COMPUTER AIDED AIRCRAFT ENGINEERING DRAWING LABORATORY

LAB MANUAL

Subject Code   **:**   **AAE106**
Regulation   **:**   **R16**
Class   **:**   **III Year I Semester**
Branch   **:**   **AE**

Department of Aeronautical Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

INSTITUTE OF AERONAUTICAL ENGINEERING
(AUTONOMOUS)
Dundigal, Hyderabad - 500 043

Certificate

This is to certify that it is a bonafied record of practical work done by Sri/Kum. _____ bearing the Roll No. _____ of _____ class _____ branch in the Engineering Physics laboratory during the academic year _____ under our supervision.

Head of the Department   **Lecture In-Charge**

External Examiner   **Internal Examiner**

COMPUTER AIDED AIRCRAFT ENGINEERING DRAWING LAB SYLLABUS

S. No.	List of Experiments	Page No.	Date	Remarks
1	Introduction about CATIA and different workbenches in it.	8		
2	Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools , Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations.	10		
3	Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.	13		
4	Walls, Cutting and Stamping, Bending, Rolled Walls	15		
5	Surfacer, Operations, Wireframe, Replication.	17		
6	Product Structure Tools, Constrains.	19		
7	Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, Types of Tolerances, Types of views, Roughness Symbols.	20		
8	Views, Annotations, Sheet Background.	21		
9	Design of any two types of Aircraft structures	21		
10	Design of fuselage with internal components	23		
11	Design of Nose cone structures	24		
12	Design of Main landing gear and nose landing gear	25		

COMPUTER AIDED AIRCRAFT ENGINEERING DRAWING LABORATORY

OBJECTIVE:

The objective of this lab is to equip students with knowledge in the interface of three dimensional designing software and to make students efficient to produce CAD designs. By the end of course one should also be able to understand what a machine drawing is and will also be able to produce machine drawings and gain knowledge about all symbols used in production drawings and how they are inserted in production drawings using design softwares.

OUTCOMES:

Upon the completion of computer aided aircraft engineering drawing laboratory course, the student will be able to attain the following:

1. Understand the concepts and various tools used in design module
2. Understand the design of typical structural components.
3. Understand the techniques and standards of designing a component in CATIA.
4. Understand the design of three view diagram of a typical aircraft..

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AERONAUTICAL ENGINEERING

	Program Outcomes
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PO12	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

	Program Specific Outcomes
PSO1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products
PSO2	**Problem solving skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles
PSO3	**Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies
PSO4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.

ATTAINMENT OF PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Introduction about CATIA and different workbenches in it.	PO3	PSO1
2	Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools , Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations.	PO3	--
3	Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.	PO5	PSO2
4	Walls, Cutting and Stamping, Bending, Rolled Walls	PO5	--
5	Surfacer, Operations, Wireframe, Replication.	PO3	--
6	Product Structure Tools, Constrains.	PO5	--
7	Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, Types of Tolerances, Types of views, Roughness Symbols.	PO5	--
8	Views, Annotations, Sheet Background.	PO5	PSO2
9	Design of any two types of Aircraft structures	PO3	--
10	Design of fuselage with internal components	PO5	--
11	Design of Nose cone structures	PO5	--
12	Design of Main landing gear and nose landing gear	PO3	PSO2

EXPERIMENT 1
DESIGN OF TWO DIMENSIONAL COMPONENTS

Aim: To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench.
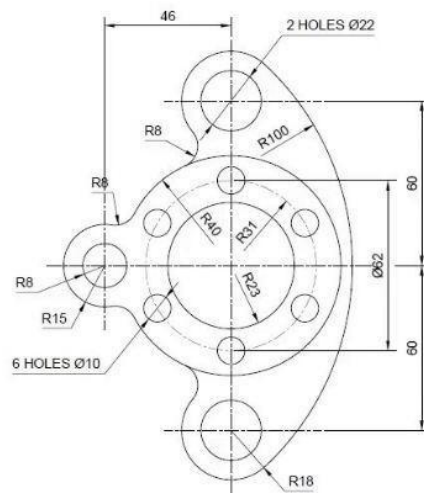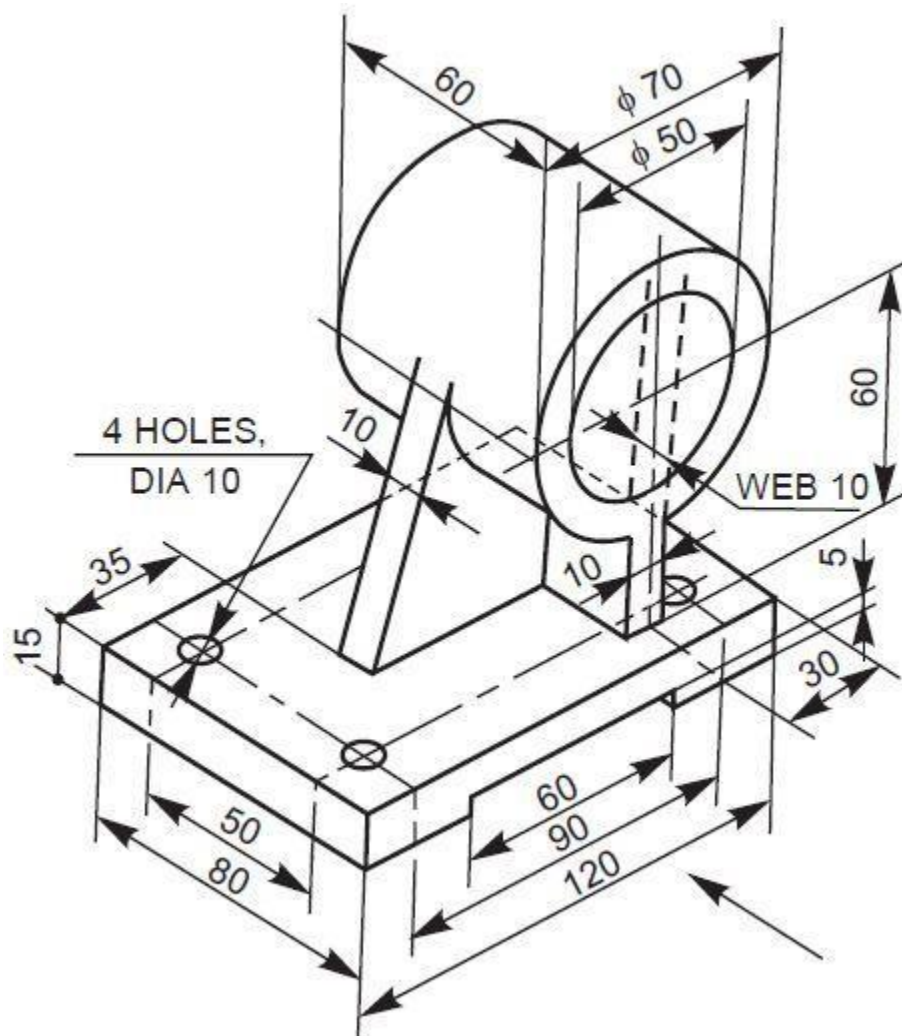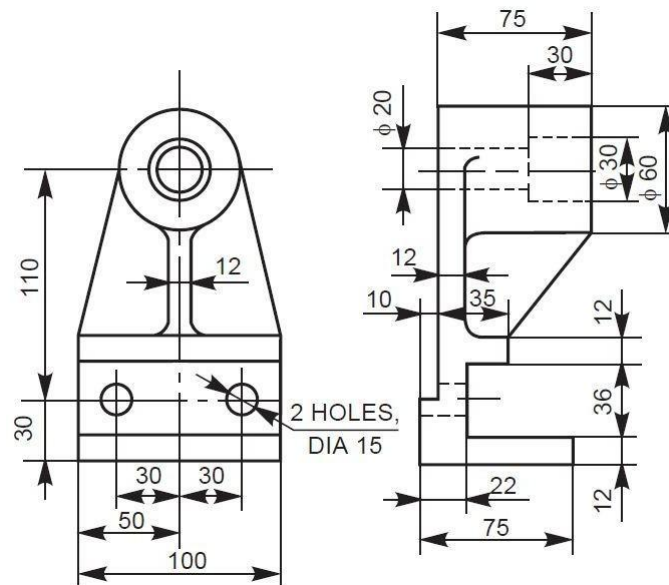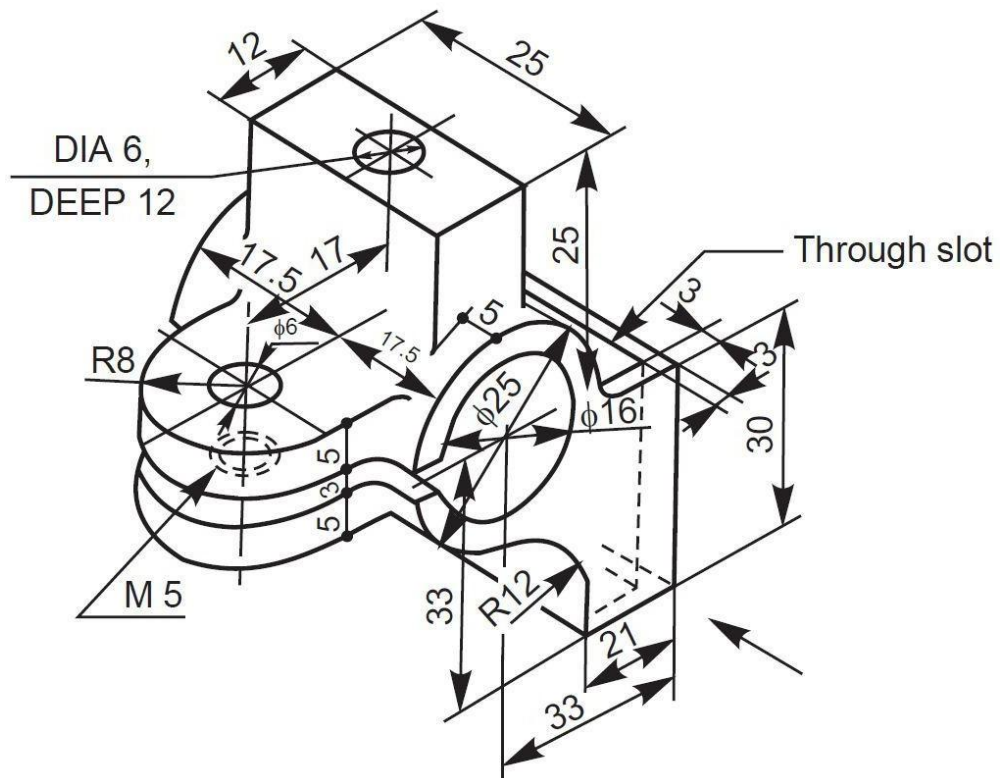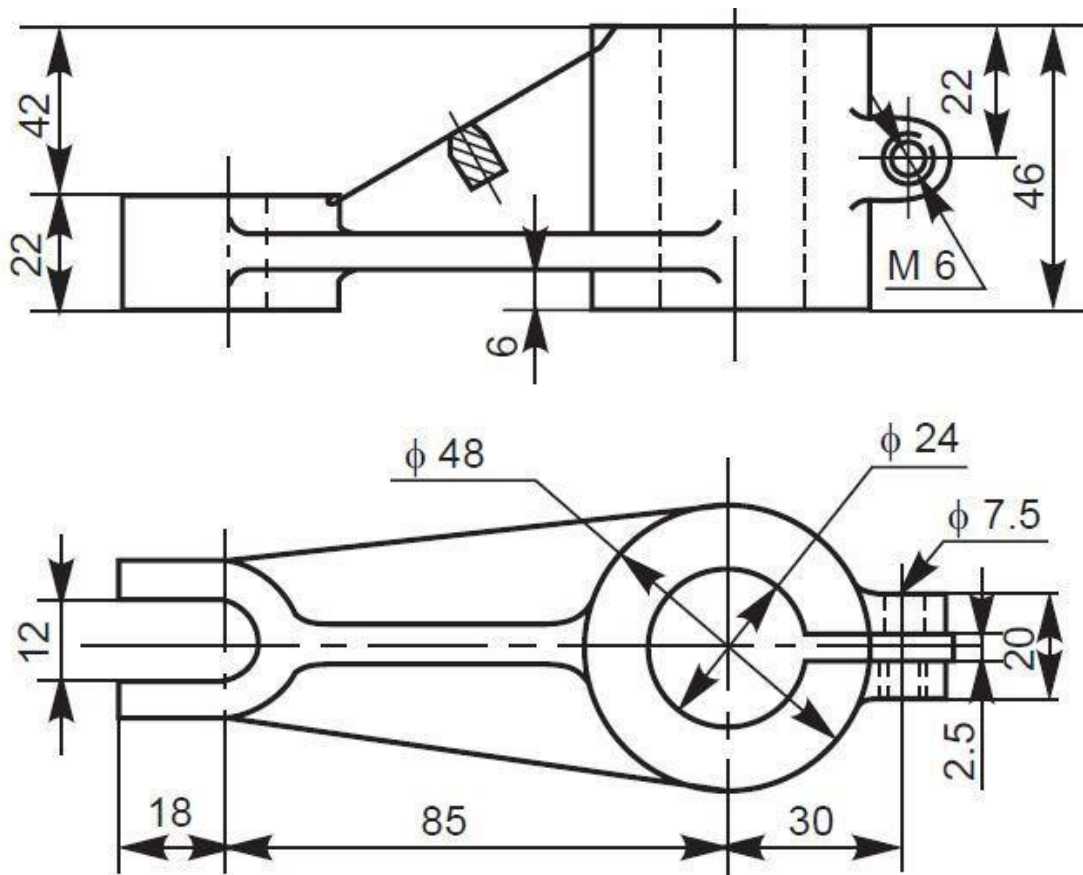
Software used:
CATIA V5

CAD Model:
Sketch 1:
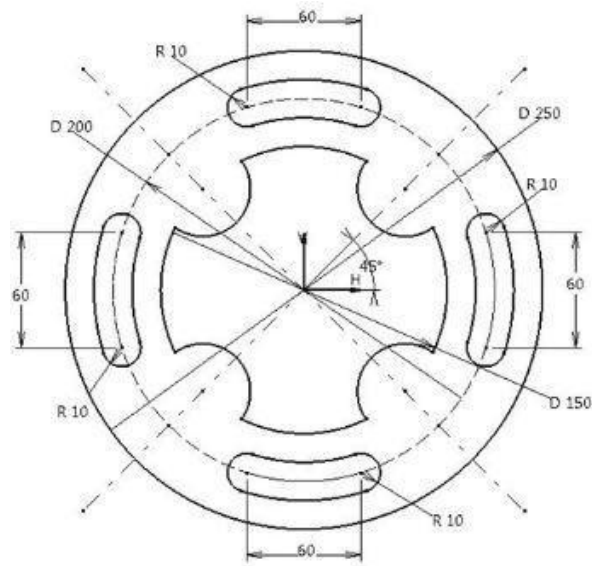
Sketch 2:

Result:

The given CAD model has been designed in CATIA V5 using sketcher workbench.

EXPERIMENT 2

DESIGN OF SHAFT SUPPORT, CENTERING BEARING, MOTOR BRACKET

Aim:
To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench.
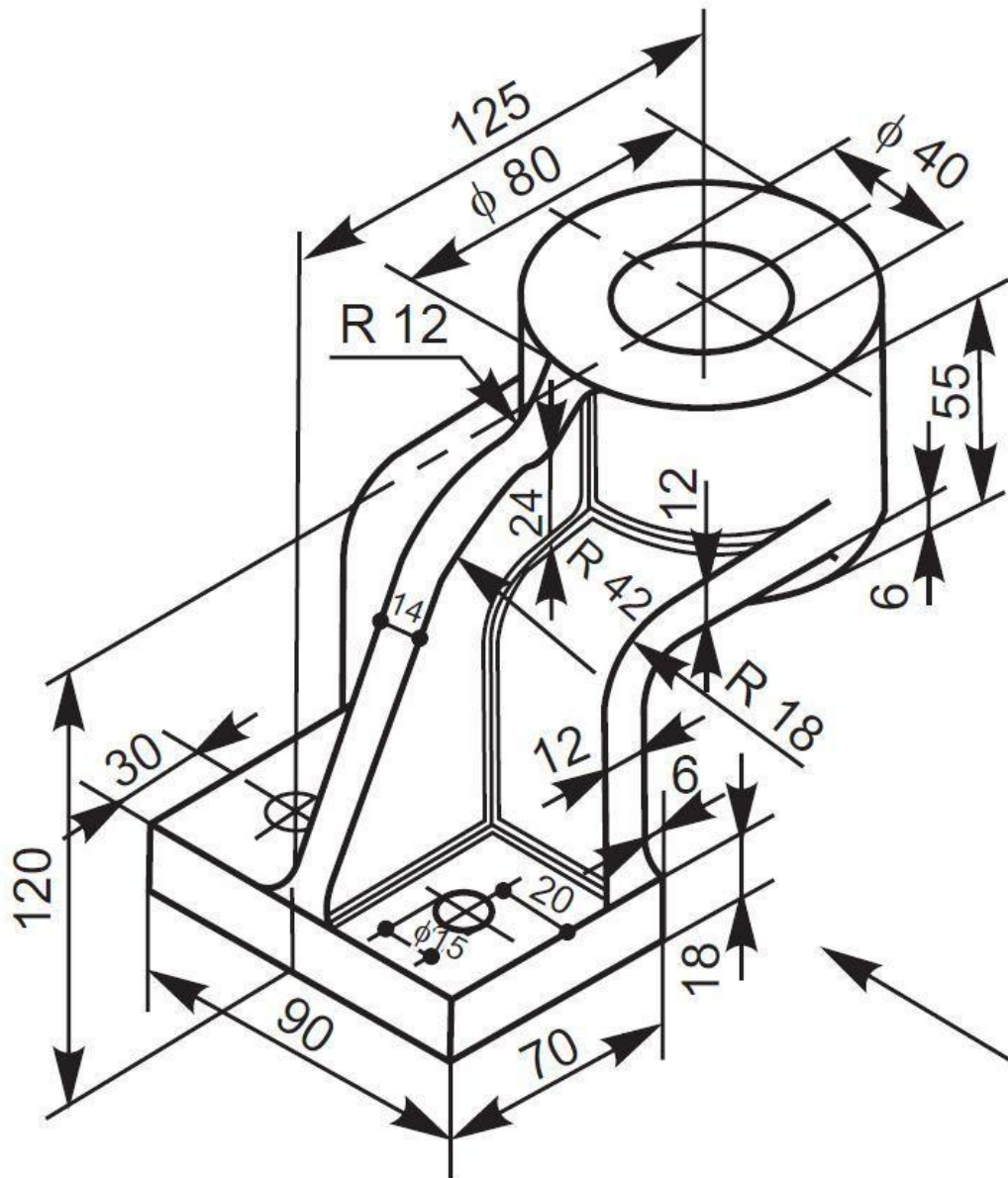
Software used:
CATIA V5

CAD Model: SHAFT SUPPORT:

CENTERING BEARING:

MOTOR BRACKET:

Result:

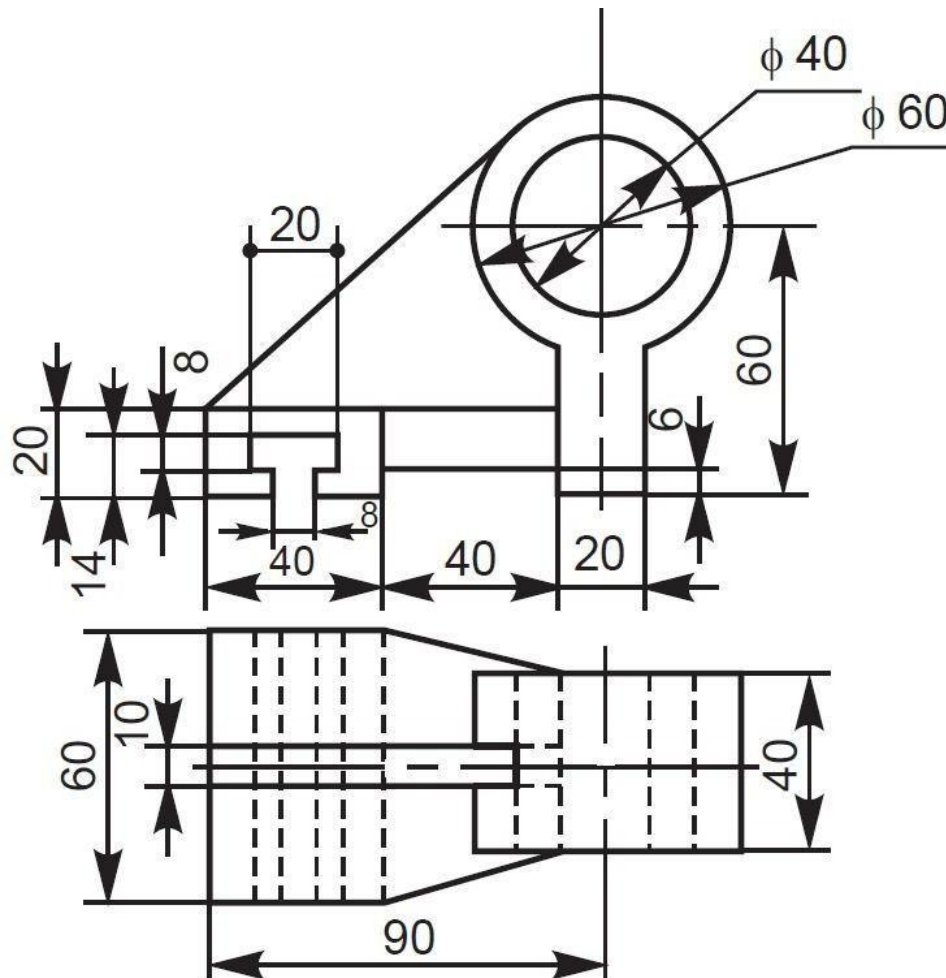The given CAD model has been designed in CATIA V5 using Part design workbench.
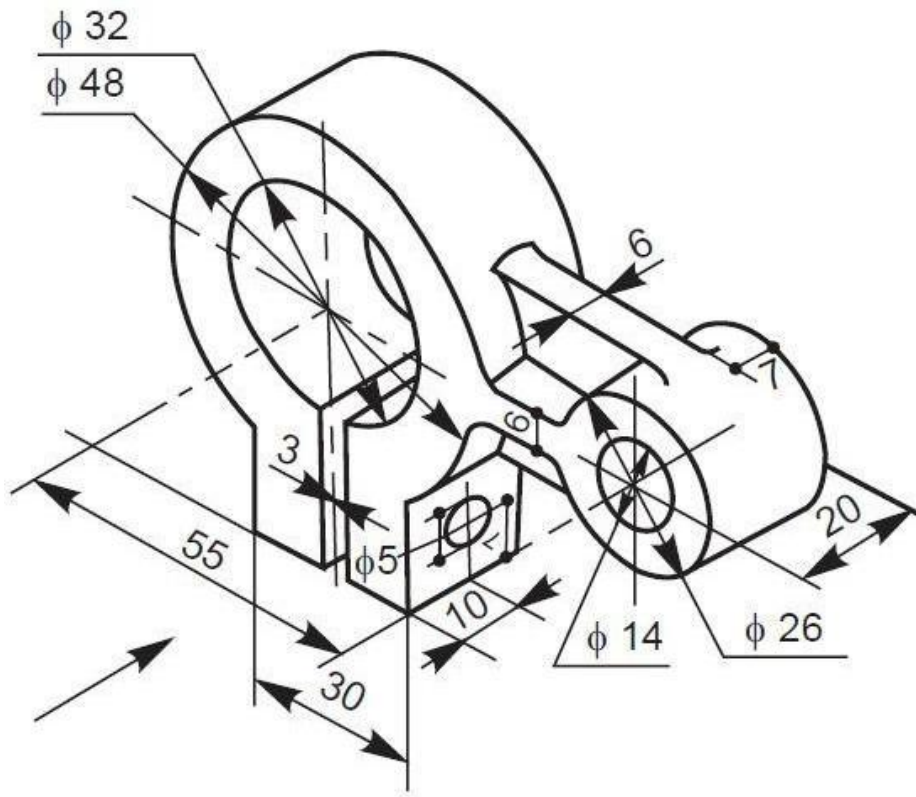
DESIGN OF BEARING BRACKET, SHIFTER

Aim: To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench**.**

Software used:
CATIA V5

CAD
Model:
shifter:

Bearing bracket:

Result:

The given CAD model has been designed in CATIA V5 using Part design workbench.
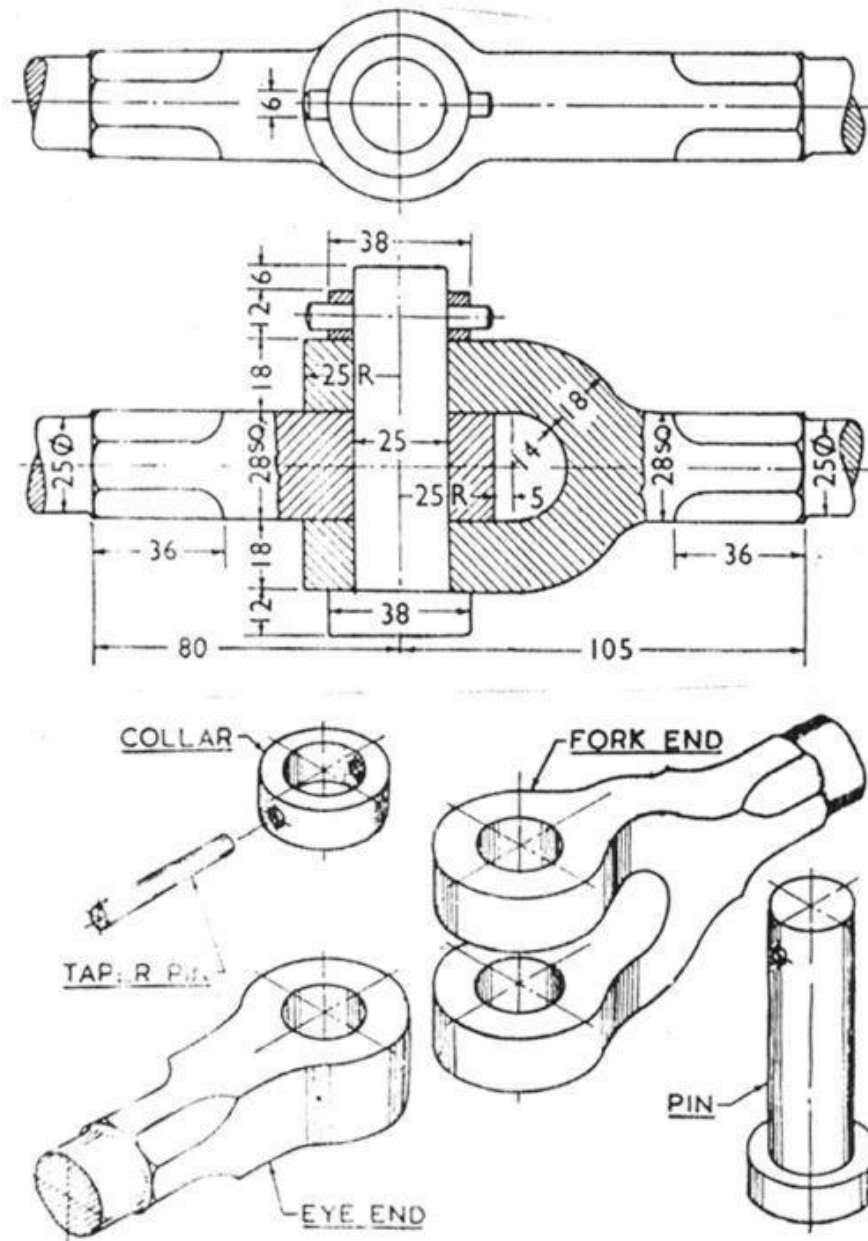
DESIGN OF SLIDING BRACKET, DEPTH SLOT

Aim: To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench.

Software used:
CATIA V5

CAD Models:
Sliding bracket**:**

Depth slot:

Result:

The given CAD model has been designed in CATIA V5 using Part design workbench.

EXPERIMENT 5
DESIGN KNUCKLE JOINT

Aim: To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench.

Software used:
CATIA V5

CAD Models:

Knuckle joint**:**

Result:

The given CAD model has been designed and assembled in CATIA V5 using Assembly design workbench.
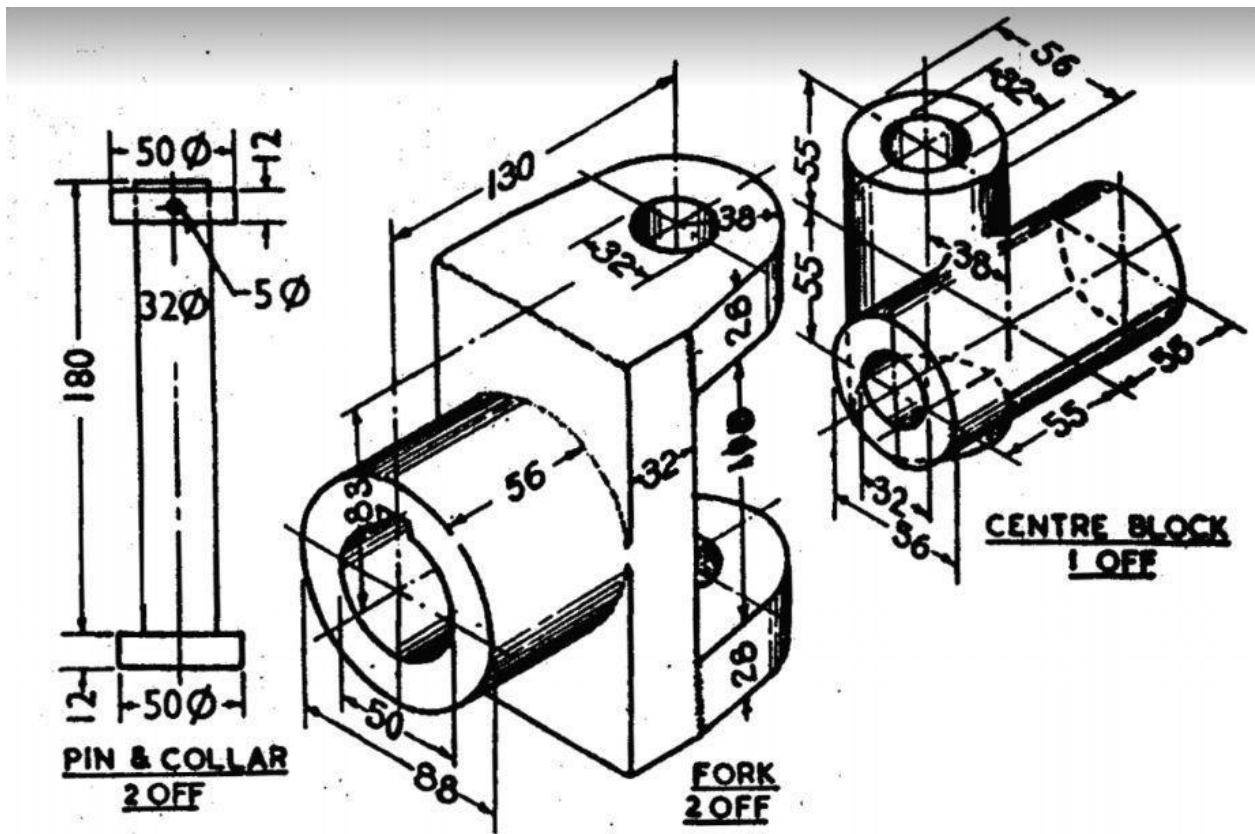
Aim: To design the given two dimensional component according to dimensions in three dimensional designing software CATIA in sketcher workbench**.**

Software used:
CATIA V5

CAD Models:
Universal coupling:

Result:

The given CAD model has been designed and assembled in CATIA V5 using Assembly design workbench.

EXPERIMENT 7

DESIGN OF FLANGED COUPLING

Aim: To design the given two dimensional component according to dimensions using three dimensional designing software CATIA in part design and assembly workbench.

Software used:
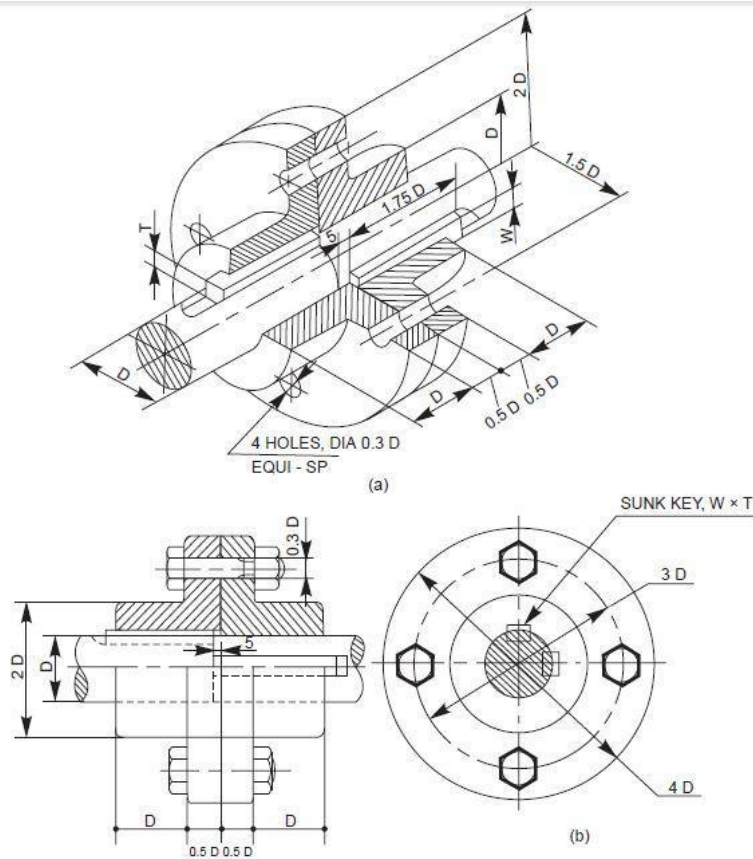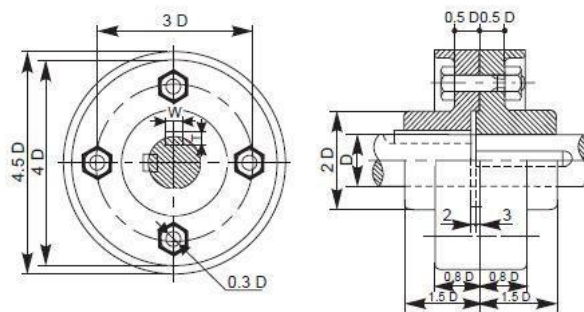CATIA V5

CAD Models:
Flanged coupling:

Fig. 7.4 Flanged coupling

Result:

The given CAD model has been designed and assembled in CATIA V5 using Assembly design workbench**.**
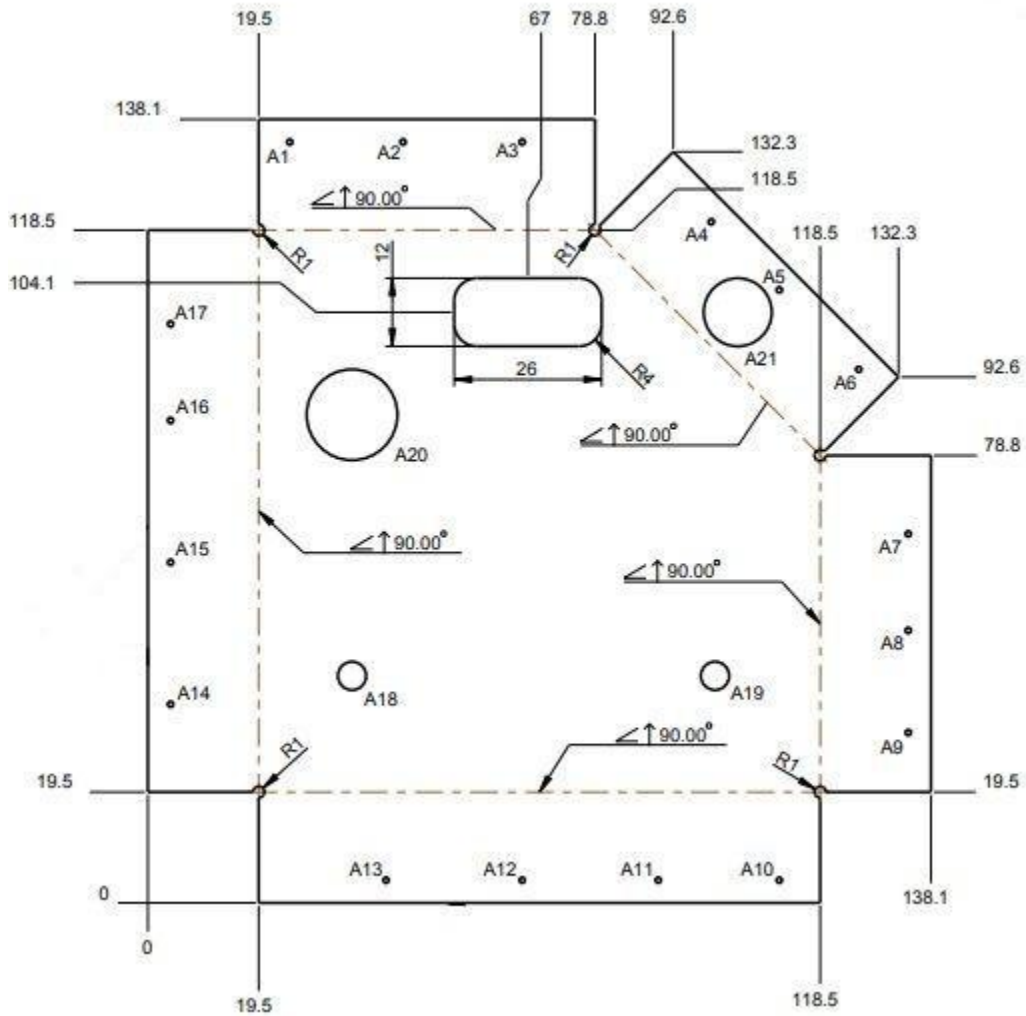
EXPERIMENT 8
DESIGN OF METAL CAP

Aim: To design the given two dimensional component according to dimensions using three dimensional designing software CATIA in sheet metal design workbench.

Software used:
CATIA V5

CAD Model:

Result:

The given CAD model has been designed in CATIA V5 using Sheet metal design workbench.

Aim: To design the given two dimensional component according to dimensions using three dimensional designing software CATIA in sheet metal design workbench**.**

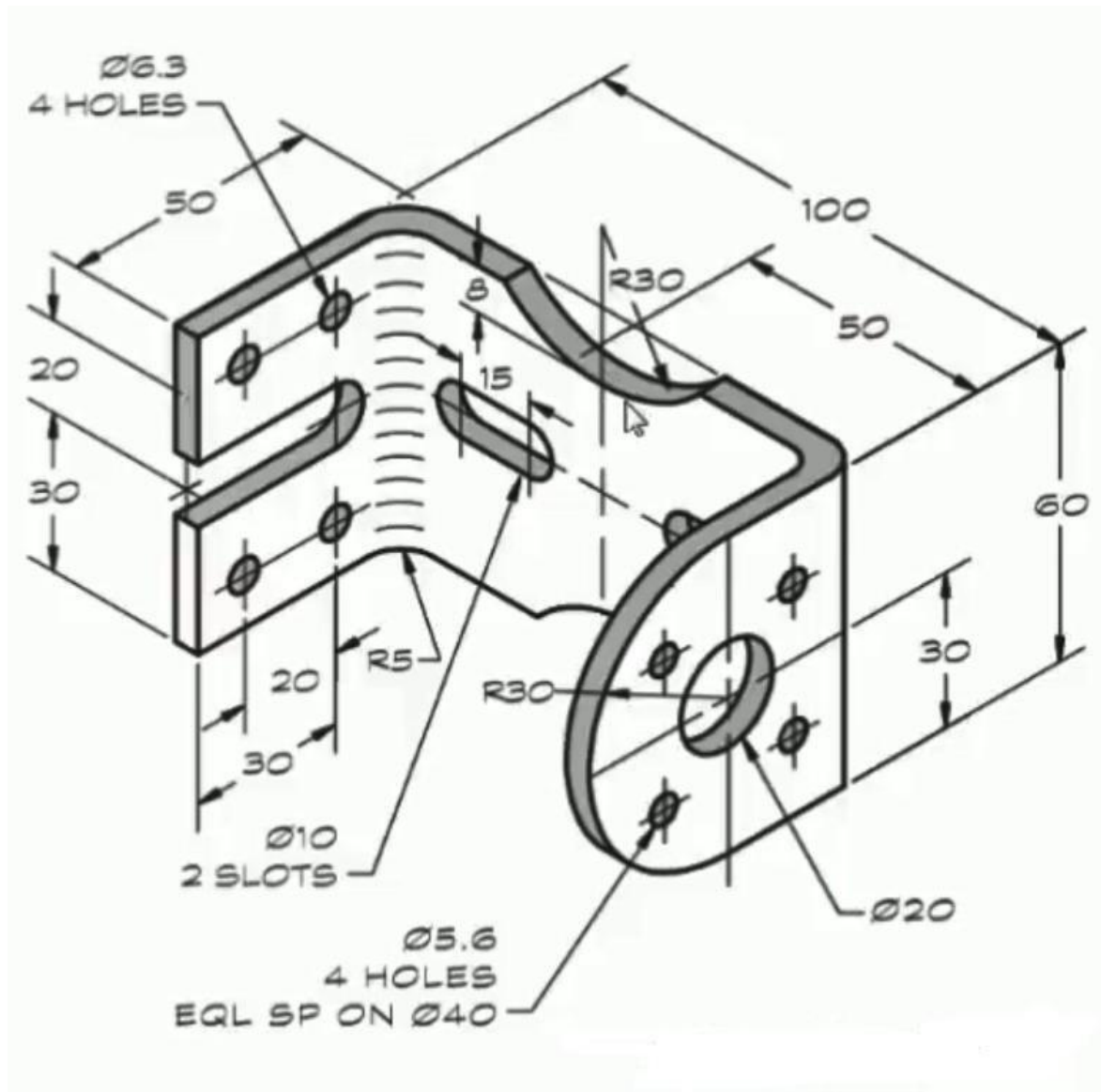**Software used:**
CATIA V5

CAD Model:
Angle bracket

Result:

The given CAD model has been designed in CATIA V5 using Sheet metal design workbench**.**

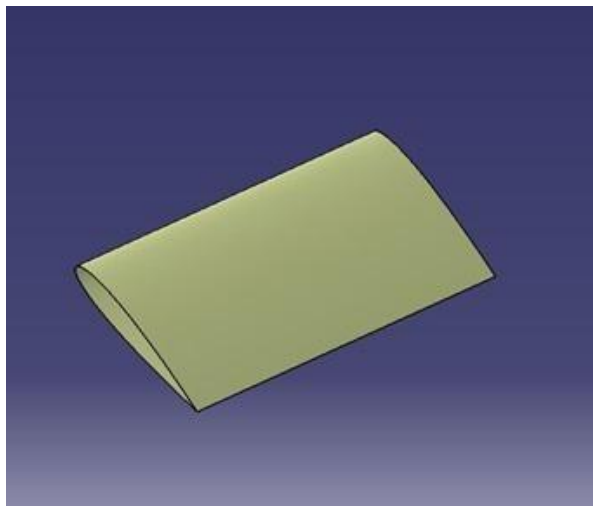**DESIGN OF AIRCRAFT WING NUMERICAL MASTER DATA**

Aim: To design the given two dimensional component according to dimensions using three dimensional designing software CATIA in sketcher and surface design workbench.

Software used:
CATIA V5

CAD Model:

$$area = 0.08206$$
$$thick. = 0.12002$$
$$camber = -0.00000$$
$$r_{LE} = 0.01391$$
$$\Delta\theta_{TE} = 15.76°$$
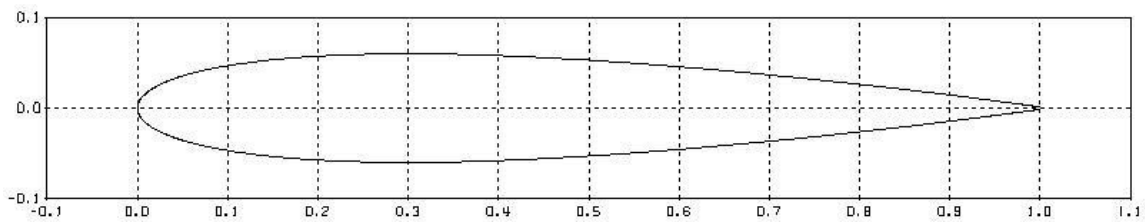
Result:

The numerical master data for designing a wing has been created using surface design in CATIA V5

EXPERIMENT 11

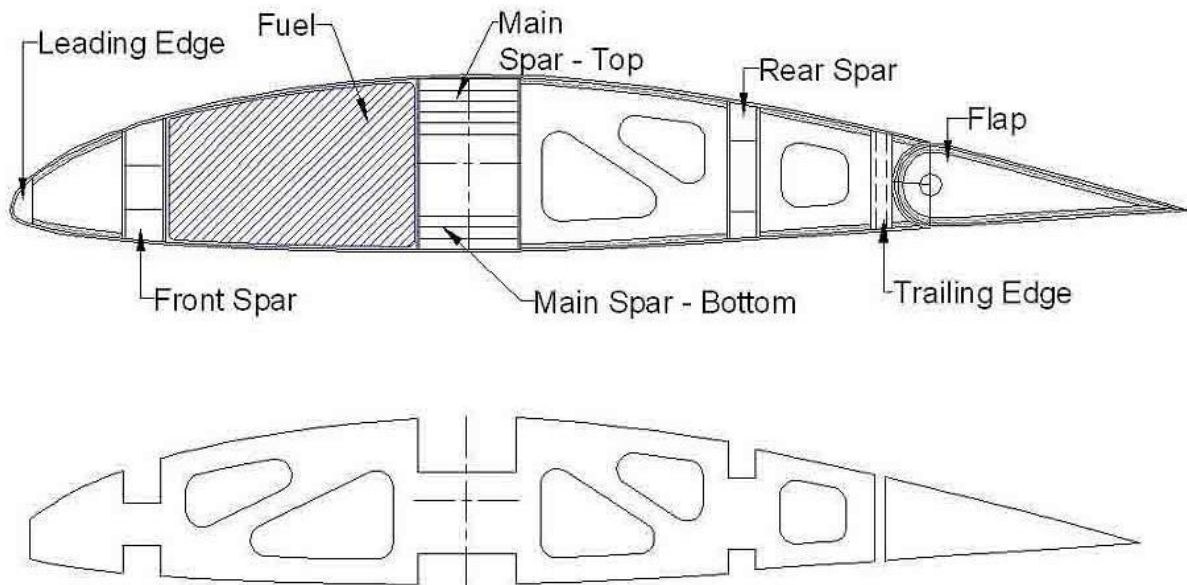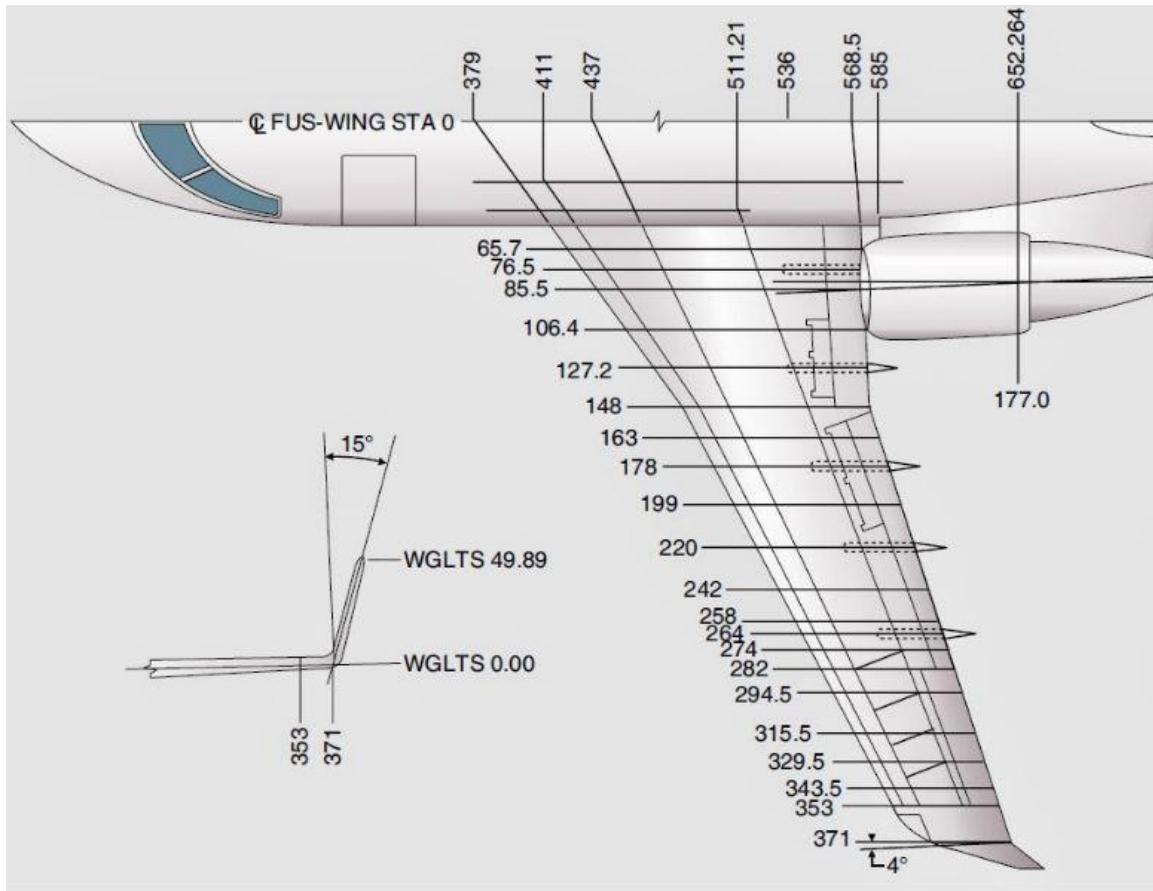## DESIGN OF INTERNAL COMPONENTS OF AIRCRAFT WING

Aim: To design the internal components of a wing i.e ribs, spars and skin at given sections of wing using three dimensional designing software CATIA in surface design, part design and assembly design workbenches.

Software used:
CATIA V5

CAD Model :

Result:

The internal components of wing are designed and assembled using CATIA V5.

EXPERIMENT 1

1.1   PRE-LAB QUESTIONS

1. What is the difference between first angle projection and third angle projection?
2. What are different types of lines used in engineering drawing?
3. What are different steps in designing?

1.2   POST-LAB QUESTIONS

1. What is the full form of CATIA?
2. What are different workbenches we use in CATIA?
3. What is the importance of sketch tools?

1.3   ASSIGNMENT QUESTIONS

1. What is meant by constraining? What are different types of constraints used in CATIA?
2. What is the use of swap visible space?

EXPERIMENT 2

2.1   PRE-LAB QUESTIONS

1. How to enter part design?
2. What is the need of constraining a sketch before exiting sketcher?
3. What is the use of sketch analysis?

2.2   POST-LAB QUESTIONS

1. What are different tool bars in part design workbench?
2. How do you use pad option on a open profile?
3. What is multiple pad?

2.3   ASSIGNMENT QUESTIONS

1. What is an open profile and why is it not recommended in CATIA?
2. What is the difference between sketch and positioned sketch?

EXPERIMENT 3

3.1   PRE-LAB QUESTIONS

1. How do you recognize a open sketch after entering other workbenches?
2. Name different positive and negative operations in CATIA.
3. What is the use of reference planes?

3.2   POST-LAB QUESTIONS

1. What are different types of patterns in CATIA?
2. Explain the procedure to use solid combine tool.
3. What is the use of stiffener tool?

3.3   ASSIGNMENT QUESTIONS

1. Explain the need of using spline when many other tools produce curves.
2. Explain about different colours and their significance in identifying type of constraints.

EXPERIMENT 4

4.1   PRE-LAB QUESTIONS

1. What are different tools in dress up features toolbar?
2. What is the difference between hole and pocket option?
3. What is the use of closing direction?

4.2   POST-LAB QUESTIONS

1. What is the use of shell option in CATIA?
2. Explain the significance of thickness tool.
3. Where is the tool remove face used?

4.3   ASSIGNMENT QUESTIONS

1. Explain different standards of holes that are available in CATIA.
2. What is draft angle? Explain its applications in manufacturing industry.

EXPERIMENT 5

5.1   PRE – LAB QUESTIONS

1. How to add material to the designed component in CATIA/
2. What is meant by Boolean operation?
3. What is the difference between 'add' and 'assemble' in Boolean operations?

5.2   POST LAB QUESTONS

1. What are different constraints used while assembling components in CATIA?
2. What is the use of clash analysis?
3. How do you call a component that is already saved to assembly workbench?

5.3   ASSIGNMENT QUESTION

1. What are advantages and disadvantages of top down assembly?
2. When is bottom up assembly opted over a top down assembly?

EXPERIMENT 6

6.1   PRE LAB QUESTIONS

1. How do you move a component in workspace in assembly workbench?
2. What is the need to 'fix' a component while assembling?
3. What is exploded view?

6.2   POST LAB QUESTIONS

1. Name different option to analyze a assembly in CATIA.
2. How do you call a same element again in CATIA?
3. What is the use of snap tool?

6.3   ASSIGNMENT QUESTIONS

1. Explain the significance of fast multi instantiation and define multi instantiation.
2. Write down in detail about manipulation toolbar.

EXPERIMENT 7

7.1   PRE LAB QUESTIONS

1. What is the difference between surface, sheet and plate?
2. Explain the significance of surface design workbench.
3. What are common tools for different mechanical workbenches in CATIA?

7.2   POST LAB QUESTIONS

1. What are different coordinate systems?

2. What are different common types of joints?
3. What is the difference between part, component and product?

7.3   ASSIGNMENT QUESTIONS

1. What is the use of stop manipulation on clash tool?
2. What is meant by parametric design?

EXPERIMENT 8

8.1   PRE LAB QUESTIONS

1. What is meant by K Factor?
2. Why are all toolbars inactive immediately after opening in sheet metal design workbench?
3. What is corner relief?

8.2   PRE LAB QUESTIONS

1. What is meant folded view and un folded view?
2. What is meant by wall in sheet metal component?
3. What is a flange?

8.3   ASSIGNMENT QUESTIONS

1. What are different stamp tools in sheet metal design workbench?
2. What is difference between cut out and pocket?

EXPERIMENT 9

9.1   PRE LAB QUESTIONS

1. How is a line extruded in surface design workbench?
2. What is the circular cut out?
3. What is 'recognize'? Explain its significance.

9.2   PRE LAB QUESTIONS

1. What is difference between bend and conical bend?
2. Explain the procedure to use bend from flat.
3. How do you set corner relief?

9.3   ASSIGNMENT QUESTIONS

1. Explain the procedure to use hopper tool?
2. What are different tool in rolled walls tool bar?

EXPERIMENT 10

10.1   PRE LAB QUESTIONS

1. How is a line extruded in surface design workbench?
2. What is the difference between split and trim?
3. What is 'translate'? Explain its significance.

10.2   PRE LAB QUESTIONS

1. What is the tool used to create helical structures?
2. Explain the use of intersection and parallel curve tools.
3. What is a projection in surface design workbench?

10.3   ASSIGNMENT QUESTIONS

1. Explain in detail about different option in sweep tool?
2. What is 'join' command and what are different cases where it is used?

EXPERIMENT 11

11.1   PRE LAB QUESTIONS

1. How is blend tool useful in CATIA?
2. What is pulling direction?
3. What is 'Multi section surface' command?

11.2   PRE LAB QUESTIONS

1. What is the difference between 'shape fillet' an 'edge fillet'?
2. Explain different option you have in chamfer.
3. How can you extrude a surface from edge of another surface in CATIA?

11.3   ASSIGNMENT QUESTIONS

1. Explain the use of formula in CATIA?
2. How do you extract weight of a component designed in CATIA?