Skill India
कौशल भारत - कुशल भारत

Directorate General of Training

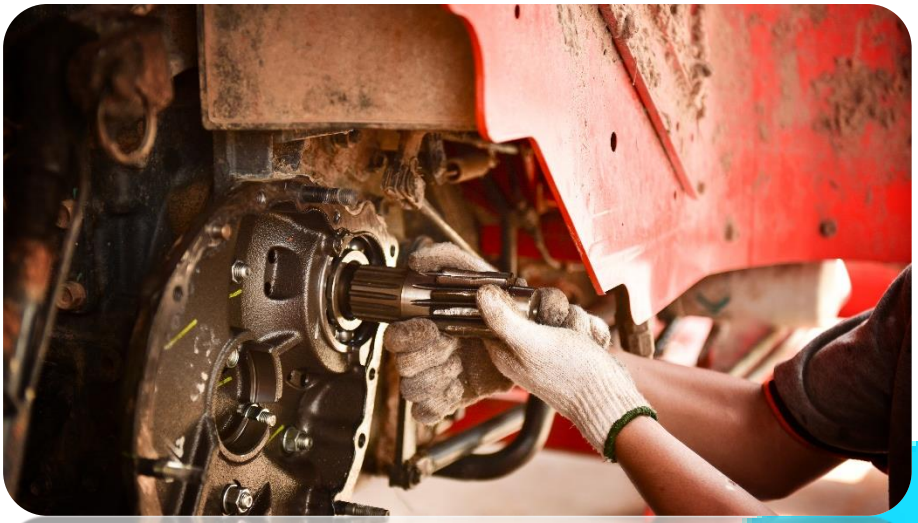
सत्यमेव जयते

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

COMPETENCY BASED CURRICULUM

CERTIFICATE COURSE ON

BASICS OF REPAIR AND MAINTENANCE OF METAL CUTTING MACHINES



NSQF LEVEL- 3.5

SECTOR - CAPITAL GOODS AND MANUFACTURING

BASICS OF REPAIR AND MAINTENANCE OF METAL CUTTING MACHINES

Duration: 240 Hours

NSQF LEVEL- 3.5

(Version: 1.0)

Designed in 2024

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

&

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

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CONTENTS

1. COURSE INFORMATION

1.1 GENERAL

This course has been developed for CTS/CITS trainees to take up as optional courses during course of study for technical and behavioural upgradation of trainees to meet industry related job roles. During the 240 hours duration of Repair and Maintenance of Metal Cutting Machines course, a candidate is trained on professional skills & knowledge related to job role. The Broad components covered during the course are given below:

The content broadly covers maintenance of different machine tools and manufacturing of components, for maintenance in conventional & CNC machines, the contents cover from safety aspect related to trade, basic fitting operation viz., marking, filling, sawing, chiseling, drilling tapping & grinding.

1.2 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)	180
2.	Professional Knowledge (Trade Theory)	60
	Total	**240**

1.3 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through assessment at the end of the course through skill testing at Training Center & CBT through examination conducted by DGT.

The minimum pass percentage for skill test is 60% and for theory will be 33% as in main CTS examination.

2. JOB ROLE

Brief description of Job roles:

Mechanic Machine Tool Maintenance installs, erects and changes layout of machines and equipment in mills, factories, workshops etc. according to instructions or specifications. Studies drawings and lay out sketches of machines or equipment to be erected. Calculates available floor area in relation to dimension of machines, working space required etc. and marks areas on floor for foundations of machines. Guides' construction of foundations and setting of foundation bolts and fixtures according to type of machines to be installed and allows foundations to dry up and settle for required number of days. Places base or holding device of machines through foundation bolts or on fixture one by one, using lifting equipment and aligns and levels them with spirit level. Fastens or secures machines tightly to foundation bolts or fixtures and rechecks alignment and leveling to ensure correctness. Makes adjustment if necessary and gets grouting of foundations done. Allows grouting to dry up and adjust position of different parts of machine for efficient operation. Gives necessary power supply to machine or connects machine to line shaft. May run machine and observe performance. May assemble, repair and overhaul machines. May specialize in erecting particular type of machine or equipment such as printing machine, lathe, pneumatic hammer, grinder, pumps, etc.

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.

Reference NCO-2015:

i. 8211.1000 – Erector, Machine and Equipment
ii. 8211.0100 – Assembler, Workshop Machine and Equipment

Mapped NOS: CSC/N9577

3. GENERAL INFORMATION

Name of the Trade	**BASICS OF REPAIR AND MAINTENANCE OF METAL CUTTING MACHINES**
Reference NCO - 2015	8211.1000, 8211.0100
NOS Covered	CSC/N9577
NSQF Level	3.5
Duration of Craftsmen Training	240 Hours
Entry Qualification	10th Class passed and perusing/ passed out CTS in Fitter, Turner, Machinist, MMTM, TDM (D & M), TDM (J & F)/CITS in Fitter, Turner, Machinist, MMTM, TDM Candidates
Unit Strength (No. of Student), Space & Power Norms	As per Mechanic Machine Tools Maintenance trade under CTS
Instructors Qualification	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. OR NTC/NAC passed in the Trade of "Mechanic Machine Tool Maintenance" With three years' experience in the relevant field.
List of Tools and Equipment	As per Annexure – I

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. Dismantle, repair and assemble of mechanical power transmission elements in machine tools and check for functionality.
2. Conduct preventive maintenance, predictive maintenance, condition-based maintenance (CBM), perform dismantling and assembly of different components machine and test for accuracy.
3. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work.
4. Troubleshoot & Overhaul of motors, pumps, fans, blowers & compressors and perform preventive maintenance.
5. Identify fault, carryout maintenance work and break down of machine tools/ equipment viz., power saw machine, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools & equipment to ensure its functionality.

5. SYLLABUS

SYLLABUS – BASICS OF REPAIR AND MAINTENANCE OF METAL CUTTING MACHINES			
Duration: 240 Hours			
Duration Weeks	**Reference Learning outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Practical 50 Hrs Theory 10 Hrs	LO-1: Dismantle, repair and assemble of mechanical power transmission elements in machine tools and check for functionality.	1. Identify different components of power transmission. 2. Dismantle and assemble different components of power transmission. 3. Identification and inspection of components of different types of brakes in machine tools. 4. Fitting of hub and shaft with key. 5. Installation of belt in transmission with adjusting the tension. 6. Impression testing of split bush bearing for proper contact on journal & housing. 7. Preloading of Precision angular contact bearing 8. Dismantling, inspection and mounting of ball bearing on shaft with press & pullers. 9. Dismantling & assembly of tail stock of a lathe. 10. Demonstrate of different types of knots and hitches used in material handling. 11. Different types of rope and their maintenance. 12. Lift an object by using slings. 13. Identification different types of gears and gear bones used in machine tools. 14. Checking of backlash and	Overview of machines and functionality of different building block of the machines. **Maintenance Practice and Mechanical Assembly** Introduction to various maintenance practices such as preventive maintenance, predictive maintenance, breakdown maintenance & reconditioning. Organization Structure for maintenance, Roles and responsibility, advantage and disadvantage of TPM. **Transmission of Power** Elements of mechanical power transmission, type of spindles and shafts (Universal spindle, Plain shaft, Hollow shaft, crank shaft, cam shaft). Positive and Non-positive drive, Friction drive, Gear drive, Belt drive, Chain drive and Rope drive. **Clutches** Function of Clutches, its types and use in power transmission system. Function of mechanical & electromagnetic system in clutch mechanism. **Couplings:** Concept of coupling and its type viz. Rigid coupling- Muff coupling, Flange coupling, Flexible coupling, Pin-bush coupling, Chain coupling, Gear

		root clearance by feeler gauge, DTI & lead wire in gear meshing. 15. Inspection & replacing the lubricating oil of a given gearbox. 16. Overhauling of gear box of lathe & milling machine.	coupling, Spider coupling, Tyre coupling, Grid coupling, Oldham-coupling, Fluid coupling, Universal coupling and their specific applications. **Brakes** & Braking Mechanism: Types & Functions. Inspection of brakes for safe & effective working. **Belts-** Belt types (Flat and V) and specifications. Pulleys used for belt drive. Installation, Alignment of belts. Problems related to belts (Creep and slip) Belt maintenance. Sheave alignment, Chain drive-Roller chain, Silent chain, alignment of sprockets, and maintenance of chain drive. **Bearing:** Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact bearings- Ball bearings- single row & double row, Deep groove ball bearing, Angular contact, Self-aligning and Thrust bearing. Roller bearing- Cylindrical, Needle roller, Taper roller, Spherical roller, self-aligning and Spherical roller thrust bearing. Use of ISO bearing designation code to generate market survey and purchase. Checking and adjustment of

			bearing clearance. Methods of Mounting and dismounting of roller contact bearing, taper roller bearing and angular contact ball bearing. (Back-to-back, Face-to-face, tandem) Mounting-dismounting and adjustment of Taper bore bearings with adopter and withdrawal sleeve. Handling and storage of bearings. Related hazards, risk and precautions. Rigging Knowledge of different tools & tackles used in rigging. Construction and capacity of wire rope/steel rope/belts. Application of knots and hitches. Care and maintenance of all types of ropes. **Gear:** Type, description and function of gears- Spur, Helical, Spiral, Bevel, Straight and Spiral bevel, Worm gears, Rack and pinion. Gear Terminology. Gear train- simple, compound, reverted and epicyclic. Types of Gear box Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and lead wire. Impression testing of gear mesh with Prussian blue. Running maintenance Related hazards, risk and precautions.
Practical 40 Hrs Theory	LO-2: Conduct preventive maintenance, predictive	17. Preventive maintenance of lubrication system of lathe, drilling and grinding machines.	Types of Maintenance. Standard safety precaution

05 Hrs	maintenance, condition-based maintenance (CBM), perform dismantling and assembly of different components machine and test for accuracy.	18. Preventive maintenance of coolant system. 19. Analyse and perform predictive maintenance of machine.	
Practical 40 Hrs Theory 20 Hrs	LO-3: Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work.	20. Behaviour of Proximity Sensors. 21. Behaviour of ultrasonic sensors. 22. Limit & Level Control using Sensors. 23. Interfacing of Sensors with Electrical Actuators. 24. Making simple wiring circuits and measurement of current and voltage. 25. Testing of power supply (AC & DC). 26. Demonstration of use of test lamp and megger. 27. Connections of DC/AC motors and its speed control - demonstration only. 28. Identification of passive & active electronic components. 29. Testing and measurement of resistors, capacitors, inductors using multi meter. 30. Perform soldering and de-soldering of components. 31. ICS –identification & testing. 32. Assembly of simple battery eliminator circuit	Switches, Fuse and Circuit Breakers. Introduction To Sensors--Fundamental of Sensor. Potentiometer -Ultrasonic and Optical Sensors-Industrial Application. Basic principles of DC generators and motors, Alternators and AC motors and transformers. Various types of switches, circuit breakers, fuses, lamps, proximity switches, relays and contactor in electrical circuits. Passive circuit elements – resistors, capacitors and inductors. Its identification and testing. Colour code. **BASIC ELECTRONICS** Introduction to electronics and its industrial applications. Introduction to digital electronics – numbers system and logic gates. Study of electronic circuit – macro level with block diagram Study of rectifiers Discharging of capacitor.
Practical 20 Hrs Theory 10 Hrs	LO-4: Troubleshoot & Overhaul of motors, pumps, fans, blowers & compressors and perform preventive maintenance.	33. Demonstrate various types of machines related centrifugal pump and their parts. 34. Overhauling of pumps with fitting of gland packing. 35. Priming of pump.	**Centrifugal Pump, Fan, Blower and Compressor: - Pump** Function of pump. Types and working principle of centrifugal pump (machine related).

		36. Testing of pump. 37. Trouble shooting in pump operation. 38. Identification of various types of fans, blowers and their parts. 39. Dismantle, inspect, repair/ replace work out part and assemble the same. 40. Demonstrate compressors and their parts. 41. Cleaning and changing of filters of compressors 42. Perform schedule and preventive maintenance of blower & compressor. 43. Change compression ring & oil rings in a reciprocating compressor.	Constructional detail of pump Starting and stopping Pump performance and characteristics. Capitation & aeration Preventive & schedule maintenance of pumps. Gland packing changing procedure. Concept of Mechanical seal Trouble shooting in pump. **Fan & Blowers:** Types and working principle Constructional detail of Fans & Blowers. Starting and stopping of Fans and Blowers Different parts of Fans & Blowers Concept of surge. Preventive & scheduled maintenance. **Compressors:** Compression theory, Types of compressors Constructional detail of compressors, working mechanism Different parts and their function. Loading unloading system Concept of air dryer. Preventive & schedule maintenance.
Practical 30 Hrs Theory 15 Hrs	LO-5: Identify fault, carryout maintenance work and break down of machine tools/ equipment viz., power saw machine, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools & equipment to ensure its functionality.	44. Demonstrate mechanical & hydraulic jack, rope puller, chain puller, chain block, and winch. 45. Shift a small machine from layout to loading centre/ different work place. 46. Practice various belt & chain joining methods. 47. Demonstrate belt conveyor system, vibratory screen & feeder. (Video demo) 48. Trouble shooting on	Different type of jacks, chain block and pull lift. Knowledge of different types of scaffolding. Material movement by using different rigging tools and techniques. Safety appliances & precautions in rigging. Maintenance of tools and tackles. Bulk Material Handling (Conveyor belt, Vibratory

		machine tools such as drill, shaper, lathe & power saw machine. 49. Perform overhauling of feed units of lathe milling & grinding. 50. Write an inspection report for maintenance job. 51. Prepare an action plan for maintenance work.	screen, Feeders) Principle & mode of material handling. Various components used in belt conveyor system & their functions. (Pulleys, idlers, scrapers, skirts, belt, take up unit system and safety devices). Vibratory screen- working mechanism. Feeders- types, working mechanism. Maintenance practice-Pulley lagging, belt sway control belt joining methods. Breakdown Maintenance, Preventive Maintenance, Predictive Maintenance & Concepts of TPM, OEE. (Without calculations) Difference between breakdown and preventive maintenance – Its importance in productivity, types. Normal procedure followed for maintenance of machine tools on the shop floor. Accuracy testing of machine tools. Various maintenance practices. Concepts & Measurement of machine performance: MTBF, MTTR. (Without calculations)

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENTCRITERIA
1. Dismantle, repair and assemble of mechanical power transmission elements in machine tools and check for functionality.	Safety aspects while working with power transmission system.
	Explain the functions and constructional features of various mechanical power transmission elements and drives
	Drain out lubrication oil from the power transmission system.
	Select proper tools for the required task.
	Dismantle the shaft, coupling, gears, belt, clutch, pulley, chain & sprockets. keys, bearing from the power transmission system.
	Clean and check for damage of all dismantled parts.
	Repair / replace damaged parts.
	Assemble the power transmission system in sequence.
	Fill lubrication oil and check functionality.
2. Conduct preventive maintenance, predictive maintenance, condition-based maintenance (CBM), perform dismantling and assembly of different components machine and test for accuracy.	Collect relevant information to conduct preventive maintenance of machine.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Observe safety procedure while carrying out above task
	Collect relevant information to conduct predictive maintenance of machine.
	Perform Condition-based maintenance (CBM).
3. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work.	Identify different electrical equipment viz. multi-meter, transformer, relays, solenoids, motor & generator.
	Identify different sensors viz, proximity &ultrasonic.
	Examine functioning of different electrical equipment, sensors and their utilization in industrial application.
	Observe safety precautions during examination of electrical equipment and sensors
4. Troubleshoot & Overhaul of motors, pumps, fans, blowers & compressors and perform preventive maintenance.	Acquaint the safety practices related to the motors, pumps, fans, blowers & compressors.
	Understand & identify the different types of motors, pumps, fans, blowers and compressors.
	Plan and prepare trouble shoot chart for motors, pumps, fans, blowers & compressors and perform the task.
	Carry out the preventive maintenance of motors, pumps, fans, blowers and compressors.
	Interpret the industrial applications of motors, pumps, fans, blowers and compressors in different machine tools.
5. Identify fault, carryout maintenance work and	Acquaint the safety practices related to the break down maintenance of machine tools
	Identify various machine tools under break down.

break down of machine tools/ equipment viz., power saw machine, surface grinding, drilling, lathe, milling, in the shop floor, using appropriate tools & equipment to ensure its functionality.	Demonstrate the faults arised in the machine tools. Conduct the break down maintenance of faulty machine. Carry out the performance test.

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
BASICS OF REPAIR AND MAINTENANCE OF METAL CUTTING MACHINES			
S No.	Name of the Tools and Equipment	Specification	Quantity
Same as Mechanic Machine Tools Maintenance trade under CTS			

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.

Trade committee meeting to finalize the syllabus of "Basics of Repair and Maintenance of Metal Cutting Machines" (240 hrs.) held on 16.04.2024 at CSTARI, Conference Room.

Sl. No.	Name and Designation (Shri/Smt./Kumari)	Organization with Address	Remarks
1.	G C Saha Jt. Director	CSTARI, Kolkata	Chairman
2.	Brindaban Das Dy. Director	CSTARI, Kolkata	Member
3.	Joydeb Roy Chowdhury Instructor	Govt. ITI, Tollygaunge	Member
4.	Binoy Krishna Biswas Asst. Professor	B.P.P. Institute of Management & Technology Kolkata – 700 052	Member
5.	Dilip Kumar Chattopadhyay Ex-ADT	46 A/8, Shibpur Road, Howrah – 2	Member
6.	Rounak Bandopadhyay	Zreyas Technology. New Town, Kolkata	Member
7.	Subrata Pully Supervisor	Govt. ITI, Gariahat	Member
8.	Jayanta Koley	ITI Durgapur	Member
9.	Jaharlal Maity Instructor (RAC)	Govt. ITI, Gariahat	Member
10.	Atanu Ghosh Training Officer	NSTI, BBSR, Odisha	Member
11.	Anurag Chakraborti Asst. Professor	Techno Engineering Collage, Banipur, Habra	Member
12.	Subhankar Bhattacharjee Asst. Professor	Techno Engineering Collage, Banipur, Habra	Member
13.	Amaresh Naskar Instructor	Govt. ITI, Tollygaunge	Member
14.	Md. Waseem Siddiqui	VECC/DAE I/AF Bidhannagar, Kolkata – 64	Member
15.	Atanu Bhuniya Instructor (RAC)	Govt. ITI, Howrah Homes, Santaragachi, Howrah	Member

16.	Prodip Mukhopadhyay Former MD – Webel and Sr. Advisor - MAKAUT	Webel MAKAUT	Member
17.	B. Sharanappa Asst. Director	CSTARI, Kolkata	Member
18.	Sk. Altaf Hossain Asst. Director	CSTARI, Kolkata	Member
19.	Murari Barui Asst. Director	CSTARI, Kolkata	Member
20.	Akhilesh Pandey Asst. Director	CSTARI, Kolkata	Member
21.	Nirmalya Biswas PA-to-Director	CSTARI, Kolkata	Member
22.	B. Biswas Training Officer	CSTARI, Kolkata	Member
23.	P.K. Bairagi Training Officer	CSTARI, Kolkata	Member
24.	B K Nigam Training Officer	CSTARI, Kolkata	Member
25.	K.V.S. Narayana Training Officer	CSTARI, Kolkata	Member
26.	Pradip Biswas Jr. D/man	CSTARI, Kolkata	Member
27.	Hemant Kujur Jr. D/man	CSTARI, Kolkata	Member
28.	Abhisek Mitra HOD INCHARGE	Asansol institute of engineering and management polytechnic Kalipahari Asansol	Member
29.	SUNIL SITARAM CHORE CMD, SIMUSOFT TECHNOLOGIES, PUNE	SIMUSOFT TECHNOLOGIES B11-1204, NEAR IBM INFOCITY, KUMAR INFENIA, PHURSUNGI, PUNE 412308	Member
30.	Makarand Joshi Product Manager	Grok Learning Pvt. Ltd. Plot No. 29, Amba Bhavan, 3rd Floor, 'A' Wing, Sion Circle (West), Mumbai	Member
31.	Kunal Sharad Bhagat Developement Engineer	Grok Learning Pvt. Ltd. 3rd Floor, A-wing, Amba Bhavan, Plot No 29, Next to Bharat Petrol Pump, Sion Circle (west), Mumbai 400022	Member
32.	MANOHAR SADASHIV DESAI Technical Head	SKILL BAHN LLP. UNIT NO. 912 / Plot-B, Lodha Supremus, Lodha Business District, Kolshet Rd, Thane, Maharashtra	Member

		400607	
33.	Mandar Bhate Associate Manager	Tata Technologies Ltd Hinjewadi, Ph-1, Pune, Maharashtra	Member
34.	Ashish Kulkarni Industrial Skill Consultant	Bhan skill Mumbai Thane Mumbai	Member