

INDUSTRIAL TRAINING INSTITUTE

CRAFTSMEN TRAINING SCHEME (CTS)

ANNUAL INSTRUCTIONAL PLAN BREAKUP (42 WEEKS) TURNER - SECOND YEAR

(Curriculum as per DGT / CSTARI Guidelines for Turner CTS Scheme - 2nd Year)

Trade Name	TURNER (Engineering Trade)
NSQF Level & Duration	NSQF Level-4 Two Years Duration (Second Year - 42 Weeks)
Academic Session	
Instructor Name & Designation	
Group Instructor (GI) Name	
Principal / Superintendent Name	
Institute Name & Address	

WEEKLY INSTRUCTIONAL BREAKUP - TURNER 2ND YEAR (42 WEEKS)

Week No.	Trade Practical (Professional Skills)	Trade Theory (Professional Knowledge)
Week 1	- Form turning practice by hand manipulation of cross-slide and carriage handwheels. - Re-sharpening and profile grinding of concave and convex form tools using bench grinder. - Turning machine handle to given profile using simultaneous combination feed.	- Form tools: Types (flat, circular, tangential), function, and profile generation techniques. - Template: Types, purpose, fabrication, and checking profiles using radius gauges. - Dial Test Indicator: Construction, types (lever and plunger), uses, and reading method.
Week 2	- Turn Morse taper plug (different numbers MT-2, MT-3) and check with ring gauge or MT sleeve. - Manufacture bush-type revolving tailstock centre (C-40 steel) by proof machining. - Machine Morse taper sleeve and verify accuracy with standard taper plug gauge.	- Calculation involving modified rake and clearance angles at above and below center height. - Subsequent effect of tool setting height on effective cutting angles and workpiece finish. - Jigs and Fixtures: Definitions, differences, types, and applications in production lathe work.
Week 3	- Make test mandrel / plug gauge to accuracy of ± 0.02 mm using tungsten carbide tools. - Practice turning using indexable throw-away carbide tips and setting chip breakers. - Check taper accuracy with sine bar, precision rollers, and slip gauges.	- Cutting tool materials: HCS, HSS, Stellite, Tungsten Carbide, Cermets, and Ceramics. - Chip breakers: Types (ground groove, step, mechanical clamped) and functions. - Checking taper with sine bar and rollers: Principles and mathematical calculations. - Cutting speed, feed, and turning time calculations for tungsten carbide tooling.
Week 4	- Setting and turning operations on irregular shaped jobs involving Face Plate and Angle Plate. - Manufacture precision angle plate using face plate clamping and counterbalancing. - Truing workpiece surface and bore using dial indicator on face plate.	- Face plate: Construction, T-slots, clamps, balancing weights, and mounting procedures. - Angle plate: Construction, accuracy, and use with face plate for eccentric components. - Balancing on face plate: Dynamic and static unbalance, necessity, and safety precautions.
Week 5	- Holding and truing of single-throw Crankshaft on lathe using offset fixtures or independent chuck. - Machining crank pin journal, cheeks, and counterweight balancing.	- Surface finish symbols used on blueprints: Roughness grades (N1 to N12) and lay symbols. - Honing, lapping, and super-finishing processes for crank journals. - Marking table and surface gauge setup for eccentricity checking of crankshaft throws.
Week 6	- Turning long slender shaft supported by Fixed and Travelling (roller) Steady Rests (within 0.1 mm). - Practice using lathe attachments for special operations (spherical turning, milling attachment). - Turning standard stub arbor with accessories: spacing collars, tie rod, and lock nut.	- Roller and revolving steady rests: Construction, adjustments, and applications for slender bars. - Lathe attachments: Taper turning, spherical turning, grinding, and milling attachments. - Thread measurement methods: Screw pitch gauge, thread micrometer, and toolmaker's microscope.
Week 7	- Perform eccentric boring in 4-jaw chuck and assemble male & female eccentric components. - Position boring on lathe using tool maker's buttons for precision center distances. - Verification of hole centers using dial indicator and height gauge.	- Tool maker's buttons: Parts, construction, accuracy, and mounting method on face plate. - Telescopic gauges: Construction, application, and measurement using outside micrometer. - Inside micrometer: Construction, extension rods, graduation, and least count (0.01 mm).
Week 8	- Precision through boring and stepped boring within ± 0.05 mm accuracy. - Cutting internal helical oil grooves in bushes and sleeve bearings (figure-of-eight oil groove). - Checking stepped bores using bore dial gauge and inside micrometers.	- Stepped boring techniques: Tool deflection compensation and setting boring depths. - Helical oil grooves: Purpose in hydrodynamic lubrication, pitch calculation, and lathe setting. - Care in holding and clamping thin-walled bushes to avoid distortion.

Week No.	Trade Practical (Professional Skills)	Trade Theory (Professional Knowledge)
Week 9	- Turning and boring of split bearings using boring bar and specialized fixture between centers. - Machining split halves, shims fitting, and truing bore concentricity. - Finishing bore by reaming or fine boring to specified tolerance.	- Split bearings: Construction, applications, and shimming methods. - Fixtures for split bearings: Balancing, clamping without deformation, and alignment. - Boring bars: Types (single point, floating cutter), rigidity, and vibration damping.
Week 10	- Cutting fractional threads (8 TPI and 11 TPI) on lathe. - Gear train calculation for cutting fractional pitch and odd/even TPI threads. - Testing thread profile and pitch with screw pitch gauges and optical profile gauges.	- Calculations involving fractional and special pitch threads. - Odd and even thread rules for half-nut engagement with thread chasing dial. - Mechanics of thread chasing dial for British and Metric lead screws.
Week 11	- Multi-start thread cutting (B.S.W.) External: Setting tool, indexing starts, and cutting threads. - Multi-start thread cutting (B.S.W.) Internal: Tool grinding and cutting multi-start thread in nut. - Verification of lead, pitch, and proper assembly of male and female parts.	- Multiple-start threads: Definition, applications, and relationship between pitch and lead ($\text{Lead} = \text{Start} \times \text{Pitch}$). - Indexing methods for multi-start threads: Faceplate indexing, change gear indexing, and compound slide indexing. - Tool profile, lead angle, and clearance angle requirements for multi-start threading.
Week 12	- Multi-start thread cutting (Metric) External and Internal. - Calculate change wheels, lead, and tool width for Metric multi-start threads. - Matching and checking with pitch gauges and thread micrometers.	- Calculation of change gear trains for Metric multi-start threads on various lead screws. - Helix angle, leading angle, and following angle calculations for rapid lead threads. - Common errors in multi-start thread indexing and rectification techniques.
Week 13	- Multi-start thread cutting of Square form (Male & Female components). - Manufacture standard half-nut matching specified lathe lead screw. - Functional assembly and backlash testing with lead screw.	- Square form multi-start threads: Tool design, core diameter, and depth proportions. - Half-nut mechanism: Construction, split alignment, and engagement with lathe lead screw. - Wear patterns and backlash adjustment in half-nut assemblies.
Week 14	- CNC machine personal safety and machine safety: Safe handling of tools, chucks, and control console. - Identification of CNC lathe machine parts: Bed, spindle motor, drives, turret, LM guideways, ball screws. - Working of parts explained using multimedia simulator and interactive software.	- CNC technology basics: Advantages and limitations of CNC over conventional machines. - Machine axes convention for CNC turn centers: X-axis (cross) and Z-axis (longitudinal). - Construction of CNC machines: Slant bed, LM guides, recirculating ball screws, and servo drives.
Week 15	- Identification of machine over-travel limits, emergency stop, and electrical interlocks. - Preliminary checks: Lubrication level, coolant pressure, pneumatic/hydraulic pressure, and referencing. - Machine power-on sequence and zero return (homing) in all axes.	- Feedback devices in CNC machines: Encoders, linear scales, and resolvers. - Coordinate geometry: Workpiece coordinate system (WCS) and Machine coordinate system (MCS). - Machine reference point, tool reference point, and program zero point.
Week 16	- Operating CNC lathe in JOG, Reference Point, and Incremental modes. - Practice manual data input (MDI) commands for spindle start/stop, coolant on/off, and turret index. - Moving slides using Manual Pulse Generator (MPG) handle.	- Structure of CNC part program: Character, word, block, block format, and program sequence. - Standard ISO/DIN G-codes (preparatory functions) and M-codes (miscellaneous functions). - Absolute (G90) vs Incremental (G91) programming methods.

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Week 17	• Write simple CNC part programs using ISO codes and test on simulation software. • Verify program simulation on screen for tool path correctness and collisions. • Absolute and incremental programming exercises and contour simulations.	1. Basic motion commands: Rapid traverse (G00), Linear interpolation (G01), Circular interpolation (G02/G03). 2. Cutting parameters: Cutting speed, feed rate, constant surface speed (G96), and maximum spindle speed (G50). 3. Tool layout and process sequencing for CNC turning.
Week 18	• Practice linear and circular interpolation programming assignments and simulations. • Workpiece and tool setup: Setting job zero (G54-G59) and mounting live/static tooling on turret. • Soft jaw boring and adjustment according to component diameter.	1. Tool nose radius compensation (TNRC): Necessity, tool nose center vs imaginary tip, G41/G42/G40. 2. Cutting tool materials and insert geometry for CNC turning: ISO nomenclature for tool holders and inserts. 3. Clamping systems: Hydraulic power chucks, pressure adjustment, and soft jaw preparation.
Week 19	• CNC turning center operation in various modes: EDIT, AUTO, SINGLE BLOCK, and DRY RUN. • Part program entry directly into CNC control console memory and editing. • Work offset measurement and tool geometry offset entry (X and Z values).	1. Tool presetting and tool offset principles: Geometry offset, wear offset, and tool orientation numbers (1 to 9). 2. Program checking techniques: Graphic simulation, dry run, single block execution, and override switches. 3. Safety interlocking and emergency procedures during program execution.
Week 20	• Part program preparation, simulation, and auto-mode execution for plain facing and step turning. • Program execution with radius, chamfering, and TNRC (G41/G42). • Dimensional inspection of components using digital vernier calipers and outside micrometers.	1. Stock removal turning cycles (OD/ID roughing): Multi-repetitive canned cycles (G71/G72). 2. Finishing cycle (G70) programming format and parameter definitions. 3. Cutting parameter selection from tool manufacturer catalogs based on workpiece material.
Week 21	• Blue-print programming and machining contours with radius, chamfers, and tapers. • Machining components on CNC lathe involving parallel, taper, step, and radius turning. • Adjusting finish size by over-sizing and tool wear offset entry.	1. Tool path optimization and minimization of idle traverse in CNC turning. 2. Effect of cutting parameters on surface roughness, tool wear, and dimensional tolerances. 3. Geometry wear correction and tool life management in production.
Week 22	• Carry out drilling and boring operations on CNC lathe using canned cycles (G74/G75/G83). • Practice OD and ID grooving operations with specific dwell cycles (G04). • Inspection of bore and groove dimensions using bore dial gauges.	1. Drilling and deep hole peck drilling cycles in CNC turning. 2. Grooving tool selection, insert widths, chip evacuation, and grooving canned cycles. 3. Boring bar deflection, overhang ratio (L/D), and vibration dampening.
Week 23	• Practice CNC thread cutting on external and internal surfaces using threading cycles (G76/G92). • Execute multiple threading passes with varying depths of cut and thread runout. • Check finished threads with thread ring and plug gauges.	1. Threading cycles on CNC lathe (G76 two-line/single-line formats, G92, G32). 2. Infeed methods in CNC threading: Radial infeed, flank infeed, and modified flank infeed. 3. Tapping operations on CNC turning centers: Floating tap holders and rigid tapping cycles.
Week 24	• Write and execute part programs using sub-programs with repetitions (M98/M99). • Machine components combining grooving, threading, and profile turning. • Parting off operation on CNC lathe with bar puller/stopper setup.	1. Main programs and sub-programs: Structure, nesting, repetition counts, and modular programming. 2. Parting off parameters: Tool geometry, feed rate reduction near center, and burr minimization. 3. Factors affecting turned part quality, dimensional repeatability, and productivity.

Week No.	Trade Practical (Professional Skills)	Trade Theory (Professional Knowledge)
Week 25	- Produce components involving profile turning, threading on taper, boring, and internal grooving. - Demonstration of automatic bar feeding system on CNC lathe (video/simulation). - Practice input and output of CNC part programs using USB / RS-232 / Ethernet LAN interface.	- Bar feeder mechanisms: Pneumatic and servo bar feeders, magazine loaders. - Data communication: DNC systems, baud rates, parity, and interfacing CNC with computers. - Introduction to CAM software for automated toolpath generation and post-processing.
Week 26	- DNC system setup and execution of large part programs in DNC / drip-feed mode. - Demonstration of CAM software toolpath simulation and G-code generation. - Comprehensive troubleshooting of dimensional, positioning, and program alarm errors on CNC lathe.	- Direct Numerical Control (DNC) operation principles and high-speed data transmission. - CAM post-processors: Function and machine controller compatibility. - Common alarms on CNC lathes: Servo alarms, spindle drive alarms, overtravel, and interlocks.
Week 27	- Thread cutting on taper surface (Vee form) on conventional lathe using taper attachment. - Tool setting, infeed calculation, and depth adjustment for taper threading.	- Setting of tools for taper threads: Calculation of taper angle, pitch correction, and thread depth. - Heat treatment: Principles, critical temperatures, and transformations of steel. - Hardening and tempering processes: Quenching media, temperatures, and soaking times.
Week 28	- Practice heat treatment processes: Hardening, tempering, and case hardening (carburizing) of lathe tool bits and components. - Hardness testing and inspection of heat-treated parts.	- Case hardening methods: Pack carburizing, liquid cyaniding, and gas nitriding. - Normalizing and annealing of medium carbon steels and tool steels. - Ferrous and non-ferrous metals used in heavy engineering and machine building.
Week 29	- Manufacturing and assembly of utility item: Screw Jack / Bench Vice spindle / Box Nut. - Performing turning, threading (Square/Acme), boring, knurling, and assembly fitment. - Verification of functionality, smooth operation, and load bearing.	- Interchangeability: Concept, selective assembly vs interchangeable manufacture, and standards. - Quality control procedures: Sampling, inspection methods, and control charts. - Manufacturing planning and assembly tolerances for machine sub-assemblies.
Week 30	- Prepare industrial workshop documentation: Process planning sheets, route cards, and job inspection logs. - Calculate cycle time, machining cost, and material estimation from technical drawings.	- Technical documentation in modern industries: Process charts, job cards, and activity logs. - Technical English terminology used in mechanical production and CNC shops. - Cycle time, productivity calculation, and machine hour rate concepts.
Week 31	- Turning Bevel Gear blanks to specified angles (face angle, cutting angle, root angle). - Checking angles and face dimensions with bevel protractor and vernier calipers.	- Bevel gears: Terminology (pitch angle, face angle, addendum angle, dedendum angle). - Machining blank angles on lathe using compound slide swivelling. - Tolerances and geometrical symbols on drawings: Cylindricity, runout, parallelism, and concentricity.
Week 32	- Read complex part drawings, formulate process plans, and manufacture turning arbor with clamping nut (hexagonal). - Checking thread and concentricity of arbor assembly.	- Interpretation of geometric dimensioning and tolerancing (GD&T) on production blueprints. - Design and machining of precision arbors, locating surfaces, and clamping nuts. - Selection of materials and heat treatment schedule for machine arbors.
Week 33	- Practice special operations on lathe: Worm shaft cutting (lead, pitch, and depth calculations). - Grinding worm cutting tool (29°/40° standard pressure angle) and cutting worm thread.	- Worm and Worm Wheel: Terminology, module, axial pitch, lead angle, and gear ratio. - Calculation of change wheels and lead screw gearing for cutting worm shafts. - Tool geometry and side clearances required for deep worm profile cutting.

Week No.	Trade Practical (Professional Skills)	Trade Theory (Professional Knowledge)
Week 34	- Boring on lathe using soft jaws to manufacture collared bush on non-ferrous metal (brass/bronze). - Check finished bore with dial bore gauge to specified accuracy of ± 0.05 mm.	- Soft jaws: Purpose, truing and boring soft jaws for holding pre-machined workpieces without marks. - Dial bore gauge: Construction, calibration with micrometer/ring gauge, and measurement procedure. - Properties and machining parameters of bearing bronzes and non-ferrous alloys.
Week 35	- Manufacture Arbor Support Bush (Proof Machining) with accurate internal and external concentricity. - Check fitting with standard arbor and inspect diametrical runout using dial indicator.	- Arbor support bushes: Function in horizontal milling machines and lubrication grooves. - Concentricity and total indicator reading (TIR) verification between centers. - Fit standards (H7/p6, H7/g6) for precision machine bushes.
Week 36	- Demonstration of Single Spindle Automatic Lathe (automats): Operating mechanisms, headstock, and camshaft. - Study of disc cams, bar stop, and cross-slide tooling arrangements. - Study of circular form tools and flat form tools used in automats.	- Automatic lathes: Classification (single spindle, multi-spindle automatics), operation principles. - Cam design fundamentals for automatic lathes: Rise, dwell, and cycle time. - Circular form tools: Construction, mounting, sharpening method, and corrected profiles.
Week 37	- Comprehensive project fabrication: Producing multi-component assembly on lathe involving turning, boring, and threading. - Inspection of interchangeable components and assembly fitment.	- Assembly procedures, sequence of fitting, and rectification of minor misalignments. - Total Productive Maintenance (TPM): Autonomous maintenance, 5S on CNC/conventional machines. - Environment, Health, and Safety (EHS) regulations in manufacturing industries.
Week 38	- Final overhaul inspection, precision testing, and preventive maintenance of conventional lathes and CNC machines. - Preparation of final trade portfolio, inspection sheets, and machine service records.	- Preventive maintenance schedule: Monthly, quarterly, and annual maintenance audits. - Geometrical alignment re-testing: ISO 230-2 and ISO 13041 standards for machine tool accuracy. - Review of trade theory topics and preparation for All India Trade Test (AITT).
Week 39	On the Job Training (OJT) / Group Project	On the Job Training (OJT) / Group Project
Week 40	On the Job Training (OJT) / Group Project	On the Job Training (OJT) / Group Project
Week 41	On the Job Training (OJT) / Group Project	On the Job Training (OJT) / Group Project
Week 42	On the Job Training (OJT) / Group Project	On the Job Training (OJT) / Group Project

APPROVAL & SIGNATURES

Sign of Instructor	Sign of Group Instructor (GI)	Sign of Superintendent / Principal