Skill India
कौशल भारत - कुशल भारत

Directorate General of Training

सत्यमेव जयते

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

COMPETENCY BASED CURRICULUM

CERTIFICATE COURSE ON

CNC WOOD WORKING AND MACHINING OPERATOR

NSQF LEVEL- 5

SECTOR : FURNITURE AND FITTING

CNC WOOD WORKING AND MACHINING OPERATOR

Duration: 480 Hours

NSQF LEVEL - 5

(Version: 1.0)

Designed in 2020

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

Sectoral Trade Course Committee of Furniture & Fitting Sector

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CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. COURSE INFORMATION

1.4 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of the economy/ labour market. The vocational training programs of short-term duration are intended for up skilling of NTC/ NAC pass out candidates. After passing out of the course, the trainee is awarded a competency-based certificate approved by DGT.

In terms of Skilling and up-skilling of ITI workforce in industries and Instructors and trainees in ITI ecosystem, the CNC Wood Working & Machining Operator Short term training (STT) under Furniture and Fitting Sector is one of the high demand job roles which penetrates more employment and entrepreneurship delivered nationwide through a network of ITIs.

During the three months duration of CNC wood working and machining Operator trade a candidate is trained on professional skills & knowledge, Auto CAD 2D & 3D, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered during the course are given below:

First Two Months: In this period the trainee learns about safety and machine interface, and various short cut keys in the software. He gets the idea of trade tools & its standardization, identify the Nodes, Fillet, offset, Trim, Views, fill tool, Editing. Get the idea to draw in 2D, Square, Rectangle, Circle, Poly line, Polygon, Text etc. Application of Join vector, offset vector, weld vector, Mirror vector (vertical and horizontal) and align. The trainee practices on 2D tool path throughout cut using the various steps as Profile (outside, Inside, along), allowance, cutting depth- start depth, finish depth, tolerance, Profiling tool-select, finish depth calculation, feed rate, Plunge rate, spindle rate, spindle speed, Tool number, cutting direction-climb or conventional, Cut sequence optimize, safe Z, material thickness, Tool path name, calculate now, preview, tool path, simulation, save the tool path, file name, machine file format, save as “txt” format and bring that file to machine. Programming-2, engraving and embossing, create area clearance tool path, for end mill cutter- step over, step down, feed rate, plunge rate spindle speed, Tool clearance strategy- offset or raster, start point, machine safe Z, material thickness, tool path name and then calculate and simulate. Its fault detection call Doctor vector to clear nodes, are done by trainee. The trainee will practice for How to take origin, how to load a program, before starting the program set the spindle speed, cycle speed, as per material, to see the program trace, How to start program. How to change the tool and how to load a program from computer through LAN cable.

Third Month: In this Month the trainee will study the details of 3D programming with the machine. More practice to make 3D program on various complicated design available on internet or as per requirements. Concept of making 3D Object with the help of CAD, CAM software. Export the Drawing file to the CAM / MC control Software. Generate the Tool Path/ set Machining Parameters. Concept of Program Verification/ observe the 3d simulation. Concept of Data Transfer / N.C Program from computer to Mc. Variable Depth of Operation, 3D Planes /Operational process. Cutting of a 3D Job with rough & finish operations. Concept of Job set up/ Tool set up for 3D Job making. Concept of Job Cutting in DNC system / Data Transferring process. Overview of Complex Job design with the help of CAD CAM software. Concept of Making of Tool Path/set parameters/set tool parameters. Process of Editing Program/ optional stop & Back ground editing at the time of Auto mode. Inspection Process / methods/instruments used/ report making. Inspection Process over Finished Job/making of Inspection Report.

1.4 PROGRESSION PATHWAYS

- Can join industries as CNC Router Operator and will be progress further as Supervisor and can rise to the higher level.
- Can become Entrepreneur in the related field.

1.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of 6 weeks: -

S No.	Course Element	Notional Training Hours
1.	Professional Skill (Trade Practical)	360
2.	Professional Knowledge (Trade Theory)	120
	Total	**480**

1.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by Formative Assessment Method by testing for assessment criteria listed against learning

outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline.

b) The pattern and marking structure is being notified by DGT from time to time. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment.

c) Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop/Field
- Answer sheet of assessment
- Viva-voce
- Participation and punctuality

Evidences of internal assessments are to be preserved until forthcoming Block examination for audit and verification by examining body.

d) The minimum pass percentage for skill test is 60%.

2. JOB ROLE

Brief description of Job roles:

CNC Wood Working & Machining Operator:

The operator selects the machine tool (such as a 0.25-inch v-bit or a 0.75- inch core box bit), speed, cut depth and tool path. For cut path, most machines give the options of tracing the vectors, cutting outside the vectors, or cutting inside the vectors. The operator determines the centre point of the part, clamps the part onto the table, moves the bit directly above the marked centre and down to the face of the part, and marks this as the starting point. The operators move the bit up a few inches and select the run G-code function. The machine begins to cut the design.
A CNC router can be used to produce items such as door carvings, interior and exterior decorations, wood panels, sign boards, wooden frames, moulding, musical instruments, and furniture. In addition, they see use in industry in the thermoforming process. CNC routers can help ensure part repeat ability and sufficiently efficient output for production or allow one-off designs to be made.

Wood Working Machine Setters and Setter Operators, Others; Wood Product Machine Operators, Other include those who operate and monitor automatic and semiautomatic woodworking machines which perform repetitive work and are always set up by woodworking machine setters not elsewhere classified.

Reference NCO-2015:

(i) 7523.9900 - Wood Working Machine Setters and Setter Operators, Others

3. GENERAL INFORMATION

Name of the Trade	**CNC Wood working and Machining Operator**
Trade Code	DGT/8014
Reference NCO - 2015	7523.9900
NSQF Level	Level 5
Duration of Craftsmen Training	480 Hours
Entry Qualification	NTC (ITI) in Carpenter Trade with one-year experience in relevant field
Eligibility for PwD	LD, CP, LC, DW, AA, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. of Student)	25
Space Norms	112 Sq. m
Power Norms	25 KW
Instructors Qualification for:	
(i) CNC Wood working and Machining Operator	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field
List of Tools and Equipment	As per Annexure – I

Distribution of training on hourly basis: (Indicative only)

Total hours	Trade practical	Trade theory
40	30	10

4. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

4.1 LEARNING OUTCOMES

1. Execute CNC Router interface /control program screen.
2. Plan and prepare 2D program with various tool keys, vector keys, etc. and Execute to load program from computer to CNC machine.
3. Prepare tool path in 2D and make program with throughout cut.
4. Execute saving of tool path & program file to machine.
5. Plan and prepare program with multiple tool use in ATC (Alternative Tool Changing), Installation of tool and mounting of job with zero offset.
6. Prepare job operating CNC router machine and inspect job accuracy.
7. Check drawing and execute operation with various relief functions.
8. Prepare 3D object with the CAD, set machine and make the job.
9. Describe Complex Job designing on CAD, Editing Program and Inspection Process of Job.
10. Execute application oriented small project.

8. SYLLABUS

SYLLABUS – CNC WOOD WORKING AND MACHINING OPERATOR			
Duration: 480 Hours			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Execute CNC Router interface /control program screen.	1. Demonstration of CNC-router interface/control programmed screen. 2. Practice with the framework, start panel, project panel and Tool setting 3. Practice with the various key Function. 4. Practices with the shortcut keys.	Role of CNC Router in Industries. Advantages of CNC Router over Conventional Machines. Overview of CNC Technology / CNC-router Technology. Overview of Construction features of CNC Router Machine. Overview of Machine Specification: Hardware, Software & Optional Components.
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Plan and prepare 2D program with various tool keys, vector keys, etc. and Execute to load program from computer to CNC machine.	5. Practice with the various Tool key, vector key 6. Draw Square, Rectangle, Circle, Polygon and text in 2D view window. 7. Load a program to CNC machine	Overview of Axis Nomenclature of CNC& work Planes. Overview of Co-ordinate systems. Overview of Job set up Process. Overview of Tooling/ ATC in CNC router M/C. Overview of Related Parameters.
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Prepare tool path in 2D and make program with throughout cut.	8. Practice with the new model in 2D Tool path. 9. Make program with throughout Cut. 10. Select bit for suitable operation. 11. Calculate finish depth, feed rate, plunge rate, spindle speed, cutting direction, safe Z, Material thickness.	Overview of Starting of M/c: ON/Off/Referencing/Jogging/MDI /EDIT/ Tool Change/Auto etc. Overview of CNC Key Board Features: Soft key/Key Board/Functional Key etc. Overview of Speed, Feed & RPM of CNC. Overview of Mode switches/ Program search / Edit etc. Overview of Program Writing.
Professional Skill - 30 Hrs.; Professional	Execute saving of tool path & program file to machine.	12. Practice to save the Tool path. 13. Practice to save the Program in “txt” format.	Overview of CNC Programming Methods / ABS INC method/ related. Overview of CNC G Codes, M codes

Knowledge - 10 Hrs.		14. Practice to bring program file to machine 15. Practice for Create area clearance Tool path.	& Words. Overview of CNC Control: Different programming Methods. Overview of Editing Keys for Program Writing. Methodology of writing of a Simple Programme in a CNC Router MC.
Professional Skill - 60 Hrs.; Professional Knowledge - 20 Hrs.	Plan and prepare program with multiple tool use in ATC (Alternative Tool Changing), Installation of tool and mounting of job with zero offset.	16. Practice to make program with multiple tool use in ATC (Automatic Tool changing) 17. Installing tool and mount tools in the collets or tool holder and Indicate zero offset. 18. Mount job on the machine table and indicate zero offset 19. Enter the program and verify the same. 20. Set the Spindle speed, Cycle speed	Overview of Program Simulation Prg. Set/ Graph page Set/Methodology. Over view of Job Zero set/Tool Offset Overview of Auto Run / Methodology. Overview of Background Editing. Overview of Repetition of Cycle/ Part count. Overview of Making of 2D drawing with Straight, Circular, Taper & Complex Contour path with the help of related CAD Software. Overview of Making of Combination Tooling Prgm./ concept of unit vector for circular contour. Difference between Manual Program & CAM program.
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Prepare job operating CNC router machine and inspect job accuracy.	21. Select proper switches on control panel 22. Move the slide in jog mode 23. Take slide to reference point to see the program trace. 24. Operate the machine tool CNC router 25. Inspect the job accuracy.	Overview of Tool nose radius Compensation/ Codes/use. Overview of Length Compensation /codes & its use. Tool parameter set up page/ geometry / wear. Over view of Multi Operations in a single Program. Overview of Multi Tools Set up/offset and ATC parameters set up. Overview of In-put / Out-Put process in CNC Interfacing system. Overview CNC DNC system/CAM interfacing.
Professional Skill - 30 Hrs.;	Check drawing and execute operation with various relief	26. Check drawing in computer by Doctor vector 27. Practice to change Tool,	Concept of making 2D Object with the help of CAD CAM software. Export the Drg. file to the CAM /

Professional Knowledge - 10 Hrs.	functions.	practice to load a program from computer through LAN cable. 28. Operate with the various relief function in program.	MC control Software. Generate the Tool Path / set Machining Parameters. Concept of Program Verification/ observe the 2D/3D simulation. Concept of Data Transfer/N.C Program from computer to Machine.
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Prepare 3D object with the CAD, set machine and make the job	29. Verify 3D program and observe simulation 30. Make 3D object in CAD CAM Software. 31. Draw various complex shapes in the program 32. Set the machine to cut the required material 33. Run the program and monitor the process.	Concept of making 3D Object with the help of CAD CAM software. Export the Drawing file to the CAM / MC control Software. Generate the Tool Path / set Machining Parameters. Concept of Program Verification/ observe the 3d simulation. Concept of Data Transfer/N.C Program from computer to Machine. Overview of Variable Depth of Operation. Overview of 3D Planes / Operational process. Overview for Cutting of a 3D Job with Rough & Finish operations. Concept of Job set up/ Tool set up for 3D Job making. Concept of Job Cutting in DNC system / Data Transferring process.
Professional Skill - 30 Hrs.; Professional Knowledge - 10 Hrs.	Describe Complex Job designing on CAD, Editing Program and Inspection Process of Job	34. Overview of Complex Job design with the help of CAD CAM software. 35. Concept of Making of Tool Path/set tool parameters. 36. Process of Editing Program/ optional stop & Back ground editing at the time of Auto mode. 37. Overview of Inspection Process / methods/instruments used / report making. 38. Overview of Inspection Process over Finished Job/making of Inspection	Overview of Complex Job design with the help of CAD CAM software. Concept of Making of Tool Path/set parameters/set tool parameters. Process of Editing Program/ optional stop & Back ground editing at the time of Auto mode. Overview of Inspection Process / methods/instruments used / report making. Overview of Inspection Process over of Finished Job/making of Inspection Report.

		Report	
Professional Skill - 80 Hrs.;	Execute application oriented small project	Prepare application oriented small job Batch wise.	
Examination			

7. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Execute CNC Router interface /control program screen.	Explain and identify the CNC –router interface and control programmed screen
	Identify the framework, start panel, project panel and tool setting.
	Identify and explain various key functions with short cut key.
2. Plan and prepare 2D program with various tool keys, vector keys, etc. and Execute to load program from computer to CNC machine.	Identify various tool key and vector key.
	Draw the square, Rectangle, Circle, polygon, and Text in 2D.
	Save the Prepared program and load to CNC machine.
3. Prepare tool path in 2D and make program with throughout cut.	Prepare a model in 2D tool path.
	Prepare and draw the model with throughout cut.
	Start the simulation, check the problem in design tool path and make correction.
4. Execute saving of tool path & program file to machine.	Illustrate saving of Tool Path
	Exhibit saving of the Program in “txt” format.
	Create area clearance Tool path.
5. Plan and prepare program with multiple tool use in ATC (Alternative Tool Changing), Installation of tool and mounting of job with zero offset.	Make program with multiple tool use in ATC
	Demonstrate mounting of tools in collets or tool holder and Indicate zero offset.
	Demonstrate mounting of job on machine table and indicate zero offset
	Enter the program and verify the same.
	Set the Spindle speed, Cycle speed, etc. as per the program.
6. Prepare job operating CNC router machine and inspect job accuracy.	Identify proper switches on control panel
	Move the slide in jog mode and take to reference point to check program trace.
	Prepare job by operating CNC router machine
	Inspect dimensions of the job for its accuracy.
7. Check drawing and execute operation with various relief functions.	Examine drawing in computer by Doctor vector
	Demonstrate tool changing
	Demonstrate operation with the various relief function in program.
8. Prepare 3D object with the	Demonstrate verification of 3D program and simulate it.
	Develop 3D object in CAD CAM Software.

CAD, set machine and make the job.	Construct various complex shapes in the program
	Demonstrate machine setting to cut the required material
	Employ the program and monitor the process.
9. Describe Complex Job designing on CAD, Editing Program and Inspection Process of Job.	Explain designing of complex Job with the help of CAD software.
	Describe making of Tool Path/set tool parameters
	Explain Process of Editing Program/ optional stop & Back ground editing at the time of Auto mode
	Demonstrate Inspection Process / methods / instruments used / report making.
10. Execute application oriented small project.	Develop a small project
	Load the program to machine, execute tool path and simulate the program.
	Demonstrate job holding and tool setting
	Operate the machine and demonstrate preparation of job
	Demonstrate Inspection of finished job

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
CNC WOOD WORKING AND MACHINING OPERATOR			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel Measuring Scale	Twelve inches	5
2.	Steel Tape	6 mtrs.	5
3.	Marking Knife	200 mm length	4
4.	Bebel Square	150 mm	4
5.	Carpenter Marking/Mortise Gauge		4
6.	Hand Saw	450 mm	4
7.	Metal Jack Plane	335 mm x 50 mm Cutter	4
8.	Bevel Edge chisel	(6, 10, 15, 20, 25) mm width	5 each
9.	Screw Driver Set		2
10.	Mallet	Medium size	4
11.	Claw Hammer	500 gms	2
12.	Oil Stone	Carborundum Universal Selicon Carbide combination rough and fine	4
13.	Hand Brush for cleaning	450 mm	5
B. SHOP TOOLS & EQUIPMENT –			
(i) List of Tools & Accessories			
14.	File Half Round	2nd Cut 250 mm	5
15.	File slim Tapper	100 mm	5
16.	Pincer	200 mm	2
(ii) List of Equipment			
17.	Carpenter Vice	300 mm jaws	4
18.	Saw Sharpening vice	250 mm jaws	2
19.	Carpenter work Bench	1500 x 600 x 800 mm	2
20.	"G" Clamp	150 mm	2
21.	Blower		2
C. Shop Machinery -			
22.	Wood working CNC Router Machine	1. HSD/HSK Electro spindle 9 KW (min) 2. Boring or Drilling Head- 5(min) 3. Servo Motor/ Induction Motor-Double 4. Vacuum Pump-Multi zone	1

		5. Linear Guide 6. Flat Bed 7. Cutting, Drilling, Shaping, and Nesting 8. PC control system with simulation software 9. AC Unit for electrical cabinet 10. Axis speed X/Y/Z 22/22/15 m/min. (min) 11. Lubrication system- automatic 12. Table size- 8ft/4ft 13. Z axis stroke – 100 mm (min) 14. Tool changing system including – 6 (min) 15. Tool pick up system 16. Rock and Pinion mechanism 17. Spindle speed- 20000 rpm(min) 18. Voltage Stabilizer Input- 350-450V, Output- 400-420V, Power-25KVA (min), 3phase 50 Hz 19. Compressor 75 HP at 10 kg/cm Sq. pressure 35 CFM 250 litre of storage tank with integrated Air drier. 20. Dust collector Air suction 3500 m motor-10HP (min).	
23.	Portable electric drill	6 mm capacity	2
24.	Portable sander machine	5” dia. disk	2
D. Shop Floor Furniture and Materials -			
25.	Steel Almirah with selves	1980x910x480 mm depth	1
26.	Instructor Table	Secretariat	1
27.	Instructor Chair		2
28.	Material rack		1

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in designing/ revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members contributed/ participated for finalizing the course curriculum of CNC Wood Working and Machining Operator trade.

S No.	Name & Designation Shri/Mr./Ms	Organization	Remarks
1.	K.L. Kuli, Director	RDSDE, Kolkata	Convener
2.	C.S. Murthy, Joint Director	CSTARI, Kolkata	Coordinator
3.	H. C. Goyal, JDT	RDSDE, Kolkata	Member
4.	Abhishek Anand, ADT	RDSDE, Kolkata	Member
5.	Supriya Rana, VI	NSTI Kolkata, Dasnagar, Howrah	Member
6.	Atanu Ghosh, T.O.	NSTI, Haldwani, Uttarakhand	Expert
7.	Vijay Singh Chauhan, President	New Vijay Furniture Works, Nanded, Maharastra	Expert
8.	Iresh, Works Manager	Senses Lifestyle, Moradabad, UP	Expert
9.	Ramsh Bagrecha, Executive Manager	Propteck Shreimer Pvt Ltd., Bangalore	Expert
10.	Subendu Patra, President	Patra Arts & Crafts, Cuttack, Orissa	Expert
11.	Prashant Nayak, Sr. Manager	Amaze Creation, Raipur, CG	Expert
12.	Kalpesh Halba, Head CNC	Mehta Cad Cam Systems Pvt. Ltd. Kathwada	Expert
13.	Nani Gopal Mondal, Supervisor	Govt. I.T.I, Tollygunge, Kolkata,W.B.	Expert
14.	Joy Mondal, Instructor	Govt. I.T.I, Howrah Homes	Expert
15.	Dilip Kr. Sarkar, Instructor	Govt. I.T.I, Hooghly, W.B.	Expert
16.	Nirmal Adhikari, Instructor	Govt. I.T.I, Kalyani, W.B.	Expert
17.	G.N. Eshwarappa, JDT	CSTARI, Kolkata	Member
18.	R.N. Manna, TO	CSTARI, Kolkata	Member
19.	Bharat Kumar Nigam, TO	CSTARI, Kolkata	Member
20.	Snehasish Bandyopadhyay, TO	CSTARI, Kolkata	Member
21.	Ashoke Rarhi, DDT	CSTARI, Kolkata	Member
22.	K.V.S. Narayana, Training Officer	CSTARI, Kolkata	Member
23.	P. K. Bairagi, Training Officer	CSTARI, Kolkata	Member

24.	B Biswas, Training Officer	CSTARI Kolkata	Member
25.	Akhilesh Pandey, Training Officer	CSTARI, Kolkata	Member
26.	Samir Sarkar, T.O.	NSTI, Howrah	Expert
27.	Subrata Polley, Instructor	ITI Howrah Homes	Expert
28.	Madhusudan Karmakar, V.I.	NSTI, Howrah	Expert
29.	Kartick Dutta, Instructor	ITI Kalyani	Expert
30.	Manirul Islam, Instructor	ITI Gariahat	Expert