

Upgradation of ITIs into Centers of Excellence-Broad guidelines for implementation of the scheme

Production & Manufacturing

These Centres will be providing multiskill training to meet the skill requirement of particular sector of industry with their active involvement in all aspects of training. The training will be provided in three parts as given below:

- ✓ Training in Basic skill areas for a period of one year.
- ✓ Training in Advanced modules of six months duration after Broad based basic Training(BBBT)
- ✓ The testing & certification for the Basic skill training & advanced training during next six months will be conducted by NCVT
- ✓ Training in specialized modules mainly in the industry(The course curricula, duration etc will be designed in consultations with the IMC/local industry). The trade testing & certification for specialized module will be done jointly by the State Government & Industry. Said certificate will have recognition from NCVT

As per the recommendations of the EFC, Training in the shop floor should constitute atleast 25-40% of the curriculum.

The training programme will have multi-entry and multi-exit provisions as given below:

- ✓ trainee can opt to go to the labour market after completing broad based basic training of one year duration or after completing advanced module.
- ✓ trainee can come back after some time to seek admission for advanced/ additional advanced /specialised module

Training in Advanced modules

- After the BBBT of one year duration, for subsequent training in Advanced Module, a CoE may select minimum three modules, so as to ensure that all the 96 trainees could be accommodated in the three modules in two shifts each.
- If it is felt that available modules are not sufficient to cater to the needs of local industry in a particular state, States may develop suitable module(s) accordingly in consultations with the industry & forward the same to DGE&T for seeking approval of NCVT.
- A trainee at a time can opt only for one module of 24 weeks duration.
- Admission Criteria, Space requirement, Qualification of instructor of the various modules of "Production & Manufacturing" sector are attached herewith.

Facilities for passed out trainees from Conventional Pattern for admission in Advanced module.

Subject to availability of seats, NTC /NAC passed outs from conventional system of the trades mentioned against each advanced module in the enclosed statement, could be offered admission accordingly.

MODULE NO.	NAME OF THE MODULE	Admission criteria	Space requirement	Duration In Weeks	Qualification/Status Of Instructor
PMAT-01	CNC MACHINING	Completed BBBT in Production & Manufacturing sector OR NTC/NAC in Turner/Machinist OR Diploma in Mechanical Engg/ Production Engg	80 sq m	24 weeks	Degree in Mechanical/Production Engg with minimum three years teaching/industrial experience in the relevant field OR Diploma in Mechanical/Production Engg with min five years teaching/industrial experience in the relevant field
PMAT-02	CAD / CAM	Completed BBBT in Production & Manufacturing sector OR NTC/NAC in Turner/Machinist OR Diploma in Mechanical Engg/ Production Engg			
PMAT-03	PLC & AUTOMATION	Completed BBBT in Production & Manufacturing sector OR Diploma in Mechanical / Production/Electronics Engg			
PMAT-04	QUALITY ENGINEERING	Completed BBBT in Production & Manufacturing sector OR Diploma in Mechanical / Production Engineering			
PMAT-05	MANUFACTURING OF JIGS & FIXTURES	Completed BBBT in Production & Manufacturing sector OR NTC/NAC in Turner/Machinist/Fitter OR Diploma in Mechanical Engg/ Production Engg			
PMAT-06	ADVANCED WELDING	Completed BBBT in Production & Manufacturing sector OR NTC/NAC in Welder OR Diploma in Mechanical Engg/ Production Engg			STATUS One level higher pay scale than that of Vocational Instructor to attract better talent

I N D E X

UPGRADATION OF ITIs INTO CENTRES OF EXCELLENCE (CoE)

SECTOR / AREA : **PRODUCTION AND MANUFACTURING**

ADVANCED MODULES IN II YEAR (FOR THE FIRST 6 MONTHS OF II YEAR)

MODUL E NO.	NAME OF THE MODULE	DURATION IN WEEKS	PAGE NO.
PMAT- 01	CNC MACHINING	24 weeks	
PMAT- 02	CAD / CAM	- do -	
PMAT- 03	PLC & AUTOMATION	- do -	
PMAT- 04	QUALITY ENGINEERING	- do -	
PMAT- 05	MANUFACTURING OF JIGS & FIXTURES	- do -	
PMAT- 06	ADVANCED WELDING	- do -	

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : **PRODUCTION AND MANUFACTURING**

ADVANCED MODULE IN II YEAR

PMAT-01 : **CNC MACHINING**

(Duration - **24 weeks**)

I) COURSE CONTENT

Practical	Theory
SIEMENS CNC CONTROL-TURNING. (Sinumerik-802D-T or latest) Study of CNC machine, key board & specifications. Machine starting & operating in Reference Point, JOG, and Incremental Modes Co-ordinate system points, assignments and simulations. Absolute and incremental programming assignments and simulations. . Identification of machine over travel limits and emergency stop. Work and tool setting .CNC M/C Part program preparation, Simulation & Automatic Mode Execution: Simple turning & Facing (step turning)	Safety Precautions Safe handling of tools, equipment & CNC machines, Conventional & CNC machining, types of CNC machines, advantages & limitations of CNC, computer numerical control applications. Future of computer numerical control technology. CNC systems CNC interpolation, open loop& close loop control systems. Co-ordinate systems and Points. CNC Machines – Turning - Milling,- Types , Machine axes. Review, assignment / practice, Test

<p>Grooving and thread cutting ID Threading cycle OD Sub program with repetition Sub program with macro call. Eccentric turning etc</p>	<p>Factors affecting Turned part quality/productivity. Tapping / rigid tapping on CNC turning.</p>
<p>CNC turning exercises: Multistart threading Programming with variables. Project work : CAD / CAM programming & DNC operations. Final test and evaluations.</p>	<p>Programming with variables and custom macros. Program data transfer from PC to CNC machines and DNC operations. Program preparation with CAD/CAM.</p>
<p>Study of CNC machines, key boards & specifications. Machine starting & operating in Reference Point, JOG, Incremental Modes Co-ordinate system points, assignments and simulations. Absolute and incremental programming assignments and simulations. Polar co-ordinate points , assignments and simulations. Identification of machine over travel limits and emergency stop. Work and tool setting . Work and tool setting . CNC M/C Exercises. Part program preparation, Simulation & Automatic Mode Execution: Simple turning & Facing , Step turning etc.</p>	<p>Safety Precautions Safe handling of tools, equipment & CNC Lathe with FANUC CNC Oi -T CNC system organization & specification. Co-ordinate systems and Points. , Machine axes. Polar co-ordinate points.CNC machine specification and Machine elements. Preventive maintenance. Review, assignment / practice, Test</p>
<p>Linear interpolation, assignments and simulations. Circular interpolation, assignment and simulations. Work off set measurement and entry in CNC Control. Tool off set measurement and entry in the control Tool off set measurement using tool pre-setter. Simulation software Program entry and editing. Partprogram preparation, Simulation &Automatic Mode Execution Of CNC Turning Practical Exercise: Turning with Radius / chamfer with TNRC etc Review, assignment / practice, Test</p>	<p>CNC Control Hardware and operating Software CNC Software organization . Input Media and tape formats Feed Drives and spindle drives. Machine tool elements. . CNC Machine working principle. Zero off sets and tool off sets in FANUC CNC Turning. Feedback devices for CNC control. TPM in CNC. Tool Nose Radius Compensation (TNRC).</p>
<p>Linear interpolation, and simulation. Assignment Circular interpolation, and simulation. Assignment Chuck removal and mounting on CNC Lathe.</p>	<p>Cutting tool materials for CNC Turning and its applications. Component Materials. ISO codes for carbide indexable inserts and tool holders for turning.</p>

<p>Tool change in CNC turning/milling & MPG, MDI mode operation. Zero offsets and tool offsets measurement on tool presetter Preparation of simple turning and facing program.</p> <p>Automatic mode operation.of CNC Machine Exercise: Radius programming contours with TNRC etc</p>	<p>Tooling systems for CNC TURNING Centers. Zero offsets and tool offsets measurement on tool presetter Cutting parameters selection and process planning. Tools layout and process sheet preparation . Using Sub Programs & Cycles in the Main Program. Direct dimension programming Review, assignment / Test</p>
<p>Geometry and wear offset correction. Part program preparation,Simulation & Automatic Mode Execution of CNC Machine Exercises : Stock removal cycle OD Drilling / boring cycles Stock removal cycle ID etc</p> <p>Review, assignment / practice, Test</p>	<p>Planning for CNC operations Work-piece zero points and ISO / DIN G and M codes for CNC. Processes sequencing, Tool path planning for practicals Stock removal cycle in CNC turning for OD /ID operation. Tooling system for turning and tooling strategies for CNC turning machines. Drilling / Boring cycles in CNC Turning</p>
<p>Simulation and machining of Part program exercises : Grooving and thread cutting OD & ID Threading cycle OD Sub program with repetition, Sub program with macro call. Ecentric turning etc</p> <p>Industrial visit</p>	<p>Grooving / Threading Tools, Processes and Tool selection Programming for Grooving / Threading on OD/ID in CNC Turning. Trouble shooting in CNC Turning. Tool wear Patterns and optimization of cutting parameters. Factors affecting Turned part quality/productivity. Tapping / rigid tapping on CNC turning.</p>
<p>CNC turning exercises: Multistart threading , Programming with variables. Etc. Project work : CAD / CAM programming & DNC operations. Final Test and evaluations.</p>	<p>Programming with variables and custom macros. Program data transfer from PC to CNC machines& DNC operations. Program preparation with CAD/CAM</p>
<p>Study of CNC Machining centre, key board & specifications. Machine starting & operating in Reference Point, JOG, Incremental Modes . Co-ordinate system points, assignments and simulations. Absolute and incremental programming assignments and simulations. Polar co-ordinate points , assignments and simulations. Identification of machine over travel limits and emergency stops. Work and tool setting . Automatic Mode operation: Face Milling etc.</p>	<p>Safety Precautions Safe handling of tools, equipment & CNC machines, CNC Mill with FANUC CNC CONTROL- (Fanuc-0i-M latest) CNC Machine &Control specifications. CNC system organization Fanuc-0i-M. Co-ordinate systems and Points. CNC Machines Milling,Types , Machine axes.</p>

	Review, assignment / practice, Test
<p>Linear interpolation, assignments and simulations.-Milling Circular interpolation, assignment and simulations.-Milling Work off set measurement and entry in CNC Control. Tool off set measurement and entry in the control.Program entry & editing. Part program preparation, Simulation & Automatic Mode Execution Of CNC Machine Practical EX.: Chamfering and end milling with CRC etc</p> <p>Review, assignment / practice, Test</p>	<p>CNC Control Hardware and operating Software CNC Software organization .Input Media and tape formats Feed Drives and spindle drives. Machine tool elements. . CNC Machine working principle. Zero off sets and tool off sets in FANUC Milling . Feedback devices for CNC control. TPM in CNC.</p>
<p>Linear interpolation, and simulation. Assignment - Milling Circular interpolation, and simulation. Assignment - Milling Tool change in CNC milling & JOG, INC,MPG mode operation. Manual Data Input mode operations & checking of zero offsets and tool offsets. Preparation of part programs for Exercises and computer simulations. Automatic mode execution of CNC Machine Exercises with Block Search and restart: End milling with polar co-ordinates. Simple drilling-G 81. etc</p>	<p>Cutting tool materials for CNC Milling.and its applications. Component Materials. ISO codes for carbide indexable inserts and tool holders for Milling. Tooling systems for CNC Machining Centers. Cutter Radius Compensation (CRC). Cutting parameters selection and process planning. Tools layout and process sheet preparation . Using Sub Programs & Cycles in the Main Program. Review assignment / Test</p>
<p>Geometry and wear offset correction. Part Program Preparation ,entry and simulation on CNC Mill & on Computers. CNC Milling Machine Exercises :</p> <p style="padding-left: 150px;">Chamfer and counter-sink drilling. Deep hole drilling G 83. Threading and tapping G 84. Boring cycles G 85 – G 89.</p> <p>Review, assignment / practice, Test</p>	<p>Planning for CNC operations-Milling. Part Features identification and process selection. Processes planning & tool selection for the practicals Work-piece zero points and ISO/DIN G and M codes for CNC milling. Machining parameters for milling. Polar coordinate & Direct dimension programming. Work locating principle and locating devices for CNC milling. Drilling / Boring cycles in CNC Milling.</p>
<p>Preparations of part programs for thread cutting / thread milling for CNC machining centers. Part Program Preparation ,entry and simulation on CNC Mill & on Computers for Part program exercises . Automatic mode execution of CNC Machine Exercises With Block Search and restart: Sub program/ repetition and macro call.</p>	<p>Grooving / Threading Tools, Processes and Tool selection. Programming for Grooving / Threading on OD/ID in CNC Milling. Helical Interpolation and Thread Milling, advantages and limitations in CNC Milling. Machining of rectangular / circular pockets on CNC milling. Drilling, milling patterns on CNC milling.</p>

Circular and rectangular pockets machining. Drilling milling patterns. Thread milling etc.	Rigid tapping on CNC milling.
CNC Machining of Custom Macro program G 65. Project Work : CAD / CAM programming & DNC operations. Final test and evaluations.	Programming with variables and custom macros on Fanuc CNC. Program data transfer from PC to CNC machines and DNC operations.
SIEMENS CNC CONTROL- Milling. (Sinumerik-802D- or latest)	
Study of CNC Machining centre, key board & specifications. Machine starting & operating in Reference Point, JOG, Incremental Modes Co-ordinate system points, assignments and simulations. Absolute and incremental programming assignments and simulations. Polar co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. Work and tool setting. Automatic Mode operation: Face Milling etc.	Safety Precautions Safe handling of tools, equipment & CNC machines, CNC Mill with SIEMENS CNC CONTROL(sinumerik 802D-M or latest) CNC Machine &Control specifications. CNC system organization Co-ordinate systems and Points & Polar coordinates. CNC Machine axes designation Review, assignment / practice, Test
Linear interpolation, assignments and simulations.-Milling Circular interpolation, assignment and simulations.-Milling Work off set measurement and entry in CNC Control. Tool off set measurement and entry in the control.Program entry & editing. Part program preparation, Simulation & Automatic Mode Execution Of CNC Machine Practicals : Chamfering and end milling with CRC etc. End Milling with Polar coordinates Review, assignment / practice, Test	CNC Control Hardware and operating Software CNC Software organization . Input Media and tape formats Feed Drives and spindle drives. Machine tool elements. . CNC Machine working principle. Zero off sets and tool off sets in FANUC Milling . Feedback devices for CNC control. TPM in CNC.
Linear, Circular interpolation, and simulation - Assignments Tool change in CNC milling & JOG, INC,MPG mode operation. MDI mode operations and checking of zero offsets and tool offsets. Preparation, simulations of part programs Exercises in Automatic mode execution with Block Search and restart : End milling with polar co-ordinates. Simple drilling-G 81.	Cutting tool materials for CNC Milling.and its applications. Component Materials. ISO codes for carbide indexable inserts and tool holders for Milling. Tooling systems for CNC Machining Centers. Cutter Radius Compensation (CRC). Cutting parameters selection and process planning.

Chamfer and counter-sink drilling. Deep hole drilling G 83. Tapping G 84.etc.	Tools layout and process sheet preparation . Using Sub Programs & Cycles in the Main Program. Review, assignment / Test
Geometry and wear offset correction. Machining of CNC Exercises : Boring cycles G 85 – G 89. Threading and Thread milling etc Rigid tapping on CNC milling Review, assignment / practice, Test	Planning for CNC operations Processes sequencing & tool selection(Tool path planning. Work-piece zero points and ISO/DIN G and M codes for CNC milling. Machining parameters for milling . Work locating principle and locating devices for CNC milling. Drilling /Boring cycles in SinumerikCNC Milling. Grooving/Threading Tools, Processes and Tool selection.Programming for Grooving/Threading on OD/ID in CNC Milling. Helical Interpolation and Thread Milling, advantages and limitations in CNC Milling.
Automatic mode execution of CNC Machine Exercises With Block Search and restart : Sub program/ repetition and macro call. Circular and rectangular pockets machining. Drilling milling patterns etc. Industrial visit	Machining of rectangular / circular pockets on CNC milling. Drilling, milling patterns on CNC milling. .
Project Work : CAD / CAM programming and DNC operations.	Programming with variables and custom macros on Fanuc CNC. Program data transfer from PC to CNC machines and DNC operations

II) TOOLS, MACHINERY, EQUIPMENTS etc. for a batch of 16 trainees

		Qty.
1.	CNC 2 axes Turning Centre with Fanuc Oi – Mate TC / Siemens Sinumerik 802 D (one each) CNC system and with required cutting tools and Tooling Package Installation and commissioning (Capacity :Intermediate Production Machines)	2 Nos.
2.	CNC 3 axes Vertical Machining Centre with Fanuc / Siemens Sinumerik 802 D CNC Controls and Tooling package Installation and commissioning, hydraulic vice, maintenance kit (one each) (Capacity :Intermediate Production Machines)	2 nos.
3.	Tool presetting machine with digital readout for measuring length and radius with all accessories	1 No
4.	CNC part program – Simulation soft wares with CAD / CAM facility for Siemens Sinumerik802 D / FANUC Oi MB Turning module - 2 axes - 8 Licenses , Milling modules – 4 axes - 8 Licenses	1 set
5.	Pentium IV computer 3GHz or latest with 512 MB DD RAM with compatible motherboard, DVD combo drive with the latest x version, hard disk with 80 GB or above, 17" Colour Monitor, 64 MB AGP card, 10/100 Ethernet card, Internal modem, UPS with 800 VA	8 Nos
6.	Tool cabinet	4 Nos

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

UPGRADATION OF ITIs into CENTERS of EXCELLENCE (CoE)

**SECTOR / AREA : PRODUCTION AND MANUFACTURING
(2 YEARS)**

**ADVANCED MODULES IN II YEAR
(FOR THE FIRST 6 MONTHS OF II YEAR)**

PMAT-02 : CAD / CAM

(Duration - 24 weeks)

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : **PRODUCTION AND MANUFACTURING**

ADVANCED MODULE IN II YEAR

PMAT-02 : **CAD / CAM**

(Duration - **24 weeks**)

I) COURSE CONTENT

Practical	Theory
Create AutoCAD shortcut at desktop, open AutoCAD, close AutoCAD, create user folder for AutoCAD files, draw a point using absolute co ordinate system , relative coordinate system, polar coordinate system, Set limits, zoom all, zoom window, zoom previous, zoom real-time. Use grid, use snap for drawing a line.	Install AutoCAD, configure AutoCAD, AutoCAD graphical user interface , point command, zoom command, limits, coordinate systems, Snap and Grids in AutoCAD
Draw a rectangle, pentagon, hexagon, star using line command with polar coordinate system and relative coordinate system. Draw circles of various dimensions by center radius, tangent method, 3point method. Draw arcs of various types using 3point , SCE, SER, SEA, SCA, SCL methods, Draw ellipse with major and minor axis length method, rotation method. Draw a tapered rod using polyline command. Convert line and arcs into ploy lines. Create spline and fit curves using polyline edit options, Explode Ploylines. Practice exercises on OSNAP snapping modes like endpoint, mid point, center of circle, and tangent, perpendicular quadrant of a circle with many example exercises.	Understanding Line command, Circle command, Arc command, Ellipse command, Polyline command, pedit command, OSNAP commands, Explode

<p>Erase the entities created in the previous examples, using different types of selection like window, all, and single entity methods. Move the drawings created from one place to other with reference to a base point. Copy the entities using different reference points, Scale the items drawn by a reference and by a value. Rotate the items at a point at different angles.</p>	<p>Understand Erase bySelection, Erase by Window, Erase by All, MOVE by a Reference, COPY by reference, Copy Multiple, Scale by Reference, Scale by Scale factor , ROTATE by Reference, Rotate by Angle commands. Learn to use different selection tools.</p>
<p>Draw offsets inside and outside of an object, trim the objects, extend the objects, fillet the corners, chamfer at an angle and distance, Fillet and Chamfer ploylines Array the objects in polar and rectangular modes, mirror the objects at X axis and Y axis, Stretch the entities from a reference point. Divide and Measure commands. Try using the above for some mechanical components like gear with many teeth, symmetrical shape parts.</p>	<p>Editing commands like Offset , Mirror along an Axis, Mirror along a line, Mirror along an angle, Array rectangular, Array Polar method, Array rotated, Fillet with Trim, Fillet without No trim, Chamfer with Trim, Chmfer without Trim, Extend along a boundary, Trim with delete, and Stretch along a reference , Divide multiple units, Measure along a line</p>
<p>Dimension the drawings created using linear, Aligned, Angular, radius and Diameter dimensioning techniques. Try to save different styles of Dimensioning for a drawing file. Edit dimension properties, Use symbols like diameter, degree, Plus or Minus in dimensioning. Use tolerances with symmetrical and deviation types. Hatch the closed objects, edit them by changing colors, hatch pattern scale, loading and creating different customized hatch patterns.</p>	<p>Dimensioning with style creation. Set the Arrow height, length, text height, width, Tolarence, dimension along the dimension line, Dimension extension line, Dimension Extension offset, Dimension Symbols, Modify Dimension, Set Current Dimension and hatching inside an Island, Along a boundary, Hatch Patterns.</p>
<p>Create layer for different objects like lines, circles, Dimensions, load line types to drawing file , convert a line to different type, assign by layer property for an object, Lock layers, freeze layers, thaw layers, Change objects from one layer to the other layer.</p>	<p>Study of Creating Layers, Modifying Layers, Freezing Layers, Thawing Layers, Make On and OFF Layers, Create Line types, Modify existing lines to different Linetypes, Create custom Line types, Imprt Linetypes.</p>
<p>Write text in drawings. Use multiline editors. Use different styles of text. Use different fonts in a text editor. Insert different symbols in a multiline text. Justify the texts for top left, top right, middle center, middle left etc. Match Properties. Practice these by creating a drawing file with border and annotations about the scale of drawing, created and edited and checked by scripts.</p> <p>Create a block by drawing a washer or thread of a particular size. Save the block as a universal block. Insert other drawings as blocks into the drawing file. Specify the scale while inserting drawings; specify the insertion point in the drawing. Use AutoCAD design center for inserting blocks, set attributes for inserting the blocks, save the blocks with attributes, explode the blocks</p>	<p>Text style Creation, Use different fonts, Set different heights, Modify the properties of Texts, save different Text styles by a name, Mtext within a window, Scaling a multiline, rotating a Multiline with style features.</p> <p>Create Blocks of Standard patterns, Insert Block Patterns, Scale the Blocks, Match the properties of the Blocks, AutoCAD Design center usage, Dragging the design Center Blocks, Attach the Attributes to Blocks, Explode the blocks, Polylines.</p>

Create templates for A4, A3, A0 size papers. Create title blocks for these sizes. Use Attributes in these templates. Save the templates. Create new drawings using these templates by assigning them as defaults. Create new layouts for printing. Freeze layers for plotting filtered drawings. Center the plot in the paper and layout, offset the plot by X and Y value, Scale the plot for different values of drawing units and printing Metric units, Select the plot by Window, Extents, display etc.	Create Layouts, Differentiate Layout with Paper Setup, Multiple Layouts for Multiple Views, Drag the window to a Layout, Drag the Extent to a layout, Create template for Different Paper Sizes, Save the templates, Use Templates for Opening a new Drawing, Use attributes in a Template, Use Text attributes in a template
Use of functional keys like f6 (coord on), F7 (grid on), F8 (ortho on), F9 (snap on) functional keys. Use of F5 for isometric planes. Drawing a cube using isometric plane setup. Draw sectional views, Full sections, Half Sections, Assembly sections of different parts like Universal Joint, use view ports for viewing them in different 4 ports. Place these view ports in different layouts for printing.	Use of F5, F6, F7, F8, F9, Functional keys. Fundamentals Of Isometric Drawings, Creation of Isometric Views, Prospective Drawings, Projectional Drawings, Cut Section drawings, Use of Cut Lines, sectional Lines, hatching along the sectional area.
Use UCS command for changing the co ordinate system. Draw 3D solid parts as exercise to study the UCS command rotation of X, Y and Z. Use UCS 3point method for creation of new custom made UCS. Mirror the objects in 3D. Rotate the 3D object by an angle.	Introduction to UCS. Differentiate WCS and UCS . Craete ucs planes, Rotate UCS along X axis, Y axis, Z axis. Mirror the objects in 3D. Rotate the objects along an angle..
Use of simple solid AutoCAD commands for creating basic primitives like, cube, box, cylinder, wedge, cone, sphere, torii . Use facetres command for proper shading, view them in different shade modes, and render them, save them as bit map. Get the mass properties, Area, perimeter of a solid. Use LIST command for 2D sketches.	Study of Solids primitives like Cube, Wedge, Box, Cylinder, Cone, Sphere, Torii. Use of Facetres for Shade mode of Solids, List out the Mass, Center Of Gravity, Moment Of Inertia, Volume using Mass properties and by LIST command.
Create composite solids using Boolean addition, Subtraction and Intersection by Joining the primitives. Sketch revolved solids like bottle, Cylinder, Pullies.	Create Region. Create Boundary, Differentiate region and Boundary. Use Boolean operation for UNION , SUBTRACTION, INTERSECTION. Use EXTRUDE and REVOLVE for Composite Solids.
Create 3D wire frames, 3D surface meshes like box, cone, Dishes, Domes, Pyramids, Spheres, Donuts, and wedges. Use Dview, Vpoints for different viewing enhancements. Use surf tab. Taper a face, Remove a face.	Introduction to 3D surfaces, 3D surface Primitives, Extruded primitives, Revolved primitive surfaces, Ruled surfaces, Shells
Master cam shortcut on desktop, setup master cam for metric system, create tools for different type of marching tools using standard tool catalogues, setup the job for machining in master cam, save the tools , filter tools for specific operation, display settings, coordinate settings.	Setup Master CAM, Install and configure MasterCAM, Create Tools, Job Setup, TOOL library setup, CONFIGURATION Settings, Review of G and M codes.

Insert drawings from AutoCAD and other CAD softwares like .DXF, .IGES, Parasolids, generate simple tool paths for these inserted drawings, verify the tool paths, back plot, generate post processed program.	Exchanging Cad data with master cam, Numerical control of machine tools, Cam Tool path modeling, and Cam part programming concepts.
Draw horizontal, vertical, polar, tangential parallel, bisecting lines. Draw arcs with polar end point, 3 point, tangent method. Draw circles using 2 point, 3 point, center point radius, center point edge method. Break a circle, line, trim using 1 point, 2 point, 3 point, to point, many entity methods, rotate and translate objects. Fillet, chamfer and Copy exercises	Geometric constructions like Horizontal Line, Vertical, Aligned Line, Angular Line, Parallel line and Circles using 2, 3 point method, center point method, trim with options, Rotation, Fillet, chamfer, Copy, Break, Translate commands.
Create ruled, loft, coons surfaces, create fillets on surfaces, create revolved surfaces, swept surfaces using along and across options, trim the surfaces and at boundaries, create shells in surfaces, move a surface, copy a surface	Create Surfaces like Ruled, Loft, Coons, Fillets, Revolved, Swept, Trimming the surface, Move a surface, Copy a surface. Identify the use of layers in creating these layers. Use z planes in creating surfaces for 3D surfaces
Create extruded solids, revolved solids, swept solids, lofts, and filleting solids at edges, join two solids, remove solids, shells in solids, edit the solids using solid manager, add chains using solid manager for solid creations.	3D solid constructions. Use of z planes. Use of secondary menu for Layers, Freezing the Layers, Set mask on Layers, Use Boolean operations ADD, SUBTRACTION, INTERSECTION.
Practice machining on created 2D contours in the previous examples like contour, pocket, drilling, island machining, boring, tapping, cutoff, threading and generate tool paths with study of parameters involved like tool selection, feed rate, spindle speed, job setup, plunge point, feed point, z depth of cut, zig zag pockets, Create custom made tool holder, Inserts into Tool Library.	Create contours, Set masks for contours, Chain a contour by mask method, use operation manager, Set tools, Change a tool, Pocket menu explanation, Drill menu Explanation, Thread menu explanation, Inserts and Holders menu, Create and Modify Tool Library
Perform the same for surfaces created in the previous examples, Text Embossing and Engraving in the surfaces, use of subprograms for reducing the program length, Custom made drilling cycles, rough and finish pockets.	Surface machining Menu, Tool Paths, Create Text, Emboss a Text, Contour the text path as a tool path, Use subprograms for repeated cycles at different heights.
Back plot the tool path, optimize the machining time by changing the tool size, changing machining parameters, feed rate, spindle speed, use of operation manager for modifying the Tool parameters, add or delete chains, change the sequence of operations by Cut and Paste. Post processing for different machine controls	Reference Point selection, Job Creation, Back plot, optimizing the machining, Cut and Paste for changing the sequence of Operations using operation manager, Simulation of the toolpath.

Transferring Part programs into the cnc machine, editing parameters in CNC machine, sample cut of a Teflon job for contour of a drawing created in MasterCAM.

CNC interface with master cam, CNC controls and editing on a machine. High Speed Machining.

II) **TOOLS, MACHINERY, EQUIPMENTS etc. for a batch of 16 trainees**

a. **MACHINERY AND EQUIPMENTS**

- | | | | |
|---|--|---|-------|
| 1 | Pentium IV computer 3GHz or latest with 512 MB DD RAM with compatible motherboard, DVD combo drive with the latest x version, hard disk with 80 GB or above, 17" Colour Monitor, 64 MB AGP card, 10/100 Ethernet card, Internal modem, UPS with 800 VA | } | 8 NOS |
| 2 | Laser printer. | | 1 NO |
| 3 | Dot matrix Printer | | 1 NO |

b. **SOFTWARE REQUIREMENTS**

- | | | |
|---|---|--------|
| 1. Windows XP or latest Operating System - 9 Copies | } | 01 set |
| 2. MS – Office XP or Latest - 9 Copies | | |
| 3. AutoCAD 2005 or Latest - 9 Copies | | |
| 4. Master CAM 9 or latest edition for Lathe, Mill and Design - 9 Copies | | |

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

UPGRADATION OF ITIs into CENTERS of EXCELLENCE (CoE)

**SECTOR / AREA : PRODUCTION AND MANUFACTURING
(2 YEARS)**

**ADVANCED MODULES IN II YEAR
(FOR THE FIRST 6 MONTHS OF II YEAR)**

**PMAT-03 : PLC & AUTOMATION
(Duration - 24 weeks)**

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : PRODUCTION AND MANUFACTURING

ADVANCED MODULE IN IInd YEAR

PMAT-03 : PLC & AUTOMATION

(Duration - 24 weeks)

I) COURSE CONTENT

Practical	Theory
Review : Identification of Valves/ Components/parts & drawing ISO symbol for the following a) Air compressor b) Pneumatic valves- different types Dismantling and assembling of service unit	Review : Physical – Fundamental of pneumatics, Boyle's Law. Air compressor-types, Air dryers- structure and signal flow of pneumatic systems. ISO symbols and standards in pneumatics.
Development / construction of Single actuator circuit. Direct control of (a) single acting cylinder (b) double acting cylinder. Indirect control of (a) single (b) Double acting cylinder.	Function and application of Actuator &Valves Linear motion-Single & Double acting Cylinder. Rotary motion-Air motor, Oscillator.
Development and Construction of Single actuator Circuit using Logic function (AND, OR Valve) And Quick exhaust valve.	Function and application of the following Direction control valves: -2/2,3/2,4/2, 4/3, 5/2, 5/3 Shuttle valve. Two pressure valve. Quick –Exhaust valve. Flow control valve

Practical	Theory
Development and construction of single actuator Circuits using the limit switches, flow control Valves, pressure dependent valve and Time Dependent valve on the Pneumatic Hammer/ Chisel circuit.	Function and application of (a) Limit switches, (b) Memory valve, (c) Pressure dependent valve (d) Time dependent valve.
Development and construction of Multi actuator Circuits. Co-ordinated motion control of two Cylinders with speed regulation and timer.	Displacement / step/sequence diagram For multi actuators. Co-ordinated motion control of two cylinders. Trouble shooting of Pneumatic systems.
Developing and construction of Electrical and Pneumatic circuit and give connection for (a) Direct and Indirect manual control. (b) Logic function control – AND & OR	Physical fundamentals of electricity - A.C. & D.C. Electro-pneumatic I.S.O. Symbols for Solenoid valves, switches, components. Principle of solenoid valves. Function and application of electro-Pneumatic valves such as solenoid valves Power pack, switches.
Constructing of electrical and pneumatic circuit With latching connection like DOMINANT ON, DOMINANT OFF. Using magnetic proximity Switch, timer etc. on Oscillating motion of a Double acting cylinder.	Function and application of the following (a) Relays / contactors (b) Limit switches, (c) Timers, (d) Proximity sensor (e) Pressure switch Use of latching circuit- (a) DOMINANT ON (b) DOMINANT OFF
Identification of Hydraulic valves/components/parts of hydraulic Power pack. Drawing of ISO Symbols and Compare with original hydraulic valves etc	Difference between Hydraulics and Pneumatics. ISO Symbols and Graphic of hydraulic Component, valves. Representation of hydraulic system Pascal's law. Hydraulic fluid-viscosity.
Dismantling and assembling of (a) Direction control valve (b) Non-return valve (c) Filters. (d) Pressure Relief valve	Function and application of (a) Hydraulic pumps-types like Vane, Gear and Piston pumps. (b) Direction control valves-types- 3/2, 4/2, 4/3, -manual, piloted (c) Filters-types
Dismantling and assembling of hydraulic Pumps like Gear pump, Vane pump etc	Function and application of hydraulic Flow control valves-types- temperature Compensated –pressure compensated.

<p>Developing and construction of hydraulic Circuit for the following; -</p> <ul style="list-style-type: none"> (a) Pressure sequence circuit. (b) By pass circuit to the pump (c) A differential circuit with flow control valves (i) inlet (ii) outlet (iii) By pass circuit. 	<p>Function and application of Pressure control valves-types</p> <ul style="list-style-type: none"> (a) Pressure relief valve (b) Pressure regulator. (c) Pressure sequence (d) Pressure switch- (e) Unloading valve etc
<p>Identifying and naming of electro hydraulic Valves and components such as solenoid Valves-3/2,4/2,4/3, -pressure switch etc</p>	<p>Function and application of electro - Hydraulic valves and components such as Solenoid valves, switches, push buttons etc</p>
<p>Constructing electro-hydraulic circuit for</p> <ul style="list-style-type: none"> (a) Direct and indirect control (b) Manual and automatic control © Actuation of hydraulic Motor. 	<p>Developing and drawing of electro - Hydraulic circuit for</p> <ul style="list-style-type: none"> (a) Direct and Indirect actuation of Hydraulic cylinders. (b) Actuation of hydraulic Motors.
<p>Assembling and construction of Electro - Hydraulic circuit for</p> <ul style="list-style-type: none"> (a) Position and pressure dependent circuit. (b) Inter-lock circuit. (c) Rapid traverse circuit. 	<p>Electro-hydraulic machine circuit of</p> <ul style="list-style-type: none"> (a) Hydraulic shaping machine (b) Hydraulic surface grinder. (c) Hydraulic Presses. <p>Maintenance of Hydraulic systems.</p>
<p>Identification of components of PLC</p> <ul style="list-style-type: none"> (a) Programming devices (b) Personnel computer <p>Practical steps for PLC programming.</p>	<p>Field of application of PLC. Basic design of PLC-</p> <ul style="list-style-type: none"> (a) Decimal numbering system/binary / Hexagonal number system (b) Logic function, switching function (c) Structure of a PLC- Main processing Unit of PLC (d) Function mode of PLC.
<p>Constructing the ladder diagram in the PC Then down loading to the PLC. Simulate and checking the ladder diagram with monitor.</p> <ul style="list-style-type: none"> (a) Lamp circuit, (b) Burglar alarm-NOT (b) Press with protective guard –AND (c) Bell system – OR Function. 	<p>Programming of PLC- Programming Languages-</p> <p>Function of block diagram</p> <p>Evaluation of NET WORK.</p> <p>Ladder diagram –Current Rung.</p> <p>Instruction list.</p> <p>Logic control system without Latching.</p>

Construct the ladder diagram in the PC Down loading to the PLC and monitoring of The working of a circuit using SIMULATION for the Stamping Device Incorporating Timer and Counter.	Logic control system with (a) Latching control system (b) Timers-Switch on signal delay - switch off signal delay. (c) Counter-Incremental counter - decremental counter
Interface wiring connection with Power Pack, PLC, & PC, and constructing the Circuit using the Electro - pneumatic Component for EX. Without latching (a) Control of a single actuator- (i) S.A.C / (ii) D.A.Cylinder. (b) Control from two position- OR Function (c) Safety circuit –AND Logic function (d) Automatic return (e) Oscillating motion of Double acting cylinder.	PLC Programming – writing of ladder Diagram for the following circuit Without latching (a) Control of a single actuator- (i) S.A.C / (ii) D.A.Cylinder. (b) Control from two position- OR Function (c) Safety circuit –AND Logic function (d) Automatic return (e) Oscillating motion of Double acting cylinder.
Interface wiring connection with Power Pack, PLC, & PC, Constructing the circuit with Latching. (a) Control of a single actuator- (i) S.A.C / (ii) D.A.Cylinder. (b) Control from two position- OR Function (c) Safety circuit –AND Logic function (d) Automatic return (e) Oscillating motion of Double acting cylinder.	PLC Programming with Latching circuit (a) Control of a single actuator- (i) S.A.C / (ii) D.A.Cylinder. (b) Control from two position- OR Function (c) Safety circuit –AND Logic function (d) Automatic return (e) Oscillating motion of Double acting cylinder.
Draw the Proportional hydraulic circuit For the following: - (a) Embossing Press-using proportional Relief valve. (b) Stamping Machine-using 4/3 Proportional D.C.Valve	Advantages of Proportional Hydraulic. Operation of Proportional Solenoid Proportional Directional control valve. Proportional Pressure relief valve. Amplifier card. Set point Value card.
Constructing the circuit interfacing with PC, & PLC, Using Proximity Sensors Like (i) Inductive (ii) Capacitive and (iii)Optical Sensors. For TWO actuators.	Mechatronic system design. Advantages of Mechatronics. Sensors - Proximity sensors - Inductive Capacitive & Optical Sensors
Constructing the circuit interfacing with PC, & PLC, Using Proximity Sensors Like (i) Inductive (ii) Capacitive and (iii)Optical Sensors.	Draw and construct the circuit With working model of 1) Model lift, 2) Model hydraulic press, 3) Model pneumatic press

For TWO actuators. With working model of 1) Model lift, 2) Model hydraulic press, 3) Model pneumatic press	
Constructing the circuit using (i) Timers (ii) Counters (iii) Proximity sensors (iv) Speed regulation (v) Inter lock for the Exercise (a) Chain-Hook bending attachment-using Three cylinders (b) Automatic strip chopper-Two cylinder (c) Rolling machine—Two cylinder	Design the circuit for the following machines (a) Chain-Hook bending attachment-using Three cylinders (b) Automatic strip chopper-Two cylinder (c) Rolling machine—Two cylinder
Constructing the circuit using (i) Timers (ii) Counters (iii) Proximity sensors (iv) Speed regulation (v) Inter lock for the Exercise (a) Silk Screen Printing-Three cylinders (b) Feed unit for Automatic Processing Unit-Four cylinders.	Design the circuit for the following machines (a) Silk Screen Printing-Three cylinders (b) Feed unit for Automatic Processing Unit-Four cylinders.

II) TOOLS, MACHINERY, EQUIPMENTS etc. for a batch of 16 trainees

Sl. No	Item	Qty (Nos)
1	Air Compressor-stationary, compression load 8 bar, Suction Capacity 200 liters/min, reservoir 200 litres	1 No
2	Pneumatic Trainer kit – consists of Cylinders, Different types of Direction control valves, pressure dependant valve and flow control valves with accessories for construction and application of different type of pneumatic circuits.	2 Sets
3	Electro- Pneumatic trainer kit - consists of Cylinders, Different types of Direction control valves, pressure dependant valve and flow control valves with accessories for construction and application of different type of Electro-Pneumatic circuits.	2 Sets
4	PLC for Electro-pneumatics and Electro-hydraulics with software.	4 Sets
5	Hydraulic Trainer kit with Power pack– consists of Cylinders, Different types of Direction control valves, Pressure control valves and flow control valves with accessories for construction and application of different type of Hydraulic circuits.	2 Sets
6	Electro-Hydraulic Trainer kit with Power pack– consists of Cylinders, Different types of Direction control valves, Pressure control valves and flow control valves with accessories for construction and application of different type of Electro -Hydraulic	2 Sets

	circuits.	
7	Working Model of Lift	1 Set
8	Working Model of Hydraulic Press	1 Set
9	Working Model of Pneumatic Press	1 Set
10	Pentium IV 3 MHz Computer (or latest) Modem internal, 10 / 100 Lan card, Multimedia Kit, 17" color monitor & UPS	8 Sets
11	Computer Table with computer chair	8 Sets
12	Laser printer	1 No

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

UPGRADATION OF ITIs into CENTERS of EXCELLENCE (CoE)

**SECTOR / AREA : PRODUCTION AND MANUFACTURING
(2 YEARS)**

**ADVANCED MODULES IN II YEAR
(FOR THE FIRST 6 MONTHS OF II YEAR)**

**PMAT-04 : QUALITY ENGINEERING
(Duration - 24 weeks)**

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : **PRODUCTION AND MANUFACTURING**

ADVANCED MODULE IN II YEAR

PMAT-04 : **QUALITY ENGINEERING**

(Duration - **24 weeks**)

I) COURSE CONTENT

Practical	Theory
<p>Exercises on measurements using digital caliper- Dial type caliper-External Micrometer covering outside measurements, Internal measurement Inside micrometer, depth Vernier caliper, Measurement of wall thickness of tubes etc.,</p> <p>Exercises on use of Height gauge (including digital), Depth Vernier Caliper, tube Micrometer, plunger dial gauges, lever dial gauges, bore dial gauges, Micrometer (3 leg) and Internal Micrometer (stick type), V-Block, Angle Plate, Straight edge, Bevel Protractor and combination set.</p> <p>Exercises on the use of feeler gauge, screw pitch gage Radius gauge.</p>	<p>Classification of measurements-Length measuring, Line Standards and End Standards</p> <p>Limits, fits, tolerances- need for tolerance, grades, types, terminologies as per IS 919-1993, types of fits, classification of fits, shaft basis systems, hole basis systems, applications and selection.</p> <p>Digital caliper- Digital height gauge- depth Vernier Caliper, Dial Gauge (Plunger and Lever Dial), Bore Dial Gauge, depth Micrometer, Tube Micrometer), V-Block, Angle Plate, Straight edge, Bevel Protractor and combination set.</p>

<p>Exercises on Slip Gauges with accessories for taking inside, outside, depth, height Measurement, marking and selection of slip gauge sets, material and grades as per IS 2964</p> <p>Exercises on reading of errors-errors due to dirt-due to temperature changes-parallax errors, sine error and cosine error</p> <p>Exercises on Angle measurements by using Bevel Protractor, Combination set, Sine bar and Digital Clino Meter</p> <p>Exercises on making a gauge dimension for a component as per IS 3455 checking of Limit plug gauge, Adjustable snap gage - GO and NO GO gages and Ring Gauges</p>	<p>Gauge Blocks -accessories, Types, Materials, Care, use, maintenance, Selection of Slip Gauges</p> <p>Sources of error-static error-environmental, error-characteristic of errors-Systematic error and its causes-Random error and its causes</p> <p>Angle measurements, Angle Gauge blocks, Bevel Protractor, Sine bar, Combination set, Digital Clino Meter</p> <p>Care, Use, Maintenance of Surface plate-Granite surface Plate-Cast Iron Surface Plate-Grades (Flatness Measurement) of surface plate</p> <p>Gauging practice as per IS 3455 for making a dimension for GO and NOGO gauge to a component - Plane gauge-Radius gauges, Feeler gauge, Taper, wire and thickness gauges</p>
<p>Exercises on all the Geometrical Features as per IS: 8000-Roundness, cylindricity, Straightness, Flatness, Profile of a line, Profile of a surface, perpendicularity, parallelism, angularity, concentricity, symmetry, position, radial run out, axes run out, maximum material condition and least material condition.</p> <p>Use of V-blocks, between centers using dials - Exercise to interpret drawings as per IS : 8000, Flatness using spirit-level</p> <p>Profile projector-measurement of profile by comparison, measurement by individual parameters - Length, width, diameter, angle, radius, etc., with a help of data processor - Manual method and Surface Illumination</p> <p>Thread measurement by using Profile Projector and Thread Pitch Micrometer.</p>	<p>Use of Fixtures for measurement, use of Angle plates for measurement-concentricity checking attachment-T-slotted sine table- -Sine vice-use of V-Blocks and Straight edges</p> <p>Geometrical Features IS: 8000-Roundness, cylindricity, Straightness, Flatness, Profile of a line, Profile of a surface, perpendicularity, parallelism, angularity, concentricity, symmetry, position, radial run out, axial run out, maximum material condition and least material condition</p> <p>Use of spirit level, radius gauge and straight edge etc</p> <p>Profile measurements-profile projector, principles, and applications.</p> <p>Metrology of screw thread-terminologies, measurement of thread by using profile projector and thread pitch comparator</p>
<p>Exercises on the use of jigs and fixtures and measurement on a surface plate using height gauge and other instruments,</p> <p>Surface roughness by using Portable Surface Roughness Measurement measure the surface finish in outside, inside inclined etc. in the components made by different machines like turning, grinding, shaper and milling machines etc.</p>	<p>Use of portable surface measuring instrument and use of its related software.</p> <p>Surface Roughness measurements- Introduction terminologies as per Indian Standard evaluating parameters like Ra, Ry, Rz etc.</p> <p>Lays - Types, symbols and its usage</p>
<p>Exercises on Mechanical, Optical, pneumatic and electronic Comparators</p> <p>Exercises on checking/inspection of gauges and components by using video inspection system for measuring length , width, height , diameter, radius,</p>	<p>Comparators-types-Mechanical, Optical, pneumatic and electronic comparator - principles, advantages and Disadvantages of various types of comparators and digital multi dimensional comparator</p>

distance between 2holes Distance between circle and a line, etc. Exercises on 2D micro height for checking height, hole diameter, distance between 2 holes , etc.	Principle , construction of video inspection system and 2 D micro height
Exercises on Calibration of Vernier Calipers Range 0 -150, 0-300 External and Internal Micrometers, Lever dial gauge and plunger dial Gauges, Height Gauges, Bevel Protractor, Bore dial gauges, Depth Micrometer, Depth Vernier Caliper, 2D micro height, Video inspection system	Calibration-What, Why, When, Where, and How to do the calibration Calibration of Vernier Caliper, Micrometer, Dial and Height Gauges, and Bevel Protractor Environmental conditions for calibration laboratories as per IS: 196 and National Accreditation board for testing and calibration labs (NABL)
Take a case study-collection of data, making histogram, normal curve, bi modal, and skewed variation curve by manual method. Calculation of mean, mode, range and standard deviation Feed the result in SPC software and find the variation. Take a case study and preparing control charts like X chart, R chart, p chart, np Chart, c chart, and u chart Calculation of Cp, Cpk, and Cr by manual method and by using computer	Statistical Process control-objective, introduction to variation, measurement of variation-histogram, pattern of variation-normal, by model, skewed pattern Measurement of variation-mean, mode, range, standard deviation, 68%, 95% and 99.7% rule for normal curve. Control Charts object – what are control charts, details of control charts i.e., information section, data section, graph section and comments section, selection of charts, parato analysis Interpretation of control charts-types of control charts, variable control charts like X bar and R chart Attribute control charts like P chart, np chart, C chart and U chart Process capability-What is process capability, measurements, types, Cr, Cp and Cpk.
Video demonstration on CMM, includes selection, types, uses of CMM types of probes, types of air bearings, details of softwares, including geometrical features, curve measurements and gear measurements. Video demonstration on Calibration Equipments like dial gauge calibrator, caliper checker, length measuring machine Video demonstration on instruments, geometrical features, surface finish, geometrical dimensioning and tolerances	Awareness of quality management system - Terms used in ISO Quality System Standards and Explanation - Industries specific standards
Exercises on Case study Exercises on Mistake Proofing Exercises on use of QC 7 tools Exercises on MSA	Problem solving methodology - Concept of mistake proofing QC7 tools - Introduction to MSA (Measuring System Analysis)

II) TOOLS, MACHINERY, EQUIPMENTS etc. for a batch of 16 trainees

SI No	Item	Qty
1	Vernier Caliper 0-150 mm (L.C. 0.02 mm)	16
2	Digital Caliper 0-150 mm (L.C. 0.01 mm) with SPC provision	6
3	SPC Cable for all instrument, Interface Box	6
4	External Micrometer 0-25 mm (L.C. 0.01 mm)	16
5	External Micrometer 25-50, 50-75mm (L.C. 0.01 mm)	4
6	Digital Micrometer with SPC 0-25 mm	6

SI No	Item	Qty
7	Tube end Micrometer, Blade Micrometer, Flange Micrometer	1 Each
8	Pitch Micrometer with 6 sets of Anvil (Metric)	1
9	Internal Micrometer 3 point (15 to 20mm)	1
10	Stick micrometer (35 to 150mm)	1
11	Dial vernier caliper 0 to 150mm, (L.C 0.05mm)	1
12	Depth Vernier 1 set	1

SI No	Item	Qty
13	Plunger Dial Gauge 0 -10 mm (L.C. 0.01mm)	16
14	Plunger Dial Gauge 0 -1 mm (L.C. 0.001 mm)	6
15	Lever Dial Gauge 0 - 1 mm (L.C. 0.002 mm)	2
16	Bore Dial Gauge 10 - 50 mm (L.C 0.01 mm)	2
17	Height Gauge 0 - 300 mm (L.C. 0.02 mm) with adjustable scale	8
18	Digital Height Gauge 0-300 mm (L.C. 0.01 mm)	1
19	Slip Gauge (Tungsten Carbide Grade I , 122Nos)	2sets
20	Slip Gauge Accessories	1
21	Caliper Checker 0-300 mm	4
22	Granite Surface Plate with Stand and fine adjustment 1000 x 630 mm with between centre attachment	4
23	2D Micro Height 0-300 mm	2
24	Profile Projector (Vertical Type) 300 mm diameter with 10x, 20x magnification with Data Processor	1
25	Feeler Gauge set, Snap Gauge, Adjustable Snap Gauge,	Each 2

SI No	Item	Qty
32	SPC training software	1
33	SPC software with provisions for online data capturing	1
34	Computers with Furnitures suitable to the SPC software for exercise	4
35	Machined Sampleswith Nickel coated (100 Nos.) , for different parameter suitable for SPC and Instrument Practice (6 models)	1
36	Airgauge suitable for above 100 nos. of machined samples	1
37	Dial Gauge Stands	6
38	Micrometer stands	8
39	Optical flat 50 mm Diameter	1
40	Optical Parallel 0-25 mm for Micrometer	1
41	Portable Surface Roughness Measuring Instruments with PC cable and software	1
42	Mechanical Comparator	1
43	Electronic Comparator	1
44	Dial Gauge Calibrator 0 – 25mm	1

	Ring Gauge, Thread Plug Gauge, Thread Ring Gauge, Pitch Gauge set, Radius Gauge set / NO GO, GO Plain Plug gauge Set of 2	
26	'V' – Block – 100x75x150 mm	6
27	Bevel Protractor (L.C. 5 Min)	4 set
28	Sine Bar 100 mm	4
29	Combination Set	4 set
30	Digital Inclino Meter	1
31	Spirit Level 0-200 mm Sensitivity 0.02 mm/Meter (Block type)	4

45	Video Inspection system CCD(Charge Coupled Device), Colour camera, Colour Monitor, light source and stand	1
46	Educational Vedio CD on CMM, Roundness and latest equipments and instruments	1set
47	Vaccume cleaner	1
48	Slip gauge set (Tungsten carbide 5Nos, Ceramic 5Nos, Steel alloys 5Nos) any size	1set
49	Fire extinguisher equipment and first aid box. Etc.	1 set
50	Air compressor suitable for Air gauge	1 No

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

UPGRADATION OF ITIs into CENTERS of EXCELLENCE (CoE)

**SECTOR / AREA : PRODUCTION AND MANUFACTURING
(2 YEARS)**

**ADVANCED MODULES IN II YEAR
(FOR THE FIRST 6 MONTHS OF II YEAR)**

PMAT-05 : MANUFACTURING OF JIGS & FIXTURES
(Duration - 24 weeks)

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : PRODUCTION AND MANUFACTURING

ADVANCED MODULE IN II YEAR

PMAT-05 : MANUFACTURING OF JIGS & FIXTURES

(Duration - 24 weeks)

I) COURSE CONTENT

Practical	Theory
Review of Engineering drawing practice <ul style="list-style-type: none">• Drawing orthographic projection 1st & IIIrd angle• Drawing Isometric views• Drawing of sectional views• Assembly drawing of simple figures	<ul style="list-style-type: none">• Course objectives and safety rules to be observed in shop floor.• Brief outline of various subjects to be revealed and scope for employment.• Methods of production and importance of Jigs and fixtures in Batch production, and continuous production• Review of Engineering drawing – sheet size, layout planning, lines & lettering, methods of projection, sections, dimensioning. Conventional representation of screw threads and gears. Indication of tolerance, surface roughness and welding symbols
Review of Bench Fitting Practice <ul style="list-style-type: none">• Filing flat, right angled parallel surfaces with an accuracy of ± 0.05 mm• Marking using Prussian blue and Vernier height gauge for the exercises on drilling machine	<ul style="list-style-type: none">• Limits, Fits and Tolerances as per IS:919 - 2002 - Necessity of specifying limits of sizes, basic size and deviation, types of fits and application, hole basis and shaft basis system, advantage of hole basis system over shaft basis system, fundamental deviation and IT tolerance, unidirectional & bilateral tolerance and interpretation of fit designation for different sizes <p>Surface roughness – Necessity of surface finish on engineering components, unit of surface roughness, interpretation of surface roughness symbols in drawings, surface roughness expected from various manufacturing processes and methods of measuring surface finish.</p>
Review of Engineering Measurements Practice <ul style="list-style-type: none">• Measurement of straightness and flatness using spirit	<ul style="list-style-type: none">• Geometric features as per IS 8000 – 1985 – Straightness, flatness, circularity & roundness, cylindricity, profile of any line or surface, parallelism, perpendicularity and squareness, angularity, position, concentricity and coaxiality, symmetry, maximum material condition

<p>level, straight edge and dial</p> <ul style="list-style-type: none"> • Measurement of circularity and roundness using between centre and dial. • Measurement of Cylindricity using V Blocks and dial • Measurement of angularity using sine bar, slip gauge and dial 	<p>and representation of geometric features in engineering drawing</p> <ul style="list-style-type: none"> • Principles of metal cutting – orthogonal and oblique cutting, chip formation, temperature on cutting edges, necessity of coolant, tool wear and tool life. • Cutting tool materials - Properties and application of carbon steel, alloy steel, high speed steel and tungsten carbides
<p>Review of Drilling Bench Fitting Practice</p> <ul style="list-style-type: none"> • Exercises including, drilling, reaming, tapping , counter boring and counter sinking • Exercise on slide fitting. 	<ul style="list-style-type: none"> • Drills – Drill materials, drill types and uses. Helix angle, point angle and clearance angle according to depth of hole, material to be drilled and drill sizes. Systems of drill size, standard designation, influence of symmetry of point angle and lip length on size of holes, selection of centre drill size according to diameter of workpiece. Carbide tipped drills and uses. • Reamers – Types of reamers and uses, reaming allowance, care and maintenance. • Taps – Hand taps, machine taps and calculation of tap drill size for 60° metric threads • Counter bore, counter sink, spot face and boring tools • Drilling machines – Types, specifications, tool holding and work holding devices • Drilling machine operations - Drilling, Centre drilling , reaming, tapping, boring, counter boring, counter sinking and spot facing procedure. Spindle speed, and feeds for these operations.
<p>Review of Turning practices</p> <ul style="list-style-type: none"> • Plain turning, facing and step turning to an accuracy of ± 0.05 mm. • Centre drilling and turning between centre. • Taper turning, drilling, boring, thread cutting and knurling using 4 jaw independent chuck 	<ul style="list-style-type: none"> • Single point tools – geometry of rough turning tool, finish turning tool, parting tool, boring tool and threading tool. Carbide tipped tools with disposable inserts. Influence of tool angles on cutting efficiency, tool life and surface finish. • Turning process – Lathe types, specification, accessories, work holding devices , lathe operations, tool setting, cutting speed, feed and depth of cut .
<ul style="list-style-type: none"> • Milling, surface hardening (Pack carburizing) and surface grinding a plain 90° V-block as per IS 2949 – 1992. (continued) 	<ul style="list-style-type: none"> • Milling machines – types, specification, attachments and accessories, tool holding and work holding devices. • Milling process – face milling and peripheral milling (up milling and down milling). • Milling cutters – cylindrical cutters, side and face cutter, slotting cutter, angular cutters, slit saws, form relieved cutters, end mills, shell end mills, T-slot cutter, slot drill, face milling cutters and milling cutters with indexable carbide inserts and their uses. Tip geometry of milling cutters. • Selection of Cutting speed, feed and depth of cut. • Milling operations - Plain milling, face milling, side milling, straddle milling, angular milling, gang milling, form milling, profile milling, end milling, saw milling, key way milling, groove milling, slot milling, helical milling and cam milling

	<ul style="list-style-type: none"> • Universal dividing head – parts and function . Indexing methods – Direct indexing, simple indexing, differential indexing, angular indexing and linear indexing calculations
<ul style="list-style-type: none"> • Milling, surface hardening (Pack carburizing) and surface grinding a plain 90° V-block as per IS 2949 – 1992. 	<ul style="list-style-type: none"> • Materials used for Jigs & Fixtures and related specifications • Classification of steel, effect of alloying elements, necessity of heat treatment and heat treating equipments. • Iron carbon equilibrium diagram , TTT diagram and quenching media. • Heat treating processes – Annealing, Normalizing, Hardening & tempering & stress relieving • Surface Hardening and cryogenic treatment. • Distortion of components during heat treatment, heat treatment defects and remedies. • Grinding processes – principles of grinding process. • Grinding machines – cylindrical and surface grinding machines, specification and work holding devices. • Grinding wheels – abrasive types, grain sizes, grades, structures and bonds . Selection of grinding wheels and standard marking system as per IS 551. • Grinding parameters – wheel speed, work speed , downfeed or infeed & traverse feed. • Wheel balancing, truing and dressing. • Factors influencing surface quality, grinding allowance, hardness requirement and coolants. • Procedure of grinding Parallel, right angled,stepped and angular surfaces
<ul style="list-style-type: none"> • Heat treatment of cylindrical components before cylindrical grinding practice. • Cylindrical grinding external and internal plain and parallel surfaces with an accuracy of ± 0.02 mm 	<ul style="list-style-type: none"> • Broaching machines – types, broaching techniques and application • Lapping and honing process – working principles, types of machines and surface finish obtainable. • Jig boring machine – Principal parts, accessories, tools, work holding devices, methods of locating an edge, co-ordinate locating system, co-ordinate factors, measurement and inspection of holes. • Jig grinding machine – parts working principles and applications. • Electrical Discharge Machining (EDM) - Types of machines, working principles and applications • Co-ordinate measuring machine and application
<ul style="list-style-type: none"> • Study of assembly drawing of plate jig ,angle plate jig, and channel drill jig and sketching of parts 	<ul style="list-style-type: none"> • Definition of Jigs & Fixtures. • Difference between Jigs & Fixtures • Advantage of Jigs & Fixtures • Basic elements of drill Jigs – Body, feet, locators, clamps,bushes and their functions. Chip removal and swarf disposal arrangements.

	<ul style="list-style-type: none"> • Presentation of work piece in the assembly drawing of Jigs and Fixtures. • Types of Jigs & Fixtures bodies – Fabricated, welded and cast. • Standard fasteners used in Jigs & Fixtures and fastening methods : - Types of threaded fasteners – Size of clearance hole with respect to threaded fasteners-positioning of fasteners with respect to dowels - counter bore and counter sink hole sizes methods of applying socket cap screws – shoulder screws and application socket button head screws – socket flat head screws – socket set screws& applications • Dowels and doweling : purpose of doweling, materials and hardness of dowels – regular and oversize dowels – shapes of dowels – Indian Standard for dowels – reaming dowel holes – proportion of through, semi blind, blind and relieved dowels – Dowels for multi parts – Richard Brothers Dowels for Blind applications - Positioning principles of dowel holes in Jigs & Fixtures
<ul style="list-style-type: none"> • Manufacturing a plate Jig to drill one hole on a rectangular component (continued) 	<ul style="list-style-type: none"> • Standard commercial sizes of steel plates, rods, bars sheets and channels. • Steps in Manufacturing Jigs & Fixtures • Process Planning : Establishment of reference datum surface, choosing cheapest machine/process which can accomplish the tolerance specified, positioning the finishing operation, economic / logical sequencing of operation, tooling, man power requirement, degree of skill necessary, operation time and machine tool setting time. • Working out the requirement of raw material sizes for manufacturing the Jig & Fixture elements
<ul style="list-style-type: none"> • Manufacturing a plate Jig to drill one holes on a rectangular component 	<ul style="list-style-type: none"> • Drill bushes – Press fit bushes (headed and headless), renewable bushes , slip bushes, threaded bushes, special bushes and bushes for drilling at curved and tapered surface. Standard drill bush sizes according to IS specification. • Manufacturing steps of a drill bush.
<ul style="list-style-type: none"> • Manufacturing of a channel Jig to drill two holes on a cubical components.(continued) 	<ul style="list-style-type: none"> • Location principles and degrees of freedom. • 3-2-1 principles of location and choice of location surface. • Redundant location, motion economy and fool proofing.
<ul style="list-style-type: none"> • Manufacturing of a channel Jig to drill two holes on a cubical components 	<ul style="list-style-type: none"> • Location from a plane surface – Fixed and adjustable support for a rectangular work piece, equilliser rocker locators, location pads, for large fixtures and recess for burr and dirt. • Location from a profile – sighting location with finger slot, profile location by pin, excentric location and location nests. • Location from a cylinder - Cylindrical locators, jamming prevention lead, diamond pin application and design, conical locators and V-locators.

<ul style="list-style-type: none"> Manufacturing an angle plate jig to drill holes at an angle on a cylindrical work piece(continued) 	<ul style="list-style-type: none"> Clamping principles – positioning of clamps on the work piece, strength of clamp according to cutting force, productivity requirement, operator fatigue and work piece variation Types of clamps – Screw clamp, flat strap clamp, pivoted strap clamp, edge strap clamp and edge jaw clamp Equalising clamp, latch clamp, swing plate clamp and double acting clamp. Quick action clamps, hinged clamp, swing clamp, wedge clamp, cam clamp, hook clamp and toggle clamp. Hydraulic clamping, pneumatic clamping, vacuum clamping and magnetic clamping. Indexing devices – Linear indexing devices and rotary indexing devices.
<ul style="list-style-type: none"> Manufacturing an angle plate jig to drill holes at an angle on a cylindrical work piece. 	<ul style="list-style-type: none"> Template jig and pot jig – description of parts and function
<ul style="list-style-type: none"> Studying assembly drawings of face milling fixture , straddle milling fixture and gang milling fixture and sketching of components 	<ul style="list-style-type: none"> Indexing Jig, turn over Jig, leaf jig and latch jig – Description of parts and functions. Milling fixtures – Description and types. Manufacturing steps of Milling fixtures
<ul style="list-style-type: none"> Manufacturing a face milling fixture for a flange type cylindrical component 	<ul style="list-style-type: none"> Direction and intensity of forces in milling according to type of milling machine, kind of cutter and direction of feed in up milling and down milling. Essentials of milling fixtures – strength, thrust, cutter setting, machine location tennons, rigid clamping, motion economy and swarf disposal
<ul style="list-style-type: none"> Manufacturing a face milling fixture for a flange type cylindrical component 	<ul style="list-style-type: none"> Straddle milling fixture, key way milling fixture and gang milling fixture – description of parts and functions
<ul style="list-style-type: none"> Manufacturing a straddle milling fixture to mill two flats on a cylindrical component 	<ul style="list-style-type: none"> Index milling fixture, string milling fixture and rotary milling fixture – Description of parts and functions
<ul style="list-style-type: none"> Manufacturing a straddle milling fixture to mill two flats on a cylindrical component 	<ul style="list-style-type: none"> Reciprocal milling fixture – Description of parts and functions. Modular jigs and fixture (universal tool kit) – Description, advantages and applications.
<ul style="list-style-type: none"> Manufacturing a gang milling fixture . 	<ul style="list-style-type: none"> Turning fixture – chucks with special jaws and soft jaws, use of face plate and balancing requirement. Spring collets and lathe mandrels – types and applications.

<ul style="list-style-type: none"> Manufacturing a gang milling fixture. 	<ul style="list-style-type: none"> Grinding fixture – Nesting of component for surface grinding, epoxy resin nest, use of sine vises and industrial adhesive tapes Broaching fixture – types and applications
<ul style="list-style-type: none"> Project Work : Manufacturing a milling fixture suitable to given component . 	<ul style="list-style-type: none"> Welding fixture – thermal expansion and contraction due to welding, clearance between locators and work piece to permit expansion and contraction, use of c-clamps and toggle clamps, spatter grooves, tilting and rotating arrangement for welding in down hand position. Typical examples of welding fixtures
<ul style="list-style-type: none"> Project Work: Manufacturing a drill jig suitable to given component. 	<ul style="list-style-type: none"> Modern jigs and fixtures using hydraulics and pneumatics. Cost estimation of jigs and fixtures Revision and Test

II) TOOLS, MACHINERY AND EQUIPMENTS (for a batch of 16 Trainees)

Sl. No.	Description of tools	QTY
Trainees Tool kit		
1	Steel Rule 150 mm English and Metric combined	17 Nos
2	Engineer's Square 150 mm with knife edge	17 Nos
3	Hacksaw frame adjustable with pistol grip for 200 - 300mm blade	17 Nos
4	Hammer Ball Pein 0,5 kg with handle	17 Nos
5	Chisel cold flat 18 x 150 mm	17 Nos
6	Hammer Cross Pein 0,75 kg with handle	17 Nos
7	Centre punch 100 mm	17 Nos
8	Prick punch 150 mm	17 Nos
9	File flat bastard 350 mm	17 Nos
10	File flat 2nd cut 250 mm	17 Nos

Sl. No.	Description of tools	QTY
19	Divider spring type - 150 mm	4 Nos
20	Odd leg caliper firm joint - 150 mm	2 Nos
21	Screw driver - 150 mm	4 Nos
22	Screw driver - 200 mm	4 Nos
23	Screw driver - phillips type no 1, 2 and 3 (2 Nos each)	1set
24	Centre gauge 55 ° and 60° (2 Nos each)	1set
25	Plier side cutting 150 mm	2 Nos
26	Oil can 250 ml.	4 Nos
27	File flat bastard 300 mm	8 Nos
28	File flat smooth 200 mm	4 Nos
29	File flat smooth with safe edge 200 mm	4 Nos

11	File flat safe edge 200 mm	17 Nos
12	File three square smooth 200 mm	17 Nos
13	Needle file assorted (12 nos.) 150 mm	17 Nos
14	File card	17 Nos
15	Dot punch	17 Nos
16	Safety glasses	17 Nos
Tools & Instruments		
17	Caliper inside spring type - 150 mm	4 Nos
18	Caliper outside spring type - 150 mm	4 Nos

30	File half round bastard 300 mm	8 Nos
31	File half round smooth 250 mm	8 Nos
32	File three square bastard 250 mm	4 Nos
33	File three square smooth 200 mm	8 Nos
34	File round bastard 250 mm	4 Nos
35	File square bastard 300 mm	4 Nos
36	File square smooth 250 mm	4 Nos
37	Knife edge file 150 mm	8 Nos
38	Scribing block universal 300 mm	4 Nos

Sl. No.	Description of tools	QTY
39	Granite Surface plate grade1 , 1000 mm x 630 mm with adjustable MS Stand	4 Nos
40	Granite Surface plate grade 1, 600 x 300 mm with between centre and adjustable stand	2 Nos.
41	Tap extractor 3 mm to 12 mm x 1.5 mm (ezy out)	1 set
42	Screw extractor sizes 1 to 8	1 set
43	Taps and dies metric 3 mm to 25 mm complete set in a box	2 set
44	Drill twist St.shank tin coated 5 mm to 12.5 mm in steps of 0.5 mm	1 set
45	Drill twist St.shank 3mm to 12.5 mm in steps of 0.5 mm	1 set
46	Taper shank drills 6 mm to 25 mm in steps of 1 mm	1 set
47	D.E.spanners 3 mm - 4mm, 6-8, 10-12, 13-14, 15-16, 18-19, 20-22, 24-26 (8 spanners)	2 sets
48	Letter punch 3mm set	1 set

Sl. No.	Description of tools	QTY
56	Reamers adjustable 10 mm to 15 mm in step of 1 mm	2 sets
57	Milling cutters, counter bore and counter sink tools as per the exercises planned	As reqd
58	HSS tool bits 3mm, 6 mm, 8 mm, square 100mm length	12 Nos. each
59	Tool holders – straight L.H and R.H to suit the size of lathe	6 each
60	Parting tool holders to suit the size of the lathe	2 Nos.
61	Parting tool blades 3mm and 4 mm with HSS	3 each
62	Boring bars with holders to accommodate 3mm, 4mm, 6mm and 8mm HSS tool bits	3 each
63	Tool makers clamp(parallel clamp) 50 mm, 75 mm, 100 mm and 150 mm	4 Nos each
64	`C' clamp, 75 mm, 100 mm, 150 mm and 200 mm	2 Nos each
65	Assorted Carbide lathe tools with tool holder of different shapes and sizes	As reqd

49	Number punch 3 mm set	1 set
50	Drill gauge 1,5 to 12.5 mm in steps of 0,5 mm	1 No
51	Allen key metric 3 to 12 mm set	2 sets
52	Centre drills No. 2 , 3 & 4	4 each
53	Parallel hand reamer 3 mm to 25 mm in steps of 1 mm	2 sets
54	Long fluted machine reamer 6 mm to 25 mm in steps of 1 mm	1 sets
55	Hand taper pin reamer 4 mm, 5 mm, 6 mm, 8 mm, 10 mm and 12 mm (set of 6 nos.)	2 sets

66	Knurling tool holders – revolving type with knurling tool	2 Nos.
67	Tool Holder for slotter Straight to suit the machine available	2 Nos
68	Oilstone assorted (10mm square, dia 10 mm and 10 mm side triangular) 100 mm length	2 Each
69	Silicon carbide dressing stick 1" square	2 Nos
70	Grease gun	3Nos
71	Oil gun	3Nos
72	Bench vice 4"	4Nos

Sl. No.	Description of tools	QTY
73	Bench vice 6"	4Nos
74	Lapping cast iron plate 250 x 250	1 No
75	Lever shearing machine hand operated complete with 300 mm blade	1 No
76	Snips 200 mm	1 No
77	Hand vice 3 inches	2Nos
78	Feeler guage 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm (13 leaves)	2 sets
79	Screw pitch gauge – Range 0.4 – 7 mm Metric 60° (21 leaves)	2 sets
80	Radius gauge 1-3 mm by 0.25 mm and 3,5,7 mm by 0.5 mm (34 leaves)	2 sets
81	Verneir height gauge – Range 300 mm vernier scale 0.02 mm	2 Nos
82	Digital vernier caliper 150 mm, least count 0.01 mm	2 Nos
83	Universal bevel protractor – Blade range 150 and 300 mm, dial 1degree, vernier 5 min with head, Acute angle attachment	2 Nos
84	Outside micrometer 0 – 25 mm,25-50mm ,50-75mm 75-100mm (least count 0.01 mm)	2 each

Sl. No.	Description of tools	QTY
88	Sine bar 150 mm with stopper plate	2 Nos
89	Sine table 200 mm length with magnetic bed	2 Nos
90	Slip Gauge blocks grade –1, 122 pieces per set, Tungsten carbide	2 set
91	V – Block – Approx. 32 x 32 x 41 mm with clamping capacity of 50 mm with clamps	4 pairs
92	V – Block – Approx. 65 x 65 x 80 mm with clamping capacity of 50 mm with clamps	4 pairs
93	Magnetic V – Block 100 x 100 x 125 mm	4 pairs
94	Angle plate 150 x 150 x 200 mm	4 Nos
95	Inside micrometer – Range 25 – 50 mm, 50mm-75mm, 75mm -100 mm	2 Nos
96	Depth micrometer – Range 0 – 200 mm, accuracy 0.01 mm	2 Nos
97	Bore gauge with dial indicator (1 mm range, 0 – 0.01 mm graduation) – Range of bore gauge 18-150 mm	1 set
98	Straight edge – Single beveled – Size 150 mm	1 No.
99	Machined Nickel coated samples which can be used for measurement as per IS 8000	16 Nos

85	Digital outside micrometer 0 - 25 mm (least count 0.01 mm)	1 No
86	Combination set – 300 mm blade with square head, center head, and protractor head	2 sets
87	Telescopic gauge range 8 – 150 mm (6 pcs/set)	1 set

100	Sprit level 300mm block type sensitivity 0.02mm / m	2 nos.
101	Parallel blocks in pairs of different sizes	4 sets
102	Dial test indicator-Plunger type- Range 0-10mm – least count 0.01mm	2 Nos

MACHINERY , EQUIPMENTS ETC.

SL NO.	Description	Qty
103	All geared head stock gap bed lathe for general purpose ,bed length approx 1000mm, centre height 150mm - motorised – fully equipped with standard accessories, including 3 jaw chuck and 4 jaw independent chuck (1 each), drill chuck – 12mm – 1no.	2Nos.
104	Tool room lathe – bed length 1200mm – centre height 150mm with standard accessories	1No.
105	Tool room milling machine size no.1 with DRO for X,Y and Z axis - positioning accuracy 0.002 mm, with standard accessories including index head, micro boring head etc.	1No.
106	Universal milling , horizontal machine size no.1 approximate with standard accessories 1 No including : 1. Long Arbor Ø 16, Ø 22 and Ø 27 and Ø 32 – 1 No.each 2. Universal dividing head with carrier, chuck , standard indexing plate and accessories – 1 No. 3. Machine vice 150mm with swivel base with 1° division - 1 No. 4. Slotting attachment – 1 No.	1 set
107	Vertical Milling machine size no.1 Turret Ram type approximate with standard accessories 1 No including : 1) Slotting attachment – 1 No. 2) Machine vice 150 mm with swivel base - 1 No. 3) Stub Arbor Style C Ø 22 and Ø 27 and Ø 32 mm – 1 each 4) Collet Adaptor– 1 No. 5) Rotary table 300mm - 1° degree division with indexing arrangement - 1 No. 6) Suitable Collets 2-24mm in step of 1 mm – 1 each	2 sets
108	Column and knee type horizontal milling machine plain size no.1 with standard accessories 1 No including : i) Machine vice with swivel base 150 mm – 1° division – 1 No ii) Long Arbor Ø 16, Ø 22 and Ø 27 and Ø 32 mm – 1 each	1 set
109	Cylindrical grinding machine with internal grinding attachment, centre height 130 mm with standard accessories including 3 jaw self centering chuck and 4 jaw independent chuck (1 each)	2 Nos.
110	Hydraulic Surface Grinding machine – Table size (approx) 250 x 1000 mm	

	<p>Infinitely variable table speed – Fine infeed by hand 0.001 mm with standard accessories ...1 No. including</p> <p>1) Magnetic chuck size 150mm x 300mm – 1 No. 2) Coolant equipment with settling tank – 1 No. 3) Diamond dresser with stand – 1 No. 4) Sine vice – 1 No. 4) Balancing Mandrel - 1 No. 6) Machine lamp - 1 No.</p>	2 sets
111	Sensitive drilling machine pillar type floor mounted capacity 12mm motorized with reduction sleeves (1set), chuck and key 15mm- (1no), Machinewise 100mm swivel base (1 No.) and standard accessories	1 No.
112	Drilling machine 20 mm pillar type capacity motorized with reduction sleeves (1set) , self locking drill chuck & key 15mm (1No) Machinewise 150mm (1 No.) and standard accessories	1 No.
113	Upright column type Drilling machine 25 mm capacity Table size 500 x 630 (approx) – Coordinate table (accuracy 0.01 mm) with DRO - atleast 6 auto feed range with self locking drill chuck & key 15mm (1No.), reduction sleeves (1set), Machinewise 150mm (1 No.) and standard accessories	1 No.
114	Universal Radial Drilling Machine 1200 mm area motorized with tapping attachment, reduction sleeve (1set), self locking drill chuck & key 15mm (1 No.), Machine wise 150mm (1No.) and standard accessories	1 No
115	Double ended grinder Pedestal type with 200 mm wheels (One fine and one rough) with twist drill grinding attachment	2 Nos.
116	Power Hacksaw machine Hydraulic drive 12" with bar and rest arrangement , vice-jaw clamping , (Saw blade size 24") and coolant system	1 No
117	Muffle Furnace 12" x 12" x 24" – 12 KW capacity 440v, 50 HZ, 3 phase with super kantal wire max.capacity – 1200°C and standard accessories	1 No.
118	Arc Welding Transformer 150A , Single phase, 230V with accessories	1 No.
119	Wheel balancing unit with stand size 150mm x 150mm x 250 height	1 No.
120	Arbor press with cylindrical rack and pinion type No.3	1 No.
121	Fly press single body with fly wheel No:4	1 No.
122	Portable crane – capacity 500 KG	1 No.
123	Hand Trolley with 4 wheels 500mm x 750 mm	1 No.
124	Electric Hand drill ¼"	1 No.
125	Electric Hand grinder – AG2	1 No.

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

UPGRADATION OF ITIs into CENTERS of EXCELLENCE (CoE)

**SECTOR / AREA : PRODUCTION AND MANUFACTURING
(2 YEARS)**

**ADVANCED MODULES IN II YEAR
(FOR THE FIRST 6 MONTHS OF II YEAR)**

**PMAT-06 : ADVANCED WELDING
(Duration - 24weeks)**

UPGRADATION OF ITIs into CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : **PRODUCTION AND MANUFACTURING**

ADVANCED MODULE IN IInd YEAR

PMAT-06: **ADVANCED WELDING**

(Duration - **24weeks**)

I) **COURSE CONTENT**

Practical	Theory
<ul style="list-style-type: none">- Familiarisation with the machinery used in the trade- Introduction to safety equipment and their use- Setting up of Arc and Gas apparatus.- Lighting and adjustment of Gas welding flame.- Striking an arc by MMAW	<ul style="list-style-type: none">- Introduction to various types of welding process.- Basic principal and application- Advantages and limitation- Nomenclature of welded joints- Term applied to welding- Explanation with simple sketches of various types of joints- Welding symbols- Edge preparation & application- Welding positions- Welding Techniques - Right ward & left ward practices.
<ul style="list-style-type: none">- Fusion run with/without filler rod on M S sheet.- Square butt joint on M S sheet- Lap, T and Edge joint on M S sheet.- MS to MS brazing- SS to copper soldering	<ul style="list-style-type: none">- Gas welding principle and application- Safety in Oxy-acetylene welding and cutting plant (DA & O₂)- Flame setting and their uses- Specification for filler rods- Use of gas welding flux- Construction and operation features of different type of regulators- Blow pipes & cutting torches- Gas welding, brazing & soldering procedures.

<ul style="list-style-type: none"> - Straight line beads on M S plate - Weaved bead on M S plate. - Fillet weld open corner joint on M S plate - Fillet weld on Tee joint - Square butt joint on M S plate. 	<ul style="list-style-type: none"> - Principles of Shielded metal Arc welding (SMAW) - Basic Electricity of welding power source - Types of power source & Connection features - AC/DC power source advantages and disadvantages. - Arc and its characteristics - Polarity types & Arc length - Electrode – Types, description & Specification – BIS, AWS, etc.. - Function of flux & Characteristics of flux - Selection of electrodes and coating factors
<ul style="list-style-type: none"> - Setting up TIG welding plant. - Beading practice on S S by TIG - Square butt and corner joint on S S by TIG - Welding of S S with back purging Technique. - Beading practice on Aluminium by TIG - Butt, T and Corner joint on Aluminium sheet by TIG 	<ul style="list-style-type: none"> - Introduction to TIG welding - TIG welding equipments - Advantages of TIG welding process - Power source – Types, polarity and application - Accessories - HF unit and DC suppressor. - Tungsten electrode, Types, sizes, and uses. - Type of shielding gases - Square wave concept and Wave balancing. - Advantages of root pass welding of pipes by TIG welding - Purging Methods - Tables/Datas relating to TIG welding.
<ul style="list-style-type: none"> - Edge preparation of plates & pipes - Root pass welding of plates by TIG in 1G, 2G, 3G & 4G. - Intermediate and cover pass welding of pipes by MMAW - Root pass welding of pipes by TIG in 5G & 6 G - Intermediate and cover pass welding of pipes by MMAW. - Pipe Flange welding by TIG & ARC 	<ul style="list-style-type: none"> - Welding of pipes - Pipes classification - Difference between pipe welding and plate welding - Types of Welding positions and its significance. - Edge preparation and tack welding procedure - Plate welding procedure in 1G, 2G, 3G & 4G positions. - Pipe welding procedure in 5G & 6G. - Pipe welding root pass and intermediate pass– Procedure - Pipe welding intermediate and Cover pass– Procedure
<ul style="list-style-type: none"> - Straight line beads on M S plate by Co₂ welding - Lap T & corner joint on M S plate - Single 'V' joint by Co₂ welding - Single 'V' joint by Argoshield welding - Double 'V' joint by Flux cored Arc welding - Square butt and T joint on S S sheet. 	<ul style="list-style-type: none"> - MIG/MAG welding - Power source & accessories - Wire Feed unit - Welding Gun & its parts - Modes of metal transfer – Dip, Globular, spray & pulsed transfer and its significance

<ul style="list-style-type: none"> - Single 'V' and fillet joint on Aluminium plate 	<ul style="list-style-type: none"> - Welding wire types and specification - Types of shielding gases - Argo shield gas advantages - Flux cored wire welding - Trouble shooting - Datas and Tables related to Co₂ welding
<ul style="list-style-type: none"> - Gas cutting of MS plate - Plasma cutting of S S sheets & Aluminium plates - Arc cutting & gouging practices on M S - Carbon Arc cutting and gouging - Profile cutting with CNC profile cutting machine 	<ul style="list-style-type: none"> - Gas cutting principles - Plasma cutting principles and advantages - Parameter setting - Types of gases used - Arc cutting & Gouging - Carbon Arc cutting and gouging - Basics of CNC profile cutting machine
<ul style="list-style-type: none"> - Cutting of sheet metal to size - Bending of sheet metal into various curvatures - Make simple square container - Make round container - Tubes – bending and Filling of steel S S and Copper tubes. 	<ul style="list-style-type: none"> - Sheet metal works - Measuring tools - Marking tools - Types of sheets and uses - Soldering process. - Methods applied in Laying out pattern - Sheet metal operations - Pipe & Tube bending
<ul style="list-style-type: none"> - Spark Test for metal identification - C I welding – Gas welding & Brazing - C I welding – By nickel based Electrodes - Powder spraying process - Hard facing & Surfacing methods. 	<ul style="list-style-type: none"> - Introduction to maintenance welding - Difference between maintenance and production welding - Types of metal and their characteristics - Classification of steels - Importance of preheating and post heating - Cast iron – pre heating methods - Bronze welding of C I - Fusion welding of C I by oxy fuel welding - Arc welding of C I - Powder spraying process - Hard facing by Arc - Stelling by TIG
<ul style="list-style-type: none"> - Spot welding of M S sheet - Spot welding of S S sheet 	<ul style="list-style-type: none"> - Resistance welding process – Spot welding - Seam welding – projection welding – Butt welding

<ul style="list-style-type: none"> - Spot welding of Aluminium - Seam welding of M S sheet - Butt weld of band saw blade 	<ul style="list-style-type: none"> - Advantages and limitation of each methods - Types of spot welding machine – Principle and application - Programme sequence & parameter setting - Seam welding – Principles application & parameter setting - Butt welding – Principle, application.
<ul style="list-style-type: none"> - Single 'V' joint on M S plate by SAW - Fillet weld on M S plate by SAW - Micro plasma welding on S S sheets & Foils 	<ul style="list-style-type: none"> - Advanced welding process - Submerged Arc welding – Principles, application - Types of fluxes, welding head, power source - Parameter setting - Plasma welding - Micro Plasma welding – Principle, parameter setting - Electro slag welding - Electro gas welding - Laser beam welding – Principles - Electron beam welding – principles - Friction welding advantages & limitation - Welding automation, Robots in welding
<ul style="list-style-type: none"> - Dimensional inspection of weldments - Visual inspection of weldments - Dye penetrant & Magnetic particle testing - Ultrasonic Testing - Radiographic film revealing - WPS & PQR writing procedure 	<ul style="list-style-type: none"> - Types of weld defects, causes and remedy - Inspection & testing of weldments - Visual inspection methods, kits & universal gauge, Fillet gauge, etc. - Non-destructive Testing methods, PT, MPT, UT & RT - Distortion - Destructive testing – Bend test & tensile test - Certification methods - Codes and standards - Structural welding codes - Pressure vessel welding codes - Welding procedure specifications (WPS) - Procedure qualification Record (PQR)

II) TOOLS, MACHINERY, EQUIPMENTS etc. for a batch of 16 trainees

Sl. No.	Description of tools	QTY
List of Hand Tools		
1	Gloves pair leather	17 Nos
2	Apron leather	17 Nos
3	Screen welding helmet type	17 Nos
4	Screen welding hand	17 Nos
5	Goggles pair welder	17 Nos
6	Hammer scaling 0.25 kg. With handle	17 Nos
7	Chisel cold flat 19 mm	17 Nos
8	Centre punch 9mm x 127 mm	17 Nos
9	Dividers 20 cm	17 Nos
10	Caliper outside 15 cm	17 Nos
11	Rule 60 cm two fold brass tipped to read inches and mm	17 Nos
12	Wire brush (M.S)	17 Nos
13	Spark lighter	17 Nos
14	Chipping screen hand	17 Nos
15	Safety boots for welders	17 Nos
16	Safety goggles	17 Nos
17	Square blade 15 cm	17 Nos
18	Scriber 15 cm	17 Nos
19	Tongs holding 30 cm	17 Nos
20	Wire brush (S.S)	17 Nos

Sl. No.	Description of tools	QTY
List of Shop Outfit		
21	Brass Rule 30 cm or nickel chrome steel rule 30 cm	4
22	Hammer ball pin 1 Kg with handle	4
23	Chisel cold cross 9 mm	1
24	Screw Driver 25 cm blade and 20 cm blade	1 each
25	Leg vice on stand 150 mm	1
26	Number punch 6 mm and letter punch 6 mm	1 set
27	Hacksaw frame adjustable 30 cm	4
28	Hammering blocks 5 cm thick 60 sq	2
29	Magnifying glass x 6	4
30	Weld measuring gauge fillet and butt	2
31	File half round bastard 30 cm	6
32	File flat 35 cm rough	6
33	Spanner 12 mm and 15 mm double ended	4
34	Spanner D E 6 mm to 15 mm be 1.5 mm set of Nos.	1 set
35	Clamps 10 cm 15 cm 20 cm 30 cm	2 each
36	Hammer sledge double faced 3 Kg.	1
37	Pipe wrench 25 cm and 35 cm	1 each
38	Steel tape 182 cm flexible in case	1
39	"Tinmans" square 60cm x 30 cm	1
40	Welding torches with 10 nozzles	6 set

Sl. No.	Description of tools	QTY
41	Eutalloy micro flow powder welding process	1 kit
42	Rototec powder welding process	1 kit
43	Earth clamps	12
44	Pipe Cutter	1 set
45	Cutting torch Oxy-Acetylene with cutting nozzle	2 set
46	Heavy duty cutting, blow pipe with cutting nozzles	1 set
47	Electrode holder 400 amps	6
48	Welding rubber hose, oxygen and acetylene 8 mm	100 mte
49	Rubber hose clips	50
50	Spindle key (for opening cylinder valve)	8
51	Pressure regulator oxygen double stage	8
52	Pressure regulator acetylene Regulators	8
53	Tip cleaner	8
54	Glasses coloured 108 x 82 x 3 mm DIN 9A 11 A & 13 A	16 each
55	Glass white 108 mm x 82 mm	20 dozen
56	Outfit spanner	8
57	Rubber hose pipe black and red 5 mm	30 mte
58	Leather sleeves	16 pairs
List of General Installation		
59	Transformer welding set with all accessories 300 A	1 set
60	Arc welding set Rectifier type 400 Amps with all accessories.	1 set
61	CO ₂ welding machine complete 400 amps (Inverter type)	1 set

Sl. No.	Description of tools	QTY
62	TIG welding set complete 300 amps AC/DC	1 set
63	Welding cables to carry 400 amps with flexible rubber	50 mte
64	Lugs for Cables	4 nos
65	CNC Profile cutting machine	1
66	Gas welding table 822 x 92 cm + 60 cm fire bricks on stand	3
67	Arc welding table all metal with positioner	6
68	Trolley for cylinder (H P unit)	2
69	Bench shear hand capacity up to 5 mm	1
70	D E grinder 30 cm wheel motorized Pedestal type	1
71	Vice bench 10 cm	6
72	Power hacksaw	1
73	Electrode drying oven Temp. range 0-250° C, 10Kg capacity	1
74	AG 7 Grinder & AG4	2 each
75	Portable drilling machine (Cap. 6 mm)	1
76	Welding helmets	16
77	Steel lockers with 8 pigeon holes	2
78	Dye penetrant Testing kit	2 set
79	Magnetic particle Testing machine	1
80	Ultrasonic flaw detector	1
81	X-ray film reference standard	1 set
82	Submerged Arc welding machine – 600 Amps	1
83	Micro plasma welding machine – 25 Amps	1

Sl. No.	Description of tools	QTY
84	Spot welding machine – 15 KVA	1
85	Seam welding machine	1
86	Universal Testing machine	1
87	Personnel Computer with latest profile	1
88	Welding CDs (Processes and Inspection methods)	1 set

Sl. No.	Description of tools	QTY
89	Fibre Welding booth & welding screen	8 each
90	Fume extractors	4
91	Oxygen, Acetylene, Argon & Co ₂ cylinders	2 each
92	Fire fighting equipment & First aid box	As required

Workshop furniture		Qty
1	Suitable Work Tables with vices	As required.
2	Stools	17 Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

