Module M 02 Machining (Turning, Off-hand tool grinding)		256 h
Evaluation criteria	Trainees are capable of resharpening simple marking- and cutting tools off-hand on the pedestal grinder Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment	
Capacity 1: **Identifying main cutting tool angles of the cutting tool wedge** Capacity 2: **Off-hand grinding of cutting tools such as chisels, twist drills and turning tools** Capacity 3: **Observing the safety precautions in tool grinding**	Content 1: **Angles on the cutting tool wedge and its relation to cutting conditions** Content 2: **Pedestal grinder and accessories; tool grinding practice** Content 3: **Safety regulations in off-hand tool grinding**	**32 h**

Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Identifying the geometry of the cutting tools (wedge angle, clearance angle, rake angle, angle of point, nose radius etc.) Explaining the appropriate materials for the cutting tools according given jobs (tool steels, high speed steels, cemented carbides) Describing the safety rules and measures in working with tool sharpening equipments. Selecting the appropriate grinding wheels according to the tool grinding work and the cutting tool material.	Determining the angles on cutting tools with the help of technical tables.	Calculations involving the angles on cutting tools	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**9**
Comparing conventional technical drawing and design with computer aided design (CAD), advantages, features and characteristics of CAD. Introducing a modern CAD-system similar to SolidWorks and describing its design features. Explaining the user interface (Benutzeroberfläche) Introducing of sketching in 2D and modelling in 3D	Identifying the components and accessories of the pedestal grinder Setting up the pedestal grinder for different grinding jobs Off-hand tool grinding practice : Re-sharpening of center punch, scriber, chisel, lathe tools and twist drills. Dressing of the grinding wheel with the star wheel dresser Adhering to the safety rules during re-sharpening	Identifying different grinding wheels and classifying them according to grit size, hardness and bond. ISO standards for grinding wheels. Changing the grinding wheels on the pedestal grinder.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 7: **Selecting the cutting speed and calculating spindle speed (rpm) and the feed for turning jobs** Capacity 8: **Maintaining the safety precautions during turning** Capacity 11: **Turning cylindrical items on the lathe as per technical drawing, according to required dimensions and tolerances**	Content 7 :**Determination of cutting data by calculation and by reading diagrams** Content 8: **Safety regulations of the trade** Content 11: **Longitudinal turning, facing, grooving, cutting**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Identifying the motions required for turning: cutting motion, feed motion and depth of cut. Classifying the machining operations on the lathe: longitudinal turning, facing, taper turning, boring, screw cutting, knurling, roughing and smoothing.	Drawing of simple cylindrical workpieces, dimensioning and lettering according to ISO	Calculation of the circumferential speed. Determining the cutting speed, spindle speed and feed for given lathe jobs using the technical tables	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**10**
Describing the relations between design elements: horizontal, vertical, perpendicular, equal, concentric, parallel, coradial, tangential relations. Designing and modelling a simple prismatic workpiece.	Identifying the main components and machine elements of a conventional lathe. Setting up the lathe for turning: devices for clamping the job and tool holders. Longitudinal turning and facing.	Determining the surface quality in turning with tools having different nose radius and turning with different cutting speeds and feeds.	

Module M 02 Machining (Turning, Off-hand tool grinding)		256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment	
Capacity 5: **Selecting the suitable cutting tools for a given job** Capacity 6: **Describing the construction and the main components of the conventional lathe** Capacity 11: **Turning cylindrical items on the lathe as per technical drawing, according to required dimensions and tolerances**	Content 5: **Roughing tool, side tool, finishing tool, boring tool, parting tool, radius tool** Content 6: **Types of lathes, construction and specification** Content 11: **Longitudinal turning, facing, grooving, cutting**	**32 h**

Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Classifying the different turning tools and explaining its typical uses Explaining the work holding devices such as three-jaw chuck, four – jaw chuck, face plate, collets, centers etc.	Elaborating a production plan for a cylindrical workpiece to be machined on a lathe	Determining the cutting speed, spindle speed and feed for given lathe jobs using the technical tables	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**11**
Designing and modelling a simple prismatic workpiece. Deriving the technical drawing from the 3D model.	Machining of cylindrical workpieces according to technical drawing; maintaining the dimensions tolerances and surface finish as indicated.	Determining the relation between tool geometry and chip formation: continuous chips, discontinuous chips and chip breakers. Realizing the necessity of preventive maintenance for the machine tools. Identifying the preventive maintenance work to be carried out in intervals according to the machine manual.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 5: **Selecting the suitable cutting tools for a given job** Capacity 7: **Selecting the cutting speed and calculating spindle speed (rpm)and the feed for turning jobs** Capacity 8: **Maintaining the safety precautions during turning**	Content 5: **Roughing tool, side tool, finishing tool, boring tool, parting tool, radius tool** Content 7: **Determination of cutting data by calculation and by reading diagrams** Content 8: **Safety regulations of the trade**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Selecting the suitable tools for given jobs. Distinguishing the different carbide tipped tools with indexible inserts as per ISO. Explaining the clamping methods of indexible inserts on the tool holder.	Introducing the cross-sectional views for cylindrical workpieces: Full-sectional view, half-sectional view, partial section	Calculating the cross-sectional area on turning (depth of cut x feed)	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**12**
Designing and modelling a simple prismatic workpiece. Deriving the technical drawing from the 3D model.	Machining of cylindrical workpieces according to technical drawing; maintaining the dimensions tolerances and surface finish as indicated within the specified time. Including boring operations, tapping and threading threads with threading die, recessing, parting and knurling.	Inspecting cylindrical workpieces for dimensions and surface quality using dial gauge and vee-block, vernier caliper, micrometer and surface roughness comparison specimen.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 7: **Selecting the cutting speed and calculating spindle speed (rpm)and the feed for turning jobs** Capacity 8: M**aintaining the safety precautions during turning**	Content 7: **Determination of cutting data by calculation and by reading diagrams** Content 8: **Safety regulations of the trade**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Determining the relation between depth of cut and feed motion in turning for roughing and finishing	Drawing of a cylindrical workpiece with external and internal contours in half-sectional view, dimensioning and lettering as per ISO	Calculating the cutting force on turning and the input rating in kW	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**13**
Designing and modelling a simple, cylindrical workpiece. Deriving the technical drawing from the 3D model. Introducing the cross-sectioning function. Deriving the technical drawing from the 3D model.	Machining of cylindrical workpieces according to technical drawing; maintaining the dimensions tolerances and surface finish as indicated within the specified time. Including boring operations, tapping and threading of threads with threading die, recessing, parting and knurling.	Determining the electrical power consumption on the lathe for different cutting conditions.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 4: **Identifying important cutting tool materials linking it with the cutting conditions** Capacity 7: **Selecting the cutting speed and calculating spindle speed (rpm)and the feed for turning jobs** Capacity 8: **Maintaining the safety precautions during turning**	Content 4: **High speed steels, carbide tipped tools, ceramics, indexable inserts** Content 7: **Determination of cutting data by calculation and by reading diagrams** Content 8: **Safety regulations of the trade**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Describing manufacturing methods such as boring, knurling, parting, tapping, threading with threading die and recessing and determining the cutting conditions.	Drawing of a cylindrical workpiece with external and internal contours in half-sectional view, dimensioning and lettering as per ISO.	Calculating the cutting speed, cutting force, power on the cutting edge, and power rating of the electric drive for given cutting data and specific cutting force.	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**14**
Designing and modelling a simple, cylindrical workpiece. Deriving the technical drawing from the 3D model. Introducing the cross-sectioning function. Deriving the technical drawing from the 3D model.	Machining of cylindrical workpieces according to technical drawing; maintaining the dimensions tolerances and surface finish as indicated within the specified time. Including boring operations, tapping and threading of threads with threading die, recessing, parting and knurling.	Testing of different cutting tool materials in turning operations: HSS, cemented carbides, oxide ceramics and determining optimum cutting conditions.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 4: **Identifying important cutting tool materials linking it with the cutting conditions** Capacity 7: **Selecting the cutting speed and calculating spindle speed (rpm)and the feed for turning jobs** Capacity 12: **Inspecting and self-assessing the work**	Content 4: **High speed steels, carbide tipped tools, ceramics, indexable inserts** Content 7: **Determination of cutting data by calculation and by reading Diagrams** Content 12: **Assessment systems and assessment methods**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Describing surface roughness values in turning operations and distinguishing between R_a and R_z	Elaborating a production plan for a cylindrical workpiece to be produced on a lathe.	Calculating the cutting speed, cutting force, power on the cutting edge, and power rating of the electric drive for given cutting data and specific cutting force.	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**15**
Designing and modelling a simple, cylindrical workpiece. Deriving the technical drawing from the 3D model. Introducing the cross-sectioning function. Deriving the technical drawing from the 3D model.	Machining of cylindrical workpieces according to technical drawing; maintaining the dimensions tolerances and surface finish as indicated within the specified time. Including boring operations, tapping and threading of threads with threading die, recessing, parting and knurling.	Analyzing wear on cutting edges, identifying its causes and suggesting solutions and remedies to the problems.	

Module M 02 Machining (Turning, Off-hand tool grinding)			256 h
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Capacity 6: **Describing the construction and the main components of the conventional lathe** Capacity 12: **Inspecting and self-assessing the work**	Content 6: **Types of lathes, construction and specification** Content 12: **Assessment systems and assessment methods**		**32 h**
Technology	**Technical Communications**	**Applied Mathematics**	**Week**
Classifying the lathes and explaining its features and uses: Universal lathe, facing lathe, vertical boring and turning machine, turret lathe, multi-spindle lathe and CNC lathe	Presentation of a production plan for the manufacture of a cylindrical workpiece and visualizing it by using mind-map, poster, transparency or data projector. (group work)	Calculating the manufacturing cost of a lathe job including material cost, labour cost and cost of energy.	
Computer Applications	**Workshop Practice**	**Laboratory Exercises**	**16**
Designing and modelling a simple, cylindrical workpiece. Deriving the technical drawing from the 3D model. Introducing the cross-sectioning function. Deriving the technical drawing from the 3D model.	Self-assessing the work performed on the lathe. Inspecting the lathe and carrying out all the necessary preventive maintenance measures and cleaning work according to the machine manual.	Caring for laboratory equipment and maintenance of machines and tools.	