NAME OF THE COURSE : **PRECISION GRINDING PRACTICE – (Surface grinding, Cylindrical grinding and Centreless grinding)**

COURSE S.NO. : 9.01

COURSE DURATION : **2 WEEKS**

COURSE CONTENT

Theory

- Principles of grinding process, grinding accuracies and finish and grinding allowance.
- safety in grinding operations
- Types of surface grinding machines and applications, grinding parameters and surface grinding techniques.
- Work holding accessories for surface grinding
- Wheel balancing , truing and dressing
- Grinding wheels-Classification, coding and selection criteria.
- Cylindrical grinding machine attachments and accessories
- Cylindrical grinding procedures-external and internal.
- Cylindrical grinding parameters
- Principles of centreless grinding process, centreless grinding machine parts and functions.
- Types of centreless grinding operations and operating procedures.
- Maintenance and trouble shooting on grinding machines
- Grinding defects, causes and remedy
- Measurement of geometrical accuracies and surface roughness

Practical

- Grinding a parallel block
- Surface grinding tapered surfaces
- Wheel balancing and truing of grinding wheel
- Surface grinding groves and slots
- Cylindrical grinding plain shaft
- Cylindrical grinding a stepped shaft
- Cylindrical grinding shoulders
- Cylindrical grinding taper shaft
- Cylindrical grinding internal surface
- Cylindrical grinding internal taper
- Centreless grinding through feed
- Centreless grinding in-feed
- Measurement of flatness, and surface roughness

NAME OF THE COURSE **: TOOL AND CUTTER GRINDING TECHNIQUES**

COURSE S.NO : **9.02**

COURSE DURATION **: 2 WEEKS**

COURSE CONTENT

Theory

- Tool and cutter grinding machines – description, parts and functions
- Tool and cutter grinding machine attachments, accessories and applications
- Tool geometry of single point cutting tools and milling cutters
- Methods of re- sharpening milling cutters -
- H.S.S tool materials and selection criteria
- Tool wear and tool life
- Tool geometry of Broach
- Drill geometry, drill wear, and web- thinning.
- Tool geometry of reamer and re-sharpening methods
- Geometry of Gear hobbing and gear shaping cutters

Practical

- Re-sharpening of single point cutting tools on tool and cutter grinder.
- Re-sharpening side and face cutter by tilting the wheel head
- Re-sharpening side and face cutter by offset method and clearance angle setting gauge
- Re-sharpening axial clearance angle of side and face cutter and end mills
- Re-sharpening radial clearance angle of staggered teeth side and face cutter and end mills.
- Re-sharpening s slab milling cutter and shell end mill
- Corner chamfering of shell end mill.
- Re- sharpening of slot drill.
- Re-sharpening of twist drills
- Re-sharpening of form relieved cutters
- Re-sharpening of hand reamer
- Re sharpening of Hob and Gear shaper cutters

NAME OF THE COURSE **: MILLING PRACTICE –**

(V-Block, Helical, Cam milling etc.)

COURSE S.NO : **9.03**

COURSE DURATION **: 2 WEEKS**

COURSE CONTENT:

Theory:

- Types of Milling machines, parts and functions, specification, tool holding and work holding devices, safe handling of milling machines, and maintenance.
- Process of milling - face milling, peripheral milling (up milling and down milling) and end milling.
- Milling cutters- types, classification, elements, tool geometry, and tool materials, milling speeds, feeds and depth of cut.
- Milling machine operation and methods of milling angular surfaces using horizontal and vertical milling machines. Milling convex and concave surfaces
- Description of universal dividing head its parts and function. Indexing methods. Calculation for various indexing methods and indexing procedures.
- Types of gear trains. Elements of spur gear and calculation of dimensions.
- Rack – types, elements and calculation of dimensions. Methods of producing racks.
- Elements of bevel gear and calculation of dimensions.
- Elements of worm & worm wheel and calculation of dimensions.
- Cams – types and milling procedures
- Tool milling machine operations – Boring and facing

Practicals

- Milling and surface grinding a V-Block
- Cutting a spur gear using horizontal milling machine using indexing head
- Milling a rack
- Cutting R.H /LH helical gear
- Milling an end mill
- Milling a bevel gear
- Milling worm wheel
- Milling plate cams and drum cams
- Tool milling machine operations – Boring and facing

NAME OF THE COURSE : MANUFACTURING OF JIGS AND FIXTURES

COURSE S.NO : 9.04

COURSE DURATION : 3 WEEKS

COURSE CONTENT:

Theory

- Introduction, course objectives and safety in work shop
- Batch production and mass production.
- Machining processes- Turning, milling, drilling, tapping and grinding.
- Necessity and advantages of jigs and fixtures.
- Elements of Jigs and fixtures and principles of jigs and fixtures design.
- Principles of location and location methods.
- Principles of clamping and clamping methods.
- Types of Drill jigs and drill bushes.
- Fasteners and fastening methods.
- Dowels and doweling methods.
- Jig boring, EDM and Wire cut EDM processes for precise machining of drill bush location holes.
- Design aspects of milling fixtures.
- Types of milling fixtures.
- Limits & fits.
- Welding, grinding and broaching fixtures.
- Materials and heat treatment of jigs and fixture elements.
- Inspection fixtures.
- Geometrical features.
- Modular Jig and Fixtures.

Practical

- Study of drawings and planning for manufacturing drill jig.
- Manufacturing of Drill jig elements by conventional machining process viz. milling, turning, grinding, drilling, tapping etc.
- Jig boring operation for drill bush location holes.
- Assembling and try out of Drill Jig.
- Study of drawings and planning for manufacturing of milling fixture.
- Manufacturing of milling fixture elements by milling, grinding, drilling, tapping etc
- Assembling and try out of milling fixture.
- Practice on programming and machining on CNC EDM

NAME OF THE COURSE : **PROGRAMMING AND MACHINING ON CNC EDM (DIE SINKING)**

COURSE S.NO : **9.05**

COURSE DURATION **: 2 WEEKS**

COURSE CONTENT:

Theory

1. Principle of EDM ,advantages, applications, machine tool, power supply and dielectric Supply
2. Work Preparation, dielectric fluids and characteristics, types of flushing, setting up and operation.
3. Selection of variables - current, on time off time, gap voltage etc. and their effects.
4. Selection of parameters and parameter setting for roughing semi finishing and finishing.
5. Machine commands, codes and C- axis function.
6. Programming for machining single cavities in different axes.
7. Programming by GURU for machining Arc CW/CCW, Orbital cycles – Vector, Taper vector, XY vector Z inside, Circle, Taper circle, XY circle Z inside, Polygon, Sphere, Internal helical and External helical.
8. Programming by EXPERT– single cavity, multi cavity, PCD and assorted cavities.
9. List of specific hazards and relevant safety measures on CNC EDM.

Practical

1. Manufacturing of electrodes for roughing, semi finishing and finishing.
2. Work preparation, alignment and clamping.
3. Machining single and multi cavities in different axes.
4. Machining Arc CW/CCW, Orbital cycles – Vector, Taper vector, XY vector Z inside, Circle, Taper circle, XY circle Z inside, Polygon, Sphere, Internal helical and External helical.
5. Machining single cavities, multi cavities , assorted cavities and PCD by programme EXPERT

NAME OF THE COURSE **: MANUFACTURING OF PRESS TOOL**

(PROGRESSIVE TOOL)

COURSE S.NO : **9.06**

COURSE DURATION **: 3 WEEKS**

COURSE CONTENT

Theory

- Scope of press working and types of press tool operations
- Machining processes- Turning, milling, drilling, tapping and grinding.
- Theory of cutting and effect of excessive and insufficient die clearance.
- Steps involved in designing press tool, determination of cutting force and die Clearance
- Types of presses and selection criteria
- Computing die thickness and margins and punch dimensioning.
- Standard die sets.
- Scrap strip & strip layout for blanking.
- Die block and punch design.
- Types of stripers, striper design, stripping force and stock stops.
- Fasteners and fastening methods.
- Dowels and doweling methods.
- Die materials and heat treatment of dies and punches
- Jig boring, jig grinding, EDM and Wire cut EDM operations for precise machining of die holes.
- Methods of repairing defective and worn out punches and dies.
- Failure analysis of press tools
- Die setting

Practical

- Manufacturing of Press tool (Progressive Tool) elements by conventional machining process viz. turning, milling, grinding, drilling, tapping etc.
- Jig boring operation of machining die holes
- Heat treatment press tool elements and fish grinding
- Assembling and try out of press tool
- Rectification / re-grinding of punch and die
- Practice on programming and machining on CNC EDM

NAME OF THE COURSE **: SURFACE FINISHING TECHNIQUES –**

(surface grinding, cylindrical grinding, lapping and honing)

COURSE S.NO : **9.07**

COURSE DURATION : **2 WEEKS**

COURSE CONTENT

Theory

- Principles of grinding process, grinding accuracies and finish and grinding allowance.
- safety in grinding operations
- Types of surface grinding machines and applications, grinding parameters and surface grinding techniques.
- Work holding accessories
- Wheel balancing , truing and dressing
- Grinding wheels-Classification, coding and selection criteria.
- Cylindrical grinding machine attachments and accessories
- Cylindrical grinding procedures-external and internal.
- Cylindrical grinding parameters
- Grinding defects, causes and remedy
- Lapping principles, types of lapping
- Types of lapping machines and applications
- Lap materials, lapping abrasives and vehicles
- Lapping speeds and lapping allowance
- Measurement of flatness and surface roughness
- Honing principles, types of honing, honing machines, honing stones and honing procedure and techniques.
- Trouble shooting on lapping and honing

Practicals

- Grinding a parallel block
- Surface grinding tapered surfaces
- Wheel balancing and truing of grinding wheel
- Surface grinding groves and slots
- Cylindrical grinding plain shaft
- Cylindrical grinding a stepped shaft
- Cylindrical grinding shoulders
- Cylindrical grinding taper shaft
- Cylindrical grinding internal surface
- Cylindrical grinding internal taper
- Hand Lapping flat surface
- Lapping flat surface on flat lapping machine
- Measurement of flatness and surface roughness
- Honing a bore in hand honing machine

NAME OF THE COURSE **: GEAR MANUFACTURING TECNNIQUE**

COURSE S.NO : **9.07**

COURSE DURATION **: 2 WEEKS**

THEORY

- General classification on gears
- Characteristics of involute and cycloidal profiles
- Gear materials, their properties and heat treatment
- Basic rack and calculation of dimensions for cutting racks
- Spur and helical gear nomenclatures
- Calculation of dimensions for cutting standard spur gears
- Interference and undercutting in spur gears
- Minimum number of teeth to avoid interference (spur gears)
- Profile correction of gears and types of corrected gearing (spur gears).
- Calculation of dimensions for cutting corrected spur gears
- Calculation of dimensions for cutting standard Helical gears
- Correction in Helical gearing
- Internal helical gears
- Principles of Gear generation
- Gear shaping procedure
- Gear hobbing procedures
- Bevel gear nomenclatures and calculation of dimensions for cutting straight bevel gears
- worm and worm wheel nomenclatures and calculations for cutting worm and worm wheel
- Quality grades and errors of gears
- Metrology, inspection and tolerances of Gears

PRACTICALS

- Milling racks on milling machine and measuring dimension
- Milling spur gear on milling machine and measuring dimensions
- Milling Helical gear on milling machine and measuring dimensions
- Milling straight bevel gear on milling machine
- Milling worm wheel in milling machine and finishing it by using Hob
- Turning a worn shaft on lathe
- Gear shaping external spur gear