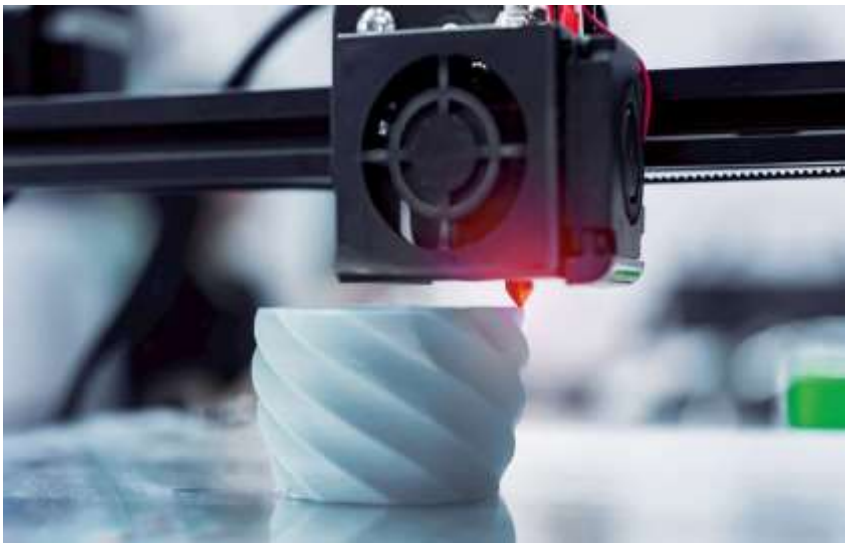
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
DEVELOPMENT COMMISSIONER
MINISTRY OF MICRO, SMALL & MEDIUM ENTERPRISES
MSME TECHNOLOGY CENTRE

MODEL CURRICULUM



Qualification Name:

TECHNICAL SUPERVISOR -ADDITIVE MANUFACTURING

Qualification Code:

Version: 1.0

NSQF Level: 5

Model Curriculum Version: 1.0

Submitted By:

Ministry of Micro, Small and Medium Enterprises, New Delhi

(Certificate awarded by MSME NSQF Examination Cell)

Director Autonomous Body

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COURSES / MODULE TEMPLATE

NOS /Module: Introduction to Additive Manufacturing (AM) Process

NOS /Module Code: MSME/MCCAM/01

Outcomes:

- Understand Additive Manufacturing technology.
- Describe various Types of Additive Manufacturing Technology
- Understand concept of product design using the AM.
- Identify suitable material for suitable additive manufacturing techniques
- Understand the various applications of AM etc.

THEORY HOURS: -60 **PRACTICAL HOURS: NA** **THEORY MARKS: -100** **PRACTICAL MARKS: NA**

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH hours	TH Marks
UNIT-I	**Introduction of Additive Manufacturing**	At the end of this Unit the student should be able to: ● Understand Additive Manufacturing Technology. ● Understand the Different Manufacturing Technology ● Discuss need of AM	Introduction of Additive Manufacturing, Definition of Additive Manufacturing, Scope of Additive Manufacturing, History of AM, Need of AM, Classification of Manufacturing Technology I.e. (Formative Mfg. v/s Subtractive Mfg. v/s Additive Mfg.), Question to determine the suitability of AM, Steps in Additive Manufacturing, Advantages & Limitation of Additive Manufacturing, Classifications of additive Manufacturing Technology, Applications. CAD for Additive Manufacturing	6	20
UNIT-II	**Additive Manufacturing Techniques**	At the end of this Unit the student should be able to: ● Understand the Liquid Base Additive Manufacturing. ● Understand the Solid Base Additive Manufacturing. ● Understand the Powder Base Additive Manufacturing.	**Liquid based Additive Manufacturing:** VAT Polymerization - Stereo lithography(SLA), Direct Light Processing(DLP). **Solid based Additive Manufacturing:** Material Extrusion – Fused Deposition Modeling (FDM), Continuous Filament Fabrication (CFF), LOM (Laminated Object Manufacturing) **Powder based Additive Manufacturing:** Direct Metal Laser Sintering (DMLS), Selective Laser Melting(SLM), Selective Laser Sintering (SLS), Electron Beam Melting (EBM)	30	40
UNIT-III	**Materials in Additive Manufacture**	At the end of this Unit the student should be able to: ● Understand the Various materials used in AM	Types of various materials used in Various forms - Liquid, Solid, Wire, Powder; likes, Polymers (Thermoplastic & Thermosetting) & their Properties, Metals	12	20

		● Identify the best suitable material as per the process & application. ● Set the best parameters as per the process requirement.	& their Properties, Non-Metals, Ceramics, Sands etc.		
UNIT-IV	**Application of Additive Manufacturing**	At the end of this Unit the student should be able to: ● Understand the Various application of AM. ● Understand the functional prototyping and their need depends on the application.	Application in the area of Additive Manufacturing Application Domains: Tooling Industries, Automotive Industries, Aerospace Industries, Electronics Industries, Health Care, Defense, Construction, Food Processing, Machine Tools, Dental Application, Arts & Jewellery, Heritage etc.	12	20

COURSES / MODULE TEMPLATE

NOS /Module: Design of Product using Design software tools

NOS /Module Code: MSME/MCCAM/02

Outcomes:

After completion of course Student should be able to

- Understand 3D CAD modeling using the CAD Software.
- Create 2D geometric sketches by using CAD software.
- Develop 3D solid & surface modeling by using advanced command.
- Understand assembly constraint & develop different types of assembly design.
- Understand design generative & interactive drafting.
- Apply knowledge in create complicated modeling & creative/innovative solution.

THEORY HOURS: 30 **PRACTICAL HOURS: 150** **THEORY MARKS:NA** **PRACTICAL MARKS: 100**

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	PR Hours	PR Marks
UNIT-I	**Introduction To CAD**	At the end of this Unit the student should be able to: ● Understand advance computer aided design. ● Understand Different types CAD s ● Understand advanced features added & changed since new release software. ● Analyze difference between various software as compare to CAD. ● Execute the concept of hardware & software.	Capability of CAD Software and Introduction to CAD Software. Description of the feature that have been added or changed since new Release software. Criteria for selection of CAD workstations, Single Design Process, Design criteria, Geometric modeling, entities, 2D & 3D Primitives. Different Types of cad software. Also comparison of various CAD Software. CAD software features. Concept of hardware & software.	10	10
UNIT-II	**Sketcher & Solid Modeling**	At the end of this Unit the student should be able to: ● Have fundamental knowledge of CAD software. ● Create complicated geometry sketch ● Understand Adding Geometric & Dimensional Constraint to sketches. ● Perform Drawing sketches for solid models. ● Understand various sketching tools. ● Understand & Create sketches in the Sketch task environment & Modeling Environment.	Introduction of CAD. Technical terms related to CAD. Drawing sketches for solid models. Creating sketches in the Sketch task environment & Modeling Environment. Understand Various Sketching Tool. Editing, Extruding, Revolving sketches. Adding Geometric & Dimensional Constraint to sketches.	40	30

UNIT-III	**Advance Solid Modeling**	At the end of this Unit the student should be able to: ● Understand Working with Datum plane, Coordinate System, and datum axes. ● Understand Advance Modelling Tool. ● Apply advance editing, modifying, creating feature. ● To execute Boolean, extrusion termination operations. ● Create 3D model design.	Working with Datum plane, Coordinate System, and datum axes. Specifying Boolean operation, Specification other Extrusion Termination option. Advance Modelling Tool like creating various types of Hole, Grooves, Slots, Chamfer, and Edge Blend. Pattern Feature Tool, Mirror Feature Tool, and Sweeping Sketches along guide curve. Creating swept, Tubes or cables, Threads, Shell Features.	50	30
UNIT-IV	**Assembly Design & Surface Modeling & Drafting**	At the end of this Unit the student should be able to: ● Understand surface modeling concept. ● Create surface model. ● Understand concept of assembly constraint. ● Understand concept of Drafting. ● Understand different types of view. ● Use different engineering symbols	Various Assembly constraints. Working with bottom up and top down assembly. Design in context. Generating bill of material. Tool Develop & design in CAD. Surface Modelling Feature, Family table. Generating, Editing, and Dimensioning the Drawing views. Types of Drawing View, Modifying the properties of Generated drawing view, printing tools, print, plot.	50	30

COURSES / MODULE TEMPLATE

NOS /Module: Develop new product using 3D Printing machine

NOS /Module Code: MSME/MCCAM/03

Outcomes:

After completion of course Student should be able to

- Understand 3D Printing technology.
- Understand 3D Scanning technology.
- Describe various parts of 3D Scanning & 3D Printing machine.
- Understand procedure of 3D Scanning & 3D Printing.
- Understand concept Reverse Engineering.
- Demonstrate the 3D Printing Process.
- Execute the 3D Printing Process for product development.

THEORY HOURS: 30 **PRACTICAL HOURS: 150** **THEORY MARKS: NA** **RACTICAL MARKS: 100**

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	PR hours	PR Marks
UNIT-I	**3D Printing & Scanning.**	At the end of this unit student should be able to ● Understand 3D Printing Process. ● Describe the 3D Printing Steps. ● Work with different parameters of 3D Printing.	Introduction to 3D Printing Technology, Elements of 3D Printing Machine and their application, Different 3D printing parameters, Preparation of 3D CAD Model for 3D Printing and Data formats. **Printer Parameter:** Bottom Up & Top Down Process, Support Structure, Support Structure, Post Processing Technique, dimensional accuracy, Warping, Infill Density, Tolerance etc. Introduction To 3D scanning: Definition, Classification 3D Scanning, History, Application, Environment of scanning, Mouse function, Import and Export the file, Scanning machine, Scanning Object, Scanning Parameter.	30	20
UNIT-II	**Preparation of Model & Print Setup**	At the end of this unit student should be able to ● Understand the Slicing Process ● Understand the General design considerations for 3D printing ● Demonstrate the 3D Printing Machine Setup ● Demonstrate the 3D Model Preparation. ● Demonstrate the 3D Printing of Prototyping Model ● Understand the 3D Printing Feature & Design rule for 3D Printing.	Data translation, STL format, SLI Format &. gcode file, Conversion of CAD model to STL Format and Conversion of STL File to Slice File and Conversion of Slice file to Gcode file by using post processing software. Cleaning the model, Introduction of Slicing software, Import and Export the file, scale, define required parameter, Capabilities of 3D printing, calibration, Procedure 3D print. General design considerations for 3D printing, Designing for SLS, SLA, FFF, SLM, DMLS and 3D Printing Feature & Design	80	40

		• Explain the Common faults in 3D Printing.	Rule for 3D Printing. Common faults and troubleshooting.		
UNIT-III	**Post Processing Techniques**	At the end of this unit student should be able to • Understand the requirement of Post processing techniques. • Demonstrate the Support removal, Sanding, Polishing technique.	What is Post Processing in 3D Printing, Post processing cost, Techniques: Support Removal, Sanding, Vapor smoothing, Priming and painting Polishing, Electroplating Gluing and welding ,Hydrographic etc.	30	20
Unit-IV	**Inspection & Quality Check**	At the end of this unit student should be able to • Understand the Need of Quality Checks before dispatch.	Check the Print Quality & do the Troubleshooting, Initial and Final Inspections.	10	20

COURSES / MODULE TEMPLATE

NOS /Module: Employability Skill

NOS /Module Code: MSME/ES/02

THEORY HOURS: 60 **PRACTICAL HOURS: NA** **THEORY MARKS: 100** **PRACTICAL MARKS: NA**

Refer Standard Curriculum developed by NCVET. (60-hours-MC-Employability-Skills_v4-DGT (1).pdf)