R-24

MRCETCAMPUS

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS INSTITUTION–UGC, GOVT.OF INDIA)


# DEPARTMENT of AERONAUTICAL ENGINEERING

# AIRCRAFT DESIGN LAB

**Prepared by:**

**Mr. S. Shailesh Babu**

**Assistant Professor**
**Department of ANE**

# AIRCRAFT DESIGN LAB

## LABORATORY MANUAL

## B.TECH (R-24 Regulation)

### (II YEAR – ISEM) (2025-26)

## DEPARTMENT OF AERONAUTICAL ENGINEERING


## MALLAREDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**(Autonomous Institution–UGC,Govt.of India)**

Recognized under2 (f) and 12 (B) of UGC ACT 1956

(Affiliated to JNTUH, Hyderabad, Approved by AICTE-Accredited by NBA & NAAC–'A'Grade–ISO9001:2015 Certified)

Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad – 500100, Telangana State, India


**MALLAREDDY COLLEGE OF ENGINEERING & TECHNOLOGY**

**(Autonomous Institution–UGC,Govt.of India)**

**Affiliated to JNTUH Approved by AICTE, NBA-Tier1 & NAAC–'A'Grade ISO9001:2015 Certified)**

Maisammaguda, Dhulapally (Post Via.Hakimpet),Secunderabad–500100,TelanganaState,India

# CERTIFICATE

Certified that this is the Bonafide Record of the work done by Mr. /Ms._____bearing Roll No._____of B.Tech II Year _____Semester for the Academic year2025-2026 in _____

Date: Faculty In-charge HOD

Internal Examiner External Examiner

## DEPARTMENT OF AERONAUTICAL ENGINEERING

### VISION

Department of Aeronautical Engineering aims to be indispensable source in Aeronautical Engineering which has a zeal to provide the value driven platform for the students to acquire knowledge and empower themselves to shoulder higher responsibility in building a strong nation.

### MISSION

(a) The primary mission of the department is to promote engineering education and research.

(b) To strive consistently to provide quality education, keeping in pace with time and technology.

(c) Department passions to integrate the intellectual, spiritual, ethical and social development of the students for shaping them into dynamic engineers.

### QUALITY POLICY

Impart up-to date knowledge to the students in Aeronautical area to make them quality engineers. Make the students experience the applications on quality equipment and tools. Provide systems, resources, and training opportunities to achieve continuous improvement. Maintain global standards in education, training, and services.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S)

| |
|---|
| **PEO1:PROFESSIONALISM & CITIZENSHIP**<br>To create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with due consideration for ethical, ecological and economic issues. |
| **PEO2:TECHNICAL ACCOMPLISHMENTS**<br>To provide knowledge based services to satisfy the needs of society and the industry by providing hands on experience in various technologies in core field. |
| **PEO3:INVENTION, INNOVATION AND CREATIVITY**<br>To make the students to design,experiment, analyze,interpret in the corefield with the help of other multi disciplinary concepts wherever applicable. |
| **PEO4:PROFESSIONAL DEVELOPMENT**<br>To educate the students to disseminate research findings with good soft skills and become a successful entrepreneur. |
| **PEO5:HUMAN RESOURCE DEVELOPMENT**<br>To graduate the students in building national capabilities in technology, education and research. |

## PROGRAM OBJECTIVES (PO'S)

# Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **Design / development of solutions**: Design solutions for complex engineering problems anddesignsystemcomponentsorprocessesthatmeetthespecifiedneedswithappropriate considerationforthepublichealthandsafety,andthecultural,societal,andenvironmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and researchmethodsincludingdesignofexperiments,analysisandinterpretationofdata,and synthesis of the information to provide valid conclusions.
5. **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.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal andcultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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 multi disciplinary environments.
12. **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.

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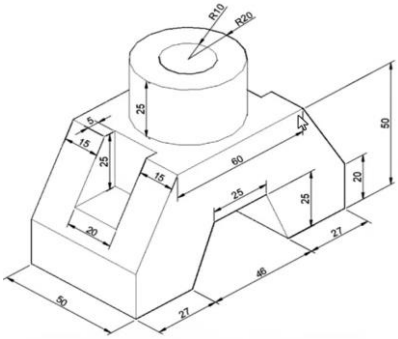
## EXPERIMENT 1

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.

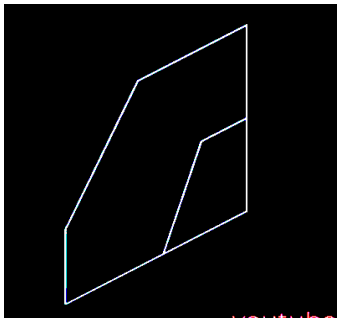



**Software Used**: AutoCAD 3D Modeling

**Commands used:** Line, circle, presspull, erase, move, 3D mirror and union

**Procedure:**

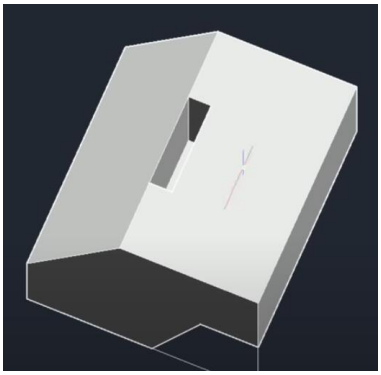
- To start new drawing, click on down arrow beside New and select **acadiso.dwt**
- To change to 3D Modeling, click on gear icon and select **3D Modeling** option.
- Click on **unsaved view** and select **SE Isometric.**
- Shift UCS icon to left bottom corner by typing **UCSICON** and selecting **"No Origin"** option.
- To change UCS, click on **world**, and select **Right**.
- To start drawing, select **line.** Type **0,0** to start from origin. Keep Ortho ON. If not press F9 to make it ON.
- Complete half of the right side of the diagram with dimensions given.



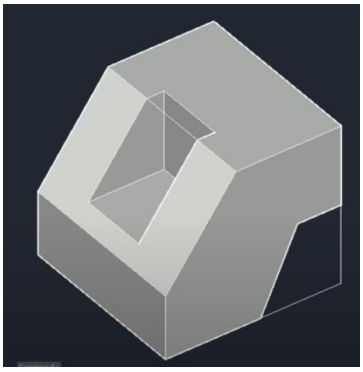
- To convert the shape into 3D, select **presspull** option and click inside the diagram.
- Move the cursor in left side and give the distance of 50 mm.
- To see the figure in 3D shaded view, click on **2D wireframe** and click on **shaded with edges**.

- To create a cut of rectangle, change the UCS to **top**.
- Draw a rectangle of 20 mm X 5 mm outside of the figure.
- Place the rectangle at the mid-point by using **Move** command.

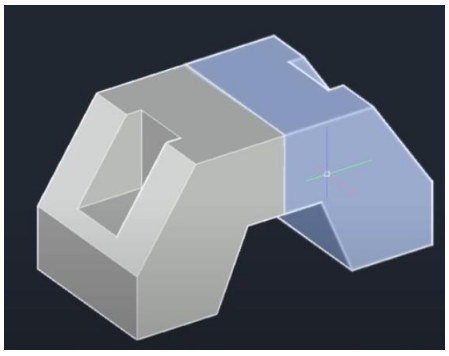
- Make a groove of the rectangle for a depth of 25 mm.
- Orbit the object by pressing shift and middle mouse button and keep the object in a convenient position.



- To remove the excess material, select **presspull**, select the inner vertical surface and take it outside. Ensure that the portion is completely outside the component.
- Press enter to cut the material.



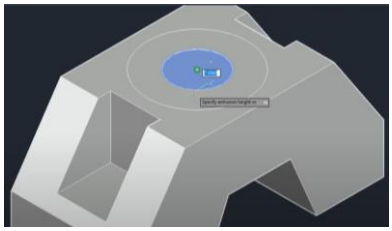
- To remove unwanted lines, press **e** (Erase) and select all unwanted lines and press enter
- To create other half of the object, select 3D Mirror, select any three corners of the plane through which the object has to be mirrored and press **No** to create the image.

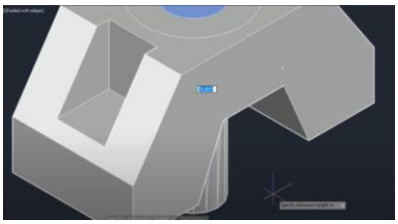


- To join these two objects, select **union** command, select the two objects and press enter.

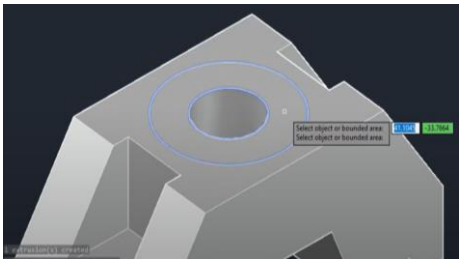
- To draw the hollow cylindrical part on the top side, select **circle** option and choose centre point and draw two concentric circles of radii of 20 and 10.

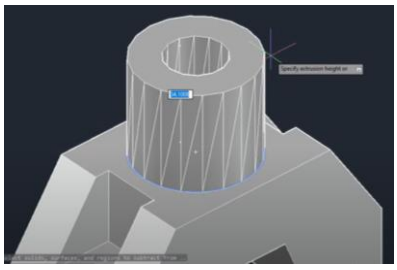
- Choose **presspull** option, click inside the smaller circle and move the cursor downwards to make a through hole.



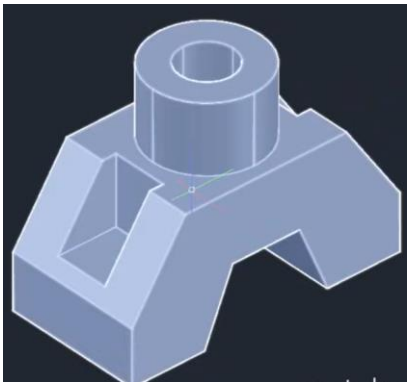


- Again, choose **presspull** option and click between two circles and give a height of 25.





- The final figure is obtained.



**PRECAUTIONS:**

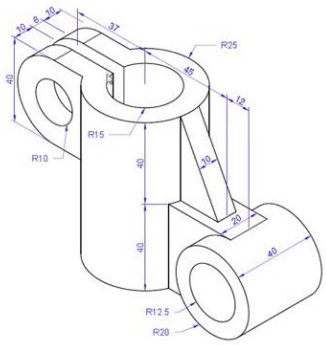
- Keep **ORTHO ON** whenever it is required.
- Choose appropriate plane to draw the cross-section.
- Keep dynamic input **OFF** while selecting a specified point.
- Keep only required options **ON** in **OBJECT SNAP** mode.
- Always join any two parts with the help of a constraint.
- Always convert any two objects into one object after joining them together.
- Always save the work at a safe place frequently.

Date of Submission

Signature of the faculty

## EXPERIMENT 2

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.



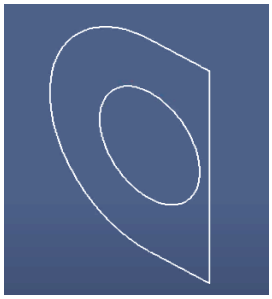

**Software Used**: AutoCAD 3D Modeling

**Commands used:** Line, circle, presspull, extrude, subtract, loft, move, erase, surfsculpt and union

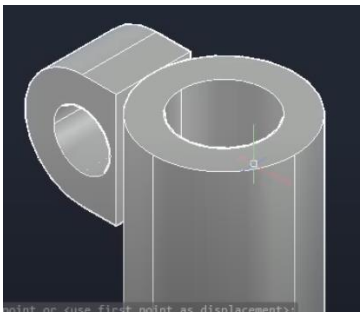
**Procedure:**

- To start new drawing, click on down arrow beside New and select **acadiso.dwt**
- To change to 3D Modeling, click on gear icon and select **3D Modeling** option.
- Click on **unsaved view** and select **SE Isometric.**
- Shift UCS icon to left bottom corner by typing **UCSICON** and selecting **"No Origin"** option.
- Draw two concentric circles of radii 15 and 25.
- Pull the two circles to a height of 80 by using **presspull** command.
- Click on **2D wireframe** and click on **shaded with edges**.

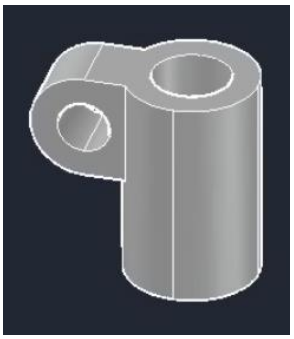
- Click **world** and choose **front** to shift UCS to front plane.
- Draw a circle of Radius 20.
- Draw a horizontal line of 12 (37-25) from top quadrant of the circle.
- Draw a vertical line of 40. Join the line with a horizontal line to the bottom quadrant of the circle.
- Trim the unwanted part of the circle.
- Join all the parts of the segment by using **join** command.
- Draw a circle of radius 10 from the same center of the semi-circle.
- Use **presspull** command to convert the segment into 3D and give a length of 26 (10+6+10).



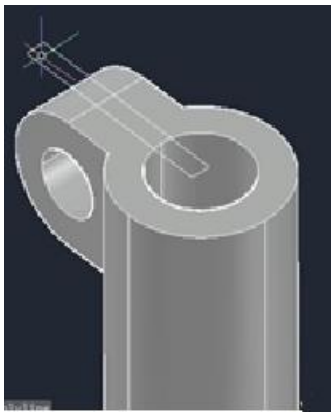
- Move this part to the cylinder and place it properly as shown in the figure below.



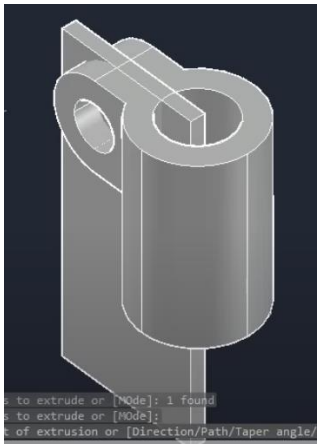
- Orbit the object by pressing shift and middle mouse button and keep the object in a convenient position.
- To merge two objects, click on **presspull** and select the face to merge into other object and give some distance such that the two objects are combined.
- To make these two as a single object, join them by **union** command.



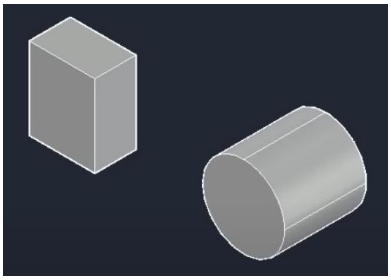
- To create cut of 6 on the top plane, change UCS to **TOP**.
- Draw a rectangle of width 6 by using **Line** command and join all the lines by **join** command.

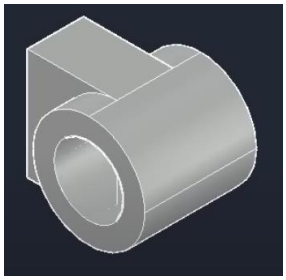


- Convert the rectangle into 3D by using **Extrude** command.
- Cut the rectangular block by using **subtract** command.

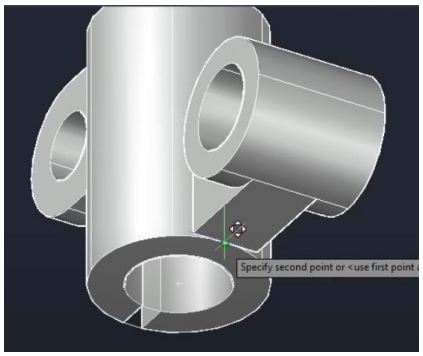



- To draw rectangle at the bottom, change UCS to **FRONT**.
- Draw a rectangle of 32x40. Give a width of 20 by using **presspull.**
- Draw a circle of radius 20 and give the width of 40 by using **presspull.**
- Join these two objects by using **move** command and **union** them.
- Create a hole of diameter 25.

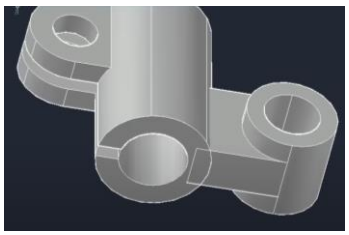




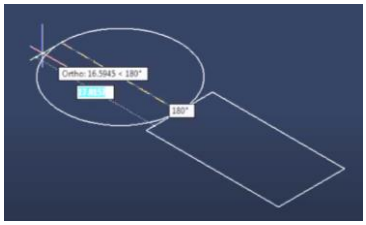
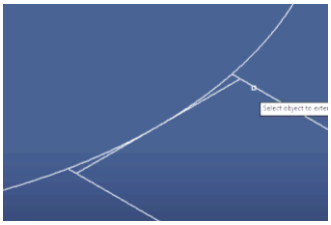
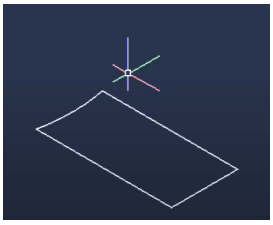
- Move the part and keep it at the bottom of cylinder as shown in the figure.



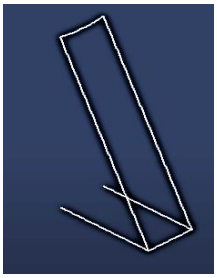

- To combine these two parts click on **presspull** and select the vertical face of the rectangle and extend the face into the cylinder. Union the parts.



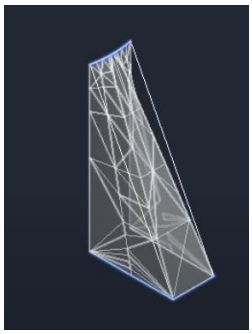
- To have triangular rib, change UCS to top plane and draw a rectangle of 20x10.
- Draw a circle of diameter 50 using 2 point method as shown in the figure.
- Explore the rectangle and extend the two sides of rectangle to touch the circle.
- Delete the unwanted portions of rectangle and circle as shown in the figure.

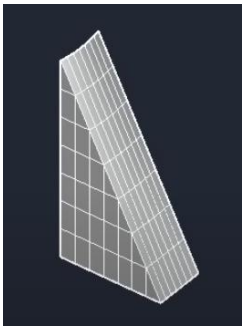




- Move the curved section to a height of 40
- Join remaining part of rectangle to make it a single object and draw lines joining the curve to corners of the rectangle as shown in the figure.



- To convert the section into 3D use **loft** command and select bottom section and top section.
- The part whichever is made is not perfect.
- To make it perfect, press enter and select **guides** and select two inclined lines.



- Select the total rib by crossing window, and using **Move** command, place the rib at appropriate place on the cylinder.
- To convert all objects into single solid object, use **SURFSCULPT** command and select all the objects and press enter.
- Thus the final figure is obtained.

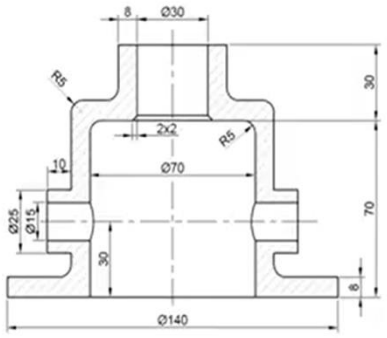
**PRECAUTIONS:**

- Keep **ORTHO** on whenever it is required.
- Choose appropriate plane to draw the cross-section.
- Keep dynamic input **OFF** while selecting a specified point.
- Convert all single lines into polyline before converting it into 3D
- Keep only required options **ON** in **OBJECT SNAP**.
- Always join two parts with the help of a constraint.
- Always convert any two objects into one object after joining them together.
- Always save the work at a safe place frequently.

Date of Submission

Signature of the faculty

## EXPERIMENT 3

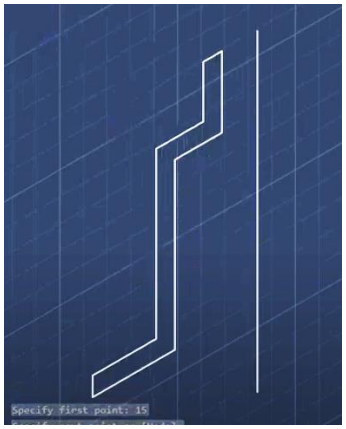



**Software Used**: AutoCAD 3D Modeling

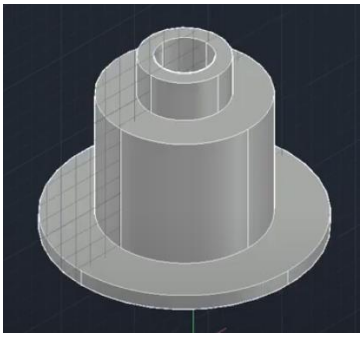
**Commands used:** Line, circle, presspull, erase, filletedge, 3D mirror and union

**Procedure:**

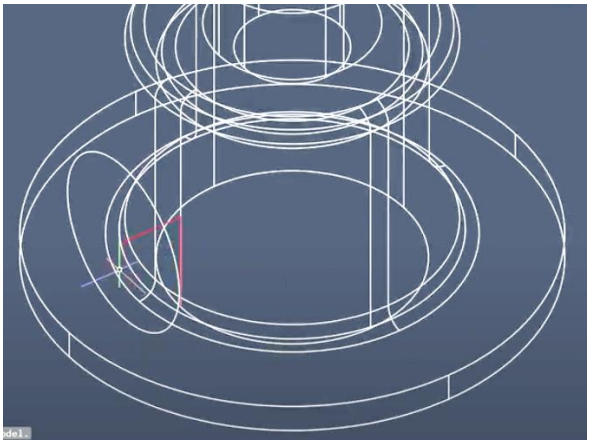
- As the object is axi-simmetric, it can be drawn by using **Revolve** option.
- To start new drawing, click on down arrow beside New and select **acadiso.dwt**
- To change to 3D Modeling, click on gear icon and select **3D Modeling** option.
- Click on **unsaved view** and select **SE Isometric.**
- Shift UCS icon to left bottom corner by typing **UCSICON** and selecting **"No Origin"** option.
- To change UCS, click on **world**, and select **Right**.
- Draw the cross-section on right plane according to the dimensions.
- Draw a vertical line at a distance of 15 as shown in the figure.




- Click on **extrude** and select **revolve** option.
- Select the cross-section, press enter and then choose **object** in command bar and select the vertical line as axis of revolution and enter 360 to rotate the object to 360$^{o}$ and press enter.
- To convert into solid, click on **wireframe** and select **solid with edges.**



- To have round corners, choose **FILLETEDGE**, select the edges where the round shape is required, select **radius** option in command bar and give the radius as 5 and press **enter** twice. If any edge is not selected, change the figure to wireframe and select the edge and press enter twice.
- To draw the protrusion of dia 20 at a height of 30, draw a vertical line of 30 and a horizontal line of 18.
- Shift the plane to **front** plane.
- Draw a circle of diameter 20 as shown in the figure.



- Use **Extrude** to extend the circle to touch the surface of the cylinder.
- Select **3D mirror** and choose **XY** from command line and select any two points vertically. Choose **No** to create a mirror image.
- Union all the parts.
- Select **circle** command and draw a concentric circle of radius 15.
- Select **presspull** command, and pull the circle to the other side to make a hole.
- Remove all unwanted lines.
- To create chamfer of 2x2, type **CHAMFEREDGE,** select the edge, choose **distance** option from the command line and type 2 enter and 2enter. Chamfer is created.
- The final component is created.

**PRECAUTIONS:**

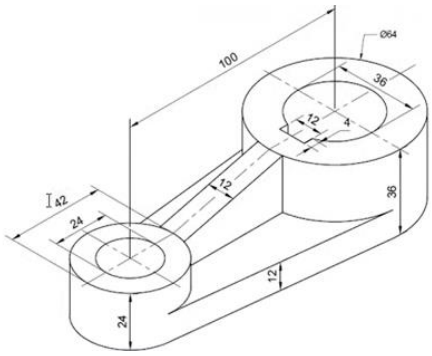
- Keep **ORTHO** on whenever it is required.
- Choose appropriate plane to draw the cross-section.
- Keep dynamic input **OFF** while selecting a specified point.
- Convert all single lines into polyline before converting it into 3D
- Keep only required options **ON** in **OBJECT SNAP**.
- Always convert any two objects into one object after joining them together.
- Always save the work at a safe place frequently.

Date of Submission

Signature of the faculty

## EXPERIMENT 4

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.

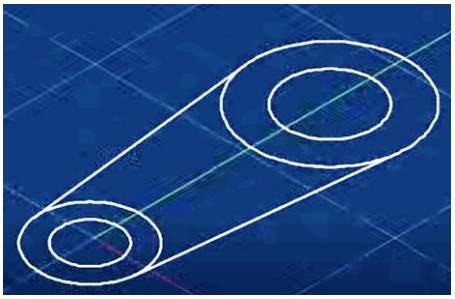



**Software Used**: AutoCAD 3D Modeling

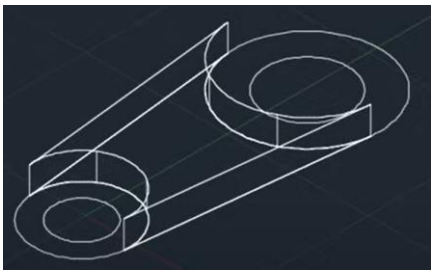
**Commands used:** Line, circle, presspull, erase, and union

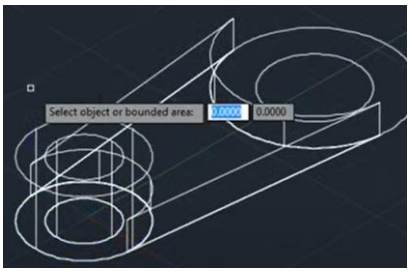
**Procedure:**

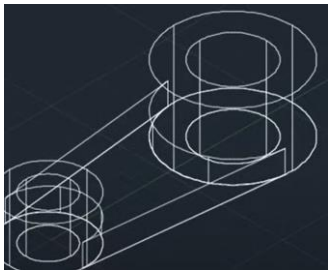
- To start new drawing, click on down arrow beside New and select **acadiso.dwt**
- To change to 3D Modeling, click on gear icon and select **3D Modeling** option.
- Click on **unsaved view** and select **SE Isometric.**
- Shift UCS icon to left bottom corner by typing **UCSICON** and selecting **"No Origin"** option.
- To change UCS, click on **world**, and select **Top**.
- Draw the circles of diameters 42, 26, 64 and 36 at a distance of 100 as shown in the figure below.



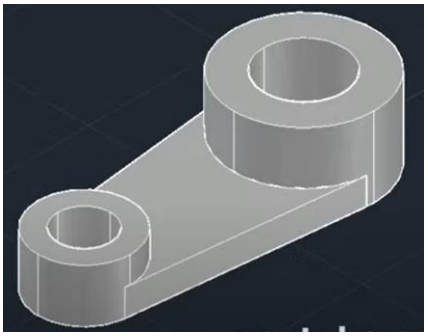
- To convert the cross-section into 3D, select **presspull** command and click in the middle part of the diagram and give the direction and type 12, then click between bottom two circles and give the direction and type24 and then click between the top two circles and give the direction and type 36.



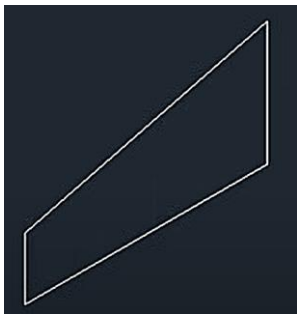


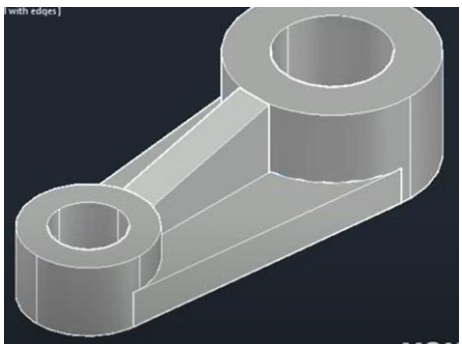
- Press enter to come of the presspull command.
- To convert this into 3D solid, click on wireframe and choose **shaded with edges.**

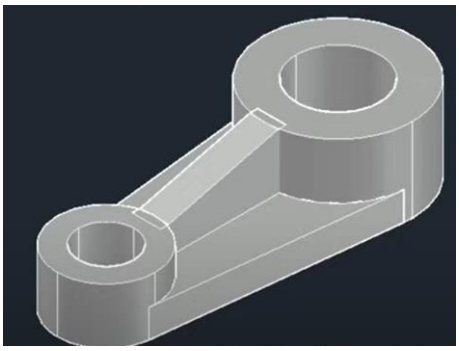


- To draw the triangular rib, shift the plane to **Right**.
- Draw a triangular rib with a length of 47 and height of 12 at one end and height of 24 at the other end and by using presspull command, give a thickness of 12.

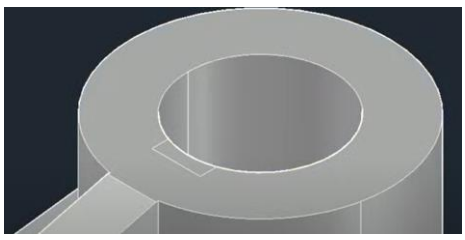


- Move the rib portion to its appropriate position.
- Orbit the figure to place it in a convenient position and use presspull command to fill up the gaps between two faces of the rib and cylindrical portions.





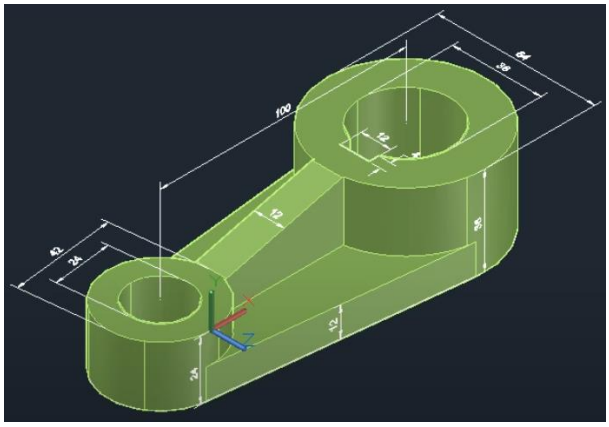
- Union all the components to convert into one object.
- To cut the key way, shift the plane to **Top**.
- Draw a horizontal line from the center of the circle. Offset it to a distance of 6 on either side of the line.
- Draw a line at a distance of 4 from the periphery of the circle and trim all the unwanted portions of the line.



- Use **presspull** and click inside the portion and pull it down and give a height of 36 and press enter to cut the portion.

**DIMENSIONING:**

- To give all the dimensions of the object, click **view** option in **coordinates** and select **face.**
- Click on the part for which the dimension is to be given and press enter.
- To modify dimension style, type **dimsty** and make necessary changes and press **set current** and close the dialog box.
- Keep always Y axis of the UCS in the direction of the text.
- To draw a center line, create a new layer with center as linetype and draw center lines as shown in the figure.




**PRECAUTIONS:**

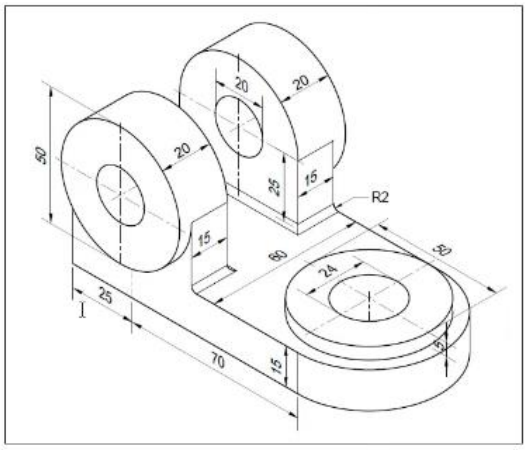
- Keep **ORTHO** on whenever it is required.
- Choose appropriate plane to draw the cross-section.
- Keep dynamic input **OFF** while selecting a specified point.
- Convert all single lines into polyline before converting it into 3D
- Keep only required options **ON** in **OBJECT SNAP**.
- Always convert any two objects into one object after joining them together.
- Always save the work at a safe place frequently.

Date of Submission

Signature of the faculty

## EXPERIMENT 5

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.




**Software Used**:

**Commands used:**

**Procedure:**

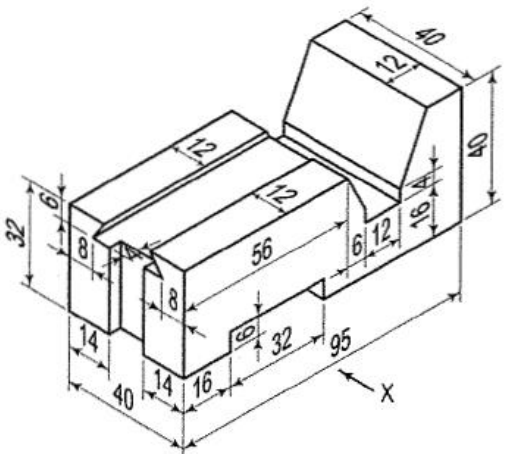
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 6

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.




**Software Used**:

**Commands used:**

**Procedure:**

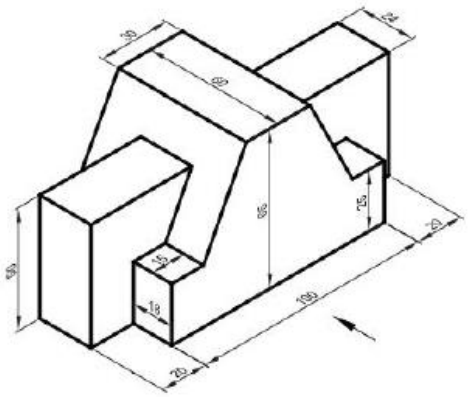
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 7

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.




**Software Used**:

**Commands used:**

**Procedure:**

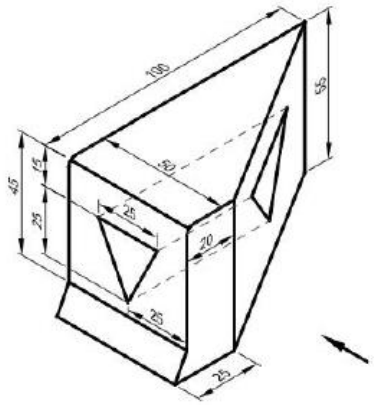
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 8

**AIM:** To draw the given figure by using AutoCAD 3D Modeling.




**Software Used**:

**Commands used:**

**Procedure:**

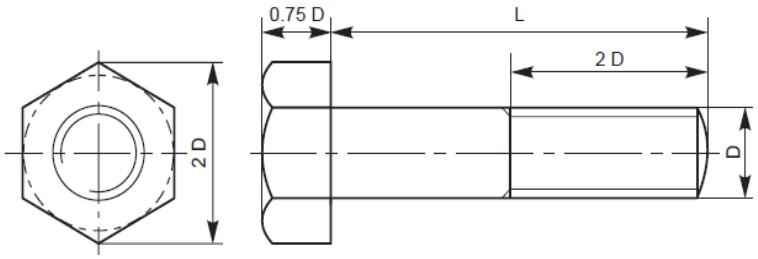
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 9

**AIM:** To draw the Hexagonal headed bolt by using AutoCAD 3D Modeling. Assume the nominal diameter 'D'.




**Software Used**:

**Commands used:**

**Procedure:**

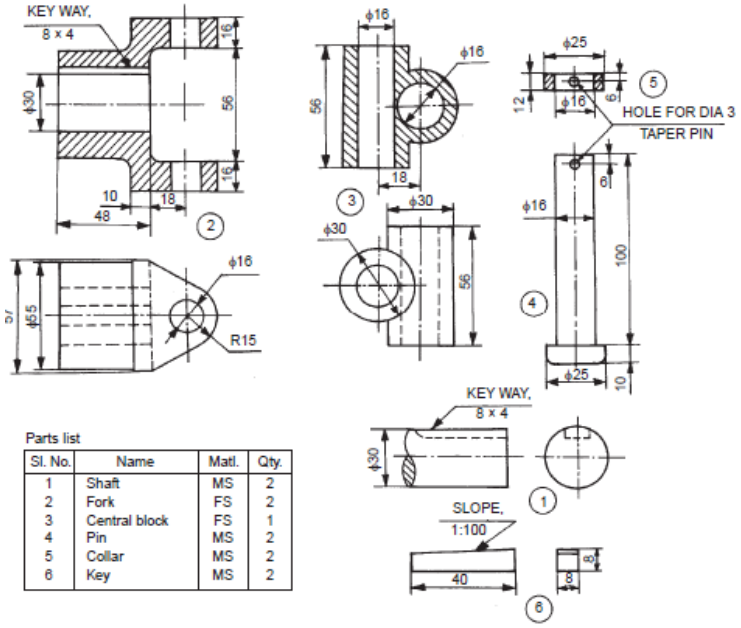
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 10

**AIM:** To draw components Universal Coupling by using AutoCAD 3D Modeling and assemble them.




Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Shaft | MS | 2 |
| 2 | Fork | FS | 2 |
| 3 | Central block | FS | 1 |
| 4 | Pin | MS | 2 |
| 5 | Collar | MS | 2 |
| 6 | Key | MS | 2 |

**Software Used**:

**Commands used:**

**Procedure:**

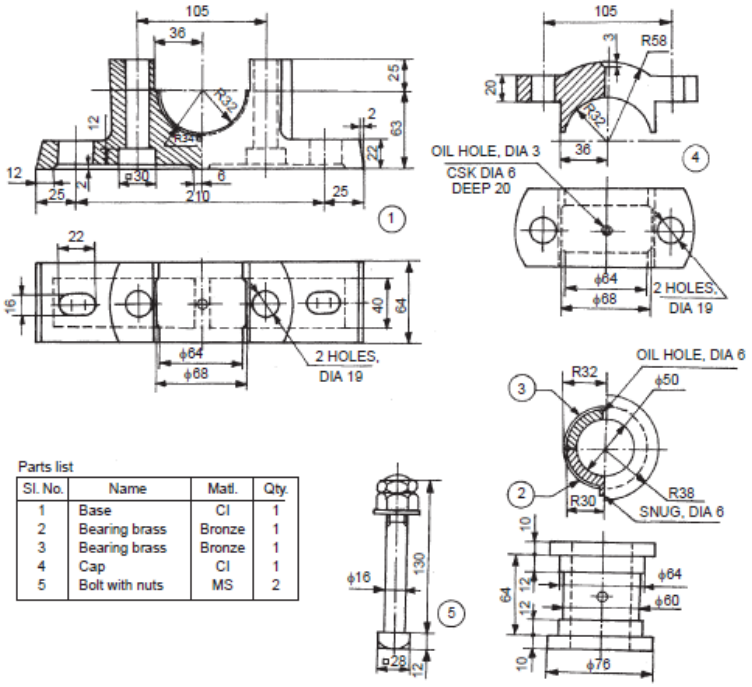
**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 11

**AIM:** To draw components Universal Coupling by using AutoCAD 3D Modeling and assemble them.




Parts list

| Sl. No. | Name | Matl. | Qty. |
|---|---|---|---|
| 1 | Base | CI | 1 |
| 2 | Bearing brass | Bronze | 1 |
| 3 | Bearing brass | Bronze | 1 |
| 4 | Cap | CI | 1 |
| 5 | Bolt with nuts | MS | 2 |

**Software Used**:

**Commands used:**

**Procedure:**

**PRECAUTIONS:**

Date of Submission

Signature of the faculty

## EXPERIMENT 12

**AIM:** Design an aircraft wing of NACA 2412 series by using AutoCAD 3D Modeling.

**Software Used**:

**Commands used:**

**Procedure:**

**PRECAUTIONS:**

Date of Submission

Signature of the faculty