CURRICULUM

FOR THE TRADE OF

CAD-CAM OPERATOR CUM PROGRAMMER

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENURESHIP
DIRECTORATE GENERAL OF TRAINING

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Co-ordinator for the course: Sh. Nirmalya Nath., ADT

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	N. Nath, ADT	CSTARI, Kolkata	Expert
2.	Prasoon Kumar Ghosh, Sr. D/Man,	CSTARI, Kolkata	Expert

2. BACKGROUND

2. 1. Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2. 2. Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2. 3. Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.

- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.

- Scope has been extended also to non-engineering occupations.

- Establishments have been permitted to outsource basic training in an institute of their choice.

- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

(Need for Apprenticeship in **CAD-CAM OPERATOR CUM PROGRAMMER** trade)

1. The greater degree of relevance of the training with latest advancements of the industry will enhance the employability opportunities.
2. It will enhance the ability to acquire responsibility for storage of equipment, tools drawings and maintenance of job folders using a method as per company's standard and procedures.
3. It will enhance the ability to create design solutions and is responsible for design concept.
4. It will enhance the ability to use Tool design for assembly operations and uses control sensors for electronic interface.
5. It will enhance to be conversant with design and detailing of Numerical Control tool devices.
6. It will enhance the ability to ensure the quality of the work by using various measurement methods and equipment.
7. It will enhance the ability to propose solution and tool design for assembly tools and prepares the production drawing for tool components and bills of material.
8. It will enhance the ability to perform file management using Pro/Intralink and local SAP system.
9. It will enhance the ability for preparing the documentation and the algorithm for the design process.
10. CAD/CAM Operators assist the engineering department in the drafting and design of production and specialty parts, maintenance of drawing library, and execution of all client RFQs. Some of the duties of the CAD/CAM Operator shall include:
    - Conversion of supplied drawings to company CAD standards
    - Design of specialty parts/jigs/fixtures for clientele or in-house use
    - Producing CAD drawings from shop/mechanical drawings or from scratch
    - Assembly of production work orders and job packets
    - Assist sales with quotes and estimates
    - Programming of laser, press brake and other production equipment utilizing CAM software or other appropriate methods
    - Any other task assigned by Production Manager CAD Operators must be highly detail oriented, able to multi-task in a fast-paced environment and possess a high degree of problem solving capabilities.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

CAD/CAM Operator (Computer Aided Design/Computer Aided Manufacturing Operator), prepare detailed working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information, using computer-assisted drafting (CAD) equipment. Layout and draw schematic, orthographic, or angle views to depict functional relationships of components, assemblies, systems, and machines. Coordinate with and consult other workers to design, layout, or detail components and systems and to resolve problems. Check dimensions of materials to be used and assign numbers to the materials. CAD/CAM operator use software to convert the designs of engineers into technical drawings. Using CAD systems, create and store technical drawings digitally. These drawings contain information on how to build a structure or machine, the dimensions of the project, and what materials are needed to complete the project. Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used. Verifies model generated in CAD and incorporates the same in CAM software which then controls the machine tool. Setup mastercam for metric system, create tools for different type of marching tools using standard tool catalogues, set up the job for machining in master cam, save the tools, filter tools for specific operation, display settings, coordinate settings.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Perform TPM (Total Production Management), TQM (Total Quality Management) and record keeping system.

Reference NCO:

i) **NCO-2004: --**

5. GENERAL INFORMATION

1. **Name of the Trade** **: CAD-CAM OPERATOR CUM PROGRAMMER**

2. **N.C.O. Code No.** : **--**

3. **Duration of Apprenticeship Training**

(Basic Training + Practical Training) : 15 Months

3.1 **For Freshers: -**Duration of Basic Training: -

a) Block –I : 3 months

Total duration of Basic Training: **3 months**

Duration of Practical Training (On -job Training): -

a) Block–I: 12 months

Total duration of Practical Training: **12 months**

3.2 **For ITI Passed: -** Duration of Basic Training: **- NIL**

Duration of Practical Training (On -job Training): **12 months**

4. **Entry Qualification** **:** Passed 10^{th} class examination under 10+2 system of education or its equivalent

5. **Selection of Apprentices** **:** The apprentices will be selected as per Apprenticeship Act amended time to time.

6. **Rebate for ITI passed trainees** **:** i) **Three months (**Basic training) in the trade of **Draughtsman Mechanical and CAD/CAM under P&M sector (CoE)**

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

6. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-15
Basic Training	**Block– I**	**-----**
Practical Training (On - job training)	**----**	**Block – I**

Components of Training	**Duration of Training in Months** →														
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Basic Training Block - I															
Practical Training Block - I															

7. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I & II)
DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **CAD-CAM OPERATOR CUM PROGRAMMER**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 2.5 KW
5) **Space Norms** : 40 Sq. m.
6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of **CAD/CAM Operator cum Programmer/ Draughtsman Mechanical** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

8) **Tools, Equipments & Machinery required**: - As per Annexure – I

7.1.1 DETAIL SYLLABUS OF CORE SKILL

Block– I
Basic Training

Sl.No.	Workshop Calculation and Science	Duration (hrs.)	Engineering Drawing	Duration (hrs.)
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	20	Introduction to Engineering Drawing and Drawing Instruments : - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	30
2.	**Basic Mathematics** - BODMAS rule Fraction-Addition, Subtraction, multiplication and Division-Problem solving, Decimal-Addition. Simple calculation using Scientific Calculator.		Lines : - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment	
3.	Conversion of Fraction to Decimal and vice-		Free hand drawing of	

	versa.		- Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches.	
4.	**Percentage**: Introduction, Simple calculation. Changing percentage to fraction and decimal & vice-versa.		Drawing of Geometrical Figures: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.	
5.	**Material Science** : Definition, properties (physical & mechanical) and uses of Metal, Non-metal, Alloy &Insulator. Types of ferrous and Non-ferrous metals. Difference between Ferrous and Non-Ferrous metals.		Sizes and Layout of Drawing Sheets - Selection of sizes - Title Block, its position and content - Item Reference on Drawing Sheet (Item List)	
6.	**Mass, Weight and Density**: Mass, Unit of Mass, Weight, difference between mass and weight. Density, unit of density. Relation between mass, weight & density. Simple problems related to mass, weight, and density.		Method of presentation of Engineering Drawing - Pictorial View - Orthographic View - Isometric view	
7.	**Mensuration :** Area and perimeter of square, rectangle, parallelogram,		- Drawing of Solid figures (Cube, Cuboids, Cone) with dimensions.	

	triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.			
8.	**<u>Elasticity:</u>** Elastic & Plastic material. Stress & strain and their units. Young's modules. Ultimate stress and breaking stress.		Free hand Drawing of Solid figures (Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.	
9.	**Heat & Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, Scale of temperature, relation between different scale of temperature. Thermometer, pyrometer. Transmission of heat, conduction, convection, radiation.		Free Hand sketch of hand tools and measuring tools used in respective trades.	
10.	**Basic Electricity:** Introduction and use of Electricity. AC, DC & their comparisons. Current, Voltage, Resistance& their units. Power, Energy & their units. Insulator and conductors & their uses.		Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.	
11.	**-----**		Drawing of Orthographic projection in 3rd angle.	

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Safety: - its importance, classification, personal, general, workshop and job safety. Occupational health and safety. Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Importance of housekeeping & good shop floor practices. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Fire& safety: Use of Fire extinguishers. Safety regarding working with different types of steam and its First-Aid.	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Institute system including stores procedures. Introduction of First aid. Safety attitude development of the trainee by educating him to use Personal Protective Equipment (PPE). Response to emergencies e.g.; power failure, fire, and system failure. Accidents- Definition types and causes. First-Aid, nature and causes of injury and utilization of first-aid. Introduction to 5S concept & its application. Fire: - Types, causes and prevention methods. Fire Extinguisher, its types. Define environment, environment Pollution, Pollutants, type of Pollution (Air pollution, water pollution, soil pollution noise pollution, thermal pollution, radiation. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.
2.	Draw a rectangle, pentagon, hexagon, star using line command with polar coordinate system and relative coordinate system. Draw circles, arc and ellipse by different options. Perform different modifications of the entities created in the previous examples, using modify tool bar.	Installation and reinstallation of CAD Software Install AutoCAD, configure AutoCAD, AutoCAD graphical user interface, point command, zoom command, limits, coordinate systems, Snap and Grids in AutoCAD. Understanding Line command, Circle command, Arc command, Ellipse command, Poly line command, pedit command, OSNAP commands, Explode Pan command. Various types of lines, thickness of lines.

3.	Dimension the drawings created using linear, Aligned, Angular, radius and Diameter dimensioning techniques. Save different styles of Dimensioning for a drawing file. Edit dimension properties. Hatch the closed objects, edit them by changing colors, hatch pattern scale, loading and creating different customized hatch patterns.	Understand Erase by Selection, Erase by Window, Erase by All, MOVE by a Reference, COPY by reference, Copy Multiple, Scale by Reference, Scale by Scale factor , ROTATE by Reference, Rotate by Angle commands. Learn to use different selection tools. Editing commands like Offset , Mirror along an Axis, Mirror along a line, Mirror along an angle, Array rectangular, Array Polar method, Array rotated, Fillet with Trim, Fillet without No trim, Chamfer with Trim, Chamfer without Trim, Extend along a boundary, Trim with delete, and Stretch along a reference , Divide multiple units, Measure along a line.
4.	Create layer for different objects like lines, circles, Dimensions, load line type stored in drawing file, convert a line to different type, assign by layer property for an object& customization of layer. Write text in drawings. Use multiline editors. Use different styles of text.	Dimensioning with style creation. Set the Arrow height, length, text height, width, Tolerance, dimension along the dimension line, Dimension extension line, Dimension Extension offset, Dimension Symbols, Modify Dimension, Set Current Dimension and hatching inside an Island, Along a boundary, Hatch Patterns.
5.	Create & insert a block by drawing a washer or thread of a particular size. Save the block as a universal block. Create& save templatesforA4, A3, A0 size papers. Create title blocks for the different sheet sizes. Use Attributes in these templates. Save the templates.	Study of Creating Layers, Modifying Layers, Freezing Layers, Thawing Layers, Make On and OFF Layers, Create Line types. Modify existing lines to different Line types, Create custom Linetypes, Import Line types. Text style Creation, Use different fonts, Set different heights, Modify the properties of Texts, save different Text styles by a name, M text within a window, Scaling a multiline, rotating a Multiline with style features. Create Blocks of Standard patterns, Insert Block Patterns, Scale the Blocks, Match the properties of the Blocks, AutoCAD Design center usage, Dragging the design Center Blocks, Attach the Attributes to Blocks, Explode the blocks, Poly lines. Save the jobs in pdf, jpeg and other formats
6.	Drawing a cube using isometric plane setup. Draw sectional views, Full sections, Half Sections, Assembly sections of different parts like Universal Joint, use viewports for viewing them in different ports. Place these view ports in different layouts for printing.	Create Layouts, Differentiate Layout with Paper Setup, Multiple Layouts for Multiple Views, Drag the window to a Layout, Drag the Extent to a layout, Create template for Different Paper Sizes, Save the templates, Use Templates for Opening a new Drawing, Use attributes in a Template, Use Text attributes in a template. Use

		of F5, F6, F7, F8, F9, Functional keys. Fundamentals Of Isometric Drawings, Prospective Drawings, Projectional Drawings, Cut Section drawings, Use of Cut Lines, sectional Lines, hatching along the sectional area.
7.	Use UCS command for changing the coordinate system. Draw 3D solid parts as exercise to study the UCS command rotation of X, Y and Z.UseUCS3point method for creation of new custom made UCS. Mirror the objects in 3D. Rotate the 3D object by an angle.	Introduction to UCS. Differentiate WCS and UCS . Create use planes, Rotate UCS along X axis, Y axis, Z axis. Mirror the objects in 3D.Rotate the objects along an angle.
8.	Use of simple solid AutoCAD commands for creating basic primitives like, cube, box, cylinder, wedge, cone, sphere. Use facetres command for proper shading, view the min different shade mode stand render them, save them as bitmap. Get them as properties, Area, perimeter of a solid. Use LIST command for 2D sketches. Practice on editing Commands Practice on View Commands.	Study of Solids primitives like Cube, Wedge, Box, Cylinder, Cone, Sphere, Torii. Use of Facetres for Shade mode of Solids, List out the Mass, Center Of Gravity, Moment Of Inertia, Volume using Mass properties and by LIST command.
9.	Create composite solids using Boolean addition, Subtraction and Intersection by Joining the primitives. Sketch revolved solids like bottle, Cylinder, Pulleys. Create3Dwireframes,3D surface meshes like box, cone, Dishes, Domes, Pyramids, Spheres, Donuts, and wedges. Use 3D view, V points for different viewing enhancements. Use surf tab. Taper a face, Remove a face.	Create Region. Create Boundary, Differentiate region and Boundary. Use Boolean operation for UNION, SUBTRACTION, INTERSECTION. Use EXTRUDE and REVOLVE for Composite Solids. Introduction to 3D surfaces, 3D surface Primitives, Extruded primitives, Revolved primitive surfaces, Ruled surfaces, Shells
10.	Mastercam short cut on desktop, setup mastercam for metric system, create tools for different type of marching tools using standard tool catalogues, set up the job for machining in master cam, save the tools, filter tools for specific operation, display settings, coordinate settings. Insert drawings from AutoCAD and other CAD softwares like. DXF,. IGES, Para solids, generate simple tool paths for these inserted drawings, verify the tool paths, back plot, generate post processed program.	Setup Master CAM, Install and configure Master CAM, Create Tools, Job Setup, TOOL library setup, CONFIGURATION Settings, Review of G and M codes. Exchanging Cad data with master CAM, Numerical control of machine tools, Cam Tool path modeling, and Cam part programming concepts. 3D solid constructions. Use of z planes.

11.	Practice machining oncreated2Dcontourslikecontour, pocket,drilling,islandmachining,boring,tapping, cutoff,threadingandgeneratetoolpaths with study of parameters involved like tool selection, feed rate, spindle speed, jobsetup,plungepoint,feedpoint,zdepthofcut,zig zagpockets,Createcustommade tool holder, Inserts into Tool Library. Performthesameforsurfacescreatedintheprevious examples,TextEmbossingand Engraving in the surfaces, use of subprograms for reducing the program length, Custom made drilling cycles, rough and finishes pockets.	Create contours, Set masks for contours, Chain a contour by mask method, use operation manager, Set tools, Change a tool, Pocket menu explanation, Drill menu Explanation, Thread menu explanation, Inserts and Holders menu, Create and Modify Tool Library Surface machining Menu, Tool Paths, Create Text, Embossa Text, Contour the text path as a tool path, and use subprograms for repeated cycles at different heights.
12.	Transferring Part programs into the CNC machine, editing parameters in CNC machine sample cut of a Teflon job for contour of a drawing created in Master CAM.	Reference Point selection, Job Creation, Back plot, optimizing the machining , Cut and Pates for changing the sequence of Operations using operation manager, Simulation of the tool path. CNC interface with master cam, CNC controls and editing on a machine. High Speed Machining. Cutting speed and feed calculations. Types of Cutting Tools, its' geometry.
13.	**Revision &Internal Assessment**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only
3)	**Hours of Instruction**	**:**	**55Hrs.**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**7**
1.	**Reading** Reading and understanding simple sentences about self, work and environment	
2.	**Writing** Construction of simple sentences Writing simple English	
3.	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality,Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**10**
1.	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2.	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets. Use of External memory like pen drive, CD, DVD etc,	
3.	**Computer Networking and INTERNET** Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication.	
	Communication Skill	**18**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication - components-Para-language Body - language Barriers to communication and dealing with barriers.	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.	

3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self-awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning.	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
	Entrepreneurship skill	**8**
1.	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue. Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2.	**Institutions Support** Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes& procedure & the available scheme.	
	Productivity	
1.	**Productivity** Definition, Necessity.	
2.	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3.	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**6**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents andsafety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
	Labour Welfare Legislation	
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI) and Employees Provident Fund Act.	

	Quality Tools	**6**
1.	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2.	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3.	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
4.	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)

(BLOCK – I)

DURATION: 12 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **CAD-CAM OPERATOR CUM PROGRAMMER**

2) **Batch size** : a) Apprentice selection as per Apprenticeship guidelines.
b) Maximum 20 candidates in a group.

3) **Examination** : i) The internal assessment will be held on completion of each block
ii) NCVT exam will be conducted at the end of 2nd year.

4) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board With one/two year post qualification experience in the relevant field.

OR

ii) NTC/NAC in the trade of **CAD-CAM Operator cum Programmer/ Draughtsman Mechanical** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

5) **Infrastructure for On-Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. BLOCK – I (12 months)

1. Draw H,L,S,T and C, etc shapes with respective actual product of respective industry.
2. Practice on Drafting settings. Insert different designs in drawing using Design Centre, Tool Pallets & drawing consisting of above commands.
3. Practice to draw Simple & Complex Isometric Drawings.
4. Practice to draw 3D like Box, Sphere, Cone, Wedge, Cylinder, etc.
5. To draw Simple & Complex 3D Solid Models.
6. Practice on Rendering commands. Plotting the 2D &3D Drawings.
7. Installation of Master CAM. Working on Master CAM.
8. To open & Save files. Importing & Exporting files in other formats. Changing units. 2D Creation commands. Create simple solids using line, circle, arc, fillet, chamfer, etc. commands. Practice on Modifying X-form Commands.
9. Practice on dimension. Analyzing command. Working on levels & attributes.
10. Basic of G-View. C-Plane & construction depth. Basic of Wire frame modeling.
11. Creating Box shape & creating different shapes in all the 6 faces. X-form translate join option. Exercise in wire frame modeling.
12. Surface Modeling Basics Flat boundary creation. Loft & Ruled surface creation, Revolve surface, Sweep surfaces, Net Surfaces, Offset Surfaces, etc.
13. Editing & Trimming of surfaces. Creating curves, view Manipulation. Draw various jobs in Surface Modeling.
14. Practice on Solid Modelling commands like Extrude, Revolve, Sweep, Loft, Fillet & Chamfer. Solid editing Command. Solid to surface & surface to solid conversion, solid manager. Solid editing & regeneration. Construct various solid objects.
15. Configuration & screen related commands, Machine type selection Machine definition & control definition. Job Setup. Basics of Milling.
16. 2D Milling Commands like Facing, Contour, Pocket, Drilling, Engraving tool paths, Tool path manager & Tool path addition & modification. Back plotting, solid verification, Program Generation .Exercise on 2d Milling.
17. Creating simple to complex jobs operation by using all type of machine tools, preparation of part program for turning, milling & EDM wire cut, etc.

18. Practice on part programming by actual data transfer from computer to CNC MACHINE. Feedback from actual result, analysis of outcome & correction.
19. Use of Robotics on Man-less machines, preparation of part program or robotics machining, loading & unloading.
20. Project on CAD-CAM containing Solid/ Surface Modelling, Machining& CNC Interface.

8. ASSESSMENT STANDARD

8.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST FOR APPRENTICE

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	08 hrs.
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50	-	50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under all India trade test.

9. FURTHER LEARNING PATHWAYS

Employment opportunities:

On successful completion of this course, the candidates may be gainfully employed in the following industries:

1. Production & Manufacturing industries.
2. Industries/ organizations involve in designing and mechanical drafting.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: CAD-CAM OPERATOR CUM PROGRAMMER

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

I) TOOLS, MACHINERY, EQUIPMENTS etc.

a. MACHINERY AND EQUIPMENTS

1. Computer with latest configuration to run CAD software- 10Nos

2. Laser printer. -1No

b. SOFTWARE REQUIREMENTS

1. AutoCAD 2005 or Latest - 10 Copies

4. Master CAM 9 or latest edition for Lathe, Mill and Design - 10 Copies

Workshop furniture		Qty
1	Computer table Tables	As required.
2	Stools	20 Nos
3	Firefighting equipment, first aid box etc	As required
4	Instructor Table	1 No
5	Instructor chair	1 No

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: CAD-CAM OPERATOR CUM PROGRAMMER

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20 Nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 Nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 Nos.
4.	Mini drafter	20 Nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 Nos.

B : FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 Nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01
6	White Board (size: 8ft. x 4ft.)	01
7	Trainer's Table	01
8	Trainer's Chair	01

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: CAD-CAM OPERATOR CUM PROGRAMMER

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 12 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.