing designs for additive manufacturing, considering factors such as minimizing support structures, reducing build time, and improving part performance. • Describe how to utilize CAD software and simulation tools proficiently to assess manufacturability, conduct feasibility studies, and generate recommendations for design modifications. • Explain implementing quality assurance measures to ensure designs meet required standards and specifications for additive manufacturing processes, including dimensional accuracy, surface finish, and mechanical properties. • Discuss the need of maintaining accurate records of design reviews,	• Communicate effectively with design engineers to understand design requirements and convey manufacturability constraints and recommendations. • Collaborate with design engineers to identify and resolve potential manufacturability issues early in the design process. • Apply deep knowledge of additive manufacturing processes, materials, and limitations to provide informed feedback to design engineers. • Utilize CAD software and simulation tools proficiently to assess manufacturability and generate recommendations for design modifications. • Implement quality assurance measures to ensure designs meet required standards and specifications for additive manufacturing processes. • Maintain accurate records of design reviews, recommendations, and modifications, and provide detailed reports to design engineers. • Stay updated on advancements in additive manufacturing technologies, materials, and processes through ongoing learning and professional development. • Provide timely feedback to design engineers to minimize delays in the design iteration process. • Deliver manufacturable designs that meet or exceed performance

recommendations, and modifications, and providing detailed reports outlining manufacturability assessments and proposed design enhancements to design engineers. • Discuss the importance of efficiency and Timeliness.	requirements while adhering to project constraints and objectives.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
Computer-Aided Design (CAD) Software, Simulation and Analysis Software, Additive Manufacturing Software, Material Selection Software, Topology Optimization Software, Project Management Tools, Quality Control and Inspection Tools, Additive Manufacturing Machines, Post-Processing Equipment, Metrology Equipment, Safety Equipment, Material Handling and Storage, Computing Hardware, 3D Scanners, Collaboration Tools, Training and Documentation Tools, Educational Resources	

- ## Module 8: Collaborate and coordinate with Team

Bridge module ,Mapped to CSC/N1339 v1.0

Terminal Outcomes:

- Facilitate effective collaboration between CG artists, additive manufacturing designers, engineers, and software developers to achieve cohesive and integrated solutions.
- Act as a bridge between computer graphics and additive manufacturing teams, ensuring a shared vision and smooth communication throughout the design and production processes.
- Collaborate on cross-disciplinary projects to maximize the synergy between CG and additive manufacturing technologies

Duration: 20:00	Duration: 40:00
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Define and explain the key concepts of team dynamics, including roles, norms, and communication patterns. • Discuss the importance of applying effective communication strategies within a team, considering various communication channels and styles. • Describe the components necessary for creating a positive and productive team environment in the context of a Data Analytics Engineer role. • Describe the importance of collaboration in the field of data analytics. • Define the role of each team member in the decision-making process. • Define and demonstrate a sense of responsibility in the context of a Data Analytics Engineer.	• Conduct a practical team-building exercise to foster collaboration and teamwork. • Demonstrate the experience and identify strategies for building a cohesive team environment. • Participate in a communication simulation, considering various scenarios encountered in a data analytics team. • Receive feedback on communication effectiveness and adapt communication styles accordingly. • Work on a collaborative data analytics project, addressing real-world challenges. • Demonstrate the ability to effectively collaborate with team members to achieve project objectives. • Simulate decision-making scenarios specific to data analytics projects. • Contribute actively to decision-making processes and analyze the impact of decisions on project outcomes. • Take on specific responsibilities within the team, such as project management or task ownership. • Demonstrate a proactive approach to fulfilling responsibilities and meeting project deadlines. • Attend a diversity training workshop to gain insights into respecting diverse opinions, customs, and preferences.

	• Apply the knowledge gained to enhance collaboration within the team, considering cultural and professional diversity.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop	
Tools, Equipment and Other Requirements	
NA	

- **Module 8: Follow health, safety and environment guidelines at workplace**

Bridge module ,Mapped to CSC/N0505 v1.0

Terminal Outcomes:

- Demonstrate ways to maintain personal health and safety.
- Describe the process of assisting in hazard management.
- Explain how to check the first aid box, firefighting and safety equipment.
- Describe the process of assisting in waste management.
- Explain the importance of following the fire safety guidelines.
- Explain the importance of following the emergency and first-aid procedures.
- Demonstrate the process of carrying out relevant documentation and review

Duration: 10:00	**Duration: 20:00**
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the recommended practicesto be followed to ensure protection from infections and transmission to others, such as the use of hand sanitizer and face mask. • Explain the importance and process of checking the work conditions, assessing the potential health and safety risks, and take appropriate measures to mitigate them. • Explain the importance and process of selecting and using the appropriatePPE relevant to the task and work conditions. • Explain the recommendedtechniques to be followed while lifting and moving heavy objects to avoid injury. • Explain the importance of following the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, toolsand equipment. • Explain the importance and process of identifying existing and potential hazards at work. • Describe the process of assessing the potential risks and injuries associated with the various hazards. • Explain how to prevent or minimize different types of hazards.	• Demonstrate the use of appropriate Personal Protective Equipment (PPE) relevant to the task and work conditions. • Demonstrate how to handle hazardous materials safely. • Demonstrate the process of testing the firefighting and various safety equipment to ensure they are in usable condition. • Demonstrate the process of recycling and disposing different types of waste appropriately. • Demonstrate how to use the appropriate type of fire extinguisher to extinguish different types of fires safely. • Demonstrate how to administer appropriate first aid to the injured personnel. • Demonstrate the process of performing Cardiopulmonary Resuscitation (CPR) on a potential victim of cardiac arrest. • Demonstrate the process of carrying out appropriate documentation following a health and safety incident at work, including all the required information.

• Explain how to handle and store hazardous materials safely. • Explain the importance of ensuring the first aid box is updated with the relevant first aid supplies. • Describe the process of checking and testing the firefighting and various safety equipment to ensure they are in a usable condition. • Explain the criteria for segregating waste into appropriate categories. • Describe the appropriate methods for recycling the waste. • Describe the process of disposing of the non-recyclable waste safely and the applicable regulations. • Explain the use of different types of fire extinguishers to extinguish different types of fires. • State the recommended practices to be followed for safe rescue during afire emergency. • Explain how to request assistancefrom the fire department to extinguish a serious fire. • Explain the appropriate practices to be followed during workplace emergencies to ensure safety and minimize loss to organizational property. • State the common health and safety hazards present in a work environment, associated risks, and how to mitigate them. • State the safe working practices to be followed while working at various hazardous sites and using electrical equipment. • Explain the importance of ensuring easy access to firefighting and safety equipment. Explain the appropriate preventative and remedial actions to be taken in the case of exposure to toxic materials, such as poisonous chemicals and gases. • Explain various causes of fire in	

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different work environments and the recommended precautions to be taken to prevent fire accidents. • Describe different methods of extinguishing fire. • List different materials used for extinguishing fire. • Explain the applicable rescue techniques to be followed during a fire emergency. • Explain the importance of placing safety signs and instructions at strategic locations in a workplace and following them. • Explain different types of first aid treatment to be provided for different types of injuries. • State the potential injuries associated with incorrect manual handling. • Explain how to move an injured person safely. • State various hazards associated with the use of various machinery, tools, implements, equipment and materials. • Explain the importance of ensuring no obstruction and free access to fire exits. • Explain how to free a person from electrocution safely. • Explain how to administer appropriate first aid to an injured person. • Explain how to perform Cardiopulmonary Resuscitation (CPR). • Explain the importance of coordinating with the emergency services to request urgent medical assistance for persons requiring professional medical attention or hospitalisation. State the appropriate documentation to be carried out following a health and safety incident at work, and the relevant information to be included.	

• Explain the importance and process of reviewing the health and safety conditions at work regularly or following an incident. • Explain the importance and process of implementing appropriate changes to improve the health and safety conditions at work.	
Classroom Aids	
Computer, Projection Equipment, PowerPoint Presentation and Software, Facilitator's Guide, Participant's Handbook.	
Tools, Equipment and Other Requirements	
Personal Protective Equipment, Cleaning Equipment and Materials, Sanitizer, Soap, Mask	

- ## Module 10: Employability Skills

Bridge module ,Mapped to DGT/VSQ/N0102 -Employability Skills (60 hours) v1.0

Terminal Outcomes:

- Discuss the Employability Skills required for jobs in various industries
- Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen
- Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan

Duration: *20:00*	**Duration: *40:00***
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
•Discuss the Employability Skills required for jobs in various industries •List different learning and employability related GOI and private portals and their usage •Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen •Discuss importance of relevant 21st century skills. •Describe the benefits of continuous learning. •Explain the importance of active listening for effective communication •Discuss the significance of working collaboratively with others in a team •Discuss the significance of escalating sexual harassment issues as per POSH act. •List the common components of salary and compute income, expenditure, taxes, investments etc. •Discuss the legal rights, laws, and aids •Describe the role of digital technology in today's life •Discuss the significance of displaying responsible online behaviour while	•Practice different environmentally sustainable practices. •Exhibit 21st century skills like Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life. •Demonstrate to use basic English sentences for everyday conversation in different contexts, in person and over the telephone •Read and interpret text written in basic English •Write a short note/paragraph / letter/e -mail using basic English •Create a career development plan with well-defined short- and long-term goals •Communicate effectively using verbal and nonverbal communication etiquette. •Demonstrate how to behave, communicate, and conduct oneself appropriately with all genders and PwD •Outline the importance of selecting the right financial institution, product, and service •Demonstrate how to carry out offline and online financial transactions, safely and securely •Operate digital devices and use the associated applications and features,

browsing, using various social media platforms, e-mails, etc., safely and securely •Explain the types of entrepreneurship and enterprises •Discuss how to identify opportunities for potential business, sources of funding and associated financial and legal risks with its mitigation plan •Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement •Detail the significance of analyzing different types and needs of customers •Explain the significance of identifying customer needs and responding to them in a professional manner. •Discuss the significance of maintaining hygiene and dressing appropriately •Explain the significance of maintaining hygiene and confidence during an interview •List the steps for searching and registering for apprenticeship opportunities	safely and securely •Create sample word documents, excel sheets and presentations using basic features •Utilize virtual collaboration tools to work effectively •Devise a sample business plan, for the selected business opportunity •Create a professional Curriculum Vitae (CV) •Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively •Perform a mock interview
Classroom Aids:	
PPT, Laptop, White Board, Marker, Projector & Screen, Audio-visual, Chart paper, telephone connection, landline phone, and other required stationery.	
Tools, Equipment and Other Requirements	
Computer (PC) with latest configurations – and Internet connection with standard operating system and standard word processor and worksheet software (Licensed) (all software should either be latest version or one/two version below), Scanner cum Printer	

- **Trainer Requirements**

Annexure

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
PhD	(Mechanical/ Electrical/ Mechatronics)	2		1		Practical skills and knowledge required in the relevant field
PG (Mechanical/ Electrical/ Mechatronics)	(Mechanical/ Electrical/ Mechatronics)	3		2	•	Practical skills and knowledge required in the relevant field
UG Degree (Mechanical/ Electrical/ Mechatronics)	(Mechanical/ Electrical/ Mechatronics)	4		3	•	Practical skills and knowledge required in the relevant field

Trainer Certification	
Domain Certification	**Platform Certification**
Certified for Job Role: "**Additive Manufacturing Design and Application engineer**" mapped to QP: "CSC/Q0412, v1.0". Minimum accepted score is 80%	Recommended that the Trainer is certified for the Job Role: "Trainer(VET and skills)", mapped to the Qualification Pack: "MEP/Q2601 V3.0". Minimum accepted as per respective SSC guidelines is 80%.

- ## Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training/Assessment Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
PHD	(Mechanical/ Electrical/ Mechatronics)	3		2		Practical skills and knowledge required in the relevant field
Post graduate	(Mechanical/ Electrical/ Mechatronics)	4		3		Practical skills and knowledge required in the relevant field
Graduate	(Mechanical/ Electrical/ Mechatronics)	5		4		Practical skills and knowledge required in the relevant field

Assessor Certification	
Domain Certification	**Platform Certification**
Certified for Job Role: "**Additive Manufacturing Design and Application engineer**" mapped to QP: "CSC/Q0412, v1.0". Minimum accepted score is 80%	Recommended that the Assesor is certified for the Job Role: "Assessor(VET and Skills)", mapped to the Qualification Pack: "MEP/Q2701, v3.0", with a minimum score of 80%.

- ## Assessment Strategy

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

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

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

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

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

References

- ## Glossary

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

- ## Acronyms and Abbreviations

Term	Description
NOS	National Skills Qualification Committee
NSQF	National Skills Qualification Framework
OJT	On-the-Job Training
OMR	Optical Mark Recognition
PC	Performance Criteria
PwD	Persons with Disabilities
QP	Qualification Pack
SDMS	Skill Development & Management System
SIP	Skill India Portal
SSC	Sector Skill Council
TC	Trainer Certificate
ToA	Training of Assessors
ToT	Training of Trainers
TP	Training Provider