A

Laboratory Manual

Machine Drawing

&

Elements of Machine Design

(BE03000231)

B.E. Semester 3

(New Syllabus)

Mechanical Engineering/ Automobile Engineering /

Mechatronics / Manufacturing Engineering & Allied Branch

Institute logo

Directorate of Technical Education, Gandhinagar, Gujarat

Government Engineering College, Patan

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Certificate of Completion

This is to certify that Mr./Ms. ____________________________________, a student of the 3rd Semester in Mechanical Engineering (Enrolment No. _________________), has successfully and satisfactorily completed all practical and tutorial work prescribed for the course **“Machine Drawing and Elements of Machine Design” (Course Code: BE03000231)** at L. D. College of Engineering during the academic year 2025–26.

Date of Submission___________

Faculty In charge **External Examiner** **Head of Department**

Practical—Course Outcome matrix

Course Outcomes (COs):

Sr. No	Course Outcomes	Level
1	Interpret various stress-strain, CG, and MI of machine components and their design procedure.	U
2	Evaluate machine components under static loading and application of various basic theories of failures.	E
3	Design and analyze of levers, shafts, keys , couplings and power screw	C
4	Analyze machine components under fluctuating loading and design for finite and infinite life.	N
5	Make use of modelling/ drafting software for machine drawing and production drawing.	A

Sr. No.	Objective(s) of Experiment	CO1	CO2	CO3	CO4	CO5
1.	Introduction to modeling software					√
2.	Elements of 2D drawing in modeling/drafting software					√
3.	2D drawing of machine components in software					√
4.	Orthographic drawing of machine components using software					√
5.	Isometric view, Isometric projection using software					√
6.	Assembly drawing using software			√		√
7.	Production Drawing using software			√		√
8.	Design of machine components as per content and computerized production drawings.	√	√	√	√	√
9	Case study	√	√	√	√	√
10						
11						

Justification of Program Outcomes (PO1–PO12)

PO No.	Program Outcome	Justification – How the Course Addresses This PO
PO1	Engineering knowledge	Students apply the fundamentals of mechanics, strength of materials, and design methodology to machine elements, enhancing core engineering knowledge.
PO2	Problem analysis	Through the application of stress analysis and failure theories, students learn to identify, analyze, and solve mechanical design problems.

PO3	Design/development of solutions	Students design components like levers, shafts, and screws using industry practices, ensuring safe and functional engineering solutions.
PO4	Conduct investigations of complex problems	Students engage in design-based investigations such as fluctuating load cases and fatigue failure to derive reliable design parameters.
PO5	Modern tool usage	Students utilize advanced CAD software for modeling, drafting, and simulating machine assemblies, aligning with current industry tools.
PO6	The engineer and society	By focusing on safety factors and failure prevention, the course supports the development of socially responsible engineering solutions.
PO7	Environment and sustainability	Through optimal material selection and design efficiency, the course fosters awareness of sustainable engineering practices.
PO8	Ethics	Students learn the ethical implications of accurate and safe designs, including the necessity of adhering to established codes and standards.
PO9	Individual and teamwork	Group design tasks and collaborative software exercises promote teamwork and leadership in an engineering context.
PO10	Communication	The course enhances technical communication skills through structured drawing practices, annotations, and design documentation.
PO11	Project management and finance	Exposure to software tools and real-world case studies prepares students for managing technical resources and design workflows effectively.
PO12	Life-long learning	The course encourages adaptability by introducing students to evolving software tools and contemporary design methodologies.

Laboratory Instructions for Machine Drawing and Elements of Machine Design

1. **Be Prepared**
    - Read the lab manual and understand the objectives before coming to the lab.
    - Review related theory from the textbook or class notes.
2. **Maintain Discipline**
    - Arrive on time and maintain decorum throughout the session.
    - Follow the instructor’s guidelines at all times.
3. **Software Familiarity**
    - Learn basic commands and operations of the modeling/drafting software (e.g., AutoCAD, FreeCAD, etc.).
    - Do not install unauthorized software or tamper with system settings.
4. **Workstation Handling**
    - Use only assigned computer systems.
    - Save your work regularly and back up your files.
5. **File Management**
    - Use consistent naming conventions (e.g., `Name_ExpNo.dwg`) for all drawing files.
    - Maintain a separate folder for each practical assignment.
6. **Drawing Standards**

- Follow BIS standards for dimensioning, tolerances, and drawing formats.
- Ensure clarity in sectioning, annotation, and labeling.

7. **Data Entry and Design Inputs**
    - Use appropriate design values such as material properties, loads, and dimensions.
    - Validate inputs for designing machine components using formulas and references.
8. **Group Collaboration**
    - Collaborate effectively during assembly and case study work.
    - Share responsibilities and document contributions.
9. **Documentation**
    - Maintain a practical file with printed or PDF copies of completed work.
    - Write clear explanations of steps and design choices taken.
10. **Safety and Ethics**
    - Use equipment responsibly and avoid plagiarism.
    - Report any system malfunctions or issues immediately to the lab in-charge.
11. **Assessment Readiness**
    - Keep all drawings and simulations ready for viva/practical evaluation.
    - Be prepared to explain the design process and justify choices.
12. **Clean Workspace**
    - Log off and shut down the system properly after use.
    - Leave the workspace clean and tidy.

Attainment Rubric for Practical's (As per NBA Requirements)

Course Code: BE03000231
Course Name: Machine Drawing and Elements of Machine Design

Pr. No.	Title	Mapped CO(s)	Assessment Tool	Performance Criteria	Rubric Levels (Marks Range)
1	Introduction to modeling software	CO5	Observation + Viva	Understanding of UI, navigation, tool identification	L3: Confident use, no help (8–10) L2: Basic operations with some help (5–7) L1: Unable to operate independently (0–4)
2	Elements of 2D drawing in software	CO5	Drawing File + Viva	Correct use of lines, dimensions, constraints	L3: Precise & clean 2D drawing (8–10) L2: Minor errors (5–7) L1: Incomplete/inaccurate drawing (0–4)
3	2D drawing of machine components	CO5	Drawing File + Viva	Geometry, views, dimensioning as per standard	L3: Standards followed correctly (8–10) L2: Minor dimensioning issues (5–7) L1: Major errors or incomplete (0–4)
4	Orthographic drawing	CO5	Drawing File	Proper front, top, side views with projection lines	L3: All views correct & clean (8–10) L2: One view missing/inaccurate (5–7) L1: Incomplete views (0–4)
5	Isometric view and projection	CO5	Drawing File	Accurate 3D representation of part from 2D	L3: Isometric views correct (8–10) L2: Shape correct, proportions off (5–7) L1: Incorrect or missing drawing (0–4)
6	Assembly drawing	CO3, CO5	Assembly File + Viva	Logical placement, constraints, bill of materials	L3: Fully constrained, well-labeled (8–10) L2: Minor missing parts/labels (5–7) L1: Poorly constrained/incomplete (0–4)
7	Production Drawing	CO3, CO5	Drawing File	Tolerances, fits, and notes included per standard	L3: Complete with correct symbols (8–10) L2: Missing 1–2 elements (5–7) L1: Lacks standard detail (0–4)

8	Component design and drawing	CO1–CO5	File + Calculations + Viva	Calculation correctness, model accuracy	L3: Accurate design & drawing (10) L2: Minor calculation errors (6–9) L1: Incomplete or wrong design (0–5)
9	Case study	CO1–CO5	Report + Viva	Design evaluation, innovation, software use	L3: In-depth analysis + original design (10) L2: Moderate depth, mostly correct (6–9) L1: Lacks analysis or unclear (0–5)

Attainment Levels Mapping (NBA Style)

Level	Definition	CO Attainment Status
L3 (High)	≥ 80% marks in assessment	Target Achieved
L2 (Moderate)	60–79% marks	Satisfactory
L1 (Low)	< 60% marks	Improvement Needed

Important Instructions

Students are advised to download and install the free **Autodesk Software (Version 2025/26)**, which is available exclusively free for educational use. To access the software, students must complete the registration process through the **official Autodesk website**.

Autodesk offers a **free one-year student edition** upon successful registration. For detailed steps and registration guidance, please refer to **Points No. 6 and 7** under the **References** section at the end of this document

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Department of Mechanical Engineering

B.E. Semester – III

Machine Drawing and Elements of Machine Design (BE03000231)

Index

Sr. No.	Objective(s) of Experiment	Page No.	Date of Performance	Date of submission	Assessment Marks	Sign.
1	Introduction to modeling software					
2	Elements of 2D drawing in modeling/drafting software					
3	2D drawing of machine components in software					
4	Orthographic drawing of machine components using software					
5	Isometric view, Isometric projection using software					
6	Assembly drawing using software					
7	Production Drawing using software					
8	Design of machine components as per content and computerized production drawings.					
9	Case study					
10						
11						
				Total		

PRACTICAL NO: 01

Introduction to modeling software

Course Outcome: CO5 – Make use of modeling/drafting software for machine drawing and production drawing.

Objective

To familiarize students with computer-aided modeling/drafting software used in machine design and production drawing, and to understand the basic interface, tools, and functions for creating 2D and 3D drawings.

Software Used

- Software Name: FreeCAD / AutoCAD / Fusion 360 (Any one as per availability)
- Version: (Mention version used, e.g., FreeCAD 0.20, AutoCAD 2024)
- System Requirements: Windows/Linux/Mac with minimum 4GB RAM, 2GHz CPU

Practical Tasks

1. **Understanding the Interface**
    - Opening the software and exploring the interface layout.
    - Identifying the main workspace, toolbars, browser/tree view, and status bar.
    - Navigating view controls (pan, zoom, rotate).
2. **Setting Up a New Project**
    - Creating a new part or drawing file.
    - Setting units (mm/inch).
    - Setting grid and snap settings for precise drawing.
3. **Sketching Tools Introduction**
    - Line, circle, rectangle, polygon, arc, ellipse.
    - Using dimensions and constraints (horizontal, vertical, equal, perpendicular).
    - Creating simple 2D sketches.
4. **Modelling Basics (3D)**
    - Converting 2D sketches into 3D models using:
        - Extrude
        - Revolve
        - Cut

        - Fillet and chamfer

5. **Saving and Exporting Files**
    - Saving projects in native and standard formats (.FCStd, .DXF, .STL, .IGES).
    - Understanding file version control.

Procedure

1. Launched the software and explored the interface (toolbars, workbenches).

2. Created a new file/project, set the units to millimeters.

3. Opened the Sketcher or Drawing module and drew a rectangle using line tool.

4. Applied constraints and dimensions to define the sketch fully.

5. Used Pad (extrude) feature to convert the sketch into a 3D model.

6. Explored other features like Chamfer and Fillet to enhance the model.

7. Saved the file in both native and exchange formats (e.g., .FCStd, .STEP).

8. Took screenshots of the final sketch and model for documentation.

Screenshots of Work

(Attach the following images in the report or paste printed screenshots)

· Screenshot 1: Sketch in Basic 2D view (like….circle, polygon, etc…….)

Result

Successfully explored the interface and created a basic 2D sketch. Converted sketch to 3D model using modeling tools. Learned how to apply constraints and save files for production use.

Learning Outcomes

By the end of the session, students will be able to:

- Navigate and operate basic functions of modeling software.
- Draw and constrain 2D sketches.
- Generate basic 3D models using modeling tools.

- Save and manage drawing files effectively.

Conclusion

This practical helped to understand the modeling environment used in machine design. It lays the foundation for advanced drawings and assemblies by developing hands-on skills in sketching and 2D modeling using CAD tools.

Viva Questions

1. What is the purpose of constraints in sketching?
2. What is the difference between extrude and revolve features?
3. What types of file formats can CAD software export?
4. Define parametric modeling.
5. Name two open-source and two commercial modeling software.
6. What is the difference between sketching and modeling?
7. What is parametric modeling?
8. Why are constraints important in a sketch?
9. Name some common file formats used in modeling software.

Rubrics Table for Practical Assessment (As per NBA Guidelines)

Assessment Criteria	Excellent (10)	Good (8)	Average (6)	Below Average (4)	Weightage (%)
Understanding of Software Tools	Demonstrates full understanding of interface and tools with proper application.	Understands most tools with minor errors in application.	Understands basic tools but uses them with assistance.	Struggles to understand or apply basic tools.	20%
Sketching and Modeling Skills	Creates accurate 2D sketch model with constraints applied effectively.	Minor errors in sketching or modeling but overall accurate.	Basic sketch created; limited or incorrect 3D modeling.	Incomplete or incorrect sketch/model.	30%
File Handling and Documentation	Saves and exports files correctly; report includes labeled screenshots and details.	Saves correctly; report has most required screenshots.	Files saved with some errors; incomplete report or missing screenshots.	Files not saved properly; report lacking essential components.	20%
Conceptual Clarity (Viva/Interaction)	Answers all viva questions with strong clarity and explanation.	Answers most questions correctly with some explanation.	Struggles with few conceptual questions.	Shows poor understanding of core concepts.	20%
Report Format and Presentation	Report is well-structured, neat, and follows format completely.	Report mostly neat and structured with few format issues.	Report has format inconsistencies and is partially structured.	Report is poorly organized or lacks formatting.	10%

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

Faculty Sign & Date

PRACTICAL NO: 02

Elements of 2D Drawing in Modeling/Drafting Software

Objective:

To understand and practice the use of various 2D drawing elements in CAD software. Students will use real-world examples to gain hands-on experience with drawing, dimensioning, annotating, and managing layers.

Software Required:

- AutoCAD / Free CAD / Solid Edge Draft / SolidWorks Drawing
- Operating system: Windows/Linux with minimum 4 GB RAM
- Mouse with scroll wheel (for better navigation)

Introduction to 2D CAD Drafting

What is 2D Drafting?

2D drafting is the process of creating flat drawings that represent objects and structures in two dimensions. These drawings show width and height but do not represent depth. It is an essential skill in computer-aided design (CAD) and is used in various fields like architecture, engineering, and manufacturing.

Importance of 2D Drafting

2D drafting is a foundational skill for anyone interested in design or engineering. Here are some key points about its importance:

- **Visual Communication:** 2D drawings help communicate ideas clearly. They act as a blueprint that guides builders and engineers in creating products or structures.
- **Precision:** With software tools, designers can produce highly detailed and accurate representations of their ideas. This precision is crucial in preventing errors during the construction or manufacturing process.
- **Efficiency:** Creating 2D drafts digitally through CAD software saves time compared to traditional hand-drawing methods. Designers can easily make changes, revise, or improve their designs.
- **Wide Applications:** 2D drafting is used in many industries, from planning buildings to

designing machinery parts. Understanding this skill opens up many career opportunities

What is 2D CAD drawing?

A 2D CAD (computer-aided design) drawing is a digital representation of a design or technical drawing created using computer software. In a 2D CAD drawing, geometric shapes, lines, arcs, and text are used to convey information about the size, shape, and layout of objects or components in a two-dimensional space, typically on a flat plane.

Key features of 2D CAD drawings include

1. **Geometric Entities**: These include points, lines, circles, arcs, polygons, and other basic shapes used to represent various elements of the design.
2. **Dimensions and Constraints**: Dimensions are added to define the size and position of objects within the drawing. Constraints can be applied to control relationships between different elements, ensuring geometric accuracy and maintaining design intent.
3. **Layers**: Objects within a 2D CAD drawing are organized into layers, allowing for better organization and management of different components, such as dimensions, annotations, and different parts of the design.
4. **Annotation and Text**: Text and annotations are added to provide additional information about the drawing, such as labels, notes, symbols, and specifications.
5. **Scaling and Units**: 2D CAD drawings are typically drawn to scale, meaning that the dimensions accurately represent the real-world size of objects. Units of measurement, such as inches, millimeters, or feet, are specified to ensure consistency and accuracy.
6. **Editing and Modification**: CAD software allows for easy editing and modification of drawings, enabling designers to make changes, revise dimensions, or adjust geometries as needed.
7. **File Formats**: 2D CAD drawings can be saved in various file formats, such as DWG (AutoCAD Drawing), DXF (Drawing Exchange Format), or PDF (Portable Document Format), making them compatible with different CAD software and easily shareable with collaborators.

What does CAD mean in 2D design?

CAD stands for Computer-Aided Design. In the context of 2D design, CAD refers to the use of computer software to create, modify, analyze, and document two-dimensional drawings or designs. CAD software provides tools and capabilities that enable designers, engineers, architects, and drafters to efficiently create detailed technical drawings, schematics, plans, and illustrations.

Key Features of 2D CAD Software

1. **Drawing Tools**

2D CAD software provides a variety of drawing tools such as lines, arcs, circles, and polygons. These tools help in creating detailed and accurate designs.

2. **Editing Features**

Editing tools like trim, extend, mirror, and array allow users to modify their designs without starting from scratch. This flexibility is crucial for iterating on designs quickly.

3. **Layer Management**

Layers help organize different elements of a drawing. For example, in architectural drafting, layers can separate structural elements from electrical or plumbing plans.

4. **Dimensions and Annotations**

Accurate dimensions and annotations are essential in technical drawings. 2D CAD software enables the precise placement of dimensions, text, and other annotations to convey important information about the design.

5. **Templates and Blocks**

Templates provide a starting point for new drawings, ensuring consistency across projects. Blocks are reusable drawing components, which save time and ensure uniformity in repetitive elements.

Popular 2D CAD Software

There are several 2D CAD software options available, each with its unique features and advantages. Some of the most popular ones include:

- **AutoCAD**
- **DraftSight**
- **Libre CAD**
- **QCAD**

AutoCAD is often considered the industry standard, offering a comprehensive set of tools and features. DraftSight, Libre CAD, and QCAD provide robust alternatives, especially for users looking for cost-effective or open-source solutions.

2D CAD drawings offer several benefits in various industries:

1. **Cost-Effective**: Creating 2D CAD drawings is often more cost-effective compared to 3D modeling, especially for simpler components or products.
2. **Simplicity**: 2D drawings are typically simpler to create and understand, making them suitable for conveying basic design information without the added complexity of 3D models.
3. **Efficiency**: For certain applications, such as architectural floor plans, electrical schematics, or mechanical part drawings, 2D CAD can be more efficient and faster to work with than 3D modeling. CAD software significantly reduces the time required to create and modify designs. Changes can be made quickly without the need to redraw entire sections.
4. **Clarity**: 2D drawings provide a clear representation of the object's dimensions, tolerances, and other specifications, which is essential for manufacturing and assembly.
5. **Compatibility**: 2D CAD files are often compatible with a wide range of software and systems, allowing for easier sharing and collaboration among designers, engineers, and manufacturers.
6. **Legacy Support**: Many industries still rely heavily on 2D drawings for legacy systems or components. Maintaining a library of 2D CAD drawings ensures compatibility and continuity with existing workflows and systems.
7. **Documentation**: 2D drawings serve as comprehensive documentation of the design intent, making them valuable for reference throughout the product lifecycle, including manufacturing, maintenance, and repairs.

8. **Precision and Accuracy:** 2D CAD software allows for precise measurements and accurate designs, minimizing errors that were common with hand drafting.

Disadvantages of 2D drawings

- You may get confused while checking your work, as it may be challenging to identify the errors.
- Since the tool cannot understand the assembly and git, it doesn't understand that the product design is complex.
- 2D designs need physical prototyping to display clear information.
- Making changes in 2D drawings is difficult and time-consuming.

CAD software allows users to:

- Draw and manipulate geometric shapes, lines, arcs, circles, and polygons.

- Add dimensions, annotations, text, symbols, and labels to convey information.

- Specify units of measurement, scales, and precision for accurate representation.
- Organize drawing elements into layers for better management and organization.
- Apply constraints and relationships to maintain geometric accuracy and design intent.
- Generate and edit designs with ease, allowing for iterative design processes.
- Analyze designs for factors such as stress, performance, and feasibility.
- Output drawings in various formats for sharing, printing, or further processing.

Basic Steps in Creating a 2D CAD Drawing

Step 1: **Setting Up the Workspace**

Begin by setting up the drawing environment. This includes selecting the units of measurement, configuring the grid, and defining the drawing limits.

Step 2: **Creating the Drawing**

Use the drawing tools to start creating your design. Begin with basic shapes and gradually add details. Utilize layers to organize different components of your drawing.

Step 3: **Editing and Modifying**

Make use of the editing tools to refine your design. Trim unnecessary parts, extend lines to meet new elements, and use the mirror tool to create symmetrical designs.

Step 4: **Adding Dimensions and Annotations**

Once the drawing is complete, add dimensions and annotations to provide additional information. Ensure that all measurements are accurate and clearly labeled.

Step 5: **Finalizing and Saving**

Review the drawing for any errors or omissions. Save the file in the appropriate format, and if necessary, print a copy for physical reference.

Basic Elements of 2D Drawing:

Element	Description
Line	Straight segment connecting two points
Circle	Full circular shape defined by center and radius
Arc	Curved line (part of a circle)
Rectangle	Four-sided shape with right angles
Polyline	Connected sequence of line or arc segments
Text	Used for annotations or labels
Dimensions	Add size and measurement details
Hatch	Patterned fill used in cross-sections
Layers	Organizational tool for managing drawing elements

EXAMPLE PROBLEM:

Problem 1: Draw a mechanical flange plate with the following specifications:

- Outer circle: Diameter = 100 mm
- Inner circle (hole): Diameter = 50 mm
- Four bolt holes: Each of 10 mm diameter, placed at 45°, 135°, 225°, and 315°, 35 mm from the center
- Add dimensions and hatching in the cross-section.

Step-by-Step Procedure:

Step 1: Start the Software

- Open AutoCAD (or alternative drafting software)
- Set the units to **millimeters**

Step 2: Use the Basic Elements

1. Draw Circles

- Use the CIRCLE command.
- Create:

- Outer Circle: Center at (0,0), Radius = 50 mm
- Inner Hole: Center at (0,0), Radius = 25 mm

- **Draw Bolt Holes**

- Use CIRCLE again.
- Create 4 circles of radius = 5 mm.
- Use POLAR ARRAY or manually place at:
  - $(35\cos(45°), 35\sin(45°))$
  - $(35\cos(135°), 35\sin(135°))$
  - $(35\cos(225°), 35\sin(225°))$
  - $(35\cos(315°), 35\sin(315°))$

- **Hatching**

- Use HATCH command.
- Apply hatch pattern in the region between inner and outer circles.

- **Add Dimensions**

- Use the DIM command:
  - Diameter of outer and inner circles
  - Distance between center and bolt holes
  - Bolt hole diameters

- **Text Annotation**

- Use TEXT or MTEXT tool to add:
  - “FLANGE PLATE DESIGN” as a label
  - Notes like: “All dimensions are in mm”

- **Layer Management**

- Create separate layers for:
  - Geometry (black)
  - Hatching (gray)
  - Dimensions (blue)
  - Text (green)
- Assign the elements to the correct layers

Step-by-Step Commands in AutoCAD:

Step 1: Start Drawing

```
plaintext

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Command: CIRCLE

Specify center point: 0,0

Specify radius: 50  ← (Outer Diameter = 100 mm → Radius = 50 mm)
```

Step 2: Draw Center Hole

```
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Command: CIRCLE

Specify center point: 0,0

Specify radius: 25  ← (Center Hole = 50 mm → Radius = 25 mm)
```

Step 3: Draw One Bolt Hole (Top position on PCD = 70 mm → radius = 35 mm)

```
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Command: CIRCLE

Specify center point: 0,35

Specify radius: 5  ← (Bolt Hole Ø10 mm → Radius = 5 mm
```

Step 4: Create 3 More Holes Using Polar Array

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Command: ARRAY

Select objects: (Select the bolt hole)

Enter array type [Rectangular/Path/Polar]: P

Specify center point of array: 0,0

Enter number of items: 4

Enter angle to fill: 360
```

Step 5: Add Centerlines (Optional)

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Command: XLINE

Specify a point: 0,0

Choose Horizontal or Vertical as needed to create center cross
```

Add Dimensions

```
Use the DIMLINEAR and DIMDIAMETER tools:

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Command: DIMDIAMETER

Select outer circle → Places Ø100 mm dimension

Select inner circle → Places Ø50 mm dimension

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Command: DIMLINEAR

Use for distances (e.g., PCD radius or bolt center spacing)
```

Problem 2: Machine Bracket Profile

Objective:

To draw an L-shaped bracket with holes using lines and circles.

Specifications:

- Horizontal Base: 100 mm × 20 mm
- Vertical Leg: 50 mm height
- 2 Holes on base: Ø10 mm, 20 mm from edges
- 1 Hole on vertical: Ø12 mm, 25 mm from base

Steps:

1. Draw base and leg using LINE or POLYLINE.
2. Use CIRCLE for holes.

3. Add DIMENSIONS, centerlines and hatch cross-section.

Problem 3: Connecting Rod Cross-section

Objective:

To draw a simplified 2D section of a connecting rod head and shank.

Specifications:

- Large End Hole: Ø60 mm
- Small End Hole: Ø30 mm
- Center Distance: 150 mm
- Rod width = 30 mm throughout

Steps:

1. Draw two circles for holes.
2. Connect outer tangents with LINE or TANGENT tool.
3. Add centerlines and dimensions.
4. Apply HATCH in cross-section.

Problem 4: V-Block Drawing

Objective:

To create 2D front view of a V-block used for cylindrical support.

Specifications:

- Base: 100 mm × 50 mm
- V-slot: 90° cut from top center, 20 mm deep
- 2 bolt holes: Ø12 mm, 20 mm from ends

Steps:

1. Use RECTANGLE for block.
2. Draw V-SLOT using LINE and TRIM.
3. Add CIRCLE for holes.
4. Add dimensions and hatching on cross-section.

Problem 5: U-Clamp Drawing

Objective:

To draw front view of a U-type clamp with bolt holes.

Specifications:

- Width: 80 mm, Height: 40 mm
- Thickness: 10 mm
- 2 Bolt Holes: Ø10 mm, 60 mm apart

Steps:

1. Draw the U profile using LINE or POLYLINE.
2. Create 2 bolt holes using CIRCLE.
3. Use OFFSET for thickness.
4. Add DIMENSIONS, TEXT, and centerlines.

Problem 6: Support Plate

Objective:

Draw a support plate with rounded corners and holes.

Specifications:

- Rectangle: 120 mm × 60 mm
- 4 corner fillets: Radius 10 mm
- 3 holes: 1 center (Ø15 mm), 2 side (Ø10 mm)

Steps:

1. Use RECTANGLE then FILLET at corners.
2. Place circles for holes using coordinates or center snap.
3. Add dimensions for size, hole positions.

Problem 7: Gasket Profile

Objective:

To create a gasket layout used between flanged pipe joints.

Specifications:

- Outer Circle: Ø120 mm
- Inner Circle: Ø80 mm
- 6 holes: Ø10 mm at 60° interval on 100 mm PCD

Steps:

1. Draw two concentric circles.
2. Use CIRCLE for one bolt hole.
3. Apply POLAR ARRAY for remaining holes.
4. Use DIMENSIONS, add centerlines and notes.

Result for All Problems:

After completing the above problems, students will:

- Understand how to use lines, circles, arrays, fillets, offsets, and text tools.
- Be able to dimension and annotate mechanical components.
- Manage object visibility and clarity using layers.
- Prepare clean 2D technical drawings for manufacturing or documentation.

Summary Table of Tools Used:

Tool/Command	Purpose
LINE	Basic geometry
RECTANGLE	Quick block creation
CIRCLE	Hole or round shapes
OFFSET	Wall/feature thickness
ARRAY	Repeating elements
TRIM/EXTEND	Clean drawing
DIM/DIMLINEAR	Add measurements
TEXT/MTEXT	Label elements
HATCH	Fill for cross-sections
LAYERS	Organize by category

Viva Questions:

1. What is the use of layers in a drawing?
2. How do you place holes symmetrically using polar array?

3. What is the use of hatch patterns?
4. How are dimensions different from annotations?
5. How can you modify existing geometry efficiently?
6. What is the purpose of layers in a 2D drawing?
7. How do you use polar coordinates to place objects?
8. What is the difference between single-line text and multi-line text?
9. Why is hatching important in technical drawings?
10. What tools are used to annotate a drawing?

Result:

Students will be able to:

- Draw and edit 2D shapes
- Use geometric tools effectively
- Organize drawings with layers
- Annotate drawings with text and dimensions
- Apply hatch and cross-sectional features

Instructor Tips:

- Evaluate based on accuracy, layer use, and annotation.
- Encourage students to use shortcut commands.
- Discuss how 2D elements are used in 3D modeling base sketches.

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

Faculty Sign & Date

PRACTICAL NO: 03

2D Drawing of Machine Components in Software

Objectives:

- To understand the basic commands and operations used in 2D CAD software.
- To develop the ability to create accurate 2D drawings of machine components.
- To interpret dimensions, tolerances, and symbols in engineering drawings.
- To gain hands-on experience in using industry-standard CAD software (e.g., AutoCAD, SolidWorks (2D), DraftSight, or Fusion 360 Sketch).

Software Required:

- AutoCAD / SolidWorks (Drafting mode) / DraftSight / Fusion 360 (Sketch mode)

Theoretical Background:

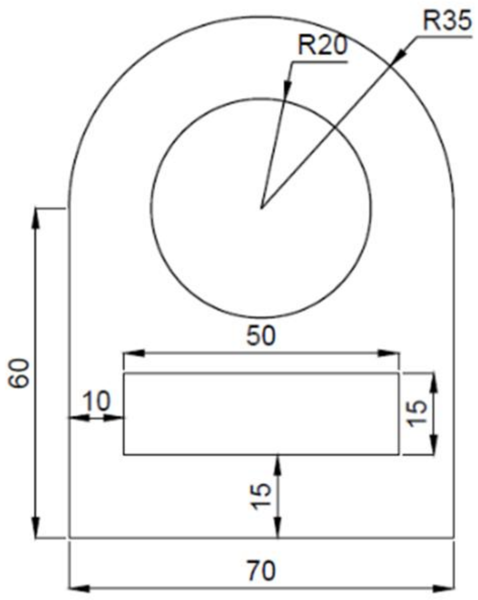
2D drawing in CAD software involves creating technical drawings with precise geometry used for manufacturing and communication of mechanical components. Key elements include:

- **Line types**: visible, hidden, center
- **Dimensions and Tolerances**
- **Orthographic Views**: Front, Top, Side
- **Section Views**
- **Symbols**: for threads, surface finish, etc.

Basic Tools/Commands in CAD:

- **Draw Tools**: Line, Circle, Arc, Rectangle, Ellipse, Polyline
- **Modify Tools**: Trim, Extend, Offset, Mirror, Fillet, Chamfer
- **Dimensioning**: Linear, Aligned, Angular, Diameter, Radius
- **Layers**: Manage visibility and line types
- **Annotation**: Text, Multileader, Hatching

Practical Exercise :1



Drawing Overview (2D Exercise 1):

The figure is a symmetric object with:

- A base rectangle (70×60 mm)
- A semicircular top arc with R35
- A central hole (R20 or Ø40 mm)
- A rectangle cutout (50×15 mm) located 10 mm from the left and 15 mm up from the bottom

AutoCAD Drawing Instructions:

Step 1: Set Units

- **Command:** `UNITS`
- Set to **Decimal**, **Precision: 0.00**, Units: **Millimeters (mm)**

Step 2: Draw the Base Rectangle (70×60 mm)

- **Command:** `RECTANGLE`
- Start point: `0,0`
- Next point: `@70,60`

Step 3: Draw the Top Arc (R35) Centered

- **Command:** `CIRCLE`
- Center point: Midpoint of the top side of rectangle → Use `MID` osnap on top line
- Radius: `35`
- **Then** use `TRIM` to trim the bottom half of the circle

Step 4: Draw the Inner Circle (Hole, R20)

- **Command:** `CIRCLE`
- Center point: Same as above (center of arc)
- Radius: `20`

Step 5: Draw the Cutout Rectangle (50×15 mm)

- **Command:** `RECTANGLE`
- First point: `@10,15` (from bottom-left corner of main rectangle)
- Second point: `@50,15`

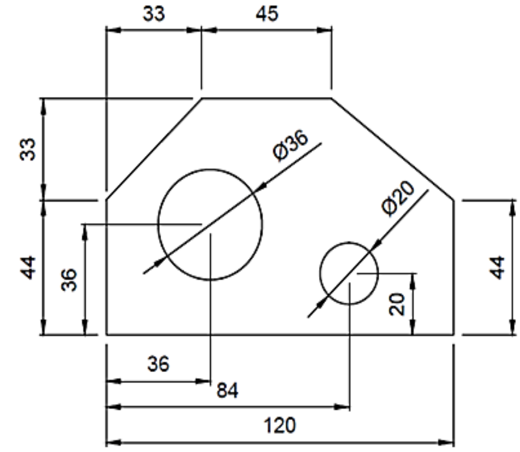
Step 6: Add Dimensions

- **Command:** `DIMLINEAR`, `DIMRADIUS`
- Use:
    - `DIMLINEAR` for:
        - Horizontal: 70 (base), 50 (cutout)
        - Vertical: 60 (height), 15 (cutout position and size), 10 (cutout offset)
    - `DIMRADIUS` for:
        - R20 (inner circle)
        - R35 (outer arc)

Practice work (Any three)

Draw the given drawing in AutoCAD, and also write the command sequence for it

1



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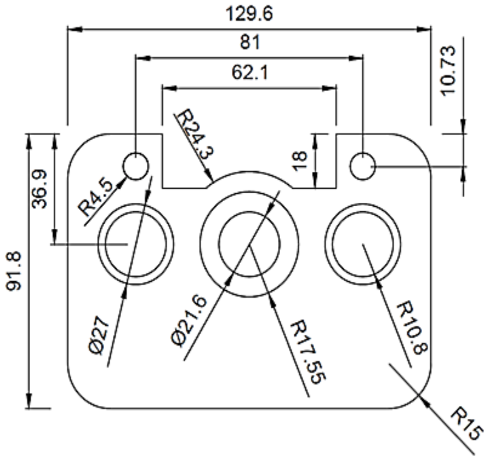

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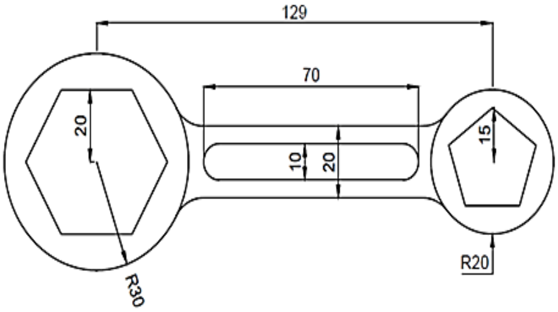

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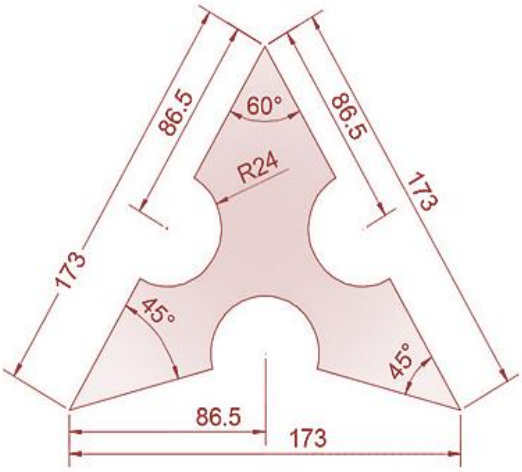

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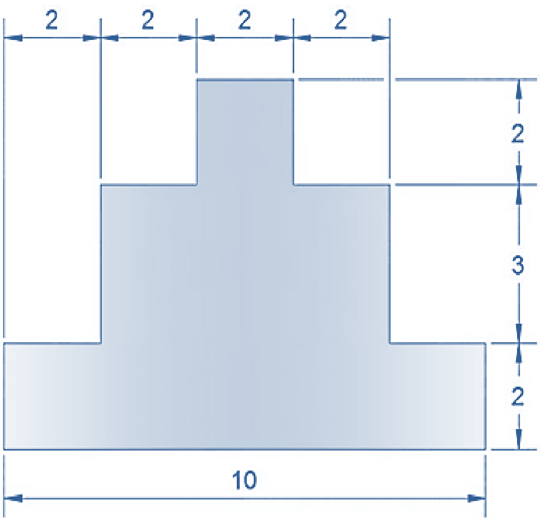

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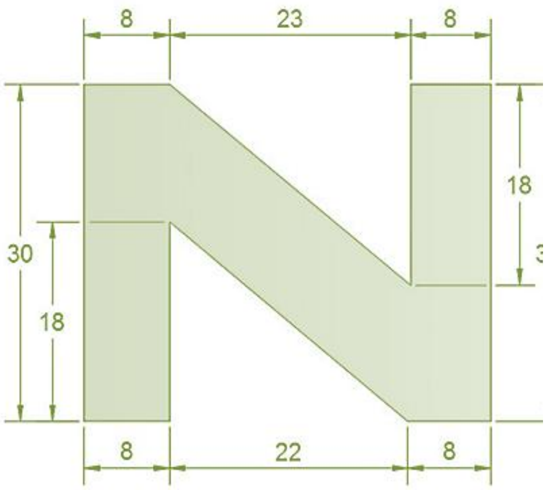

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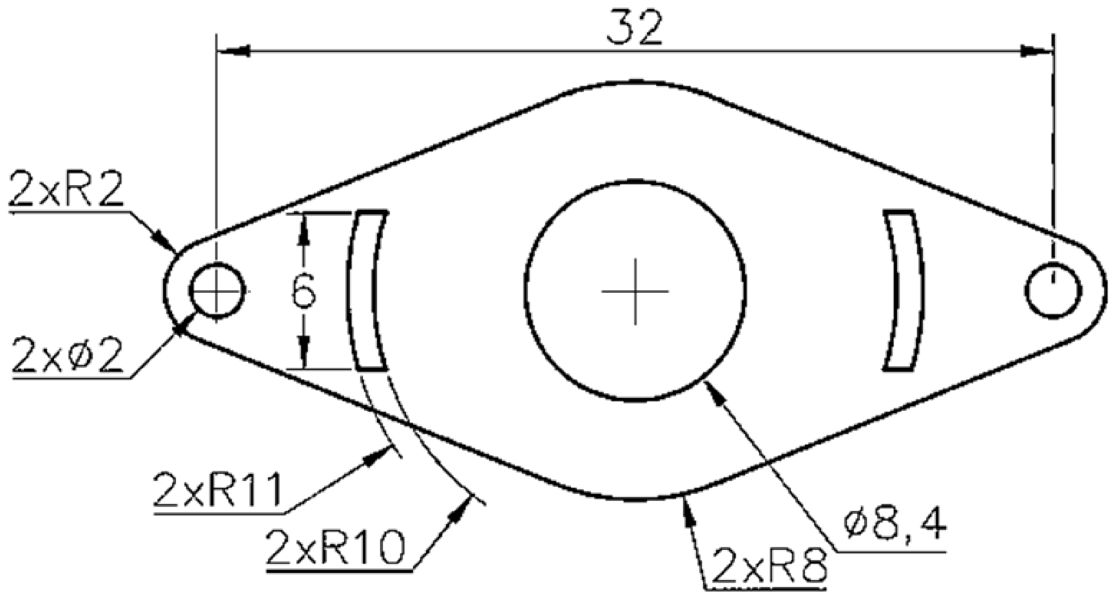

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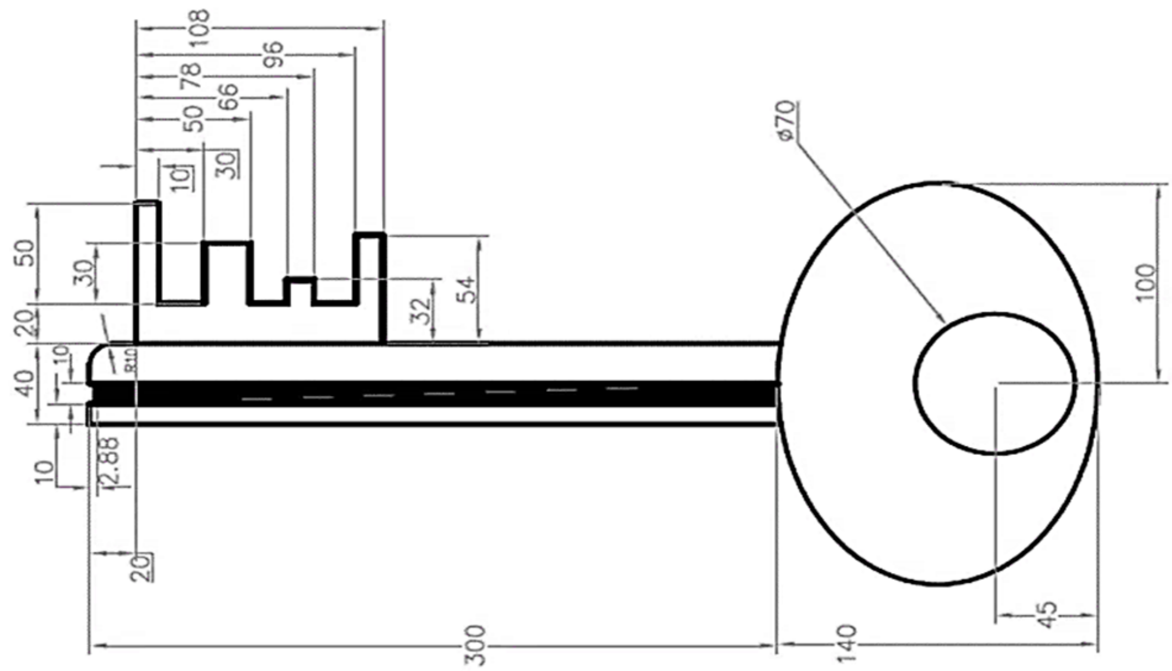


Learning Outcomes:

- Students will be able to draw 2D views of machine components.
- Students will understand dimensioning, tolerancing, and use of standard symbols.
- Students will gain hands-on software skills applicable in manufacturing and design industries.

Evaluation Rubric

Assessment Criteria	**NBA Attainment Criteria**	**Max Marks**	**Rubric Description**
Understanding of Component Geometry	PO1: Engineering Knowledge	4	Correct interpretation of shapes, sizes, and geometry of the component.
Correct Use of CAD Software Tools & Commands	PO5: Modern Tool Usage	4	Effective use of commands like LINE, CIRCLE, TRIM, FILLET, etc.
Dimensioning & Annotation Standards	PO2: Problem Analysis / PO10: Communication	4	Proper use of BIS/ISO dimensioning standards and annotations.
Application of Drawing Principles (Orthographic, Section, etc.)	PO3: Design/Development of Solutions	4	Correct use of orthographic projections or sectional views.
Accuracy, Neatness & Layer Management	PO9: Individual and Team Work	2	Use of layers, clean layout, correct scale.
Completion & Submission of Assigned Task	PO12: Life-long Learning	2	Drawing is complete, correct, and submitted on time.

<u>Rubric Wise Marks Obtained:</u>

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

Faculty Sign & Date

PRACTICAL NO: 04

Orthographic Drawing of Machine Components Using Software

Practical Objective:

To generate front, top, and side orthographic views of a given machine component using 2D drawing tools in modeling/drafting software like AutoCAD or FreeCAD, following BIS drawing standards.

Mapped Course Outcome (CO):

CO5: Make use of modelling/ drafting software for machine drawing and production drawing.

RBT Level: A – Application

Software Tools Suggested:

- AutoCAD
- FreeCAD
- LibreCAD
- SolidWorks (optional)
- Creo/Fusion360 (if available)

Pre-requisites:

- Knowledge of orthographic projection.
- Understanding of machine component geometry.
- Familiarity with CAD interface and basic drawing commands.

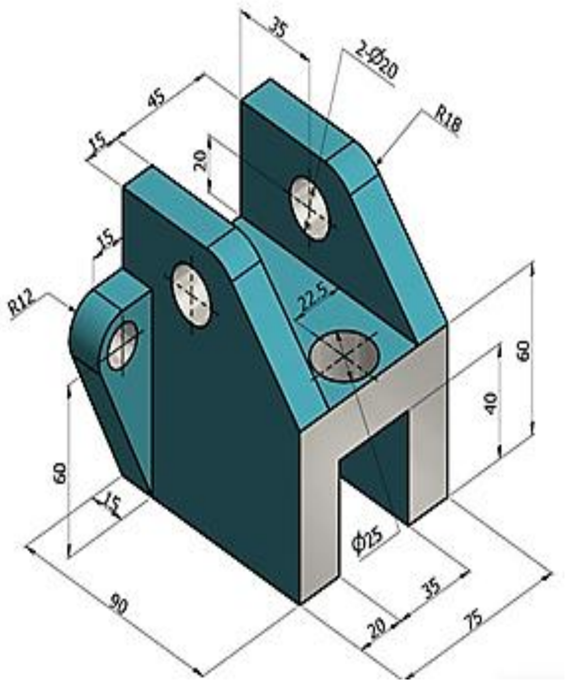
Procedure:

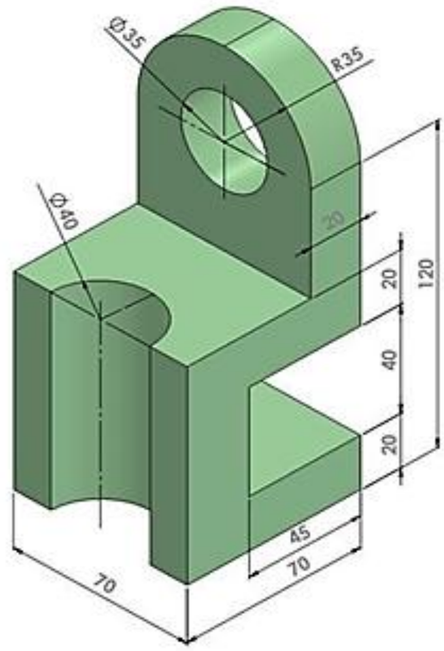
1. **Start CAD Software** and set appropriate units (mm).
2. **Create a new drawing sheet** and set up title block.
3. **Sketch or import component geometry** from given isometric view or physical part.
4. **Generate orthographic views:**
    - Front view
    - Top view
    - Side view (either left or right)
5. **Add dimensions**, annotations, and symbols (as per BIS/SP:46).

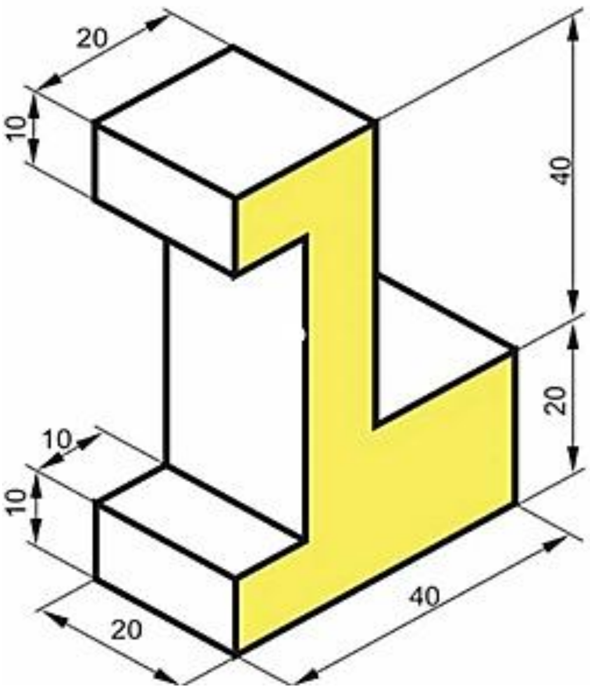
6. **Use line conventions** (object, hidden, center lines).
7. **Export final drawing** as DWG/PDF with your name and roll number.

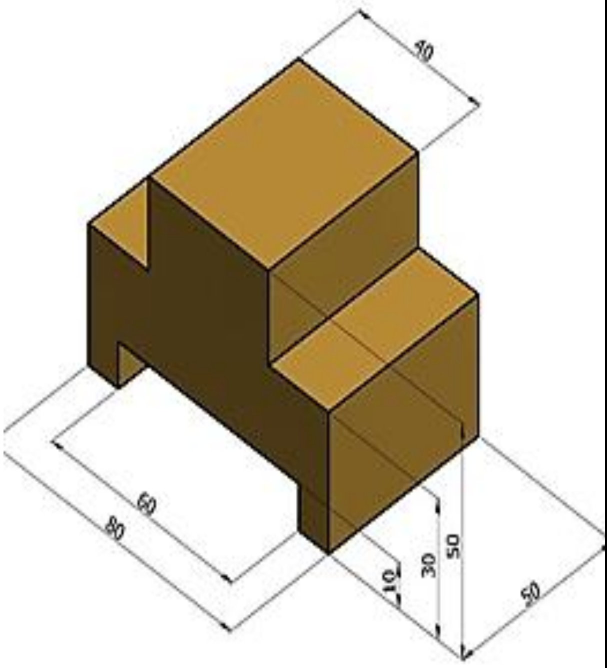
Exercise: 1

Develop the orthographic drawing of any one selected machine component in AutoCAD and take a printout/ plotting for submission.









Program Outcomes (POs) Mapped:

PO No	Description	Level
PO1	Engineering Knowledge	3
PO2	Problem Analysis	2
PO5	Modern Tool Usage	3
PO12	Lifelong Learning	2

(Level: 3 = High, 2 = Moderate, 1 = Low)

Viva Sample Questions:

1. What is the difference between first angle and third angle projection?
2. Why are center lines used in machine drawing?
3. What are hidden lines and when are they used?
4. How do you ensure drawing standards in CAD?

References:

- Machine Drawing with AutoCAD – G. Pohit & G. Ghosh
- SP:46 – Bureau of Indian Standards Manual on Engineering Drawing
- https://www.youtube.com/watch?v=3o_kKMOqMJw
- GTU Syllabus Document for BE03000231

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of** **20**

Faculty Sign & Date

PRACTICAL NO: 05

To develop the isometric projection of given 2D views using any CAD modeling software (e.g., AutoCAD, Fusion 360, SolidWorks, Free CAD, etc.).

Objective:

- To understand and apply the principles of isometric projection.
- To convert 2D orthographic views into 3D isometric drawings using CAD software.
- To develop skills in visualization and 3D modeling of machine components

Practical Outcome:

- Upon successful completion of this practical, the student will be able to:
- Accurately interpret 2D views and visualize them in 3D space.
- Construct isometric views of machine components using CAD tools.
- Enhance skills in technical drawing, spatial understanding, and use of modeling software.

Mapped Course Outcome (CO) and RBT Level:

CO5: Make use of modeling/ drafting software for machine drawing and production drawing. Apply (A)

Theory:

Isometric Projection is a type of axonometric projection where all three axes are inclined at 120° to each other. Unlike perspective projection, it maintains scale and proportion, making it ideal for technical illustrations.

Key points:

- Axes are spaced 120° apart.
- Angles are distorted, but dimensions are to scale.
- Circles appear as ellipses in isometric view.

Software Required:

- AutoCAD / SolidWorks / Fusion 360 / FreeCAD (choose based on availability)
- Windows or macOS system

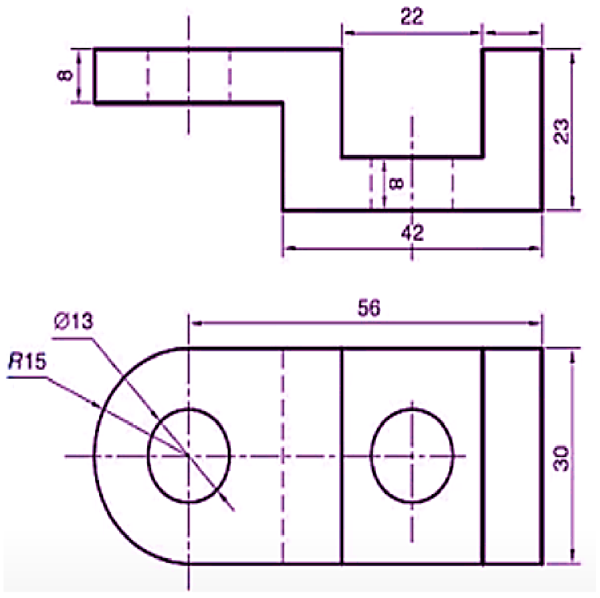
Tools & Commands Used (AutoCAD Example):

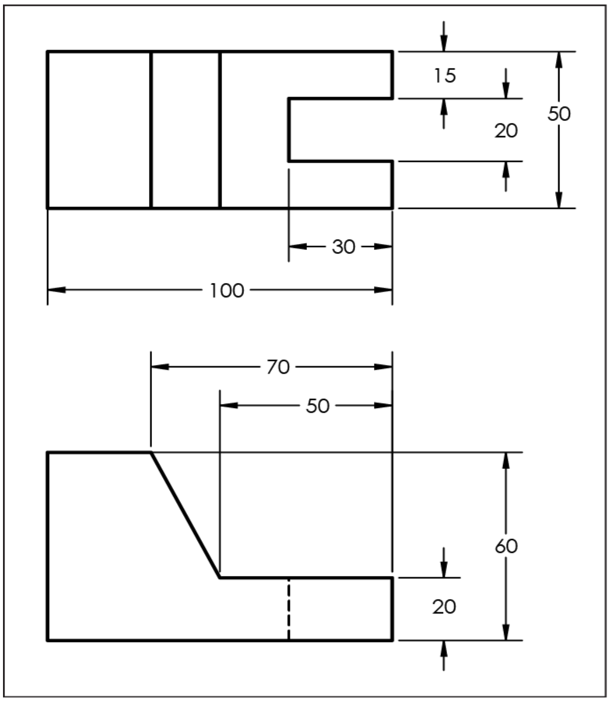
- ISODRAFT
- ELLIPSE → Isocircle
- LINE, COPY, OFFSET
- SNAP, GRID, ORTHO

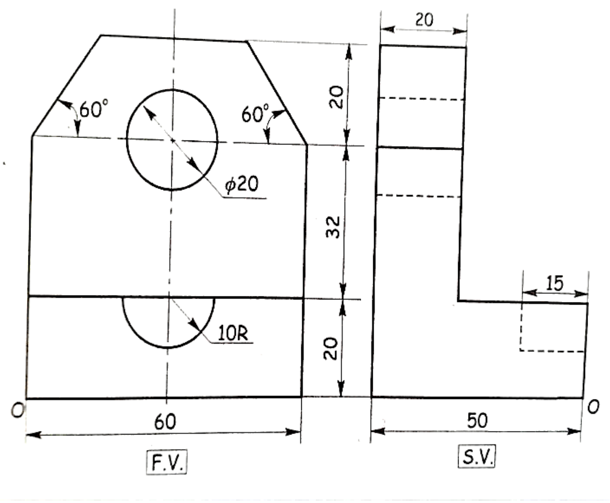
Procedure (Using AutoCAD):

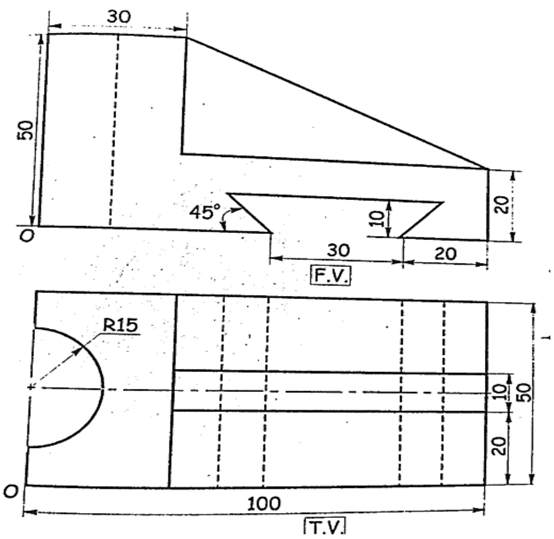
- Start AutoCAD and Create New Drawing
    - Open AutoCAD and start a new drawing.
    - Set units (e.g., millimeters).
- Enable Isometric Drafting
    - Type ISODRAFT and choose Isoplane Top.
    - Use F5 or Ctrl + E to toggle between Top, Left, and Right isoplanes.
- Draw Isometric Axes
    - Use LINE command to draw base axes at 30°, 150°, and vertical (90°).
- Construct Isometric Box
    - Based on given dimensions, draw a bounding box using LINE, COPY, and OFFSET.
- Draw Isometric Circles
    - Use ELLIPSE command → Choose Isocircle.
    - Set correct isoplane and then input center and radius.
- Final Touch
    - Add hidden lines if necessary using dashed line types.
    - Apply dimensions (optional).
    - Save your drawing file.

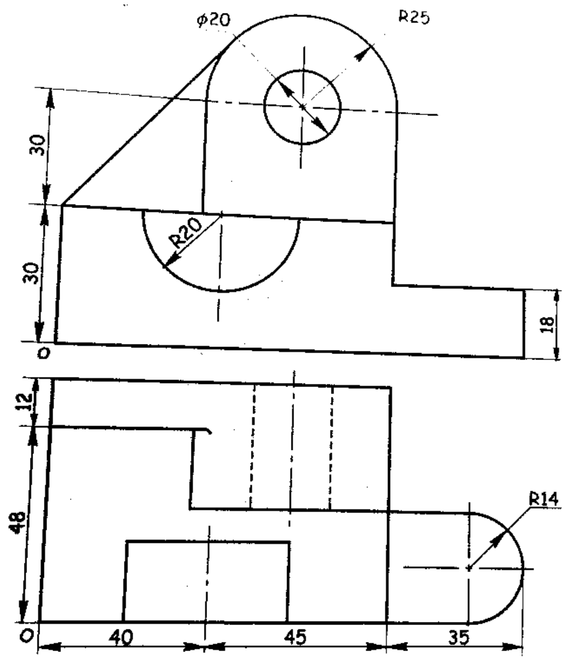
Example : (Draw any Two)

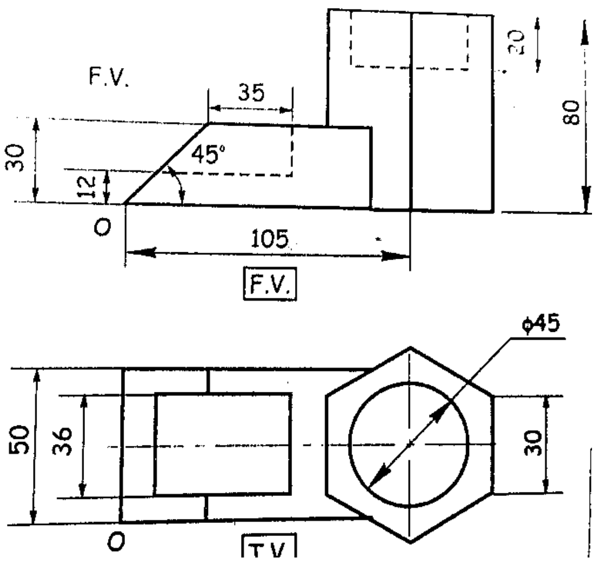












Viva Questions:

1. What is the difference between isometric and orthographic projection?
2. Why are circles drawn as ellipses in isometric view?
3. What command is used to draw an isocircle in AutoCAD?
4. How do you change isoplane in AutoCAD?

Submission:

- Submit the .dwg / .f3d / .sldprt / .step file (as applicable).
- Also submit/export final isometric projection view in PDF or JPG format.

Reference

https://www.youtube.com/watch?v=Cb1eYSxBJwI

http://engineeringessentials.com/ege5/files/ege/pic/pic_page8_ex1.htm

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

Faculty Sign & Date

PRACTICAL NO: 06

Assembly Drawing Using Software

Assembly Drawing of Connecting Rod of IC Engine

Overview of a Connecting Rod Assembly

A connecting rod in an IC engine connects the piston to the crankshaft, converting reciprocating motion into rotational motion. The assembly typically includes:

- Connecting Rod Body: The main structural component.
- Piston Pin (Gudgeon Pin): Connects the rod to the piston.
- Crank Pin: Connects the rod to the crankshaft.
- Bearings/Bushings: Reduce friction at the piston pin and crank pin ends.
- Bolts and Nuts: Secure the cap to the rod body at the big end.
- Cap: The detachable part at the big end, allowing assembly around the crankshaft.

Steps to Create an Assembly Drawing in CAD Software

1. Part Modeling

- Connecting Rod Body:
  - Sketch the side profile (typically an I-shaped cross-section) on a 2D plane.
  - Extrude to create the 3D body, ensuring proper thickness (e.g., 10–20 mm depending on engine size).
  - Add a cylindrical bore at the small end for the piston pin (e.g., Ø20 mm) and a larger bore at the big end for the crank pin (e.g., Ø40 mm).
  - Include features like oil passages or chamfers for realistic design.
- Cap:
  - Model the cap as a separate part, matching the big end’s geometry.
  - Include bolt holes (e.g., two Ø8 mm holes) for securing the cap.
- Piston Pin and Crank Pin:
  - Model as cylindrical components with appropriate diameters and lengths (e.g., piston pin: Ø20 mm × 60 mm; crank pin: Ø40 mm × 50 mm).
- Bearings/Bushings:
  - Create thin cylindrical shells (e.g., 1–2 mm thick) to fit inside the small and big end bores.

- Bolts and Nuts:
  - Model bolts (e.g., M8 × 30 mm) and matching nuts, or use standard parts from the CAD software's library.

Tip: Use realistic dimensions based on a reference engine (e.g., a small gasoline engine). If no specific dimensions are provided, standard ratios can be assumed (e.g., big end diameter ≈ 2 × small end diameter).

2. Assembly Creation

- Open the assembly environment in your CAD software.
- Import all modeled parts (connecting rod body, cap, piston pin, crank pin, bearings, bolts, nuts).
- Apply constraints/mates:
  - Concentric Mate: Align the piston pin with the small end bore and the crank pin with the big end bore.
  - Coincident Mate: Ensure the cap aligns with the rod's big end, with bolt holes matching.
  - Fastener Constraints: Secure bolts through the cap and rod, with nuts on the opposite side.
  - Bearing Fit: Place bearings inside the bores, ensuring a slight clearance (e.g., 0.01–0.05 mm) for fit.
- Verify that the assembly allows rotational movement at the piston and crank pin joints, mimicking real-world function.

3. Creating the Assembly Drawing

- Open the drawing module in your CAD software.
- Select a standard sheet size (e.g., A3 or ANSI B) and set the scale (e.g., 1:1 or 1:2).
- Insert views:
  - Orthographic Views: Front, side, and top views of the assembled connecting rod.
  - Section View: Create a cross-sectional view through the rod's centerline to show internal features like bearings and pins.
  - Exploded View: Generate an exploded view to illustrate how parts fit together (e.g., show the cap detached and bolts aligned).
  - Isometric View: Add a 3D isometric view for clarity.
- Add annotations:

    - Dimensions: Include critical dimensions (e.g., length of rod ≈ 100–150 mm, bore diameters, bolt sizes).
    - Bill of Materials (BOM): List all components (e.g., connecting rod, cap, bolts) with quantities and material specifications (e.g., steel for the rod, bronze for bushings).
    - Title Block: Include project details (e.g., "Connecting Rod Assembly for IC Engine"), date (June 19, 2025), scale, and your name or organization.
    - Notes: Specify tolerances (e.g., ±0.01 mm for bearing fits), surface finish, and assembly instructions (e.g., "Torque bolts to 20 Nm").
- Use standard drafting symbols and conventions (e.g., ASME Y14.5 or ISO standards).

4. Validation and Simulation (Optional)

- Perform an interference check to ensure no parts clash.
- Run a motion study to confirm the rod's rotation around the crank pin and piston pin.
- If the software supports it, conduct a finite element analysis (FEA) to verify the rod's strength under typical engine loads (e.g., 10–50 kN compressive force).

5. Export and Review

- Save the drawing as a PDF or DWG file for sharing.
- Export the 3D assembly as an STEP or IGES file for compatibility with other CAD systems.
- Review the drawing for completeness, ensuring all views, dimensions, and annotations are clear and accurate.

Example Dimensions (for a Small IC Engine)

- Connecting Rod Length: 120 mm (center-to-center).
- Small End Bore: Ø20 mm.
- Big End Bore: Ø40 mm.
- Rod Thickness: 15 mm.
- Bolt Size: M8 × 1.25, 30 mm long.
- Bearing Thickness: 1.5 mm.

Software-Specific Notes

- SolidWorks: Use the "Assembly" and "Drawing" environments. Leverage the Toolbox for standard fasteners.
- AutoCAD: Model parts in 3D, then use the "Layout" tab for 2D drawing views.

- Fusion 360: Utilize the "Design" workspace for modeling and "Drawing" workspace for assembly drawings.
- FreeCAD: Suitable for open-source users; follow similar steps but expect simpler tools.

Additional Considerations

- Materials: Specify materials in the BOM (e.g., forged steel for the rod, aluminum for the piston pin).
- Tolerances: Use tight tolerances for bearing fits (e.g., H7/g6) and looser ones for non-critical features.
- Standards: Adhere to ASME or ISO drafting standards for professional output.

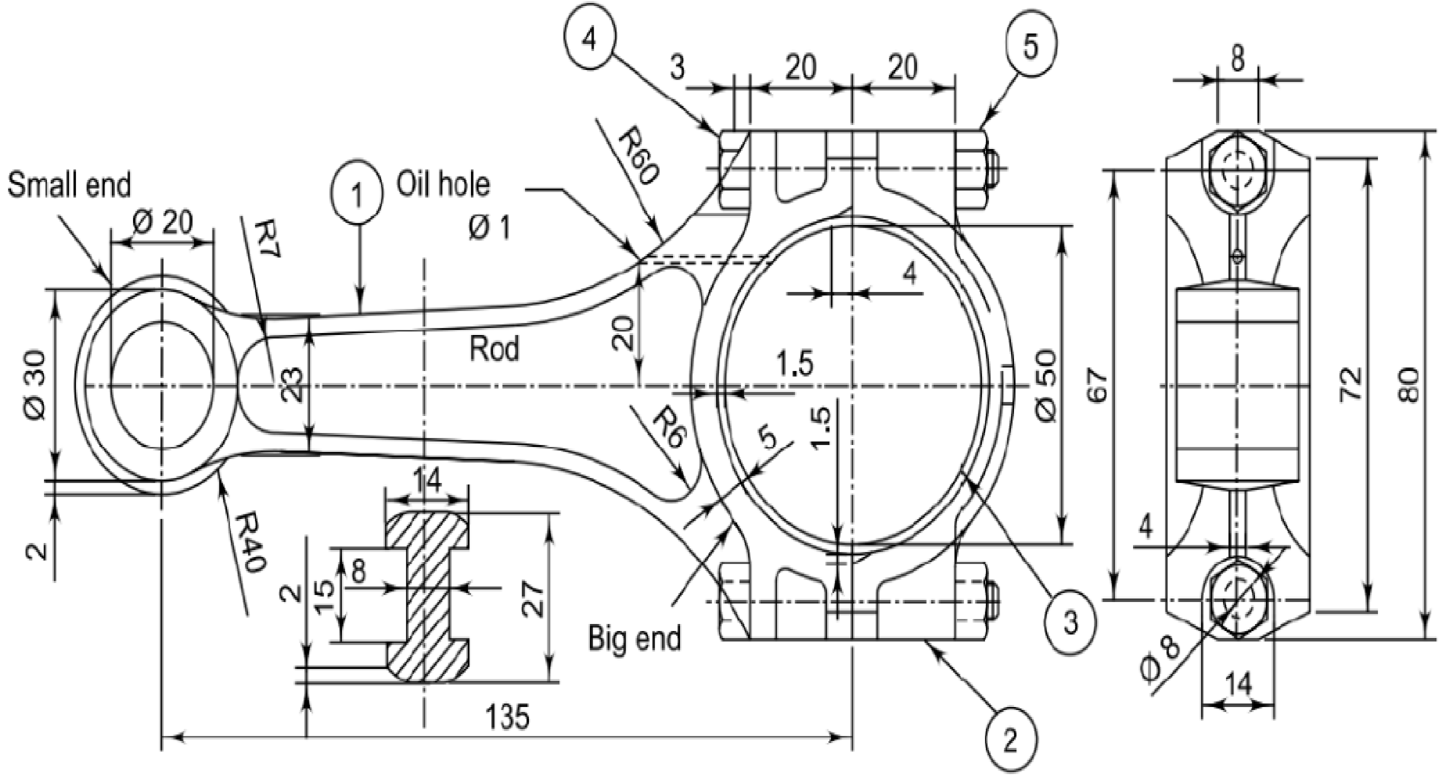
Sample Drawing : (Show in figure)

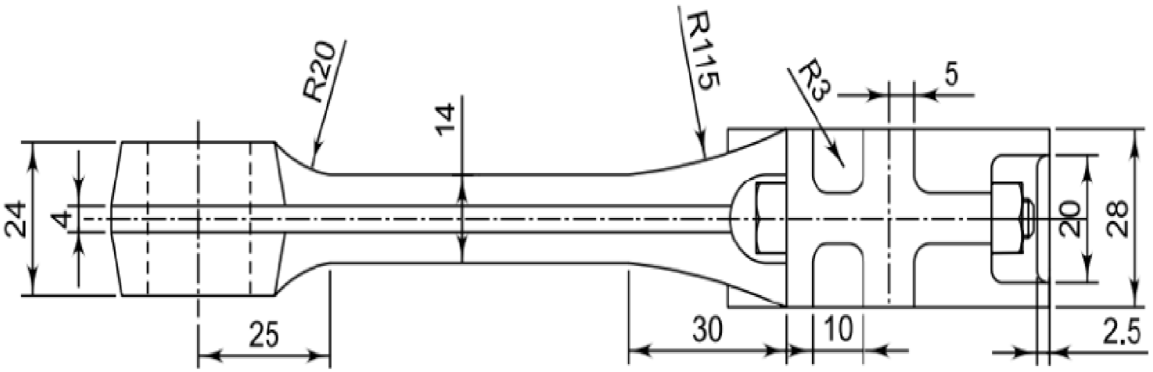
- Student can select any assembly drawing form Annexure -1 (From Assignment) or from other resources

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

Faculty Sign & Date





Part list

S.N.	Part name	Material	Qty
1	Connecting rod	Forge steel	1
2	Cover	Forge steel	1
3	Bearing	Babbit	2
4	Bolt	C.S.	2
5	Nut	C.S.	2

Assembly Drawing of a Connecting Rod

PRACTICAL NO: 07

To develop the Production drawing of given 2D/3D views using any CAD modeling software (e.g., AutoCAD, Fusion 360, SolidWorks, Free CAD, etc.). (Any one)

Objective:

- to develop production-ready machine drawings using modeling software.
- to understand and apply limits, fits, tolerances, surface finish, and standard drawing conventions.
- to generate component detail drawings and assembly drawings with proper sectioning, bom, and annotation.

Practical Outcome:

- After completing this practical, students will be able to:
- Prepare accurate production drawings of machine components.
- Apply dimensioning rules, tolerance indication, and geometric controls in drawings.
- Generate part and assembly drawings with appropriate technical standards using CAD software.

Mapped Course Outcome (CO) and RBT Level:

- CO5: Make use of modeling/ drafting software for machine drawing and production drawing. Apply (A)

Software to be Used:

- AutoCAD / SolidWorks / Fusion 360 / FreeCAD / Creo (as per lab availability)

Reference from Syllabus:

- Covered from **Unit 9 (Elements of Production Drawing)**:
- Sectioning and dimensioning
- Notes and version control
- Limits, fits, tolerances, surface finish
- Standard representation of threads, fasteners, bearings, springs, gears
- Detail and assembly drawing
- BOM generation and animation of assembly

Minimum Requirements in Drawing Sheet:

- Proper title block with name, scale, revision.
- Use of standard representation: threads, fasteners, welds, etc.
- Section views, detail views, and notes.
- Limit dimensions, tolerances, fit indications.

- BOM with part names, materials, quantities.
- Surface finish and GD&T symbols (where applicable).

Other Machine Components Suggested:

- Hexagonal Nut and Bolt
- Flanged Coupling
- Lathe Tailstock
- Cotter Joint
- Knuckle Joint
- Shaft with Pulley

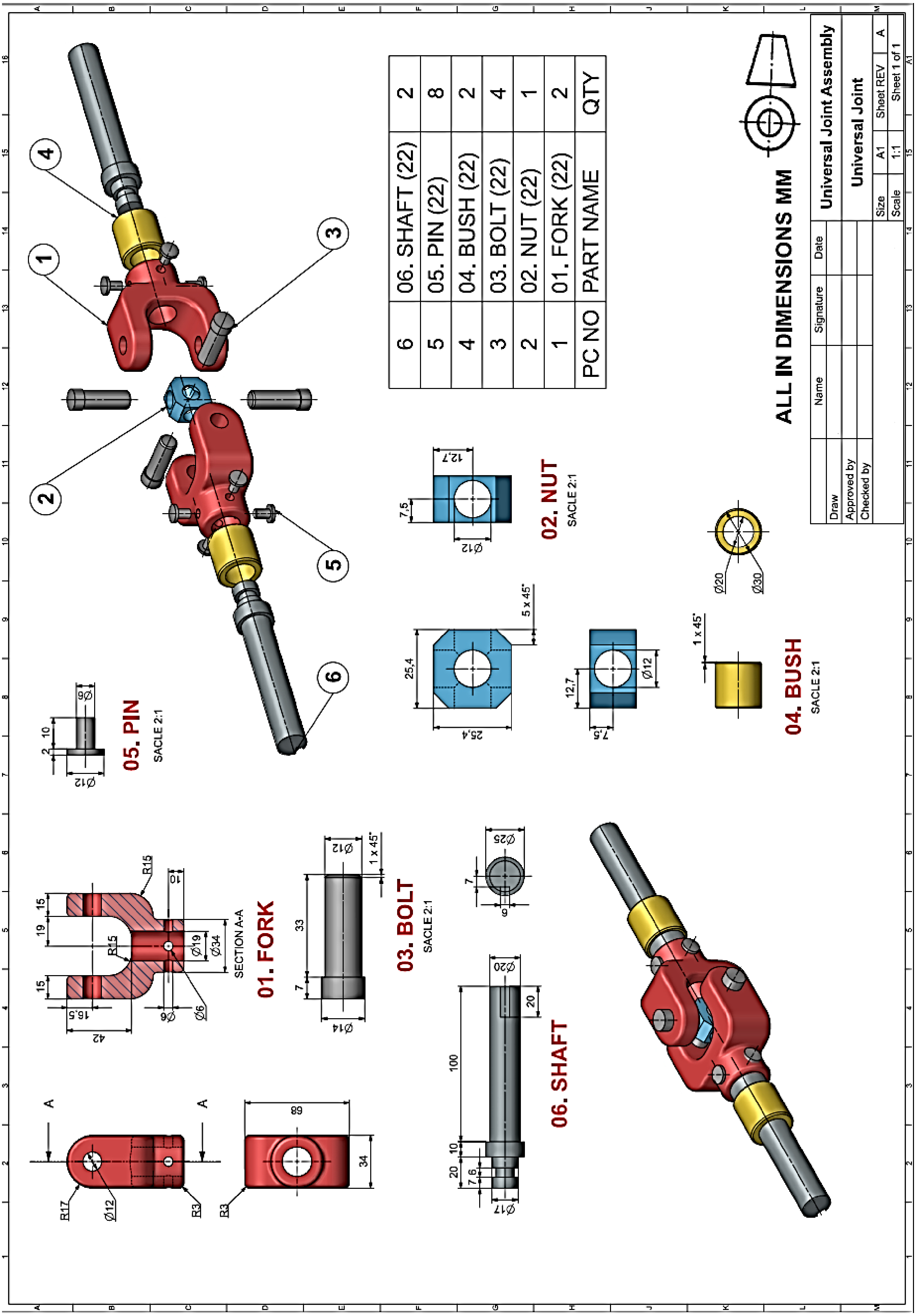
Submission:

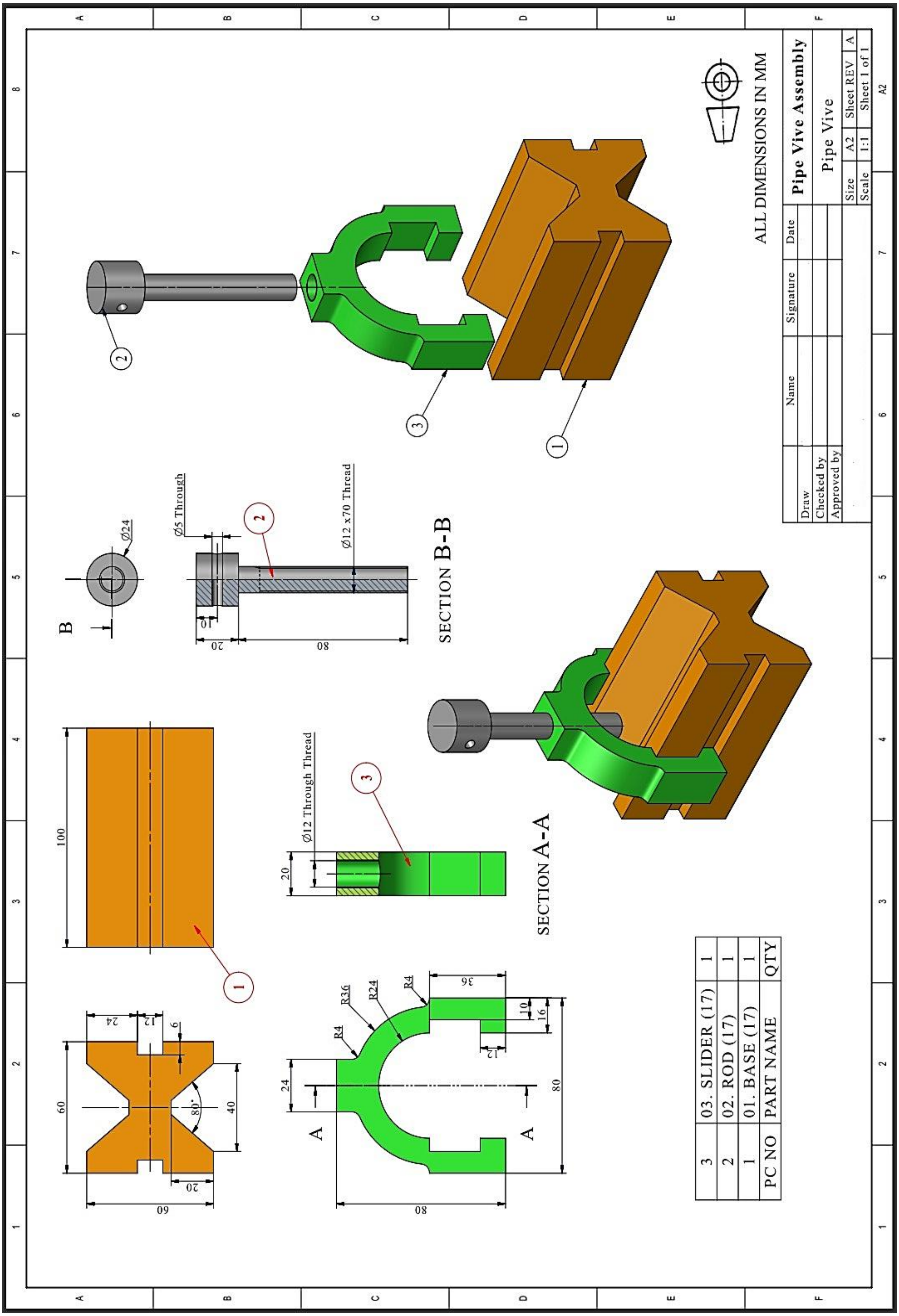
- 3D part files (.dwg / .f3d / .sldprt / .step)
- 2D drawing files (.dwg / .pdf)
- Final assembly drawing (PDF/JPG) with **BOM and sectional views**

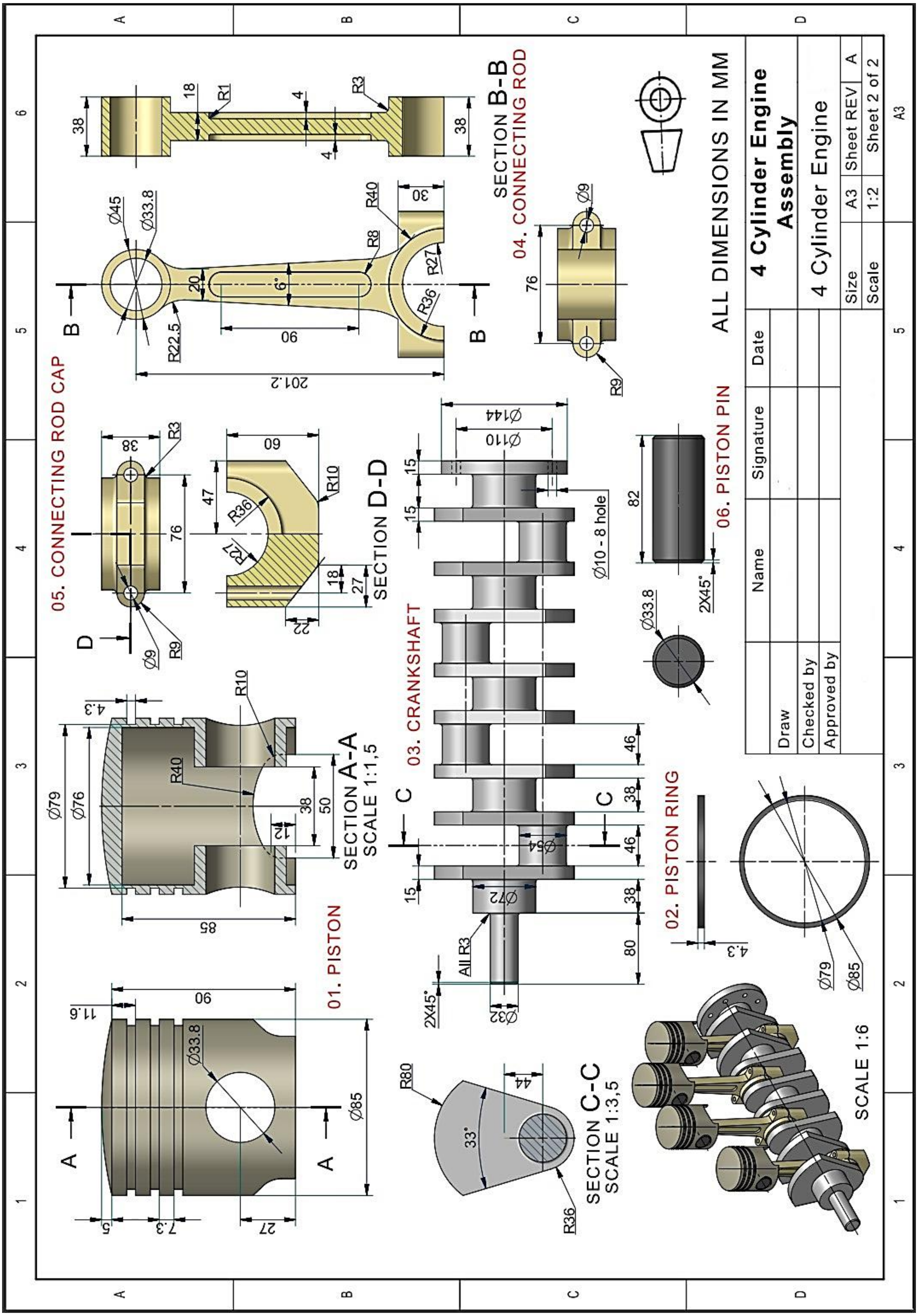
Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of 20**

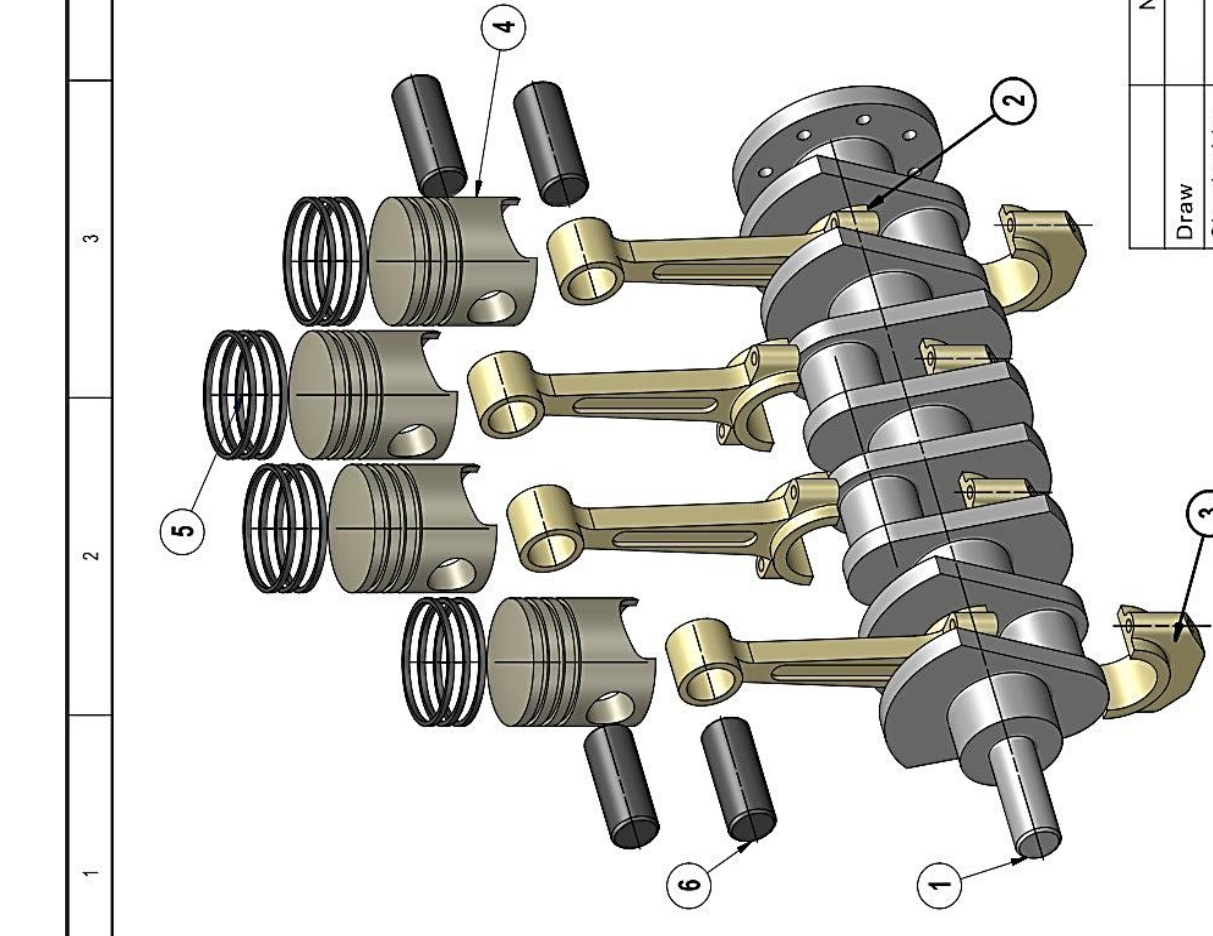
Faculty Sign & Date


ALL IN DIMENSIONS MM
Universal Joint Assembly
Universal Joint
PC NO | PART NAME | QTY
1 | 01. FORK (22) | 2
2 | 02. NUT (22) | 1
3 | 03. BOLT (22) | 4
4 | 04. BUSH (22) | 2
5 | 05. PIN (22) | 8
6 | 06. SHAFT (22) | 2
01. FORK
SECTION A-A
02. NUT
SACLE 2:1
03. BOLT
SACLE 2:1
04. BUSH
SACLE 2:1
05. PIN
SACLE 2:1
06. SHAFT
Draw
Approved by
Checked by
Name
Signature
Date
Size
A1
Scale
1:1
Sheet REV
A
Sheet 1 of 1


ALL DIMENSIONS IN MM
Pipe Vive Assembly
Pipe Vive
Draw
Checked by
Approved by
Name
Signature
Date
Size A2
Sheet REV A
Scale 1:1
Sheet 1 of 1
SECTION B-B
SECTION A-A
Ø5 Through
Ø12 x70 Thread
Ø12 Through Thread
Ø24
3 | 03. SLIDER (17) | 1
2 | 02. ROD (17) | 1
1 | 01. BASE (17) | 1
PC NO | PART NAME | QTY


01. PISTON
SECTION A-A
SCALE 1:1,5
02. PISTON RING
03. CRANKSHAFT
SECTION C-C
SCALE 1:3,5
04. CONNECTING ROD
SECTION B-B
05. CONNECTING ROD CAP
SECTION D-D
06. PISTON PIN
SCALE 1:6
ALL DIMENSIONS IN MM
4 Cylinder Engine Assembly
4 Cylinder Engine
Draw
Checked by
Approved by
Name
Signature
Date
Size
A3
Scale
1:2
Sheet REV
A
Sheet 2 of 2

PC NO	PART NAME	QTY
6	06. PISTON PIN (18)	4
5	02. PISTON RING (18)	12
4	01. PISTON (18)	4
3	05. CONNECTING ROD CAP (18)	4
2	04. CONNECTING ROD (18)	4
1	03. CRANKSHAFT (18)	1



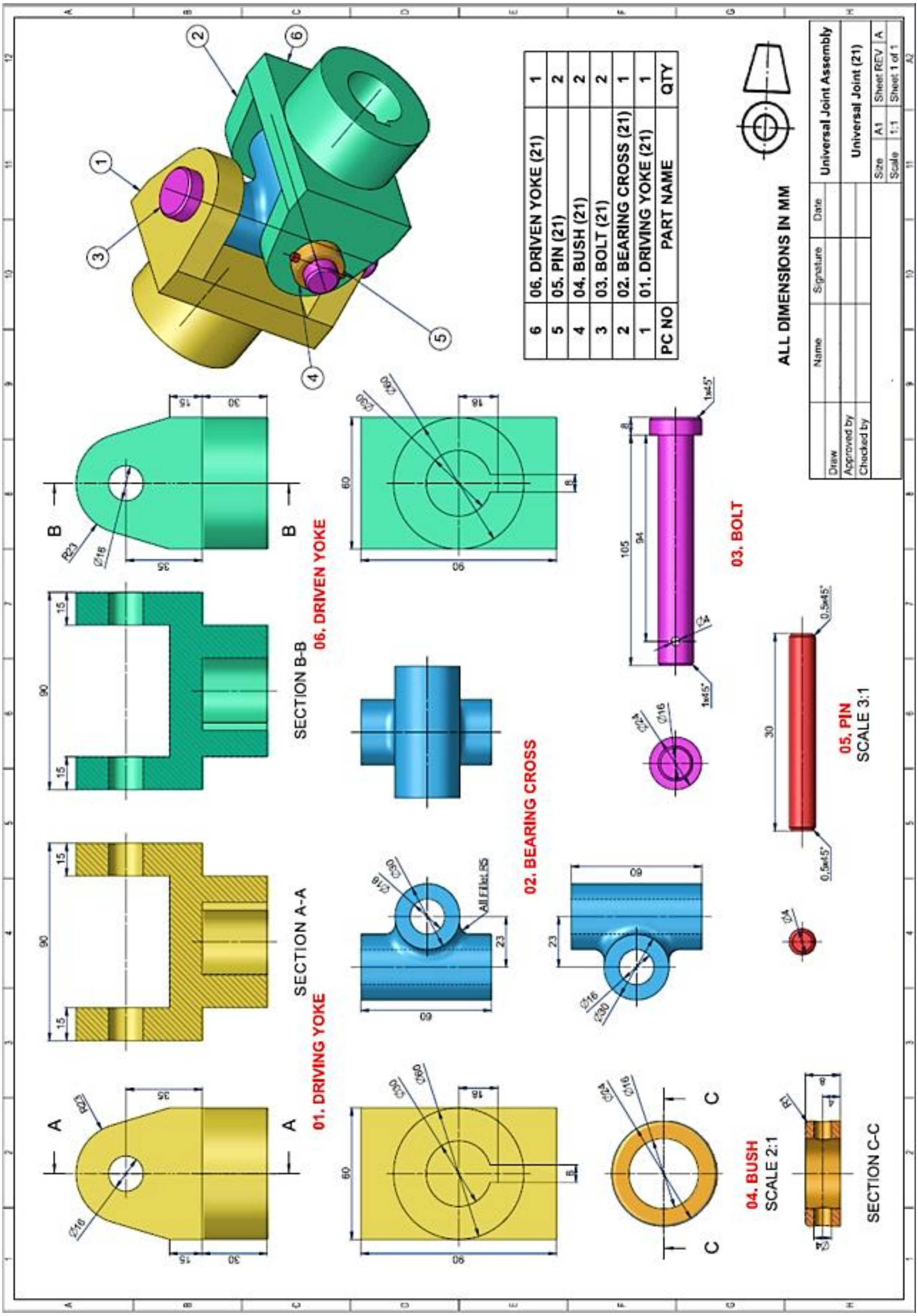
	Name	Signature	Date
Draw			
Checked by			
Approved by			

4 Cylinder Engine Explosion

4 Cylinder Engine

Size	A3	Sheet REV	A
Scale	1:3	Sheet 1 of 2	

A3


06. DRIVEN YOKE (21)
05. PIN (21)
04. BUSH (21)
03. BOLT (21)
02. BEARING CROSS (21)
01. DRIVING YOKE (21)
PC NO
PART NAME
QTY
ALL DIMENSIONS IN MM
Universal Joint Assembly
Universal Joint (21)
SECTION B-B
06. DRIVEN YOKE
SECTION A-A
01. DRIVING YOKE
02. BEARING CROSS
03. BOLT
05. PIN
SCALE 3:1
04. BUSH
SCALE 2:1
SECTION C-C

PRACTICAL NO: 08

Design of machine components as per content and computerized production drawings.

Objective:

- To develop skills in creating assembly drawings of machine components using 3D modeling software.
- To understand interfacing parts, proper assembly constraints, and exploded views.
- To generate clear 2D assembly drawings with sectional views, BOM, and standard annotations.

Practical Outcome:

- After completing this practical, the student will be able to:
- Assemble multiple 3D components in CAD software using mating constraints.
- Prepare assembly drawings with exploded views and BOM.
- Apply sectioning, dimensioning, and part identification in assembly views.
- Demonstrate understanding of mechanical fit, alignment, and fastener positioning.

Choose a simple mechanical assembly, such as:

- Oldham coupling (Given)
- Flange coupling
- Knuckle joint
- Cotter joint
- Screw clamp
- Plummer block

  (Based on design topics from Units 5, 7, or 8 of the syllabus)

Assembly Drawing Sheet Must Include:

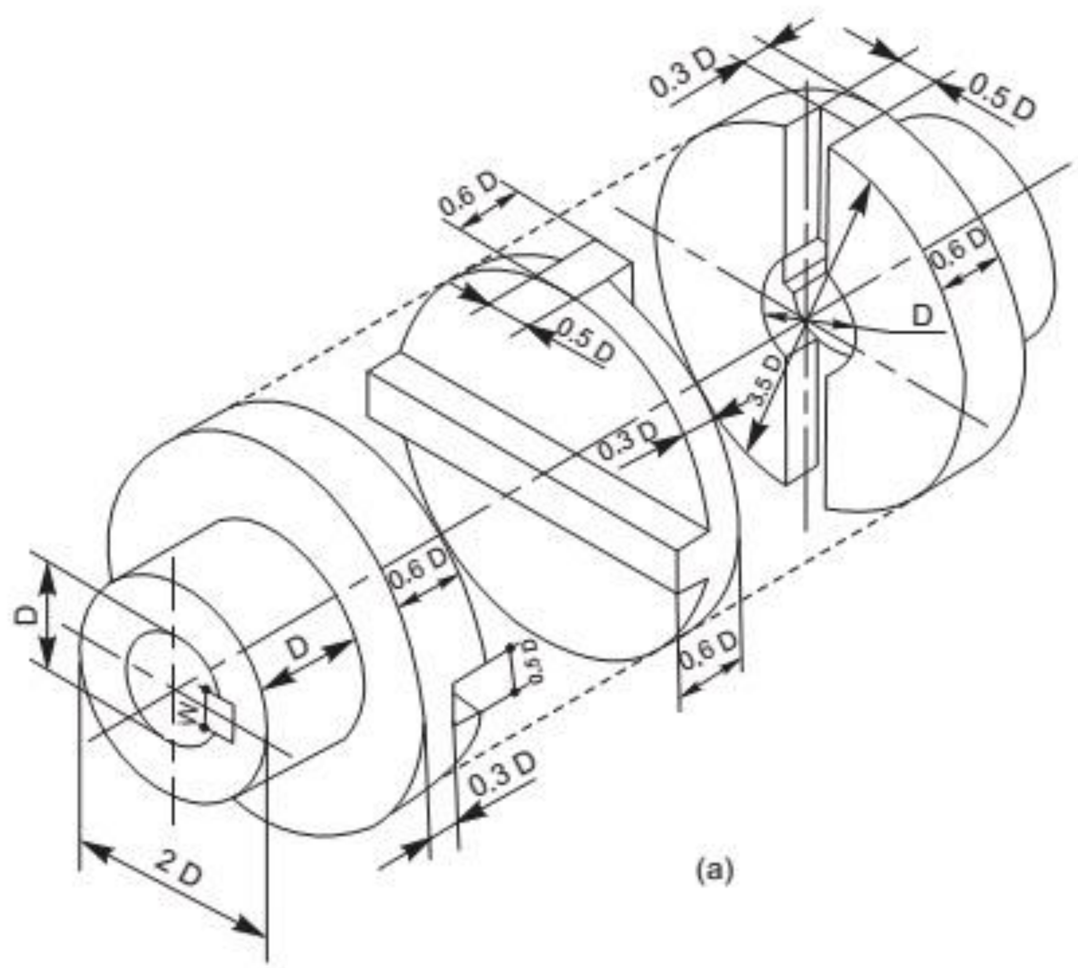
- Proper title block, scale, and version control
- Exploded view and section view
- Balloon callouts with part numbers
- BOM with part name, material, quantity
- Annotations and standard conventions
- Proper fit and alignment of parts

Submission Checklist:

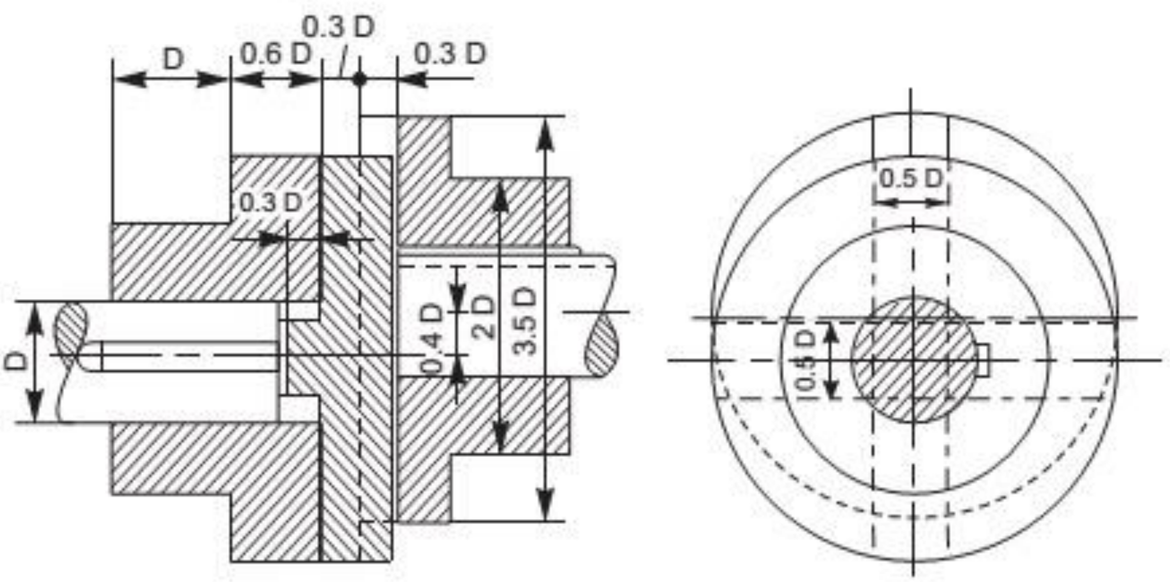
- Individual 3D part files (.sldprt, .f3d, .dwg)
- Assembly file (.sldasm, .f3d, .step)
- Final 2D assembly drawing (PDF / DWG / JPG) with all views and BOM

Examples

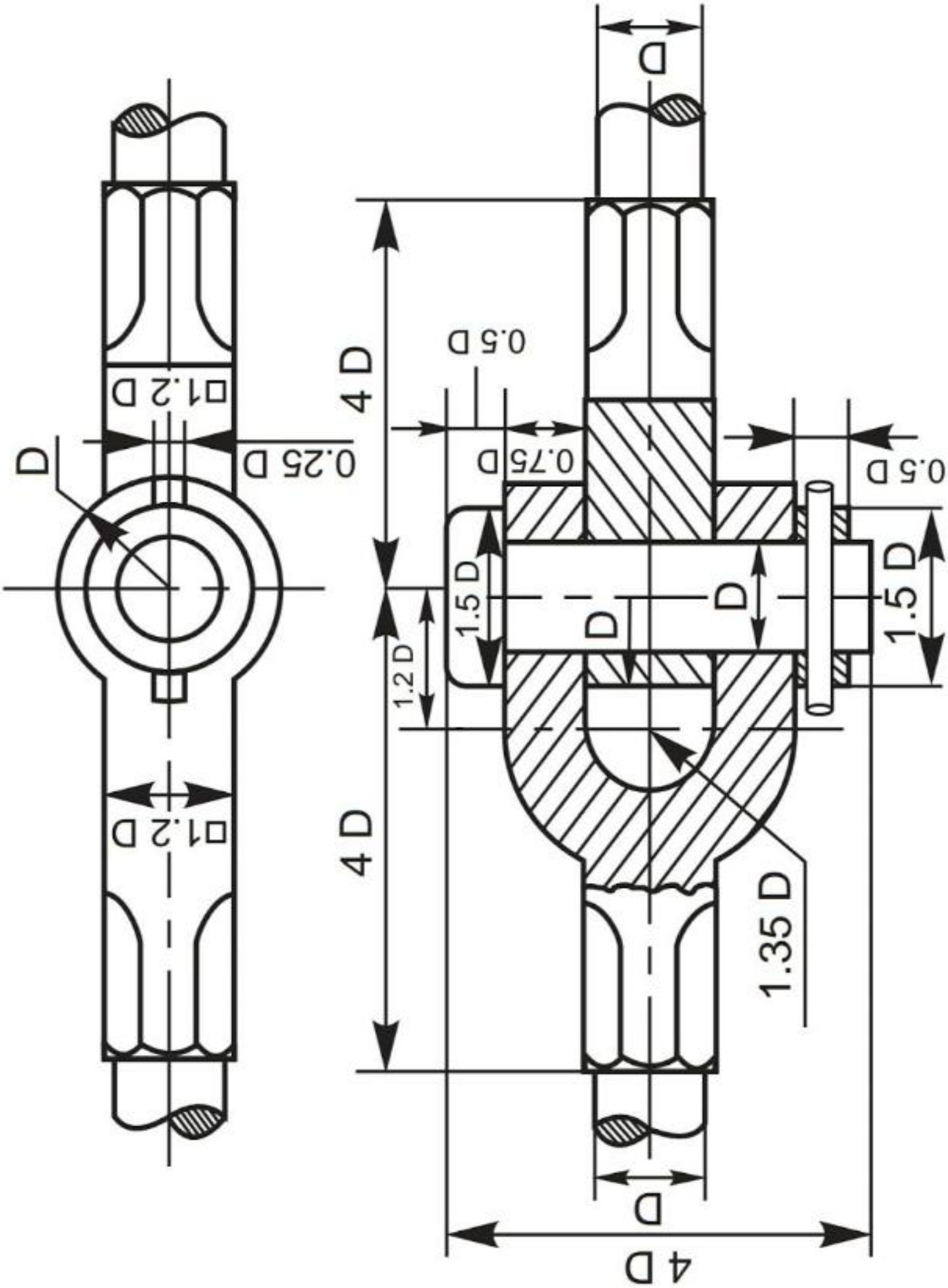
You may choose any topic from Design of Machine Components based on the syllabus covered in class lectures, or you may select any problem listed in Annexure-1 of the assignment



(a)



(b)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□1.2 D
0.25 D
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0.5 D
1.5 D
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D
1.5 D
1.2 D
□1.2 D
4 D
1.35 D
D
4 D

Rubric Wise Marks Obtained:

Understanding: 20% of 20 = 4 marks	**Sketch/Modeling** 30% of 20 = 6 marks	**File / Report** 20% of 20 = 4 marks	**Viva** 20% of 20 = 4 marks	**Attendance** 10% of 20 = 2 marks	**Total out of** **20**

Faculty Sign & Date

Reference

1. Design of Machine Elements, V B Bhandari, 3/e, McGraw Hill.
2. Shigley's Mechanical Engineering Design, R G Budnyas, J K Nisbett, McGraw Hill
3. Engineering Mechanics, Bansal R K, Laxmi Publication.
4. Strength of Materials, Bansal R K, Laxmi publication.
5. Machine Drawing with Autocad, G Pohit, G Ghosh, Pearson
6. AutoCAD 2021 Student Version | Download and installation guide https://www.youtube.com/watch?v=YOmvLLipYfo&pp=ygUQam1wYXRlbCBhdXRvY2FkIA%3D%3D
7. AutoCAD 2025 (Student Edition) Download, Installation & Activation https://www.youtube.com/watch?v=yUlCZWDyHmM&list=PLXaJMtuF51X_7wgR0_3eJBAJovz81F_WU&index=3

Laboratory Manual

Machine Drawing and Elements of Machine Design

Subject Code: BE03000231

Bachelor of Engineering:

Mechanical Engineering/ Automobile Engineering /

Mechatronics / Manufacturing Engineering & Allied Branch

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