Laboratory Manual

Subject Code: PCME-304

Subject Name: CAD/CAM

ICD Programme

Developed By

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Title of the course : **CDA/CAM Lab**
Subject Code : PCME-304
Weekly load : 2 LTP 0-0-2
Credit : 1

COURSE OUTCOMES:

After successful completion of course, the students should be able to

CO1: Enhance the knowledge of application of CAD software in drawing and modeling
CO2: To understand the fundamentals of CNC machines, additive manufacturing and industrial robots
CO3: Obtain knowledge, understand implementation of CNC programing

Pre-requisite knowledge:

Cos	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	2	3	3	3	3	3
CO2	3	3	3	2	1	3	3	3	2
CO3	3	1	2	3	1	2	2	2	3
Avg.	3	2.3	2.7	2.4	1.7	2.7	2.7	2.7	2.7

List of Experiments:

S. No.	Title
1.	Introduction to AutoCAD.
2.	Draw the 2D drawings of components using line command and write the procedure.
3.	Draw the 2D drawings of components using line command and write procedure of the same.
4.	Draw the 2D drawing of the given parts using appropriate modify commands.
5.	Draw the 2D drawing of the given parts using appropriate modify commands.
6.	Draw front view full section and top view of the given drawings.
7.	To study about the general instruction of CAD/CAM lab and safety precautions of CNC both lathe and milling machine.
8.	To study the constructional details of CNC lathe machine.
9.	To study the lathe bed & slide ways.
10.	To study the construction and working of (a) Automatic Tool changer (b) Pallets
11.	To study the constructional details of CNC milling machine.
12.	Write a program of turning / step turning using G-codes M-codes for a given job on CNC lathe machine.
13.	Write a program for threading operation using G& M-codes on lathe machine of a given job.
14.	Write a program of CNC milling machine using G-codes M-codes for a given job on CNC milling machine

GENERAL INSTRUCTION

1. All the students are instructed to wear protective uniform, Shoes and identity card before entering into the laboratory.
2. Before starting the exercise, students should have a clear idea about the principal of that exercise.
3. All the students are advised to come with completed record and corrected observation book of pervious experiment.
4. Do not operate any computer/instrument/machine without getting staff member's prior permission.
5. The entire instrument is costly. Hence handle them carefully, to avoid fine for any breakage.
6. Utmost care must be taken to avert any possible injury while on Laboratory work. In case, anything occurs immediately to the staff members.
7. Shutdown the computer in the right way at the end of Laboratory work.
8. One student from each batch should put his/her signature during receiving the instrument in instrument issue Register.

EXPERIMENT No.1

Aim: Introduction to AutoCAD

Requirements: 1) PC/Laptop 2)AutoCAD

Objective: Introduction to fundamentals of AutoCAD, familiarizing students with the user interface of AutoCAD and frequently used commands.

Introduction:

AutoCAD is a CAD (Computer Aided Design or Computer Aided Drafting) software application for 2D and 3D design and drafting, developed and sold by Autodesk, Inc. Initially released in late 1982, AutoCAD was one of the first CAD programs to run on personal computers, and notably the IBM PC. Most CAD software at the time ran on graphics terminals connected to mainframe computers or mini-computers.

In earlier releases, AutoCAD used primitive entities — such as lines, polylines, circles, arcs, and text — as the foundation for more complex objects. Since the mid-1990s, AutoCAD has supported custom objects through its C++ API. Modern AutoCAD includes a full set of basic solid modeling and 3D tools. With the release of AutoCAD 2007 came improved 3D modeling functionality, which meant better navigation when working in 3D. Moreover, it became easier to edit 3D models. The mental ray engine was included in rendering, it was now possible to do quality renderings. AutoCAD 2010 introduced parametric functionality and mesh modeling.

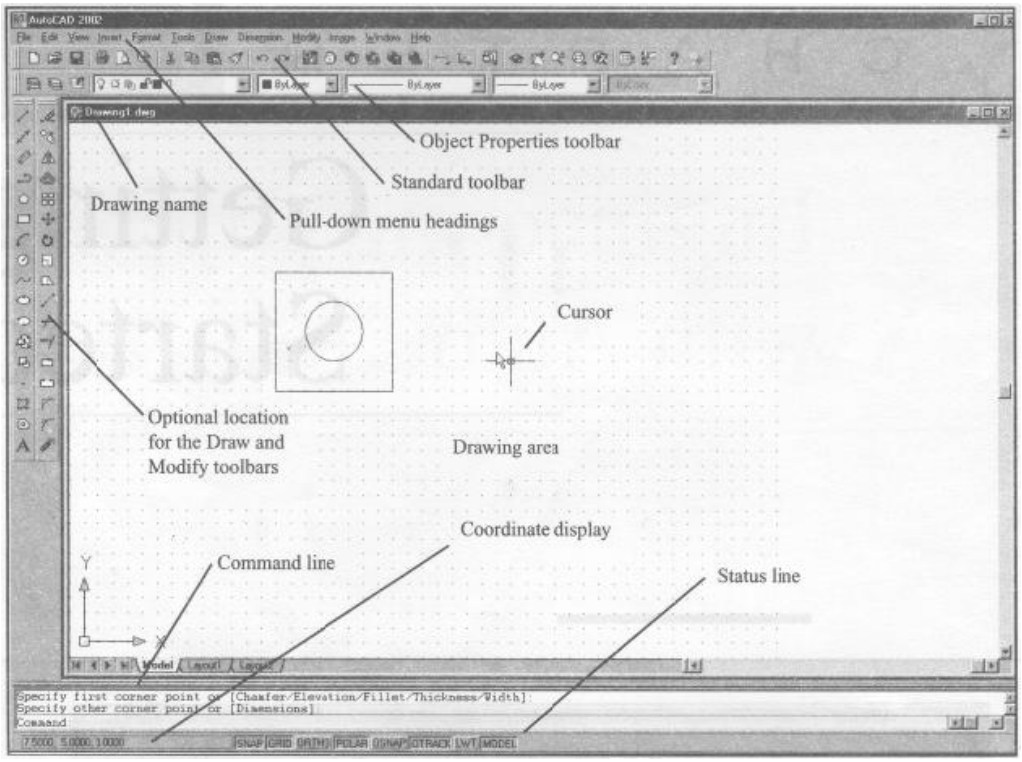
Figure 1.1 shows a typical initial AutoCAD windows screen. The top line displays the Windows pull down menus for exiting a program and changing a program.

The second line is the standard toolbar and contains a group of mostly used commands.

The third line contains some command icons and an area that shows the current docked, object properties that are active.

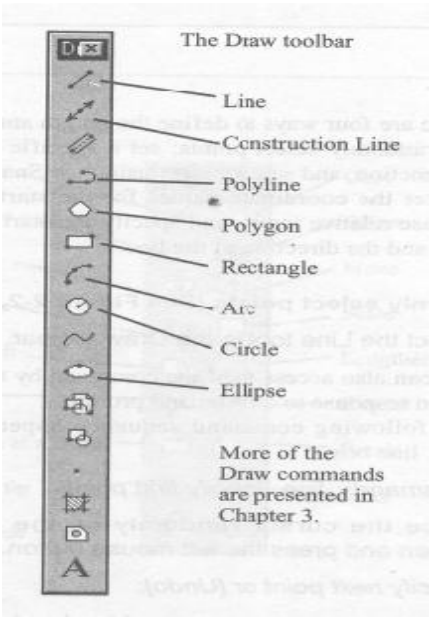
The bottom left corner of the screen shows the coordinate display position of horizontal, vertical crosshairs in terms of an X, Y coordinate value whose origin is lower left corner of the drawing screen.

Graphics user interface

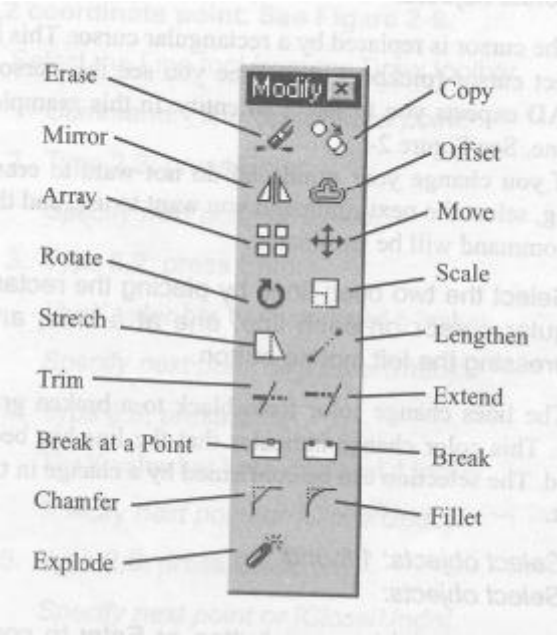


Frequently used toolbars

1. Draw



2. Modify



3. Standard

4. Dimension

5. Properties

Methods of coordinate input of a point:

ABSOLUTE CO-ORDINATES –

RELATIVE CO-ORDINATES –

POLAR CO-ORDINATES –

Brief Procedure of drawing

1. Define the drawing limits
2. ZOOM ALL
3. Define units
4. Start Drawing
5. Dimensioning
6. Title block
7. Save, print and export

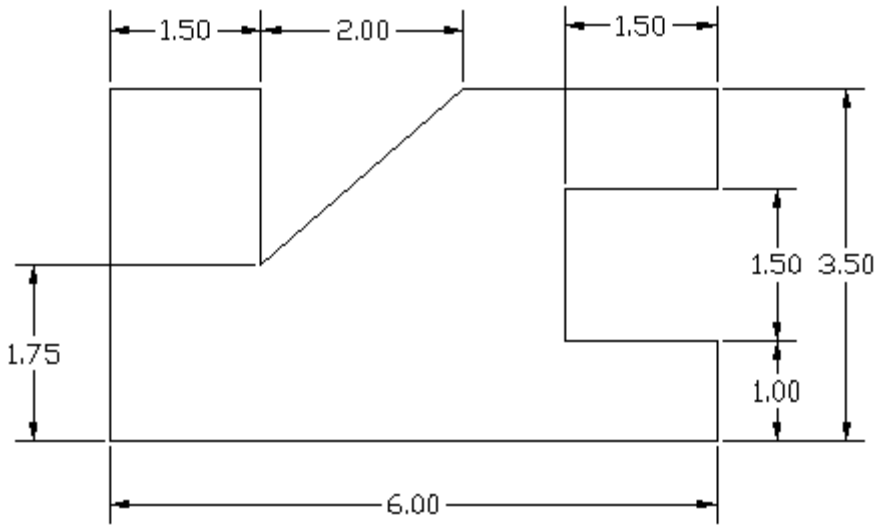
EXPERIMENT No. 2

Aim: Draw the 2D drawings of components using line command and write the procedure.

Requirements: 1) PC/Laptop 2)AutoCAD

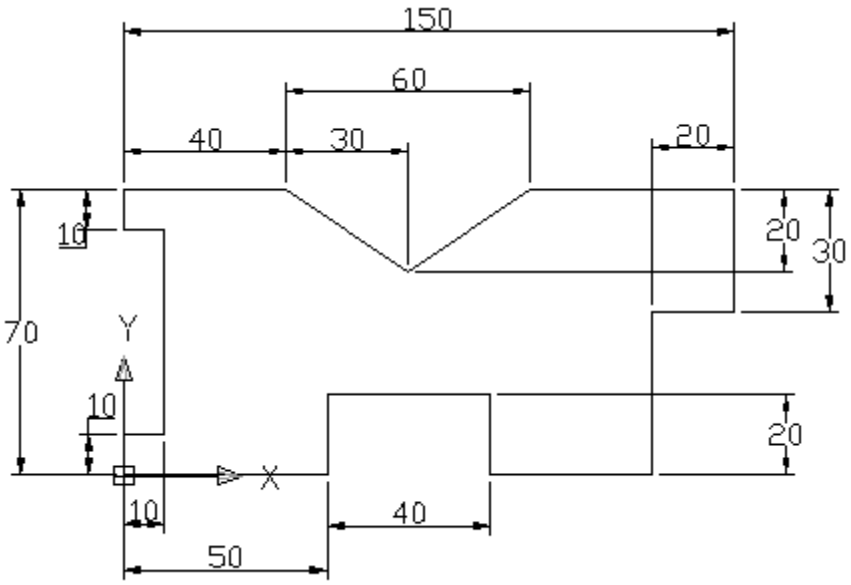
Objective. Introduction to basic commands and different modes to enter the coordinates of point to draw a part.

Lab exercise:

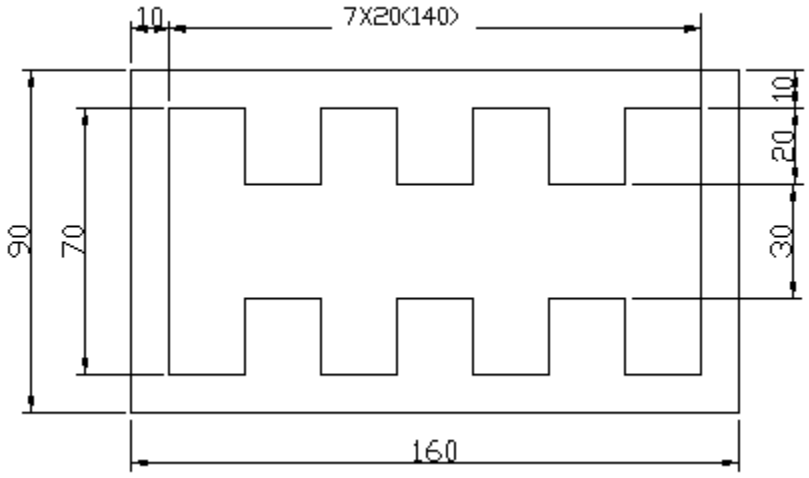


Exercise 2.1 (INCHES)

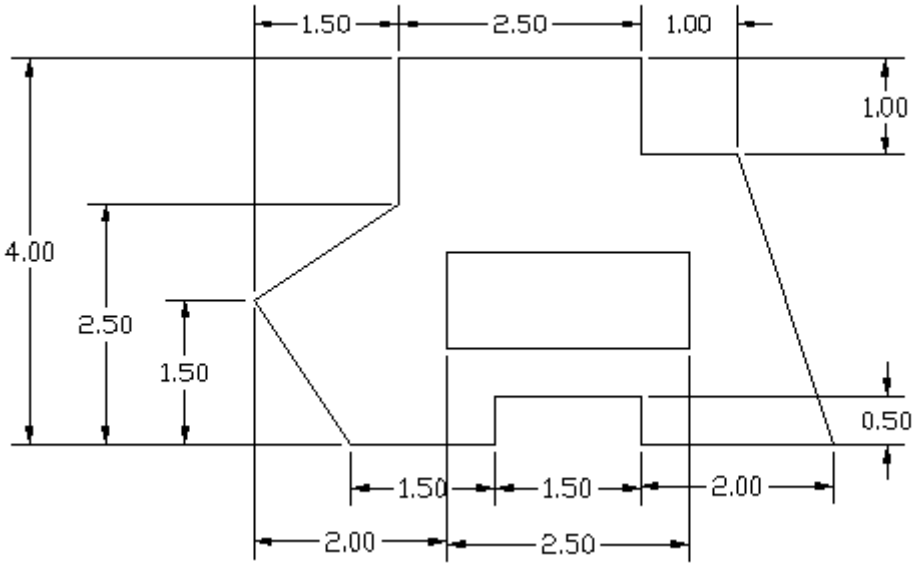
Drawings for Practice



Exercise 2.2 (MILLIMETERS)



Exercise 2.3 (MILLIMETERS)



Exercise 2.4 (INCHES)

EXPERIMENT No. 3

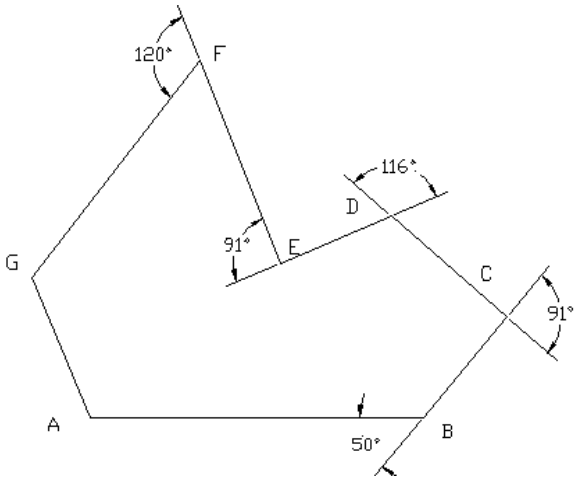
Aim: : Draw the 2D drawings of components using line command and write procedure of the same.

Requirements: 1) PC/Laptop 2)AutoCAD

Objective. Introduction to basic commands and polar mode to enter the coordinates of a point to draw a part.

Lab exercise:

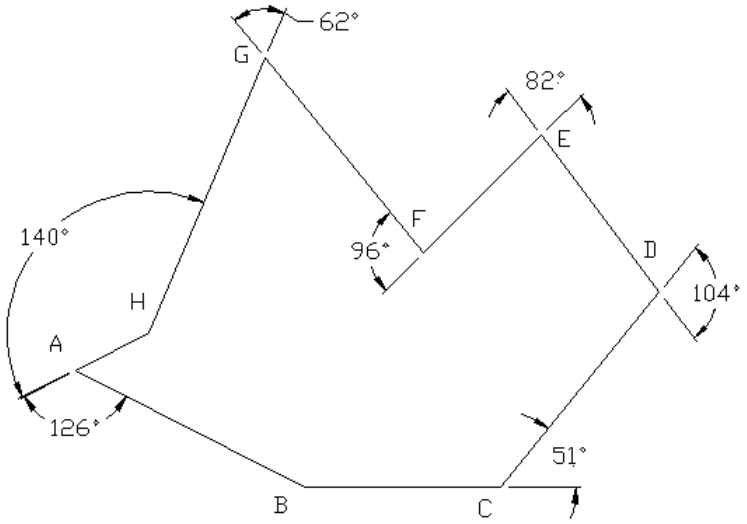
AB=5.0000
BC=1.9526
CD=2.3049
DE=1.8039
EF=3.2500
FG=4.1003
Find the length of AG



Exercise 3.1 (INCHES)

Drawing for practice

AB=65.7007
BC=50.0000
CD=64.0312
DE=50.0000
EF=42.4264
FG=64.0312
GH=76.1577
Find the length of AH



Exercise 3.2 (MILLIMETERS)

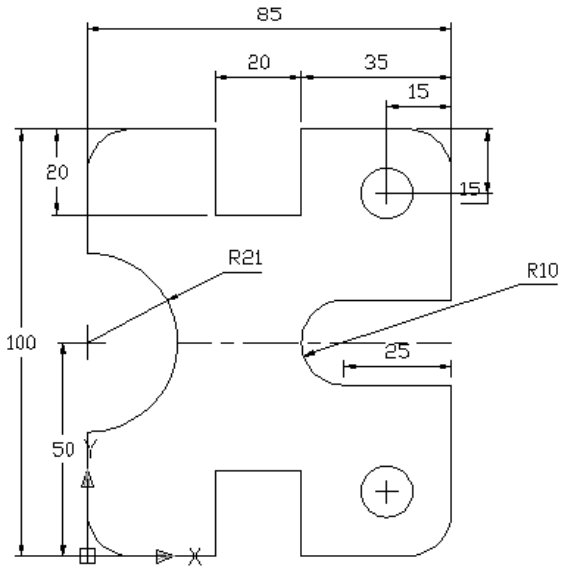
EXPERIMENT No. 4

Aim: Draw the 2D drawing of the given parts using appropriate modify commands.

Requirements: 1) PC/Laptop 2)AutoCAD

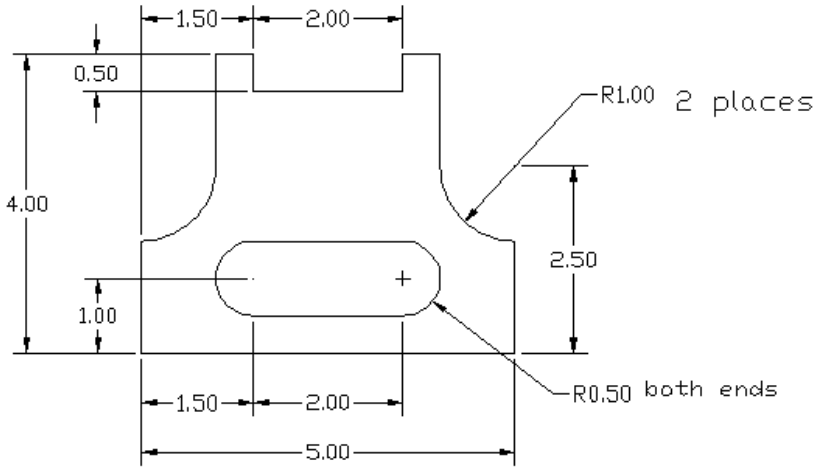
Objective.

Lab exercise:



Exercise 4.1 (MILLIMETERS)

Drawing for practice



Exercise 4.2 (INCHES)

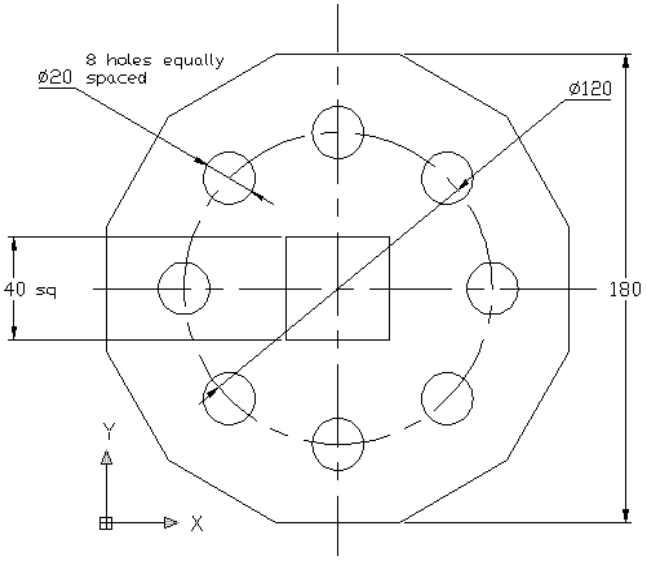
EXPERIMENT No. 5

Aim: Draw the 2D drawing of the given parts using appropriate modify commands.

Requirements: 1) PC/Laptop 2)AutoCAD

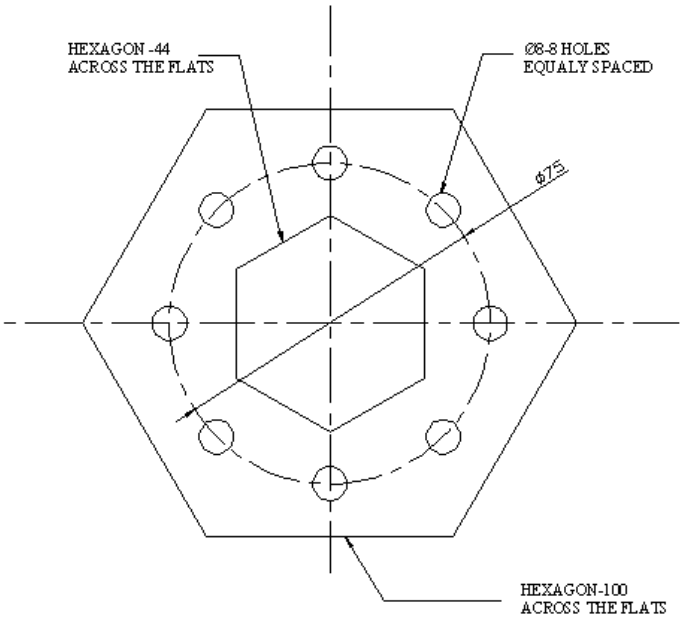
Objective.

Lab exercise:



Exercise 5.1 (MILLIMETERS)

Drawing for practice



EXPERIMENT No. 6

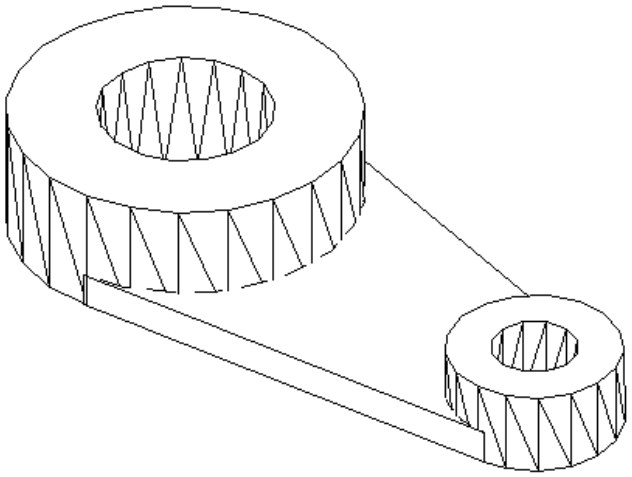
Aim: Draw front view full section and top view of the given drawings

Requirements: 1) PC/Laptop 2)AutoCAD

Objective. Introduction to the sectioning in AutoCAD and enhancing the proficiency of the students in the same.

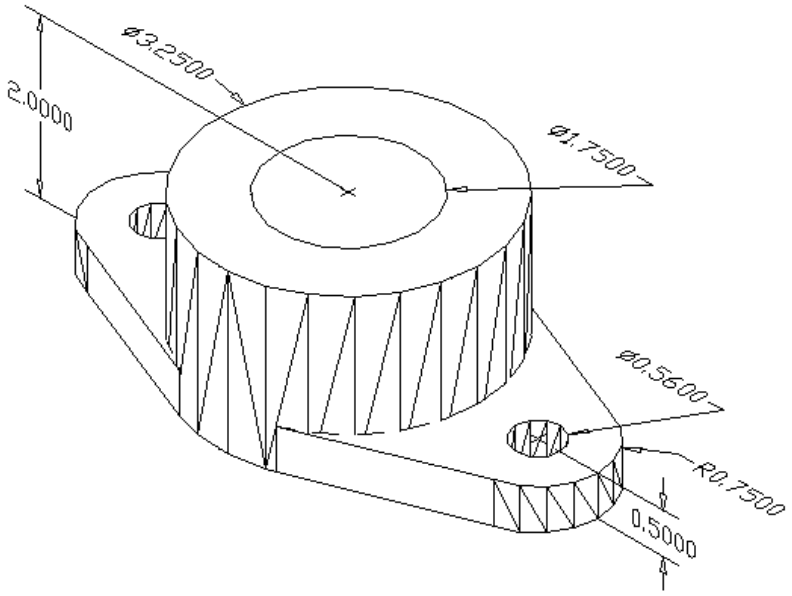
Lab exercise:

Assume missing dimensions.



Exercise 6.1(MILLIMETERS)

Drawing for practice



Exercise 6.2 (INCHES)

EXPERIMENT No. 7

Aim: : To study about the general instruction of CAD/CAM lab and safety precautions of CNC both lathe and milling machine.

Requirements:

Objective.

Safety precautions… CNC machines has safety device fitted to protect the machines and operation from unexpected accident. These safety precautions are as follows…..

1. **Tidyness…**
   - Do not place object on or around the machines so that it interface with the quarts or the operations of the machines.
2. **Power source…**
   - Ensures the correct cable for the power source is used.
   - When power fails turn off the isolators.
   - Ensure the machine is switched on before its maintenance is carried out.
3. **Lubrication** …
   - For lubrication please refers to the chart in maintenance section.
   - Checks state of slide ways lubrication each day.

4. **Recommendation on safety precautions** …

Always wears clothing that is suitable for opening the machines. Secure the work piece cleaning. Only operate the machines with safety quarts. Do not open the safety quarts during operation it is very dangerous to touch any rotating point. Never attempt to remove the scarf while the machine is turning. After setting tools, perform trail cut using manual operation. Remember to use tool offset to avoid machining errors. Never clean the machine or attachment while machine is running. Do not operate the machines with the electrical control box open. Turn the isolator to off before opening the electrical cabinet. When an emergency stop is required stop key on the operation panel. This cut power to the spindle and the axis driven reset by inserting key and turning the power on.

General instruction of CAD/CAM lab…

- Switch on to start the computer.
- Log on the computer and than enter the password.
- Do not use pen drive in the lab without permission.
- Do not delete copy any file without permission.
- Do not load any software in pc, please contact concerned faculty, staff to rectify it, if you have problem.
- Rough handling of hardware/equipment is strictly prohibited.
- Maintains decorum of lab while working.
- Shut down the computer properly after working.
- Keeps the chairs at their proper place while leaving lab….

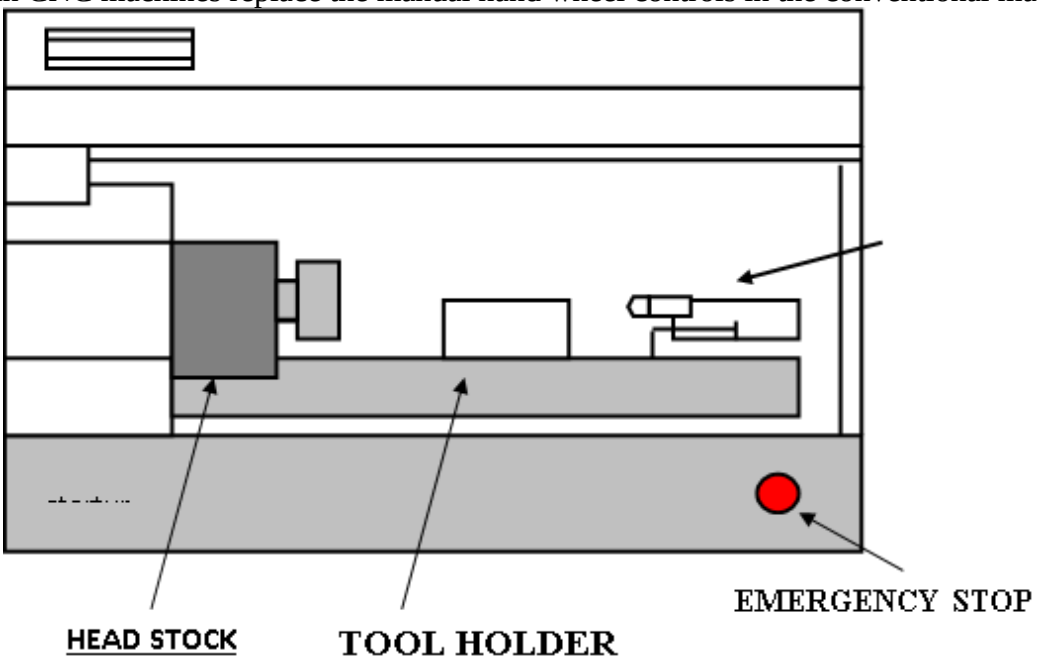
EXPERIMENT No. 8

Aim: : To study the constructional details of CNC lathe machine.

Requirements: CNC lathe machine.

Objective. Machine structure, Slide ways, drive units (spindle drive, axis drive) specification of CNC lathe

Theory : Design of a conventional machine tool is not suitable for CNC machines. Many design changes are required for CNC machines as compared to their conventional counterparts, due to a number of additional requirements which CNC machines are expected to meet. Axis drive motors in CNC machines replace the manual hand wheel controls in the conventional machine.



1. **MACHINE STRUCTURE:** The design and construction of CNC machine should be such that it meets the following main objectives:

a) High precision and repeatability
b) Reliability
c) Efficiency

2. **SLIDEWAYS:** In the conventional machine tools, there is direct metal-to-metal contact between the slide ways and the moving slide.
   The design of slide ways in a CNC machine should be:

   1) Reduce friction
   2) Reduce wear
   3) Satisfy the requirements of movements of the slides.
   4) Improve smoothness of the drive.

3. **DRIVE UNIT:** The drive unit are require to perform following functions:

- To drive the main spindle (SPINDLE DRIVE)
- To drive the saddle or carriage (AXIS DRIVE)

SPECIFICATION OF CNC LATHE

Standard features- star turn

Machine dimension list

Length:	600mm
Width:	425mm
Height:	430mm

Capacity

Distance between centers:		250mm
Swing over cross slide	:	38mm
Swing over bed	:	140mm
Spindle taper number	:	1 MT
Spindle bore	:	10mm
X-Axis ball screw	:	8mm x 2.5mm pitch
Z-Axis travel	:	10mm x 4mm pitch
Bed	:	ground

Main spindle:

Drive motor	:	0.5 HP Dc permanent magnet
Spindle nose	:	threaded type
Spindle bore	:	10mm

Saddle:

Axis motor	:	stepper motor 200 steps/ rev.

Optional indexing turret:

Turret lead type	:	Drum
No. Of tool stations	:	8
Tool size square	:	12mm x 12mm
Round	:	19mm dia.

NOTE: max. Turning diameter May be limited due to tooling

Machine work light	*:*	*110v ac*
Power supply	*:*	*1 PH 240v*
Total power connected	*:*	*8A / phase*

OPTIONAL FEATURES:

A) Pneumatic chuck

B) Spray mist coolant

EXPERIMENT No. 9

Aim: To study the lathe bed & slide ways

Requirements:

Objective..

Introduction:

In the conventional machine tools, there is direct metal to metal contact between the slide ways and the moving slide. Slide movement are very slow and machine utilization is also low .this arrangement is adequate for conventional machine tools. the demand on slide ways is much more in CNC machine because of rapid movement and higher machine utilization. The conventional type if arrangement with metal to metal contact does not meet the requirements of numerically control machine tools. The design of slide ways in a CNC machine should be:

1) Reduce friction
2) Reduce wear
3) Satisfy the requirements of movements of the slides.
4) Improve smoothness of the drive

To meet these requirements in CNC Machine tool slide ways, the technique used include hydrostatic slides, linear bearings with balls, rollers or needles and surface coating.

HYDOSTATIC SLISEWAYS:

In hydrostatic slide ways, air or oil is pumped in to small pocket or cavities machined into the carriage or slides which are in contact with the sideways. the pressure of the fluid gradually reduces to atmospheric pressure as it keeps out from the pockets through the gap between the slides and slide ways. the hydrostatic slides provides almost a frictionless condition for movement of slide. For efficient operation, it is very important that the fluids and slide ways are kept clean. Also, hydrostatic slide ways need a very large surface and to provide adequate support.

LINEAR BEARING WITH BALL, AND ROLLERS:

The sliding friction due to direct metal to metal contact, between the slides and slide ways is replaced with rolling friction by the use of antifriction ball or roller bearing. These are designed to run along precision ground shaft and offer frictionless movement over varying strokes of length with high linear precision. for movement along a flat plane, recirculation linear roll bearings are used. The main characteristic of linear roller bearing is that there is continuous roller circulation which allows unlimited linear movement. The linear roller bearing is also called tychoway ,consist of hardened and precision ground supporting element with very close tolerance. the rollers are in contact with guide ways machined on bed of machine. This arrangement provides smooth and easy movement.

CONSTRUCTION OF BED:

In CNC machine bed in general may be considered to be an assembly of the following components.

#. Structure
#.. Drives {including power units}.
#.. Actuation system
#.. Tool and work handling devices.
#.. Controller units

EXPERIMENT No. 10

Aim: : To study the construction details and working of

(a) Automatic Tool changer

(b) Pallets

(c) **Requirements**: Automatic Tool changer, Pallets

Objective. Familiar with ATC and Pallets.

Automatic tool changer:

It is an essential component of all NC/CNC machines. All the machines arte capable of holding multiple tools. in the case of lathe machine they all mounted on tooled when the operation of one tool ends, the turret moves away from the spindle. It indexes and automatically brings next tool to lead position. A motor power turret generate mechanism is used for indexing turret. Machine controller gives all signals to the motor that run the wheel on it.

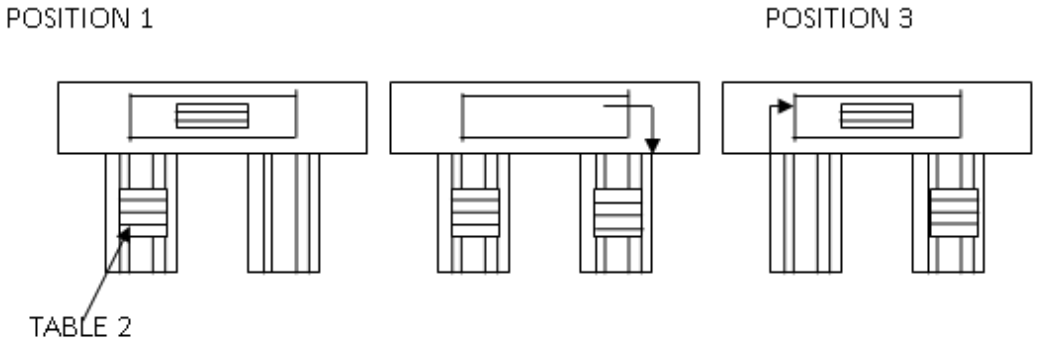
Accuracy of NC machine tool could be improved by the following ways.

(1) Rigidity of bed.
(2) Accurate control slide movement.
(3) Minimize the vibration.

If a milling machine has a long bed if while cutting at one of the edge, the outer edge which is not supported may cause deflection of bed and hence we may not get required accuracy. This phenomenon is explained in the figure. The phenomenon has happened because of the weight of the unsupported edge of the table while tapping a cut on the work piece because of forces. It will have same on the dimensional accuracy of the work piece so the machine structure and its assemblence should be designed to ensure that such deflection does not occur.

Automatic pallet changer:

Saving time can be achieved by minimizing or even eliminating the time the machine centre stands idle during the individual setting of each unmachined component. With the objective, the machines could be provided with more that one table. While machining is being performed on the work part, the operation could be unloading the complete piece or setting up the next one on other table called pallet shuttle system.



PALLETS

EXPERIMENT No. 11

Aim: : To study the constructional details of CNC milling machine.

Requirements: CNC milling machine.

Objective. Familiar with CNC milling machine.

Theory : Design of a conventional machine tool is not suitable for CNC machines. Many design changes are required for CNC machines as compared to their conventional counterparts, due to a number of additional requirements which CNC machines are expected to meet. Axis drive motors in CNC machines replace the manual hand wheel controls in the conventional machine.

MACHINE SPECIFICATION

A) CABINET:-

Length: -	550mm
Width: -	540mm
Vertical length: -	880mm

B) CAPACITY:-

Maximum cross travel: -	90mm
Maximum longitudinal travel	170mm
Maximum head travel: -	115mm
Spindle nose to table top: -	190mm
Spindle to column: -	110mm
Spindle taper: -	R8mm
Spindle tapes for ATC	BT35
Working table surface	360mmX130mm
3tee slots: -	10mm width X50mm centre
Z-axis ball screw	16dia.X 5pitchmm
X-axis ball screw: -	16d X 5p mm
Y-axis ball screw: -	.01mm
Weight: -	110kg without ATC
Weight: -	113 kg with ATC

C) ENVIRONMENTAL CONDITION:-

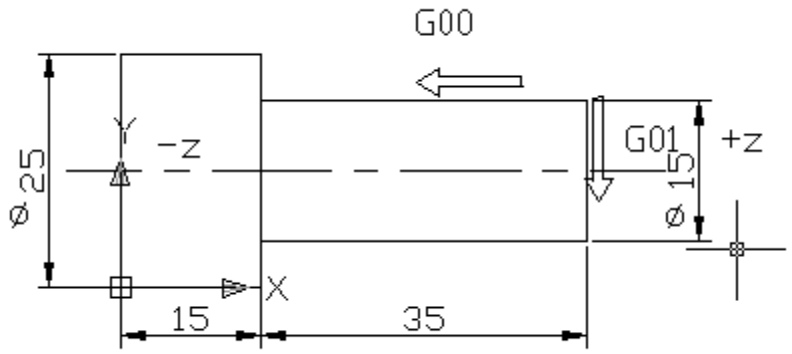
Power supply: -	220/240V, 8A 50/60 HZ single phase.

EXPERIMENT No.12

Aim: Write a program of turning / step turning using G-codes M-codes for a given job on CNC lathe machine.

Requirements: 1) PC/Laptop

Objective. CNC lathe program



Part Program

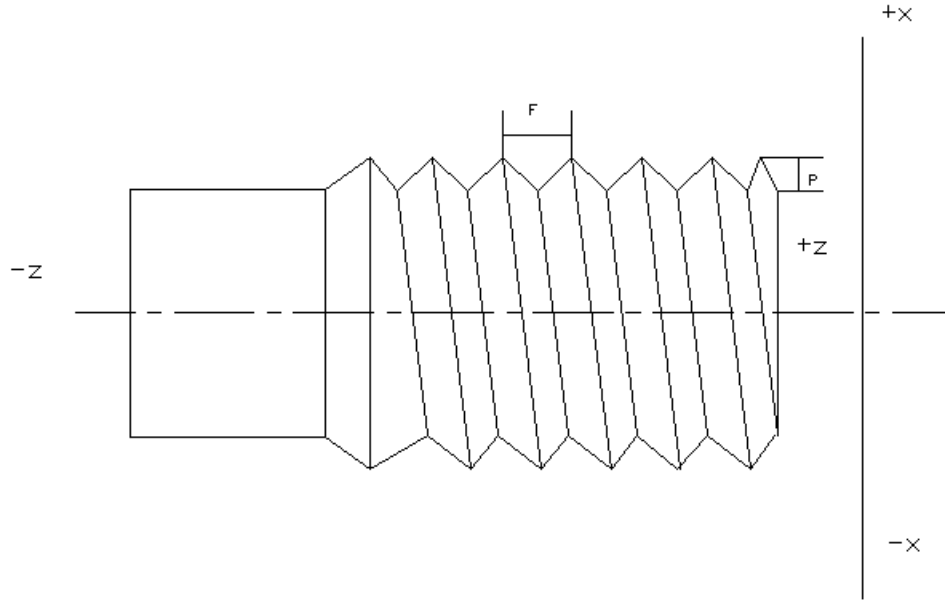
```
[BILLET X25  Z50
N10 G21  G40  G99
N20  G28  U0 W0
N30  M06  T01
N40  G97  S1500 M03
N50  G00 X23 Z5
N60  G01  Z-35  F0.1
N70  G00 X24
N80  G00  Z5
N90  G00  X21
N100  G01  Z-35 F0.1
N110  G00 X22
N120  G00 Z5
N130  G00 X19
N140  G01 Z-35 F0.1
N150  G00 X20
N160  G00 Z5
N170  G00 X17
N180  G01 Z-35 F0.1
N190  G00 X18
N200  G00 Z5
N210  G00 X15
N220  G01 Z-35 F0.1
N230 G28 U0 W0
N240  M30
```

EXPERIMENT No.13

Aim: Write a program for threading operation using G& M-codes on lathe machine of a given job.

Requirements: 1) PC/Laptop

Objective. CNC lathe program



(Suppose Major Diameter 25mm, Minor 23 and Pitch is 2mm)
BOX type threading cycle G92

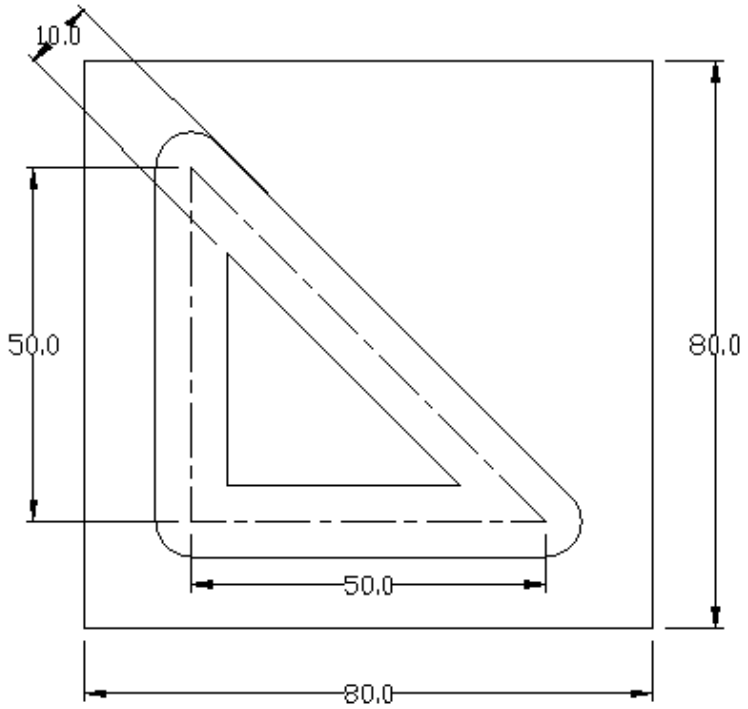
```
[BILLET X25  Z50
N10 G21  G40  G99
N20  G28  U0 W0
N30  M06  T01
N40  G97  S1500 M03
N50 G00 X25 Z5
N60 G92 X24.5 Z-50 F2
N70 G00 X25
N80 G00 Z5
N90 G92 X24 Z-50 F2
N100 G00 X25
N110 G00 Z5
N120 G92 X23.5 Z-50 F2
N130 G00 X25
N140 G00 Z5
N150 G92 X23 Z050 F2
G28 U0 W0
M30
```

EXPERIMENT No.13

Aim: Write a program of CNC milling machine using G-codes M-codes for a given job on CNC milling machine.

Requirements: 1) PC/Laptop

Objective. CNC lathe program



Size of Billet : Length 80mm Width 80mm Thickness 10mm
Machining Required : Length 50x50
Part Program

```
[BILLET X80 Y80 Z10
[EDGE MOVE X0 Y0
[TOOLDEF T1 D06
N10 G91 G28 X0 Y0 Z0
N20 M06 T0101
N30 M03 S1500
N40 G90
N50 G00 X15 Y15 Z5
N60 G01 Z-1 F50
N70 X65
N80 X15 Y65
N90 Y15
N100 G00 Z10
N110 G91 G28 X0 Y0 Z0
M120 M30
```