PNS SCHOOL OF ENGINEERING AND TECHNOLOGY

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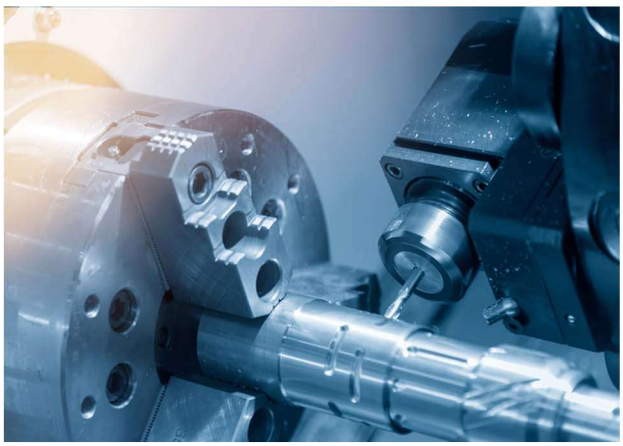


CAD/CAM LAB MANUAL

Department Of Mechanical Engineering

COURSE CONTENTS

PART-A
AUTO-CAD

INTRODUCTION TO AUTO-CAD

- AUTOCAD is a drawing package software developed by the company “AUTODESK” in USA .
- It is one of the widely used software for creating drawing easily.
- Generation of geometric modeling along with the Engineering analyze and evaluate the design and produce drawing for manufacturing with the help of computer.
- The first name of this software is “MICROCAD”. Which is evaluated in 1982.
- AutoCad is a command base, non-parametric and low end software. It is the best drawing software.

FILE	EDIT	MODIFY
	UCS : User Co-ordinate System	

FUNCTION OF MOUSE BOTTOM:

MB1 – Left Click

- It Drags or Move the icons.

MB2 – Middle Scroll

- It is used for Zoom-In Or Zoom-out of the Object.

MB3 – Right Click

- It is used for select the icon. It is also shows the Menu option.

EXPERIMENT NO -01

AIM OF THE EXPERIMENT

To create a rectangle by using 2D drafting

THEORY-

A rectangle in a two dimensional plane has 4 corner points which are specified by coordinates. By knowing all coordinates we can construct/ create rectangles in a two dimensional plane by using Auto CAD.

APPARATUS/SOFTWARE REQUIRED –

1. Auto-Desk-2010

LIMIT COMMAND :

1) Limits ↵
2) Specify the lower left corner : 0,0 ↵
3) Specify the upper right corner : 297,210 ↵
4) Z ↵
5) A↵

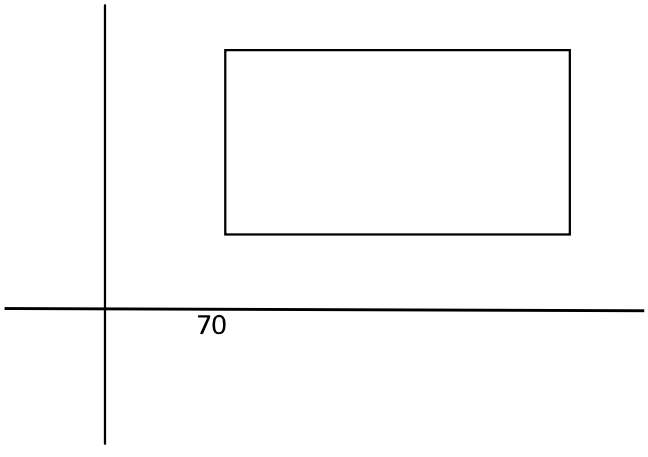
COMMAND FOR LINE :

1. Line/ L ↵
2. Specify the first point : (,) ↵
3. Specify the next point : (,) ↵
4. ESC ↵

PROBLEM -3 (To create a rectangle of size-30 ‘ x 40’)

PROCEDURE-80

1. Line ↵
2. 30, 50 ↵
3. 70, 50 ↵50
4. 70, 80 ↵
5. 30, 80 ↵30
6. 30, 50 ↵



CONCLUSION -

We successfully draw a rectangle by using 2D drafting where the co-ordinates of the rectangles are (30, 50), (70, 50), (70, 80) and (30, 80).One can take other co-ordinates and draw the rectangle also.

EXPERIMENT NO -02

AIM OF THE EXPERIMENT

Create a Circle by using 2D drafting

THEORY-

A Circle in a two dimensional plane has a fixed radius/diameter and its centre has specified by coordinates. By knowing its centre coordinates and radius/diameter we can construct/create Circle in a two dimensional plane by using Auto CAD.

APPARATUS/SOFTWARE REQUIRED –

1. Auto-Desk-2010

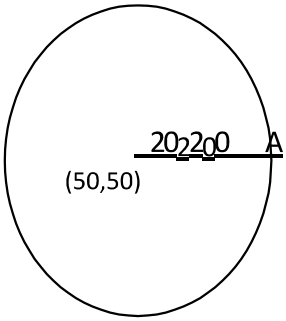
COMMAND FOR CIRCLE :

1) Circle / C ↵
2) Specify the center of circle ↵
3) Specify the radius or Diameter of the circle ↵
4) Specify the value of R / D of the circle ↵

PROBLEM :(Create a Circle/draw a circle of ϕ 40)

PROCEDURE –

1. C ↵
2. 50, 50↵
3. 20 ↵

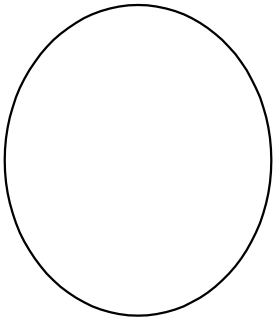


COMMAND FOR 2P (P = Point) CIRCLE :

1) Circle / C ↵
2) Specify the circle center (2P, 3P, TTR) ↵
3) 2P)↵
4) Specify the first point ↵
5) Specify the second point ↵

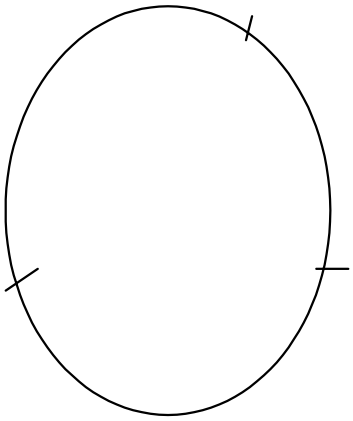
PROBLEM : To Create/draw2P Circle of ϕ60)

1. C↵
2. 2P↵(20,40) (80,40)
3. (20, 40)↵
4. (80, 40)↵



COMMAND FOR 3P (P = Point) CIRCLE :

1) Circle / C ↵
2) Specify the circle center (2P, 3P, TTR)↵(55,75)
3) 3P)↵
4) Specify the first point ↵
5) Specify the second point ↵
6) Specify the third point ↵



PROBLEM : To Create /draw a 3P circle of ϕ50)(30,50)(80,50)

1. C ↵
2. 3P ↵
3. (30, 50) ↵
4. (80, 50) ↵
5. (55, 75) ↵

COMMAND FOR TTR (Tangent, Tangent, Radius)

1) Circle/ C ↵
2) TTR ↵
3) Specify the first tangent on the circle ↵
4) Specify the second tangent on circle↵
5) Specify the radius on the circle ↵

PROBLEM : Create a Circle TTR (Tangent, Tangent, Radius)

1) C ↵
2) TTR ↵
3) Select the first tangent on the circle ↵
4) Select the second tangent on the circle↵
5) Radius found ↵

CONCLUSION –

We successfully draw a Circle by using 2D drafting where …

i. Radius and coordinate of centre are given.
ii. any arbitrary2 points on the circumference of the circle are given .
iii. any arbitrary3 points on the circumference of the circle are given .
iv. any 2 tangents are given and from it we can found the radius of the circle.

EXPERIMENT NO -03

AIM OF THE EXPERIMENT

Create a Polygon by using 2D drafting.

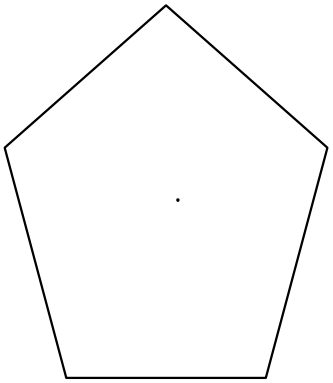
THEORY-

A Polygon of various no. of sides can be created /drawn if the centres of the polygon and no of sides are specified. We can also inscribe or circumscribe a circle in the polygon in a two dimensional plane by using Auto CAD.

APPARATUS/SOFTWARE REQUIRED –

1. Auto-Desk-2010

COMMAND FOR POLYGON



1. Polygon↵
2. Enter no of sides↵
3. Specify centre of polygon↵
4. Specify inscribed or circumscribed ↵
5. Specify radius of the circle ↵

PROBLEM-(To draw a Polygon of any size)

1. Polygon ↵
2. 5 ↵
3. 50,50 ↵
4. I or C ↵
5. 30 ↵

CONCLUSION –

We have successfully drawn a Polygon using 2D drafting where no. of sides is 5 and its centre coordinates (50, 50), having circle of radius 30 inscribed in the polygon.

EXPERIMENT NO -04

AIM OF THE EXPERIMENT

Dimensioning a rectangle / Circle/ Polygon

THEORY-

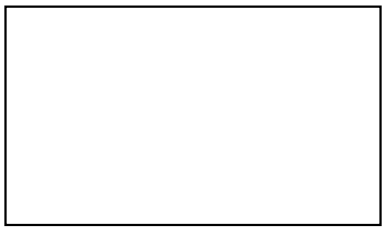
In this case **corner coordinates of any rectangle,centrecoordinates and radius of the circle**and **no of sides and circle inscribed or circumscribed on a polygon** are given then we can make necessary dimensioning of the side of the rectangle, centre, diameter / radius of a circle and the distance(dimension) of any sides of the polygon in a two dimensional plane by using Auto CAD.

APPARATUS/SOFTWARE REQUIRED –

1. Auto-Desk-2010

COMMAND FOR RECTANGLE

1. Rectangle
2. Specify 1st corner of the rectangle : (,) ↵
3. Specify the 2nd corner corner of the rectangle : (,) ↵
4. Select dimension linear : (,) ↵(150,125)

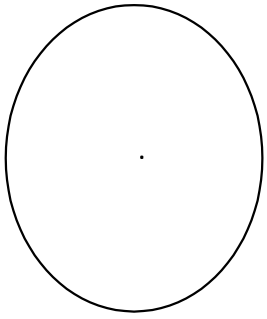


PROBLEM-

1. Rectangle↵
2. 50, 50↵
3. 150, 125↵(50,50)
4. Select dimension –Linear↵
5. Specify 1st selection line origin ↵selected
6. Specify 2nd extension line origin ↵

COMMAND FOR CIRCLE :

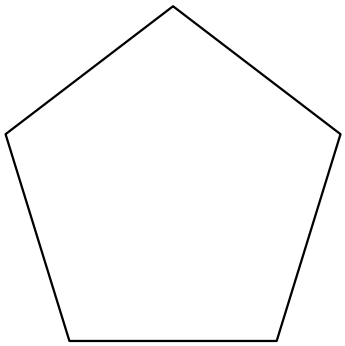
1) Circle / C ↵
2) Specify the center of circle ↵
3) Specify the radius or Diameter of the circle ↵
4) Specify the value of R / D of the circle ↵



PROBLEM :(Dimensioning of a circle)

1. C ↵
2. Specify the center and radius ↵
3. Select the dimension–radius ↵
4. Select Arc or circle ↵

COMMAND FOR POLYGON



1. Polygon ↵
2. Enter no of sides ↵
3. Specify centre of polygon ↵
4. Specify inscribed or circumscribed ↵
5. Specify radius of the circle ↵

PROBLEM-(To draw a Polygon of any size)

1. Polygon ↵
2. 5 ↵
3. Specify the centre of the polygon ↵
4. I or C ↵
5. 30 ↵
6. Specify the radius of the circle↵
7. Select dimension –Linear↵
8. Specify 1st selection line origin↵
9. Specify 2nd extension line origin↵

CONCLUSION –

We successfully dimensioning a rectangle , Circle and Polygon.

EXPERIMENT NO -05

AIM OF THE EXPERIMENT

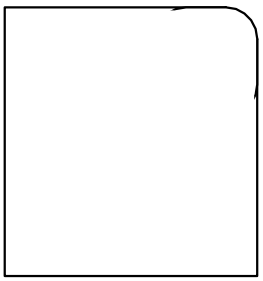
Commands essential for creating 2D drawing

THEORY-

In this case we are required to smoothening out one corner/edge of required radius of curvature by using 2D drawing of a Square/Rectangle. Further we can also draw an exact replica (mirror) of a given figure or an object. Similarly we can make/draw Ellipse and Chamfer of an Object etc. by using Auto CAD Command.

APPARATUS/SOFTWARE REQUIRED–-R-2

1. Auto-Desk-2010



COMMAND FOR FILLET :

1) Fillet / F ↵
2) Radius / R ↵
3) Specify the radius value ↵
4) Specify or select the first line of the first object ↵
5) Specify or select the second line of the first object ↵

PROBLEM:

Choose / make a rectangular whose one corner is smoothed/Fillet radius 2

1. F↵
2. R↵
3. 2↵
4. Specify or select the first line of the first object↵
5. Specify or select the second line of the first object↵

COMMAND FOR MIRROR(rectangle, circle etc) :

1) Mirror / MI ↵
2) Select the object ↵
3) Select the first end point of the mirror line ↵
4) Select the second end point of the mirror line ↵

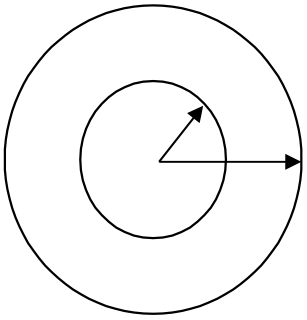
PROBLEM:(Choose an object)

Make an exact Replica of an Object/Figure.

1. Mirror↵
2. Select the object ↵
3. Select the first and point of the mirror↵
4. Select the second and point of the mirror↵

COMMAND FOR DONUT :

1) DONUT ↵
2) Specify the inside diameter : (,) ↵
3) Specify the outside diameter : (,) ↵
4) Select the position for Donut / Specify the center point of donut ↵



PROBLEM:

1. Do Nut↵
2. 40↵
3. 60↵
4. Select the position for Do nut↵

COMMAND FOR RECTANGLE :

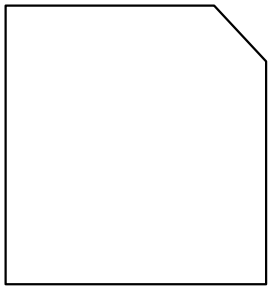
1) Rectangle ↵
2) Specify the first corner of the rectangle : [(0,0)/ (x1, y1)]↵
3) Specify the second corner of the rectangle : [(x2,y2)/ (x3, y3)]↵
4) ESC ↵

PROBLEM:(150,75)

1. Rectangle↵
2. (50,50)↵
3. (150, 75)↵
4. Esc ↵(50,50)

COMMAND FOR CHAMFER :

1) Chamfer / CHA ↵
2) Specify the chamfer distance i.e. D ↵
3) Specify the first chamfer distance (,)↵
4) Specify the second chamfer distance (,) ↵



PROBLEM:

Draw a Rectangle

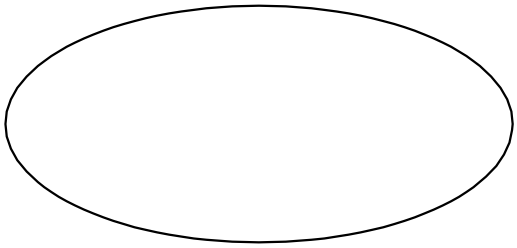
1. CHA↵
2. 6↵
3. 2↵
4. 4↵

COMMAND FOR ELLIPSE :

1) Ellipse ↵
2) Specify the center point of the ellipse (,) ↵
3) Specify the major axis of the ellipse (,) ↵
4) Specify the minor axis of the ellipse (,) ↵

OR

1. Toll bar >Ellipse > click over ellipse >
2. Define major axis (,) ↵
3. Define minor axis (,) ↵

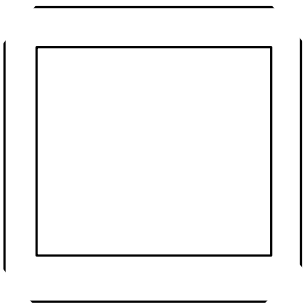


PROBLEM: Draw an Ellipse

1. Ellipse ↵
2. 50,50↵
3. 150,75↵
4. 100,25↵

COMMAND FOR OFFSET :

1. O ↵
2. Specify the offset distance : (,) ↵
3. Select the line ↵
4. Choose the side for offsetting the line and click here ↵

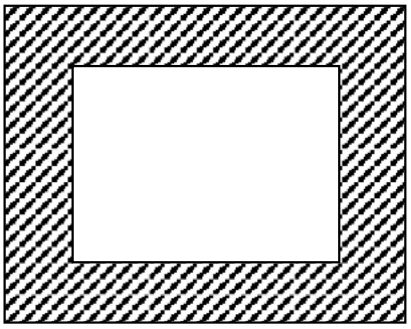


PROBLEM:

Make an offset for a rectangle

1. O ↵
2. 5 ↵
3. Select the line ↵
4. Choose the side of the offsetting ↵

COMMAND FOR HATCHING:



1. Hatch ↵
2. Click over add : pick a point ↵
3. Hatch type (Predefined) ↵
4. Select pattern of hatch ↵
5. Preview , OK↵

PROBLEM :

1. Hatch↵
2. Pick a point↵
3. Hatch type (select from table)↵
4. Select pattern of hatch↵
5. Preview OK↵

COMMAND FOR TEXT :

1. Text ↵
2. Specify the starting point of the text ↵
3. Specify the text height ↵
4. Specify the rotation angle of text ↵
5. Writing text ↵

PROBLEM:

1. Text ↵
2. Specify the starting point of ↵
3. Specify the text height ↵
4. Specify the rotation angle of text ↵
5. Writing text ↵

COMMAND FOR VERTICAL LINE :

1. XL ↵
2. V ↵
3. Place the vertical line ↵

PROBLEM:

1. XL ↵
2. V ↵
3. Selected the vertical line ↵

COMMAND FOR HORIZONTAL LINE:

1. XL ↵
2. H↵
3. Place the horizontal line ↵

PROBLEM:

1. XL ↵
2. H ↵
3. Selected the horizontal line↵

CONCLUSION –

We successfully know the various essential commands for creating 2D drawing.

EXPERIMENT NO -06

AIM OF THE EXPERIMENT

Create/draw a Screw Jack by using 2D drafting

THEORY-COMMANDS USED

APPARATUS/SOFTWARE REQUIRED –

1. Auto-Desk-2010

COMMAND USED FOR MAKING A SCREW JACK:

1. Line command ↵
2. Circle command ↵
3. Hatching command ↵
4. OSNAP command ↵
5. ORTHO command ↵
6. OFFSET command ↵
7. Method of increment ↵
8. Fillet command ↵

PROBLEM:

CONCLUSION –

We successfully draw a screw jack using 2D drafting.

PART - B

EXPERIMENT II

INTRODUCTION TO COMPUTER NUMERICAL CONTROL II

AIM: To Know Evolution of CNC, advantages of CNC, limitations of CNC, features of CNC, machine control unit (MCU) for CNC, classification of CNC machine tools; CNC machining centers: classification, features of CNC machining centers

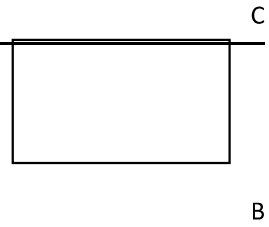
Co-ordinate system:

In order for the part programmer to plan the sequence of positions, moments, the cutting tool. Machine to the WIP, it is memory to establish a standard axis system by which the relative positions can be specified. Two axes "X & Y" are defined in the plane of the table, the 'z' axis in perpendicular. In this plane of the table the vertical motion of the spindle controls the 'z' direction. The positive and negative directions motion of the tool.

Programming methods

1) Incremental method

2) Absolute method



1) Incremental Method:

In this method, every point is considered as origin from this point; the values are calculated, for examplePoint A = (0, 0)

Point B = (20, 0)

Point C = (0, 10)

Point D = (-20, 0)

2) Absolute method:

In this absolute system, the set point is considered as a reference point as from that point, all the values arecalculated, for example

Point A = (0, 0)

Point B = (20, 0)

Point C = (20, 10)

Point D = (0, 10)

Programming methods:

In CNC machines program are programmed by two methods.

1) Manual part programming

2) Computer assisted part programming

-:Problem Practice :-

1) Manual part programming:

To prepare a part program using the manual method, the programmer writes the machining instruction ismust be hence, menu script the instruction is must be prepared in a very precise manner because the typist prepares the NC type directory from the Manu script some in various form expending on the machine tool and tape format used.

2) Computer assisted part programming:

In the more complicated point and in contour application using manual part programming because an extremely tedious basic and subject to errors. It is must more appropriate to employ the high speed digital computer to assist the part programming languages system have been developed to perform automatically most ofthe calculation which the programmer would otherwise be forced to do

PREPARATORY FUNCTIONS (G-CODE):

Preparatory functions are used for cutting operations like facing, turning, thread cutting, drilling, etc.,

MISCELLANEOUS FUNCTIONS (M-CODE):

Miscellaneous functions are used for other than cutting operations like spindle ON/OFF, coolantON/OFF, tool change, etc

Preparatory Functions (G-Codes):

G00 - Positioning at rapid speed; Mill and Lathe

G01 - Linear interpolation (machining a straight line); Mill and Lathe

G02 - Circular interpolation clockwise (machining arcs); Mill and Lathe

G03 - Circular interpolation, counter clockwise; Mill and Lathe

G04 - Mill and Lathe, Dwell

G09 - Mill and Lathe, Exact stop

G10 - Setting offsets in the program; Mill and Lathe

G12 - Circular pocket milling, clockwise; Mill

G13 - Circular pocket milling, counterclockwise; Mill

G17 - X-Y plane for arc machining; Mill and Lathe with live tooling

G18 - Z-X plane for arc machining; Mill and Lathe with live tooling

G19 - Z-Y plane for arc machining; Mill and Lathe with live tooling

G20 - Inch units; Mill and Lathe

G21 - Metric units; Mill and Lathe

G27 - Reference return check; Mill and Lathe

G28 - Automatic return through reference point; Mill and Lathe

G29 - Move to location through reference point; Mill and Lathe

G31 - Skip function; Mill and Lathe

G32 - Thread cutting; Lathe

G33 - Thread cutting; Mill

G40 - Cancel diameter offset; Mill. Cancel tool nose offset; Lathe

G41 - Cutter compensation left; Mill. Tool nose radius compensation left; Lathe

G42 - Cutter compensation right; Mill. Tool nose radius compensation right; Lathe

G43 - Tool length compensation; Mill

G44 - Tool length compensation cancel; Mill (sometimes G49)

G50 - Set coordinate system and maximum RPM; Lathe

G52 - Local coordinate system setting; Mill and Lathe

G53 - Machine coordinate system setting; Mill and Lathe

G54~G59 - Work piece coordinate system settings #1 to #6; Mill and Lathe

G61 - Exact stop check; Mill and Lathe

G65 - Custom macro call; Mill and Lathe

G70 - Finish cycle; Lathe

G71 - Rough turning cycle; Lathe

G72 - Rough facing cycle; Lathe

G73 - Irregular rough turning cycle; Lathe

G73 - Chip break drilling cycle; Mill

G74 - Left hand tapping; Mill

G74 - Face grooving or chip break drilling; Lathe

G75 - OD groove pecking; Lathe

G76 - Fine boring cycle; Mill

G76 - Threading cycle; Lathe

G80 - Cancel cycles; Mill and Lathe

G81 - Drill cycle; Mill and Lathe

G82 - Drill cycle with dwell; Mill

G83 - Peck drilling cycle; Mill

G84 - Tapping cycle; Mill and Lathe

G85 - Bore in, bore out; Mill and Lathe

G86 - Bore in, rapid out; Mill and Lathe

G87 - Back boring cycle; Mill

G90 - Absolute programming

G91 - Incremental programming

G92 - Reposition origin point; Mill

G92 - Thread cutting cycle; Lathe

G94 - Per minute feed; Mill

G95 - Per revolution feed; Mill

G96 - Constant surface speed control; Lathe

G97 - Constant surface speed cancel

G98 - Per minute feed; Lathe

G99 - Per revolution feed; Lathe

Miscellaneous Functions (M-Code):

M00 - Program stop; Mill and Lathe

M01 - Optional program stop; Lathe and Mill

M02 - Program end; Lathe and Mill

M03 - Spindle on clockwise; Lathe and Mill

M04 - Spindle on counterclockwise; Lathe and Mill

M05 - Spindle off; Lathe and Mill

M06 - Tool change; Mill

M08 - Coolant on; Lathe and Mill

M09 - Coolant off; Lathe and Mill

M30 - Program end, return to start; Lathe and Mill

M97 - Local sub-routine call; Lathe and Mill

M98 - Sub-program call; Lathe and Mill

M99 - End of sub program; Lathe and Mill

M00 - program stop

M01 - optional stop using stop button

M02 - end of program

M03 - spindle on CW

M04 - spindle on CCW

M05 - spindle off

M06 - tool change

M07 - flood with coolant

M08 - mist with coolant

M09 - coolant off

M17 - subroutine end

M20 - tailstock back

M21 - tailstock forward

M22 - Write current position to data file

M25 - open chuck

M30 - end of tape

M71 - puff blowing on

M72 - puff blowing off

M96 - compensate for rounded external curves

M97 - compensate for sharp external curves

M98 - subprogram call

M99 - return from subprogram, jump instruction

M101 - move x-axis home

M102 - move y-axis home

M103 - move z-axis home

Viva Questions:

1. Explain Few G codes and functioning?
2. Explain Few M codes and functioning?
3. Explain the methods of programming
4. Explain the advantages of incremental programming over absolute programming.

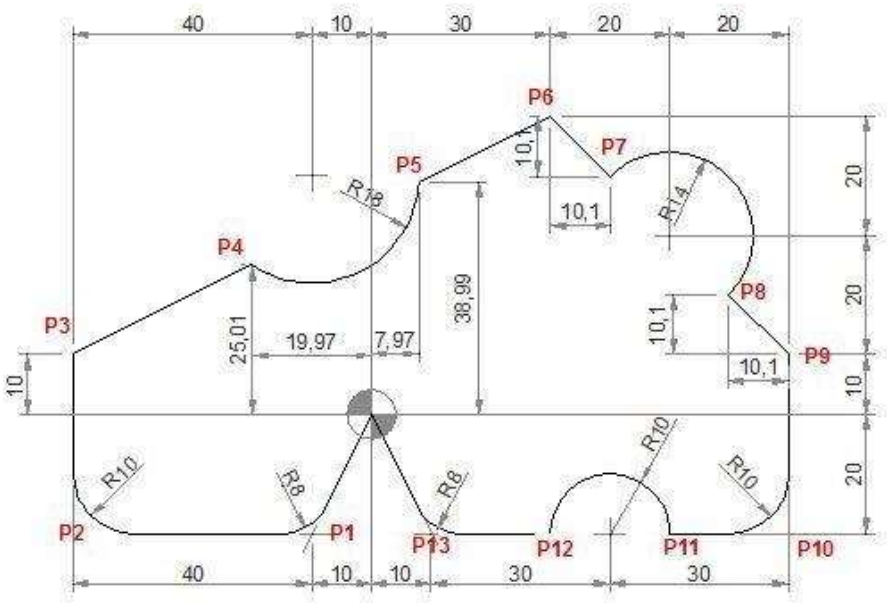
-:Problem Practice :

EXPERIMENT III

CNC MILLING I

Aim: learn the Basic fundamentals of CNC milling, familiarization of machine control panel.

Diagram:



CNC Manual Coding:

N40 G90 G00 X0 Y0

N50 G01 X-10 Y-20 R8 (P1)

N60 G01 X-50 R10 (P2)

N70 Y10 (P3)

N80 X-19.97 Y25.01 (P4)

N90 G03 X7.97 Y38.99 R18 (P5)

N100 G01 X30 Y50 (P6)

N110 G91 X10.1 Y-10.1 (P7)

N120 G90 G02 X59.9 Y20.1 R14 (P8)

N130 G01 X70 Y10 (P9)

N140 Y-20 R10 (P10)

N150 X50 (P11)

N160 G03 X30 R10 (P12)

N170 G01 X10 R8 (P13)

Viva Questions:

1. What are the basic operations can perform in milling machine?
2. List the various operating systems available in programming?
3. What is the operating system available in present system?
4. Explain G90 and G91 with example.

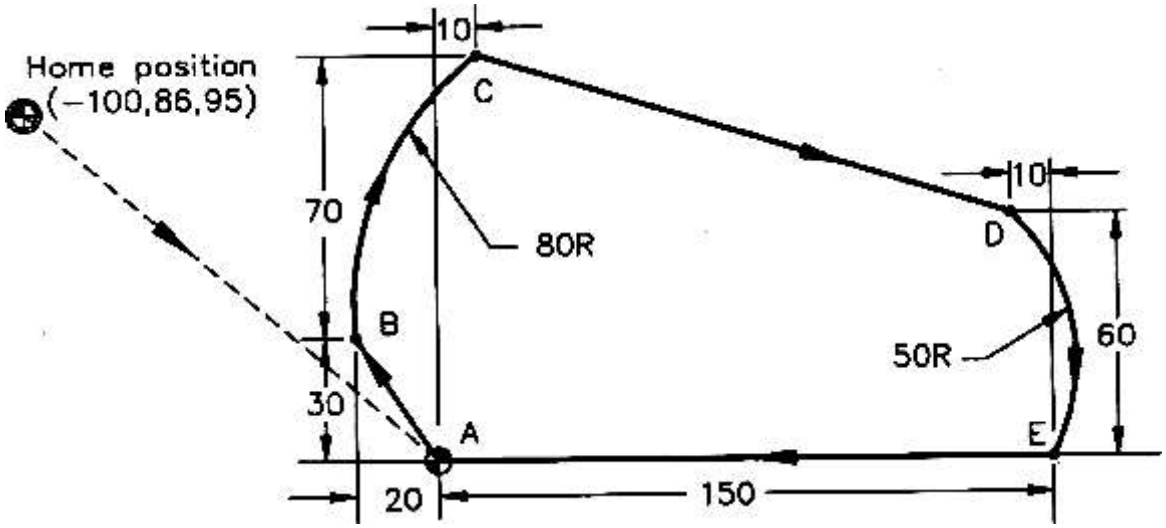
-:Problem Practice :-

EXPERIMENT IV

CNC MILLING II

Aim: Fundamentals of CNC programming, Part programming and interpolation techniques.

Diagram:



CNC Manual Coding:

N5 G90 G71N10 T1 M6

N15 G92 X-100 Y86 Z95 N20 G0 X0

Y0 S2500 M3N25 Z12.5

N30 G1 Z-12.5 F150 N35 X-20

Y30

N40 G2 X10 Y100 R80N45 G1

X140 Y60 N50 G2 X150 Y0 R50

N55 G1 X0 Y0

N60 G0 Z12.5

N65 G91 G28 Z0 M5 N70 G91

G28 X0 Y0N75 M30

Code Explanation

N5 absolute positioning, metric unit

N10 tool change to T1

N15 define work zero point at A

N20 rapid traverse to A, spindle on (2500 RPM, CW)

N25 rapid plunge to 12.5 mm above Z0

N30 feed to Z-12.5, feed rate 150 MMPM

N35 cut line AB to B

N40 cut arc BC to C

N45 cut line CD to D

N50 cut arc DE to E

N55 cut line EA to A

N60 rapid retract to Z12.5

N65 reference point return in Z direction, spindle off

N70 reference point return in X and Y directions

N75 end of program

Viva Questions:

1. What are G02 and G03? Differentiate each.
2. What are the liner motion codes?
3. What is the drilling code?
4. What is meaning of peck drilling?

-:Problem Practice :-

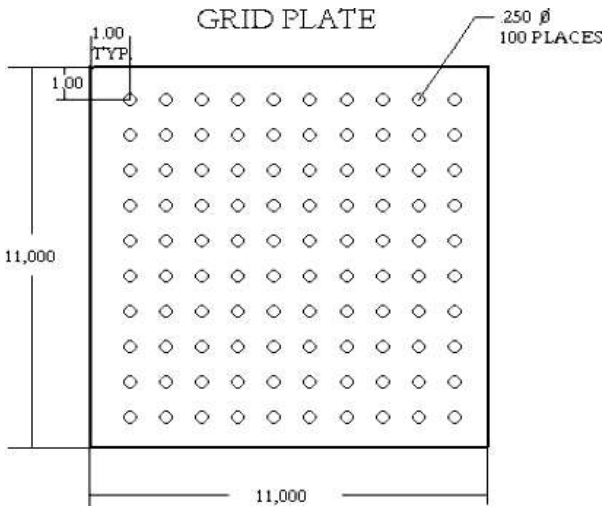
EXPERIMENT V

CNC MILLING III

Aim: Machining practice on CNC machine for drilling

Example I

Diagram:



CNC Part Programming:

03400 (Drilling grid plate)

T1 M06

G00 G90 G54 X1.0 Y-1.0 S2500 M03G43 H01

Z.1 M08

G81 Z-1.5 F15. R.1G91 X1.0 L9

G90 Y-2.0 (Or stay in G91 and repeat Y-1.0)G91 X-1.0

L9

G90 Y-3.0 G91 X1.0 L9

G90 Y-4.0 G91 X-1.0 L9

G90 Y-5.0 G91 X1.0 L9

G90 Y-6.0

G91 X-1.0 L9G90 Y-7.0

G91 X1.0 L9 G90 Y-8.0

G91 X-1.0 L9G90 Y-9.0

G91 X1.0 L9 G90 Y-10.0

G91 X-1.0 L9

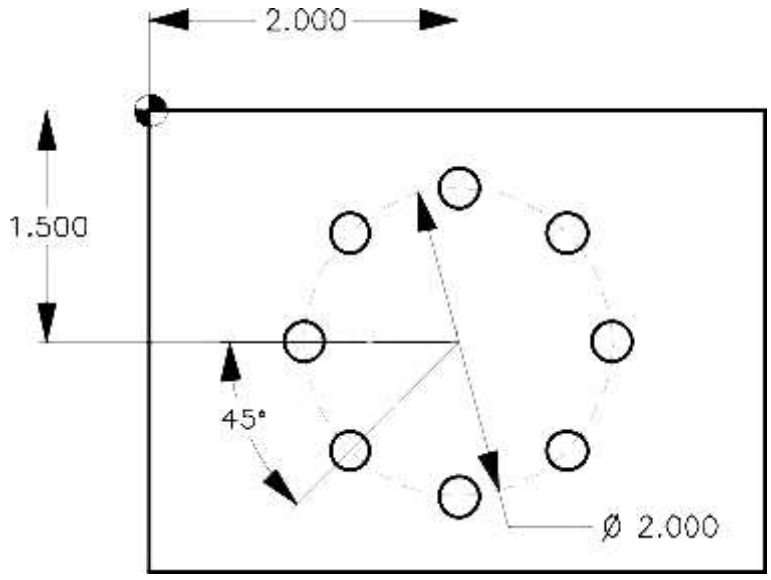
G00 G90 G80 Z1.0 M09G28 G91 Y0

Z0

M30

Example II

Diagram:



CNC Part programming:

O0009

N1 T1 M06

N2 G90 G54 G00 X2. Y-1.5 (Center position of bolt hole circle)N3 S1451

M03

N4 G43 H01 Z1. M08

N5 G81 G99 Z-0.45 R0.1 F8. L0

N6 G70 I1. J0. L8

N7 G80 G00 Z1. M09 N8

G53 G49 Z0. M05 N9

M30

Viva Questions:

1. What is mean by tool compensation?
2. What is tool compensation code?
3. What is work offset? Explain.
4. What is mean by plane selection?

-:Problem Practice :-