CURRICULUM

FOR THE TRADE OF

CNC PROGRAMMER CUM OPERATOR

UNDER

APPRENTICESHIP TRAINING SCHEME

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

CONTENTS

1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

1. L&T Ltd., Mumbai
2. Mahindra & Mahindra Ltd. , Mumbai

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Co-ordinator for the course: Sh. NirmalyaNath., ADT

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	N. Nath, ADT	CSTARI, Kolkata	Expert
2.	Jagtap D. D.	Group Institution ITI Pune	Expert
3.	Khomane S. B. Craft Instructor	Turner ITI Aundh Pune	Expert
4.	Y. M. Torpe, TO	ITI Pinpri, Chinodah	Expert
5.	G. K. Bodake, TO	ITI Nasik	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 **CNC PROGRAMMER CUM OPERATOR** 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 create a model for various computer programs that aids the functioning of the mechanical device in drilling, shaping and cutting materials used for production in industries.
3. It will enhance the ability to write or create unique patterns of translation, imputing instructions into the computer system with specific modes of commands which the device responds to accordingly.
4. It will enhance the ability to set-up computerized machines to perform machine functions on work piece
5. It will enhance the ability to input control instruction into machine
6. It will enhance the ability to evaluate program blueprints to outline machine operations and dimensions
7. It will enhance the ability to install machine tools and gadgets using manual working tools
8. It will enhance the ability to replace old machine tools when worn-out with new ones
9. It will enhance the ability to make use of network links to ensure transmission of command from computer servers to computer numerical control modules
10. It will enhance the ability to take accurate measurements of work piece and gauges for production
11. It will enhance the ability to carry out maintenance measures to ensure good condition of machines
12. It will enhance the ability to operate three or more machines with little or no assistance
13. It will enhance the ability to change or replace switches and cylinders
14. It will enhance the ability to ensure that all machines run at moderate and proper speed.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

CNC Operator cum Programmer; Sets up and operates Computer Numerical Control (CNC) machines and machining centers to fabricate metallic and nonmetallic parts, and fits and assembles machined parts into complete units, applying knowledge of machine shop theory and procedures, shop mathematics, machinability of materials, and layout techniques: Studies blueprints, sketches, drawings, manuals, specifications, or sample part to determine dimensions and tolerances of finished workpiece, sequence of operations, and setup requirements. Measures, marks, and scribes dimensions and reference points on material or workpiece as guides for subsequent machining. Selects, aligns, and secures cutting tools, attachments, accessories, and materials on machines, such as VMC & Turn Centre. Calculates and sets controls to regulate machining factors, such as speed, feed, coolant flow, and depth and angle of cut, or enters commands to retrieve, input, or edit computerized machine control media. Starts and observes machine operation to detect malfunctions or out-of-tolerance machining, and adjusts machine controls or control media as required. Verifies conformance of finished workpiece to specifications, using precision measuring instruments. Sets up and operates machine on trial run to verify accuracy of machine settings or programmed control data.

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** **: CNC PROGRAMMER CUM OPERATOR**

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 **Machinist/ Turner.**

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** :**CNC PROGRAMMER CUM OPERATOR**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 2.5KW for Workshop
5) **Space Norms** : 70 Sq. m.
6) **Examination** : The internal assessment will beheld on completion of each Block.
7) **Instructor Qualification** :

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

OR

ii) NTC/NAC in the trade of **CNC PROGRAMMER CUM OPERATOR/ Machinist/ Turner**with three year post qualificationexperience 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 DETAILSYLLABUS 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-versa.		Free hand drawing of - Lines, polygons, ellipse, etc. - geometrical figures and blocks	

			withdimension 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, triangle, circle, semi circle,		- Drawing of Solid figures (Cube, Cuboids, Cone) with dimensions.	

	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.	

7.1.2DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training (03 Months)

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	**Precision Instruments reading and handling**, Holding of round job in an independent chuck and truing it. Holding the tool in a tool post, centering the job with the tool. Facing & drilling. Parallel turning between centers, parting off, chamfering using roughing, finishing and parting off tools.	**Precision Instruments reading** Introduction to lathe. Its types, engine lathe construction, detail function of parts size and specification. Safety points to be observed while working on a lathe. Lathe tools their angles & uses. Driving mechanism, speed and feed mechanism & lathe accessories.
3	Holding the job in three jaw chuck truing, centering facing. Step turning undercutting, knurling drilling and boring. Taper turning by swiveling compound rest, setting the compound rest to correct degree, checking the tool height, clamping the saddle for no longitudinal movement, checking up with precision instruments.	Chucks-different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks. Taper introduction, types and uses. Calculations of tapers. Measurement of taper by sine bar and slip gauges.

4	Introduction to milling machine, demonstration on working principle, setting of job, setting of cutter in arbor, setting of vice on table. Safety points to be observed while working on a milling machine. Sequence of milling six faces of a solid block. Checking the accuracy with the help of try-square scribing block and vernier height gauge. Step milling using side and face cutter checking with micrometer.	Milling machine importance of milling machine, types and specification of milling machine, driving and feed mechanism of milling machine. Classification & different types of milling cutters & their use. Parts and nomenclature. Vernier height gauge construction, graduations vernier setting & reading, vernier bevel protractor, construction graduation setting and reading. Care and maintenance of vernier height gauge and bevel protractor.
5	Straddle operations including up-milling and down milling. Introduction to indexing head types, setting and aligning of indexing head with reference to job on milling machine. Milling square / hexagonal job by simple indexing method.	Different milling operations plain-face, angular, form, slot, gang and straddle milling etc. Up and down milling. Different types of milling attachments and their uses. Indexing-introduction & types. Indexing head-constructional details, function of indexing plates and the sector arms. Calculation for various types of indexing.
6.	Demo of parts of CNC machine -control switches, console buttons and machines specifications Demonstration of CNC lathe parts -bed, spindle motor and drive, chuck, tailstock, tool changer, axes motor and balls crews, guide ways, LM guides, console, electrical, coolant system, hydraulic system, chip conveyor. Working of parts explained using multimedia CNC teach ware. Parts shown on machine.	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Schematic diagram of CNC system. Axes convention. Working of parts explained using multimedia CNC teachware. Parts shown on machine.
7.	CNC part programming with simple exercises and various programming codes. Practice on CNC machine simulator.	Programming - sequence, formats, different codes, canned cycles. Absolute and incremental programming. Tool nose radius compensation (G41/42). Cutting tool materials, cutting tool geometry - insert types, holder types, insert cutting edge geometry, ISO nomenclature for turning tools, boring tools, inserts. Cutting parameters - cutting speed, feed rate, depth of cut, constant surface speed, limiting spindle speed. Process planning, tool selection and cutting parameters selection. Explained using multimedia CNC teachware and CNC machine simulator.
8.	CNC turning center operation in various modes : jog, single block, auto, MDI, edit, etc. Program entry. Setting of tool offsets, entry of tool nose radius and orientation.	Program execution in different modes like single block, manual and auto. Tool and work offsets setting. Prepare various programs as per drawing. Concepts taught using multimedia CNC teachware.

9.	Machining parts on CNC lathe with parallel, taper, step, radius turning, grooving and threading of different pitches. First 60 % of the practice is on CNC machine simulator, followed by 40 % on machine.	Prepare various programs as per drawing. Concepts taught using multimedia CNC teachware.
10.	Demo of parts of CNC machining center - control switches, console buttons and machines specifications (spindle power, axes traverse, etc.).Demonstration of machine parts - bed, spindle motor and drive, tool changer, axes motors and ball screws, guideways, LM guides, console, electrical, coolant system, hydraulic system, chip conveyor. Working of parts explained using multimedia CNC teach ware. Parts shown on machine.	Axes convention. Working of parts explained using multimedia CNC teach ware. Parts shown on machine.
11-12.	CNC part programming with simple exercises and various programming codes. Practice on CNC machine simulator. CNC machining center operation in various modes: jog, single block, auto, MDI, edit, etc. Program entry. Setting of tool offsets, entry of tool radius. Practice on CNC machine simulator.	Program execution in different modes like single block, manual and auto. Tool and work offsets setting. Prepare various programs as per drawing. Concepts taught using multimedia CNC teach ware.
13.	Program and cut parts on CNC machining center with face milling, contour milling with tool radius compensation, pocket milling, drilling, peck drilling, countersinking, tapping operations using canned cycles for hole operations. First 80 % of the practice is on CNC machine simulator, followed by 20 % on machine.	Surface finish. Surface roughness related BIS symbols
	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** :**CNC PROGRAMMER CUM OPERATOR**

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 **CNC PROGRAMMER CUM OPERATOR/ Machinist/ Turner** with three year post qualificationexperience 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

BLOCK – I (12 months)

1. Identification of machines over travel limits & emergency stop, machine parts, mode practice (Jog, MDI, Edit, Auto, Single Block, MPG) Work & Tool setting CNC m/c part program preparation
2. Linear interpolation, assignments & simulations on software on old program. Circular interpolation, assignment & simulation on old program. Work offset & tool offset measurement & entry in CNC control. Part program preparation by absolute & incremental programming.
3. Chuck removing & its assembly. Cutting tool setting Work setting Program editing & simulation
4. Cycle 95-Stock removal cycle OD/ID Drilling/boring cycles in CNC turning
5. Grooving/Threading on OD/ID in CNC turning Offset correction practice Size control on CNC machine Sub program with repetition
6. CNC turning exercise: Mutlistart threading Programming
7. FANUC CNC Control – Turning Study of CNC machine, keyboard & specifications, Machine starting & operating in reference point, jog & incremental modes, coordinate system points, assignments absolute & incremental co-ordinate. Identification of machines over travel limits & emergency stop, machine parts, mode practice (Jog, MDI, Edit, Auto, Single Block, MPG) Work & Tool setting CNC m/c part program preparation
8. Linear interpolation, assignments & simulations on software on old program. Circular interpolation, assignment & simulation on old program.
9. Work offset & tool offset measurement & entry in CNC control. Part program preparation by absolute & incremental programming. CNC m/c turning with radius/Chamfer with TNRC editing practice & simulation.
10. Linear & Circular interpolation simulation & assignment Chuck removal & mounting on CNC Lathe Tool changes in CNC turning & MPG Mode operation. Linear interpolation & circular interpolation. Manual Data Input(MDI) mode operations & zero offsets & tool offsets, measurement on tool presenter Automatic Mode Execution.
11. Part program preparation, simulation & auto mode execution of CNC m/c exercises-stock removal cycle OD drilling/boring cycles stock removal cycle ID etc. Review, assignment/practice/test

12. Geometry & wear offset correction Part program preparation, simulation & auto mode execution of CNC m/c exercises-stock removal cycle OD drilling/boring cycles stock removal cycle ID etc. Review, assignment/ practice/ test
13. Threading cycle OD Sub program with repetition,
14. FANUC CNC Control –Milling Study of CNC machine, keyboard & specifications, Machine starting & operating in reference point, jog & incremental modes, coordinate system points, assignments absolute & incremental co-ordinate. Identification of machines over travel limits & emergency stop, machine parts, mode practice (Jog, MDI, Edit, Auto, Single Block, MPG) Work & Tool setting CNC m/c part program preparation
15. Linear interpolation, assignments & simulations on software on old program. Circular interpolation, assignment & simulation on software on old program. Work offset & tool offset measurement & entry in CNC control. Part program preparation by absolute & incremental programming. CNC m/c practical milling examples, chamfering & end milling with CRC etc. Editing practice & simulation. Review, assignment, practice, test.
16. Linear & Circular interpolation simulation & assignment milling Tool changes in CNC milling with ATC & Tool Magazine & MPG mode operation. Manual Data Input (MDI) mode operations & zero offsets & tool offsets, measurement on tool preseter Automatic Mode Execution. CNC machine exercise end milling with polar co-ordinates. Drilling-G81 etc.
17. Geometry & wear offset correction Part program preparation, simulation on CNC milling & auto mode execution of CNC m/c exercises. Chamfer & counter-sink drilling. Deep hole drilling G83 Threading & tapping G84
18. Boring cycles G85-G89 Review, assignment/practice/test
19. Preparation of part programme for auto mode execution of CNC machine exercises sub program. Circular & rectangular pockets. Drilling, Milling patterns etc.
20. CNC machining programming & DNC operations introduction.
21. SIEMENS CNC Control - Milling (Sinumeric 802D-M or latest) Study of CNC machine, keyboard & specifications, Machine starting & operating in reference point, jog & incremental modes, coordinate system points, assignments absolute & incremental co-ordinate. Identification of machines over travel limits & emergency stop, machine parts, mode practice (Jog, MDI, Edit, R.P. Auto, Single Block, MPG) Work & Tool setting CNC m/c part program preparation

22. Linear interpolation & circular interpolation, assignments & simulations on software on old program Milling. Work offset & tool offset measurement & entry in CNC control. Part program preparation by absolute & incremental programming. CNC m/c practical milling examples chamfering & end milling with CRC etc. Editing practice & simulation. Review, assignment/practice test.
23. Linear & Circular interpolation simulation & assignment milling Tool changes in CNC milling with ATC & Tool Magazine & MPG mode operation. Manual Data Input(MDI) mode operations & zero offsets & tool offsets, measurement on tool presenter Automatic Mode Execution. CNC machine exercise end milling with polar co-ordinates. Drilling-Cycle 81 etc. Chamfer & counter-sink drilling. Deep hole drilling Cycle 83 Threading & tapping Cycle 84, Boring cycles 85-89
24. Geometry & wear offset correction Part program preparation, simulation on CNC milling & auto mode execution of CNC m/c exercises. Boring cycles G85-G89 Review, assignment/practice/test
25. Preparation of part programme for CNC milling center. Simulation on CNC mill computers. Auto mode execution of CNC machine exercises sub programCircular& rectangular pockets. Drilling, Milling patterns etc.
26. Row of holes (Drilling pattern cycle) HOLES 1 Circle of poles (Drilling pattern cycle) HOLES 2
27. Slot on circle practice circumferential slot practice.

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.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE:CNC PROGRAMMER CUM OPERATOR

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A. Trainees Tool Kit:

Sl. No.	Item	Qty
1	Steel rule 30 cm graduated both in English & Metric units	20 Nos
2	Outside spring caliper 150 mm	20 Nos
3	Inside spring caliper 150 mm	20 Nos
4	Hermaphrodite caliper 150 mm	20 Nos
5	Divider spring 150 mm	20 Nos
6	Centre punch 100 mm	20 Nos
7	Hammer B P 0.5 Kg	20 Nos
8	Combination plier 150 mm	20 Nos
9	Safety goggle	20 Nos
10	File Flat smooth 200 mm	20 Nos

B. Tools, Instruments and General Shop Out fits

Sl. No	Item	Qty
1.	Surface plate 900 x 900 x 1200 mm with Table	1 No.
2.	Marking off table 1200 x 1200 x 900mm high	1 No.
3.	Scribing block universal 300 mm	2 Nos.
4.	" V " block 100/7-80-A	2 Nos.
5.	Try Square 150 mm	2 Nos.
6.	Outside spring caliper 200 mm	2 Nos.
7.	Divider spring 200 mm	2 Nos.
8.	Steel rule 60 cm graduated both in English and Metric units	2 Nos.
9.	Spirit level 2V 250, 05 metre	1 No
10.	Hammer B P 800 gms with handle	12 Nos.
11.	Screw Driver, heavy duty 300 mm with handle	4 Nos.

12.	Combination set 300 mm	1 No
13.	Reduction sleeve MT (to suit the machine)	1 set
14.	Angle plate size 200 x 100 x 200 mm	2 Nos.
15.	Solid parallels in pairs (Different sizes) in Metric	4 pairs
16.	Oil can pressure feed 500 mg	6 Nos.
17.	Oil stone 150 x 50 x 25 mm	2 Nos.
18.	Twist Drill Taper shank set 12 to 20 mm in step of 1 mm	2 sets
19.	Twist drills& Drill chucks including keyless drill chuck	1 set
20.	Grinding wheel dresser (diamond)	1
21.	C-Clamps as required	2 Nos.
22.	Clamps C 200 mm	1 set.
23.	Assorted carbide lathe tools with holder different shapes and	As Reqd.
24.	sizes	
25.	Hacksaw frame adjustable 250 - 300mm with blades	2 Nos.
26.	Universal table angle plate	1 No
27.	Plier cutting 200 mm	2 Nos.
28.	Magnifying glass 75 mm	2 Nos.
29.	Hand hammer 1 Kg with handle	2 Nos.
30.	Centre drill 2,3,& 4	4 Sets
Measuring Instrument		
31.	Micrometer outside 0-25 mm	4 Nos.
32.	Micrometer outside 25 - 50 mm	2 Nos.
33.	Micrometer depth gauge 0 – 200 mm	1 No.
34.	Direct reading Vernier caliper B 300	1 No.
35.	Vernier height gauge 300 mm	1 No.
36.	Vernier bevel protractor with150 mm blade	1 No.
37.	Bevel gauge 200 mm	1 No.
38.	Telescopic gauge 13 mm to 300 mm	1 set
39.	Compound dial gauge with stand (Metric)	1 No.
40.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base	1 No.
41.	Screw pitch gauge for metric pitches (0.5 to 6mm)	2 sets
42.	Radius gauge metric set	
43.	Taper gauge M T No. 1,2,3,4, & 5	1 set
44.	3 pin micrometer 10 – 25 mm	2 Nos.

C. General Machinery Installation

Sl. No	Item	Qty
1.	Lathe General purpose all geared (gap bed), height of centres 150 mm, bed length 1500 mm with 3 jaw & 4 jaw chuck, face plate, taper turning attachment steadies etc., and set of lathe tool holders.	2 Nos.
2.	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)	1No.
3.	Milling machine universal, with standard accessories and the following attachments: i. Universal dividing head with set of change gears - 1 No ii. Long arbors dia 16, 22, 27 and 32 mm - 1each iii. Machine vice swivel base 150mm - 1 No	2 Nos.
4.	CNC Trainer Lathe with Siemens Sinumerik 802D / Latest version, FANUC 0i / Latest version CNC system , Servo stabilizer and with necessary Turning cutting tools & Tooling package Installation and commissioning	1 No each
5.	CNC Trainer Mill with Siemens Sinumerik 802D - M / Latest version, Fanuc 0i – MB / Latest version CNC system, Servo stabilizer and with necessary Milling cutters & Tooling Package Installation and commissioning	1 No each
6. *	Multimedia based simulator for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (10 trainess + 1 faculty)	10 users
7.	CNC part program – Simulation softwares for Siemens Sinumerik 802 D / FANUC - 0i MB Turning module - 2 axes -8 Licenses & Milling Modules - 3 axes - 8 Licenses	1 set
8.	Desk Top Personnel Computers – Intel Pentium IV – CPU, 17" CRT Monitor, Multimedia key board, 1.44 Floppy drive, 52 x CD Rom drive and windows x P Professional operating system	10 Nos
9.	Uninterrupted power supply UPS - 600 VA	10 Nos

NOTE: Either Sl. No. 6 or Sl. No. (4 & 5) to be procured under General Machinery Installation.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: CNC PROGRAMMER CUM OPERATOR

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: CNC PROGRAMMER CUM OPERATOR

For Batch of 20APPRENTICES

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.