LAB Manuals

for

CAD Laboratory

(w.e.f. AY 2021-22)

DEPARTMENT OF MECHANICAL ENGINEERING
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Experiment No. 1: Introduction to CAD software and working with sketcher tools, working with creating features, Point, Axis and Planes

Introduction: Computer-aided engineering primarily uses computer-aided design (CAD) software, which are sometimes called CAE tools. CAE tools are used, to analyze the robustness and performance of components and assemblies. CAE tools encompass simulation, validation, and optimization of products and manufacturing tools.

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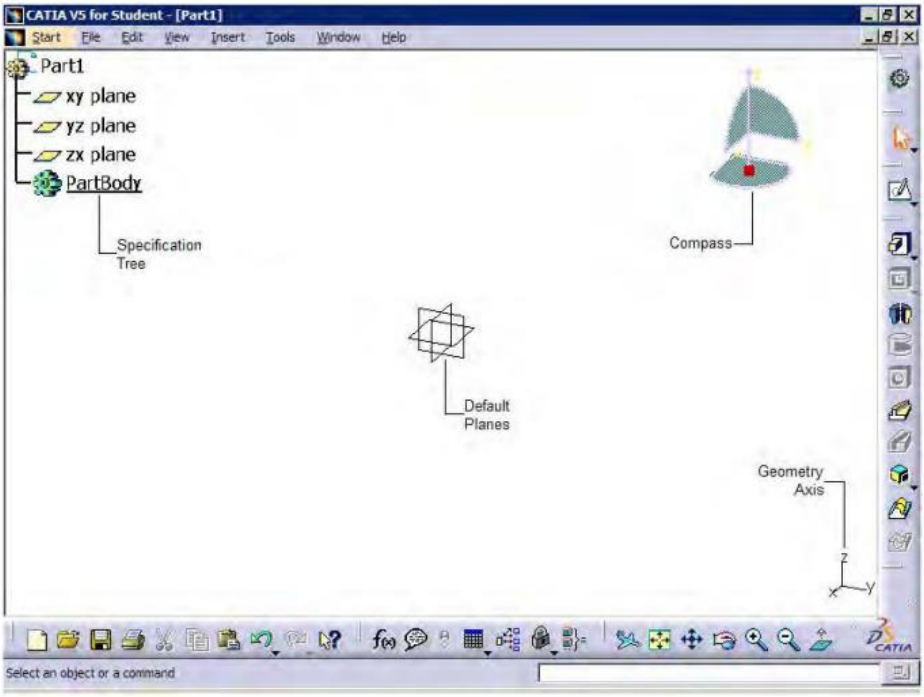
CAE systems can provide support to businesses. This is achieved by the use of reference architectures and their ability to place information views on the business process. Reference architecture is the basis from which information is modeled, especially product and manufacturing models.

CAE areas covered include:

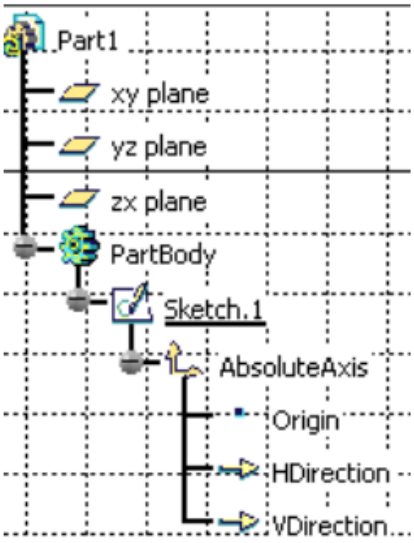
- Stress analysis on components and assemblies using finite element analysis (FEA);
- Thermal and fluid flow analysis computational fluid dynamics (CFD);
- Multibody dynamics (MBD) and kinematics;
- Analysis tools for process simulation for operations such as casting, molding, and die press forming;
- Optimization of the product or process.

Objective: Understand the Sketcher workbench of CATIA V5

- Start a new file in the Part workbench and invoke the Sketcher workbench.
- Set up the Sketcher workbench.
- Understand some important Sketcher terms.
- Draw sketches using some of the tools available in the Sketcher workbench.
- Use some of the drawing display tools.



Sketcher workbench

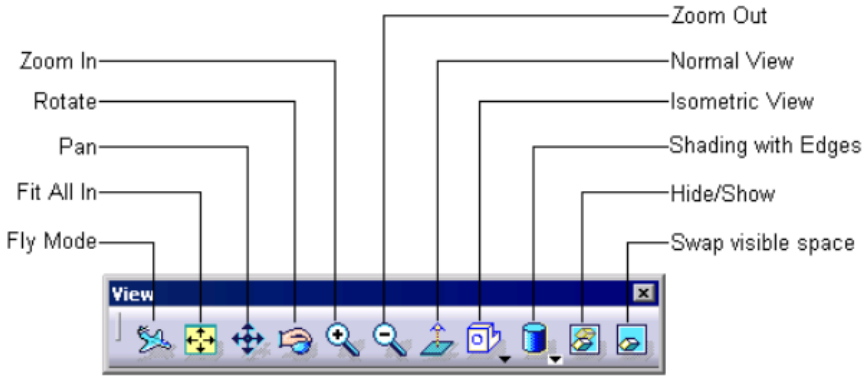


Specification Tree

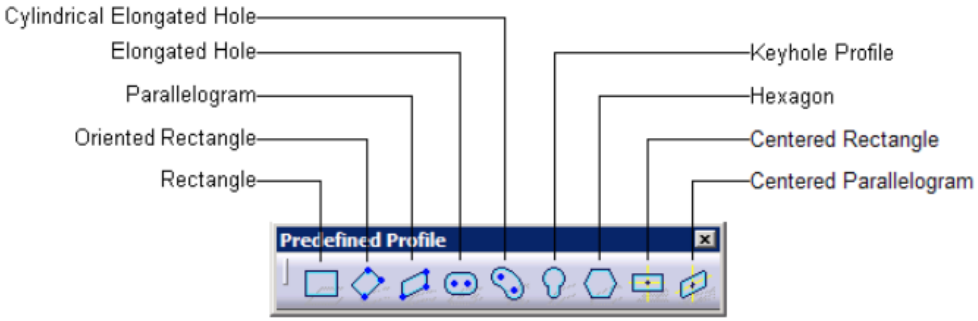
Experiment No. 2: To generate 2D models using CAD software. Working with advanced modeling tools

Creating features:

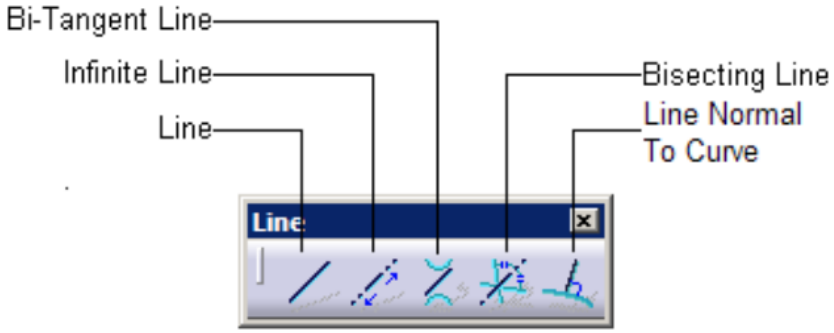
An element that is not a part of the profile while creating features and is used only as a reference or to constrain the elements of the sketch in the Sketcher workbench is called a Construction element. The construction elements can be used only in the Sketcher workbench.



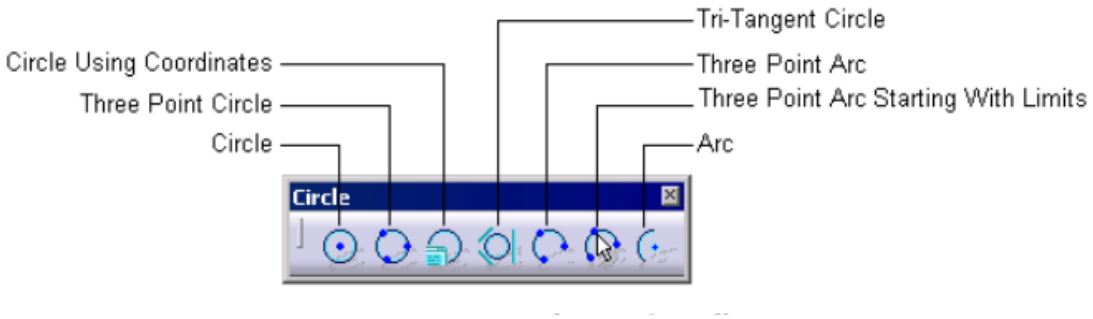
View toolbar



Profile Toolbar

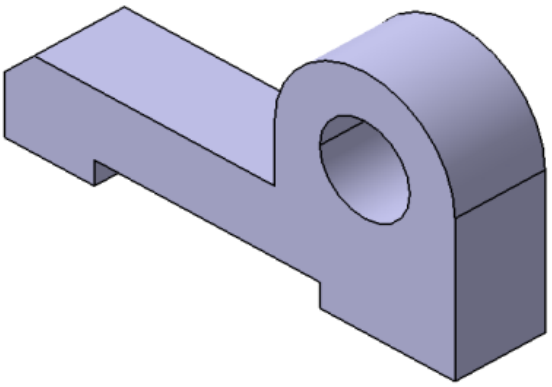


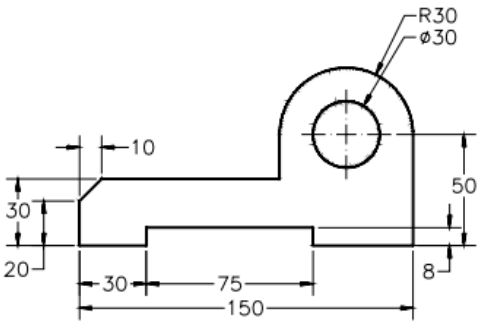
Line Toolbar

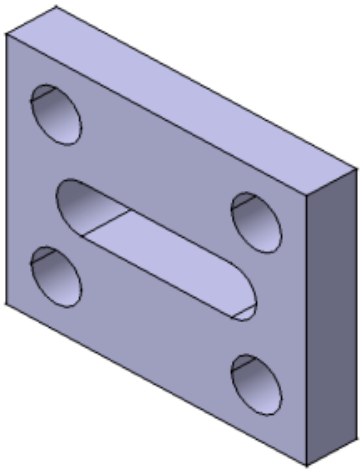


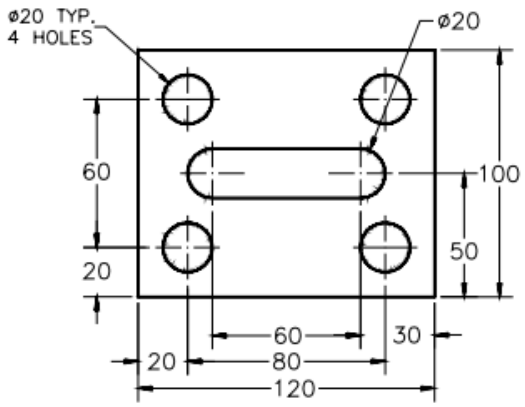
Circle Toolbar

Tutorial:



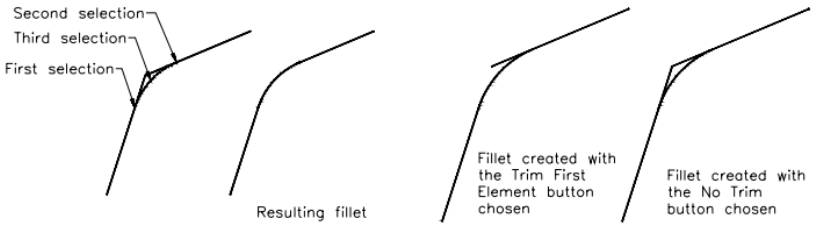




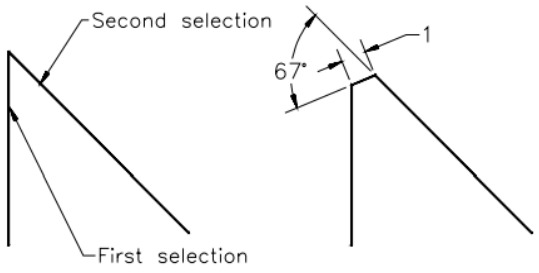


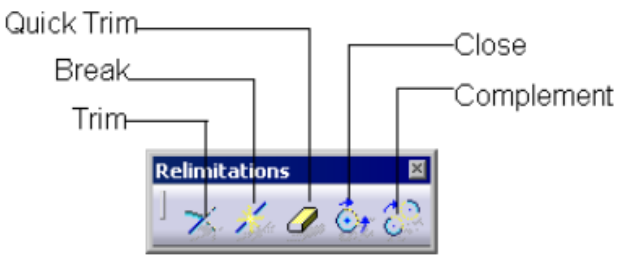
Experiment No. 3: To generate 3D models using CAD software using commands; Round, Chamfer, Fillet, Pattern, Copy, Rotate, Move and Mirror

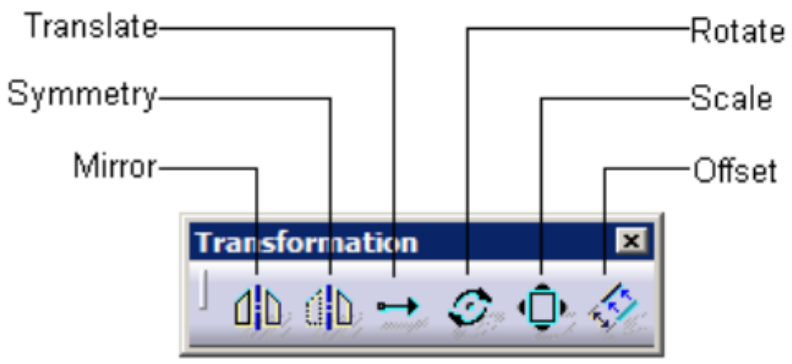
Features: In the Sketcher workbench of CATIA V5, you are provided with the Corner tool to fillet the sketched elements. When you invoke this tool, the Sketch tools toolbar expands and you are prompted to select the first curve or a common point. Select the first element to be filleted. Next, you are prompted to select the second curve. Select it and specify the fillet radius in the Radius edit box that is displayed in the Sketch tools toolbar.

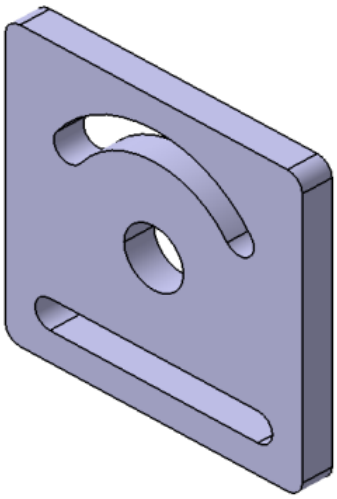


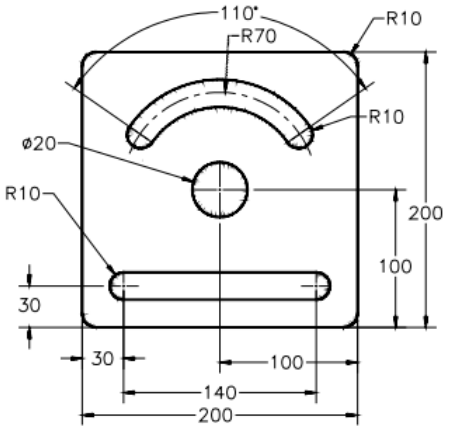
The Sketcher workbench of CATIA V5 also provides you with a Chamfer tool to chamfer the sketched elements. After invoking this tool, the Sketch tools toolbar expands and you are prompted to select the first curve or a common point. Select the first element; you are prompted to select the second element. When you select the second element, the Sketch tools toolbar expands and you are provided with the Angle and the Length edit boxes to specify the respective values. Specify the values and press the ENTER key.

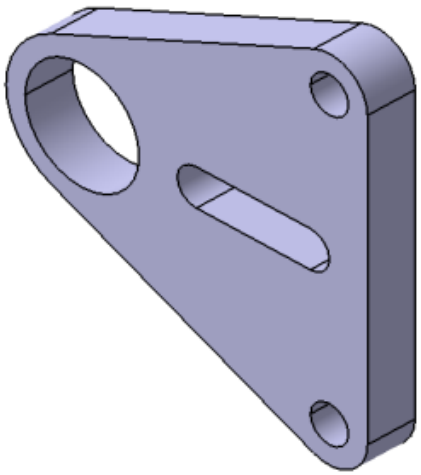


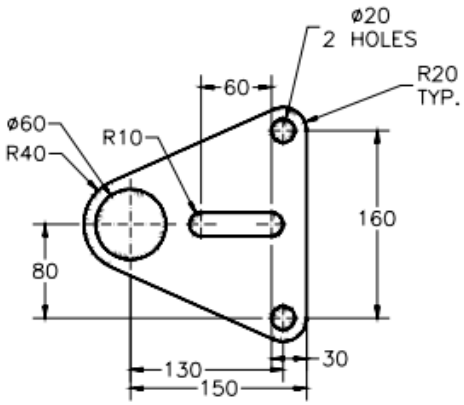



Translate
Symmetry
Mirror
Rotate
Scale
Offset
Transformation




110°
R70
R10
R10
ø20
R10
200
100
30
30
100
140
200



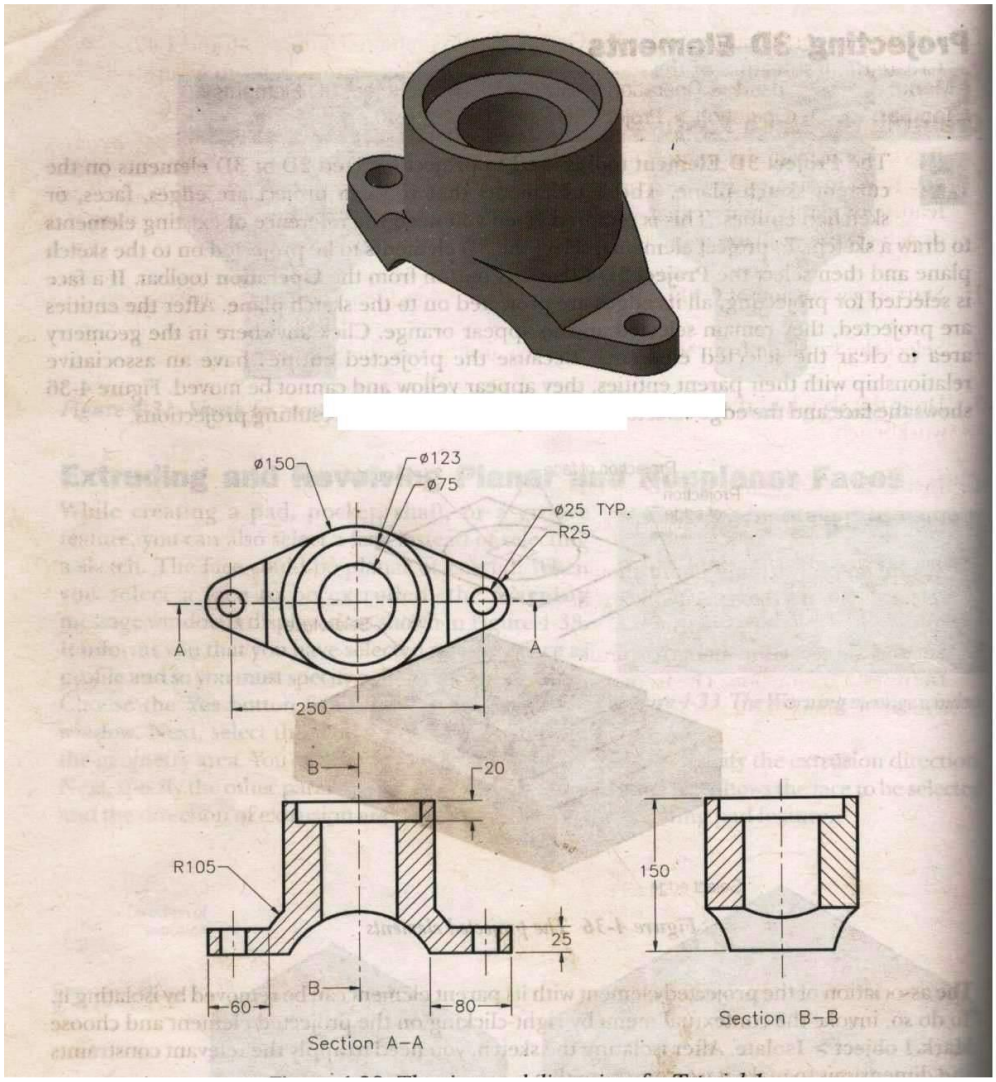

ø20
2 HOLES
R20
TYP.
60
ø60
R40
R10
160
80
130
150
30

Experiment No. 4: Working with advanced modeling tools (Sweep, Blend, Variable section Sweep, Swept Blend & Helical Sweep).

Features:

- **Translating Bodies**
- **Rotating Bodies**
- **Creating Symmetry Features**
- **Creating Rectangular Patterns**
- **Creating Circular Patterns**
- **Scaling Models**

<u>Tutorial:</u>



Experiment No. 5: Assembly modeling, Generating, editing and modifying drawings in CATIA/ Solidworks/ProE.

Features:

- **Inserting a New Body**
- **Inserting a New Body in a Set**
- **Inserting Features in the Assemble Feature**
- **Creating Rib Features**
- **Creating Slot Features**
- **Creating Lofted Features**

<u>Tutorial:</u>

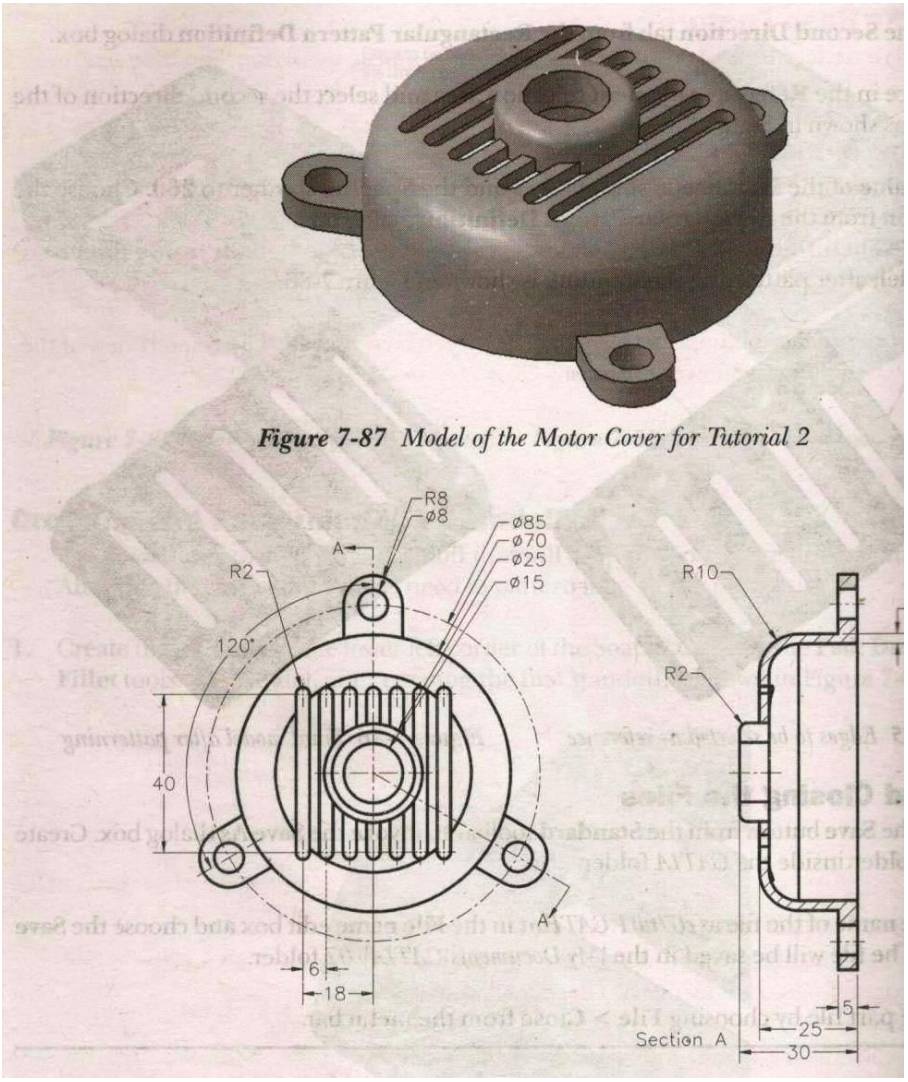
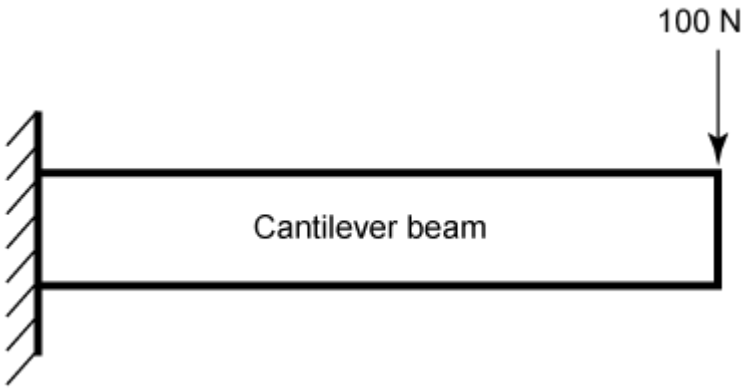


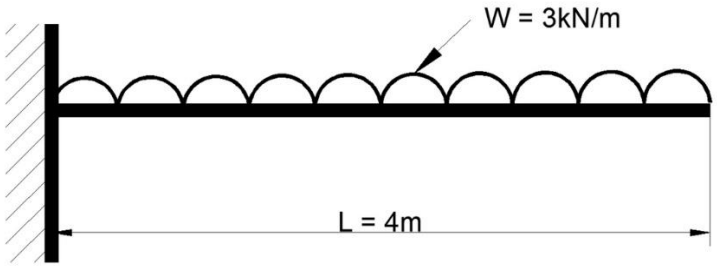
Figure 7-87 Model of the Motor Cover for Tutorial 2

Experiment No. 6: **CAE of the cantilever beam with concentrated load and UDL.**

Objective: To find out deflection & stresses in the cantilever beam with point load and UDL



Point Load

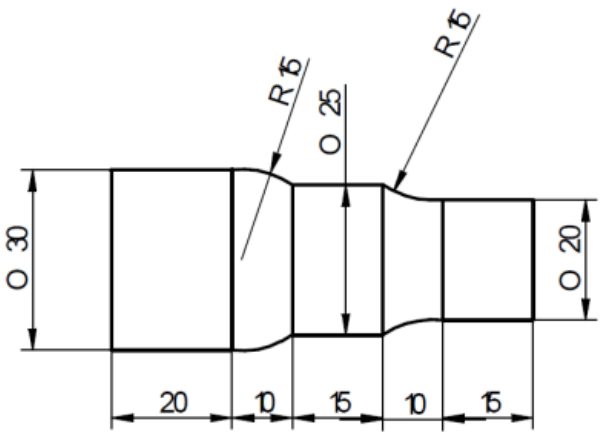


Concentrated Load

Experiment No. 7: To perform facing, step & taper turning using CNC turning centre.

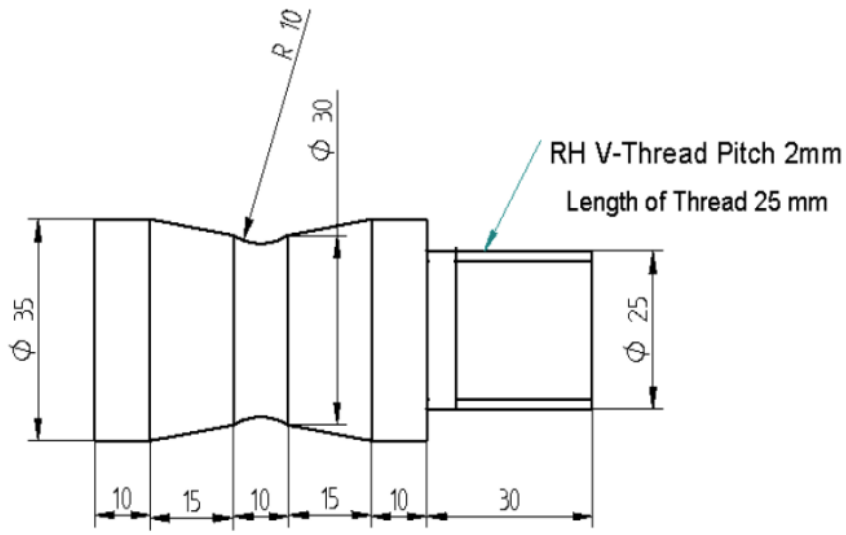
Objective: To Know Evolution of CNC, advantages of CNC, limitations of CNC, features of CNC, machine control unit (MCU) for CNC, classification of CNC machine tools; CNC machining centers: classification, features of CNC machining centers

- Preparatory Functions (G-Codes)
- Miscellaneous Functions (M-Code)
- Programming methods
    - Incremental method
    - Absolute method



CNC Part Programming:

N1 F0.5 S1200 T0101 M06 M03
N10 G00 X35 Z2
N30 G71 U0.5 R1
N35 G71 P36 Q90 U0.05 W0.05
N36 G01 X20 Z0
N50 G01 X20 Z-15
N60 G02 X25 Z-25 R15
N70 G01 X25 Z-40
N80 G03 X30 Z-50 R15
N90 G01 X30 Z-70
N100 G28 U0 W0
N110 M05 M30



CNC Part Programming:

N1 F0.2 S1200 T0101 M06 M03

N10 G00 X38 Z2

N30 G73 U5 R10

N40 G73 P50 Q130 U0.05 W0.05

N50 G01 X25 Z0

N60 G01 X25 Z-30

N70 G01 X35 Z-30

N80 G01 X35 Z-40

N90 G01 X25 Z-55

N100 G01 X25 Z-65

N110 G01 X35 Z-80

N130 G01 X35 Z-90

N140 G28 U0 W0

N150 S400 T0202 M06

N160 G00 X26 Z2

N170 G76 P010160 Q10

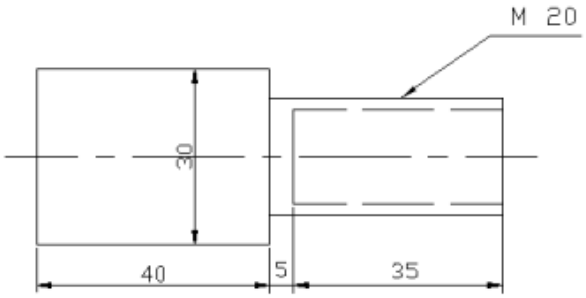
N180 G76 X23.44 Z-25 P1280 Q100 F2

N190 G28 U0 W0

N200 M05 M30

Experiment No. 8: To perform grooving, threading operation using CNC turning centre

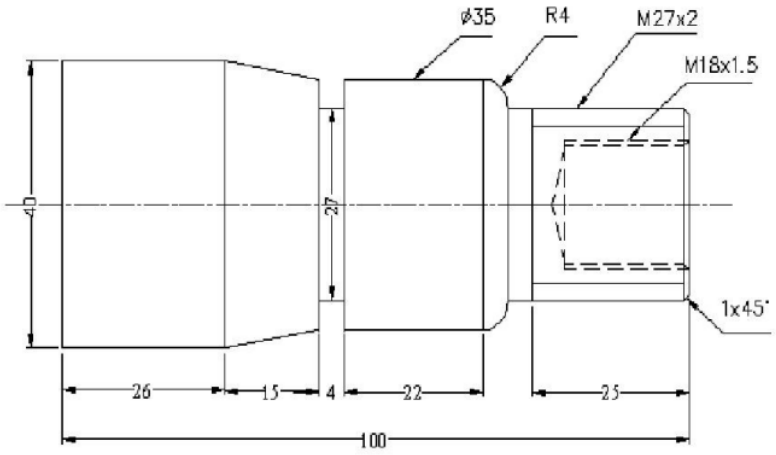
Objective: Part programming for the component shown in Figure, assuming work piece as Aluminum and the turning speed is 1200 rpm and feed is 20 mm / min and the depth of cut is 1 mm. For thread cutting reduce the speed to half of the turning speed and pitch is 0.1mm.



PART PROGRAME:

N 00	G 21	G 90				
N 01	M 03	S 1200				
N 02	G 00	X 30	Z 00			
N 03	G 01	Z -01	F 20			
N 04	G 01	X 00	F 20			
N 05	G 00	X 30	Z 00			
N 06	G 72	X 20	Z -40	I 01	F 20	
N 07	G 00	X 30	Z 05			
N 08	M 05					
N 09	T 0202					
N 09	M 03	S 600				
N 10	G 04	X 02				
N 11	G 01	X 20	Z 00	F 20		
N 12	G 93 (or) 92	X 20	Z -35	I 0.1	F 01	
N 13	G 00	X 30	Z 01			
N 14	M 30					

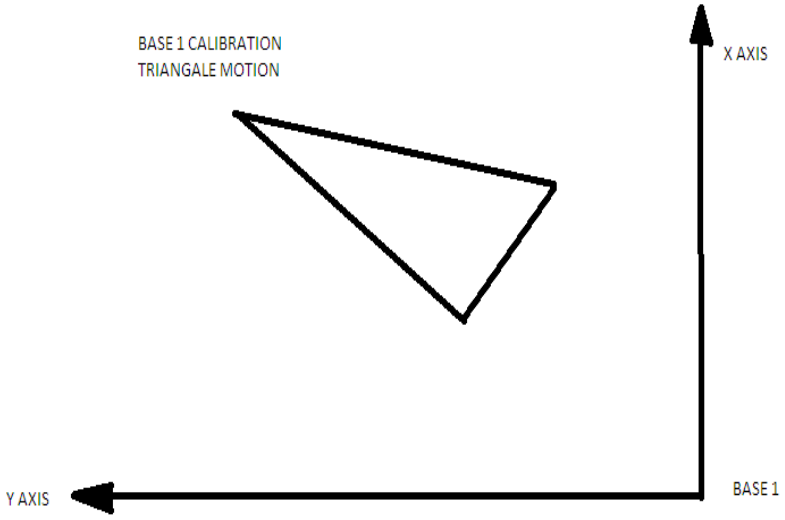
To write the CNC part program for given component drawing using Canned Cycle code, execute the program in CNC simulation software and CNC lathe machine




```
O 0014;
[BILLET X22 Z70;
G21 G97 G98;
G28 U0 W0;
M06 T01;
M03 S1000;
G00 X22 Z1;
G01 Z0 F50;
G71 U0.5 R1;
G71 P100 Q200 U0.2 W0.2;
N100 G01 X18;
Z-30;
N200 X22 Z-35;
M05;
G28 U0 W0;
M06 T02;
M03 S1200;
G00 X22 Z1;
G70 P100 Q200;
G28 U0 W0;
M05;
G28 U0 W0;
M06 T03;
M03 S1000;
G00 X0 Z1;
G74 R1;
G74 Z-25 Q5000 F50;
G00 Z1;
G28 U0 W0;
M05;
G28 U0 W0;
M06 T04;
M03 S1000;
G00 X0 Z1;
G01 X12 Z1;
G90 X12.5 Z-20 F50;
X13;
X13.5;
G28 U0 W0;
M05;
M30;
```

Experiment No. 11: To perform welding/pick-place/drawing operation using robotic assembly.

Objective:




```
1  DEF Triangle 1 ()
2  INT
3  Tool caliber
4  PTP Home vel = 100%  DEFAULT
5  PTP  hpt 1 vel = 100% PDATI  Tool  [1] :pointed Tool
6  Base [1] :Right side base
7  LIN  t1  vel = 0.5m/s CPDAT 1  Tool [1] : pointed Tool
8  Base [1] : Right side base
9  LIN  t2  vel = 2m/s CPDAT 2  Tool [1] : pointed Tool
10 Base [1] : Right side base
11 LIN  t3 vel = 2m/s CPDAT 3  Tool [1] : pointed Tool
12 Base [1] : Right side base
13 LIN  t1  vel = 2 m/s CPDAT 4   Tool [1] : pointed Tool
14 Base [1] : Right side base
15 PTP  hpt  1  vel = 100% PDATI 2  Tool  [1] :pointed Tool
16 Base [1] : Right side base
17 PTP Home vel = 100%  DEFAULT
18 END
```