Madhuben & Bhanubhai Patel Institute of Technology

(A Constituent College of CVM University)

New Vallabh Vidyanagar

LABORATORY MANUAL

Course Code	**102001208**
Subject	**Engineering Graphics**
Branch	**CE and IT**
Academic Year	**2020-2021**
Effective From	**April 2021**

Course Objectives: The subject is intended to make students familiar with the concepts of Engineering Drawing, widely used in the industries. To improve visualization skills of students which they can use in the industries for developing products. To facilitate the students in enhancing their technical communication skills using Engineering Graphics.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
2	0	4	4	40/14	20/7	60/21	30/10	150/25

J-Jury, V-Viva, P-Practical

Course Outcomes (CO):

Sr. No.	Course Outcome Statements	% Weightage
CO-1	Know about the basics of drawing including use of standards; dimensioning types and methods for technical drawings and Having basic insight about the use of Auto CAD for engineering drawing.	10
CO-2	To have an idea about the need for scales along with construction of various engineering curves and their applications.	20
CO-3	Understand the concept of different types of projection methods and orthographic projection in more details and Learn to find the material requirement for the manufacturing industry using the concept of development of surfaces.	20
CO-4	Learn to visualize multiple types of objects in different positions and also to draw sectional views.	40

Reference Books:

1. Elementary Engineering Drawing by N.D.Bhatt Charotar Publishing House, Anand.
2. A Text Book of Engineering Graphics by P.J.Shah S.Chand & Company Ltd., New Delhi.
3. A text book of Engineering Drawing by R.K.Dhawan, S.Chand & Company Ltd., New Delhi.
4. A text book of Engineering Drawing by P.S.Gill, S.K.Kataria & sons, Delhi.
5. Engineering Drawing by B. Agrawal and C M Agrawal, Tata McGraw Hill, New Delhi.
6. Engineering Graphics & Design by Arunoday Kumar, Tech-Max Publication, Pune.

Important Guidelines for students:

1. Before starting each sheet, signature of concerned batch teacher should be taken on the sheet without fail; else no credit would be given to that practical sheet.
2. Students should bring the drawing sheet ready for the practical i.e., the **Borderlines** and **Title block** should be drawn on the drawing sheet before coming for the practical.
3. Before starting each sheet in the college, each student will have to ensure that the work in the sketch Book pertaining to that sheet is completed and checked by the concern lab teacher in all respect; else the student will not be allowed to start his work in the sheet.
4. Batch wise problems will be drawn on the sheet in the scheduled practical turn in the drawing hall only.
5. Any data written on the sheets should be in the **Block (CAPITAL) letters** only.
6. All problems of all sheets should be drawn by **first angle projection method** if not specified.
7. **Name and Enrolment Number** Should be written on sheet in the title block with the **ball pen.**

Student must come with all **Drawing Equipment & Materials** for laboratory work without fail; otherwise, individual will not be permitted to enter in drawing hall.

Drawing Equipment & Materials (for Laboratory Work)

1. Mini Drafter
2. 0.5 mm Clutch pencil (with H & 2H lead)
3. Set squares: 45° and 30°- 60°
4. Eraser
5. Engineering compass box
6. Drawing clips / pins
7. Protractor
8. Sketch book
9. Scales
10. Drawing Sheet (A2 size)
11. Stencils & Circle master (Stencil 5,6 & 8 mm)

Conversion of Units for Reference:

1 mm	= 0.001 m (10^{-3} m)
1 cm	= 0.01 m (10^{-2} m)
1 dm (decimetre)	= 0.1 m (10^{-1} m)
1 dam (decametre)	= 10 m (10 m)
1 hm (hectometre)	= 100 m (10^{2} m)
1 km	= 1000 m (10^{3} m)
1 yard	= 3 foot
1 foot	= 12 inches

Work to be carried out by the student during Practical Hours:

A. To prepare a sketch book covering the topics of BIS - SP 46 such as Scales, Lines, Lettering & Numbering, general principles of dimensioning on technical drawings.
B. To solve the problems in the sketch book on the following topics of the syllabus and to carry out the same work on the A2 size Drawing Sheet.
    1. Practice sheet (which includes geometric constructions, dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
    2. Plain and Diagonal Scale
    3. Engineering Curves (Conics, Cycloids, Involutes & Spirals)
    4. Projection of Lines
    5. Projection of Planes
    6. Projection of Solids
    7. Section of Solids and Development of surfaces
    8. Orthographic Projection
    9. Auto CAD Drawing

How to begin your drawing?

1. Clean the drawing board and all the drawing instruments using handkerchief/napkin
2. Fix the drawing sheet on the drawing board (table).
3. Fix the mini-drafter in convenient position
4. Draw borderlines on sheet
5. Spacing of drawing between two problems/views is to be planned before the commencement of the drawing.
6. Print the problem number on the left top and then commence the drawing work.
7. Always keep duster/handkerchief at hand to clean any dirt on the drawing sheet.

LIST OF LABORATORY EXERCISES

SR.NO.	TITLE
	DRAWING SHEET & SKETCH-BOOK WORK
1.	Practice Sheet
2.	Plain Scale, Diagonal Scale and Conic Sections
3.	Engineering Curves (Cycloids, Involutes & Spirals)
4.	Orthographic Projections
5.	Projections of Line
6.	Projections of Plane
7.	Projections of Solids
8.	Sections of Solids and Development of Surfaces
9.	Auto CAD Drawing

EXERCISE 1
PRACTICE SHEET

Objective:

To do practice of geometrical constructions useful in engineering drawings.

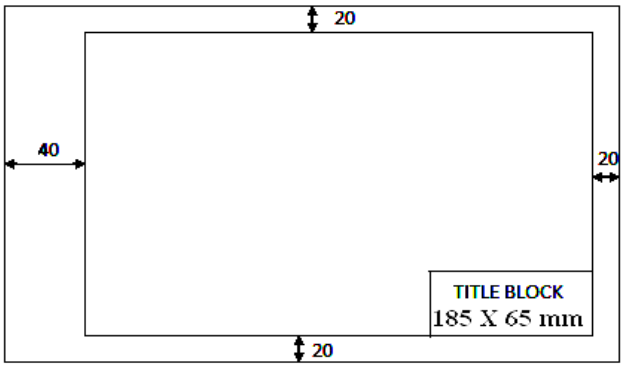
Relevance:

While drawing this sheet the students will learn uses of different drawing instruments, types of lines, dimensioning and practicing of the geometrical constructions useful in engineering drawings.

Sheet Layout and Title Block

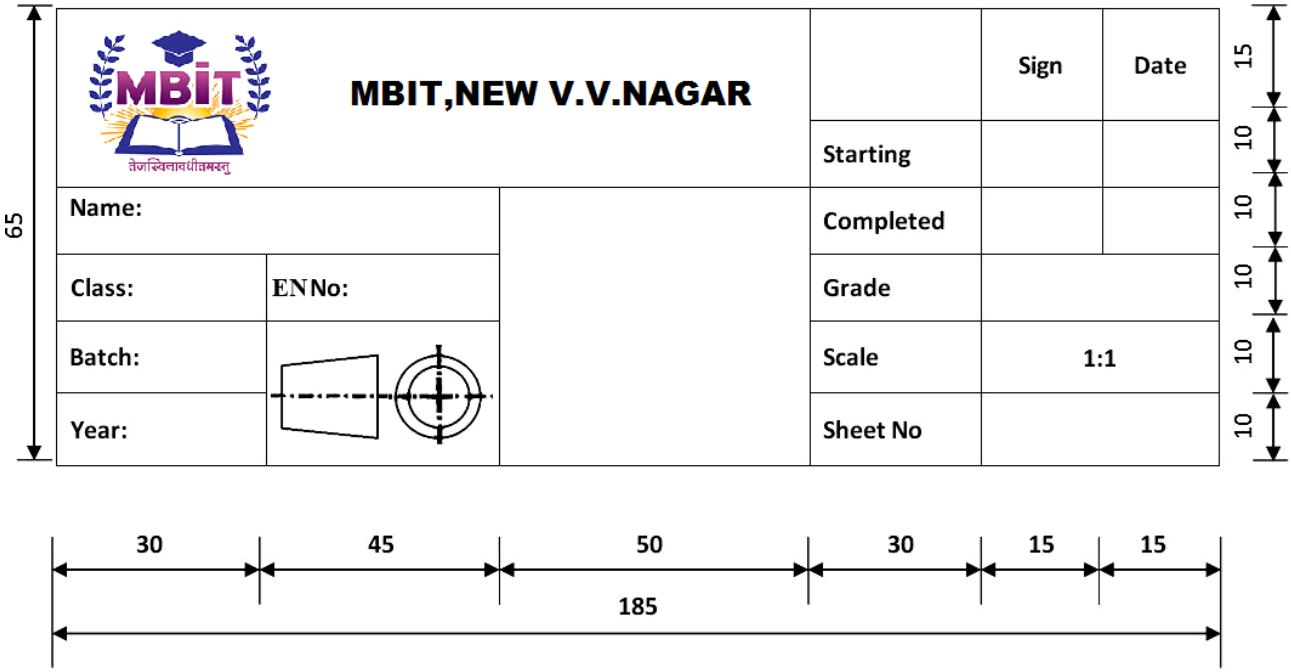
Designation	Dimensions(mm)
A0	841 X 1189
A1	594 X 841
A2	420 X 594
A3	297 X 420
A4	210 X 297

(Preferred drawing sheet sizes, First choice) ISO-A Series**)**



Drawing Sheet Layout

Title Block

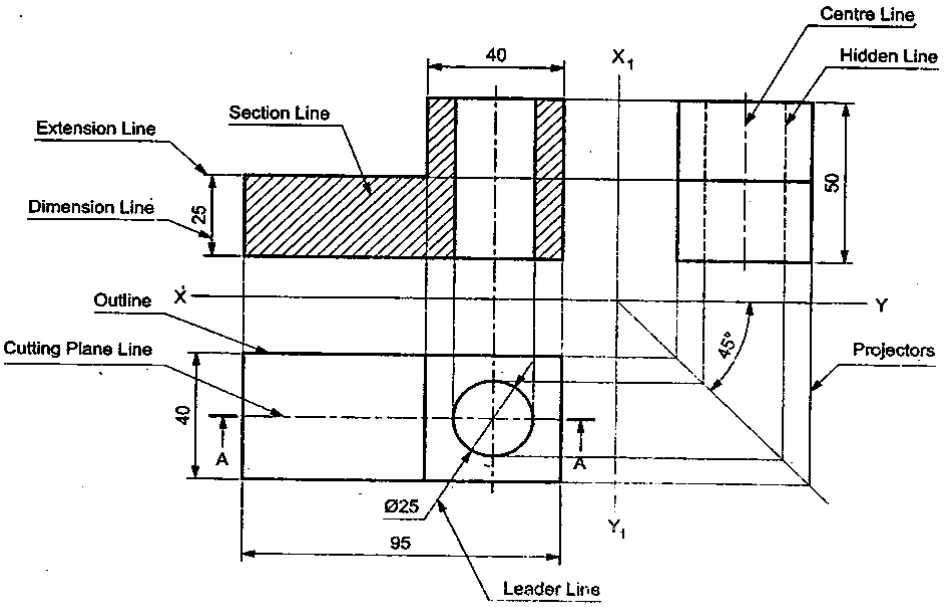


Types of Lines

SR. NO.	LINE TYPE	THICKNESS (mm)	ILLUSTRATION	APPLICATION
1	Continuous thick	0.5		Visible outlines
2	Continuous thin	0.2		Dimension, leader, extension, construction lines, outlines of adjacent parts, hatching, revolved sections
3	Dashed thin	0.2		Hidden lines
4	Chain thin	0.2		Centre lines, lines of symmetry, locus lines, pitch circles
5	Chain thin with thick ends	0.2 Thin and 0.5 for Thick ends		Cutting planes
6	Chain thick	0.2		Indication of surface to which a special requirement applies
7	Continuous thin – free hand	0.2		Irregular boundary lines, short break line
8	Continuous thin with zigzags	0.2		Long break lines

FIG 1 Types of Lines

Application of different types of lines



Dimensioning System

General Rules for dimensioning:

1. As far as possible, dimensions should be placed outside the view.
2. Dimensions should be taken from visible outlines rather than from hidden lines.
3. Dimensioning to a centre line should be avoided except when the centre line passes through the centre of a hole.
4. Each feature should be dimensioned once only on a drawing.
5. Dimensions should be placed on the view or section that relates most clearly to the corresponding features.
6. Each drawing should use the same unit for all dimensions, but without showing the unit symbol.
7. No more dimensions than are necessary to define a part should be shown on a drawing.
8. No features of a part should be defined by more than one dimension in any one direction.
9. Projection and dimension lines should be drawn as thin continuous lines.
10. Projection lines should extend slightly beyond the respective dimension lines.
11. Projection lines should be drawn perpendicular to the feature being dimensioned.
12. Where necessary, they may be drawn obliquely, but parallel to each other. However, they must be in contact with the feature.
13. Projection lines and dimension lines should not cross each other, unless it is unavoidable.
14. A dimension line should be shown unbroken, even where the feature to which it refers, is shown broken.
15. A centre line or the outline of a part should not be used as a dimension line, but may be used in place of projection line.

Elements of dimensioning

Students should identify and know the correct drawing of the following dimensioning elements: Dimension lines, Extension lines, Leader lines and Arrowheads.

Dimensions in a series may be placed in two ways: (i) Continuous or chain dimensioning (ii) Progressive or parallel dimensioning.

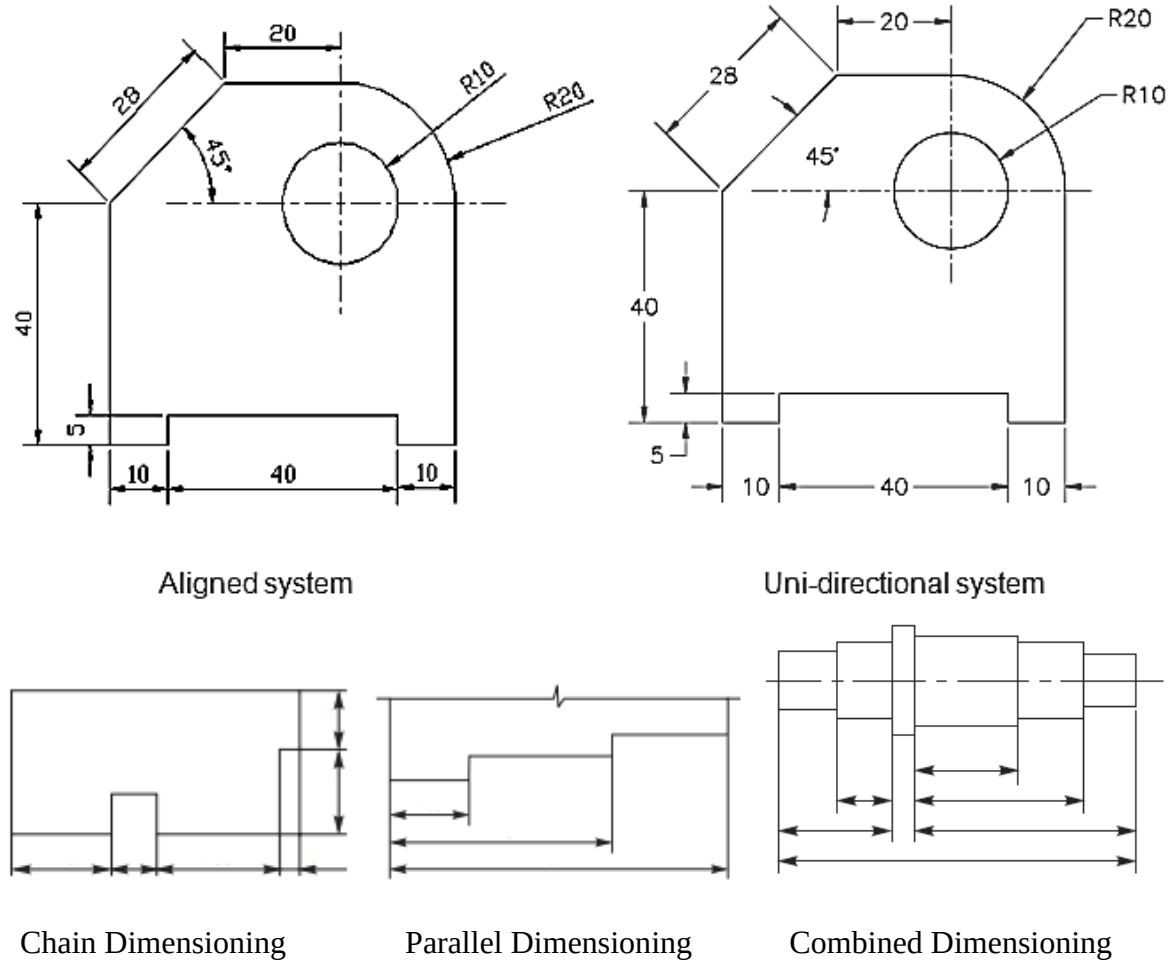


FIG 2 Dimensioning System

Geometrical Construction

Draw Fig 1 & Fig 2, Types of Lines and Dimensioning System in Sketch book only.

Solve the following Problems in Sketch book and Sheet.

1. Divide a 100 mm long line into 6 equal parts.
2. Bisect and Trisect a Right angle.
3. Bisect a line of 39 mm length.
4. Divide the circle of diameter 30 mm, into 12 equal parts with compass.
5. Construct a regular polygon, given the length of its side AB = 35 mm. Construct Square, Pentagon and Hexagon.
6. Construct a Square, a regular Pentagon and a regular Hexagon in the same figure taking AB = 40 mm as a common side.

EXERCISE 2
PLAIN SCALE, DIAGONAL SCALE & CONIC SECTIONS

Objective:

To prepare different types of scales used in engineering practice.
To draw conic curves using different methods.

Relevance:

Preparing scales in the sheet, the students will get the idea of different types of scales used in engineering drawing. Also, students will learn different uses of conic curves in engineering constructions.

BATCH A

1. Construct the scale of R.F. = 1:50 to show metres and decimetres and long enough to measure the length of 4 metres and 9 decimetres. Mark on the scale following distance 1) 2.7 metres 2) 3 metres and 4 decimetres.
2. Construct a scale of Representative Fraction = 1/36 showing yard, foot and inch. Scale should be long enough to measure 5 yards. Show 4 yards 2 feet and 5 inches on the scale.
3. The distance of a focus from the directrix is 70 mm. A point moves in such a way that the eccentricity is equal to 4/3. Draw the locus of the point and name the curve. Also draw tangent and normal at any point on the curve.
4. The foci of an ellipse are 120 mm apart. The minor axis is 80 mm long. Determine the length of major axis and draw ellipse by rectangle method. Locate a point M on the ellipse having a distance of 50 mm from the centre and draw the normal and tangent to the ellipse at this point.

BATCH B

1. Draw a plain scale to show kilometre and hectometre when R.F. = 1/35000 and long enough to measure 7 km. Measure 4.8 km on the scale.
2. Construct a scale of R.F. = 1/4000 to show 268 metres and long enough to measure up to 500 metres.
3. The foci of an ellipse are 120 mm apart and the minor axis is 70 mm long. Construct half ellipse by oblong method and another half by concentric circle method. Also draw the normal and tangent at any point on the curve.
4. A stone is thrown from a building of 6 m height. It just crosses the top of a palm tree of 12 m height. Trace the path of the projectile if the horizontal distance between building and the tree is 3 m. Also find the distance of the point from the building, where the stone falls on the ground.

BATCH C

1. On a map of Anand city 1 cm represents 1 km. construct a scale to measure the distance between Amul and Bakrol which is 6 km. also indicate on a scale, the distance between town hall and Karamsad which is 4 km and 8 hectometres.
2. Construct a scale of R.F 1:18 showing yard, feet and inches. The scale is long enough to measure up to 3 yards. Show distance 2 yard 1 feet 9 inches on the scale.
3. Two fixed points A and B are 96 mm apart. Trace the complete path of a point P moving (in same plane as that of A and B) in such a way that the sum of its distances from A and B is always the same and equal to 132 mm. Name the curve and Draw a normal and a tangent to the curve at point 70 mm from point A.
4. The vertex of a curve is at 75 mm from its focus. Draw the curve if eccentricity is 3/2.

BATCH D

1. Construct a scale of R.F = 1:10 showing the feet and inches and long enough to read the distance of 5 feet. Show on it the distance of 4 feet and 10 inches.
2. Construct a scale of R.F. = ½ to show millimetre and centimetre to measure up to 35 centimetres. Show on the scale a distance of 30.9 centimetre.
3. Construct the curve if the distance between the focus and the directrix is 50 mm. The eccentricity is 2/3. Draw the tangent and normal to the ellipse at any point.
4. Construct the parabola if the base is 105 mm and the axis length is 98 mm. Locate focus, vertex and directrix of the parabola. Also draw the tangent and the normal to the parabola at any point on it.

EXERCISE 3
ENGINEERING CURVES

Objective:

To draw Cycloidal curves, Involutes and Spirals.

Relevance:

Students will learn drawing and uses of different types of engineering curves in engineering constructions.

BATCH A

1. A circus man rides a motorcycle inside a globe of diameter 4 meters. The motorcycle rear wheel is 0.8 meters in diameter. Draw the locus of a point spot on the circumference of motorcycle rear wheel for its one complete turn in globe. Name the locus and draw normal and tangent at any point.
2. An inelastic string is unwound to a length of 120 mm from a drum of diameter 30 mm. Draw the locus of the free end of the string which is held tight during unwinding.
3. Draw an Archimedean spiral of 1.5 convolutions, the greatest and least radii being 125 mm and 35 mm respectively. Draw tangent and normal to the spiral at any point on the curve.

BATCH B

1. A circle of 50 mm diameter rolls on another fixed circle of radius 90 mm. Draw the curve traced by the point P on the rolling circle, which is at the contact point of the rolling and fixed circles at the initial position. Also draw the normal and tangent at any point on the curve. Name the curve.
2. An in elastic string 150 mm long has its one end attached to the circumference of a circular disc of 35 mm diameter. Draw the curve traced out by other end of the string, when it is completely wound round the disc, keeping always tight. Name the curve.
3. Draw an Archimedean spiral of one convolution, given the maximum and minimum radii as 55 mm and 31 mm respectively. Draw tangent and normal to the curve at any point.

BATCH C

1. A circle diameter 45 mm is rolls along a straight line without slipping. Draw the locus traced by point P, 30 mm away from the centre of the circle. Draw tangent and normal to the curve at any point. Name the curve.
2. A link OQ. 100 mm long rotates about point O in clockwise direction. A Point P on the link, 40 mm from Q, moves and reaches the end O in one complete rotation of the link OQ. Assuming the movement of the point P uniform, trace the path of point P and name the curve formed.

3. Construct the involute of hexagon of side 25 mm. Draw tangent and normal to the involute at any point on it.

BATCH D

1. A circle, of 50 mm diameter, rolls along the circumference of another circle of 150 mm diameter from inside. Draw the path of a point P on the circumference of the rolling circle for one complete revolution. Name the curve and draw normal and tangent to the curve at any point on it.
2. An inelastic string of length 100 mm is wound around a pentagon of 23mm sides. Draw the path trace by end of the string. Also draw the normal and tangent at any point on the curve.
3. Construct Logarithmic spiral for one convolution. Given the length of the shortest radius vector to 11 mm and the ratio of the lengths of successive radius vectors equal to 6/5 for vectorial angle of 30^0.

EXERCISE 4
ORTHOGRAPHIC PROJECTIONS

Objective:

To learn to draw different views of an object looking from different directions.

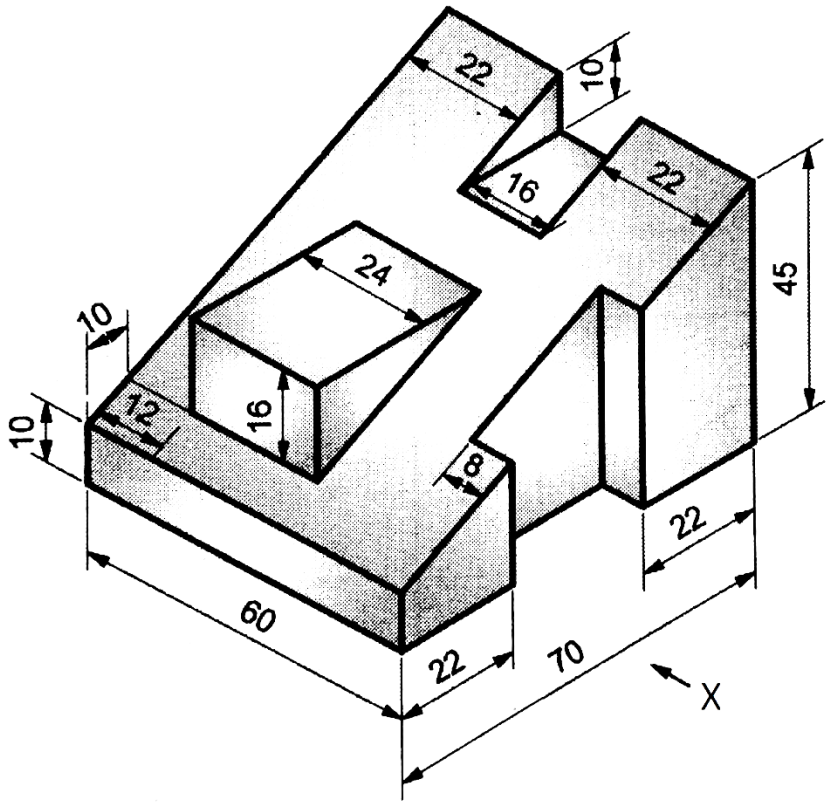
Relevance:

Drawing of this sheet will help the students to get the idea of different projection methods and learn conversion of the pictorial views into the orthographic views.

BATCH A

Problem – A1

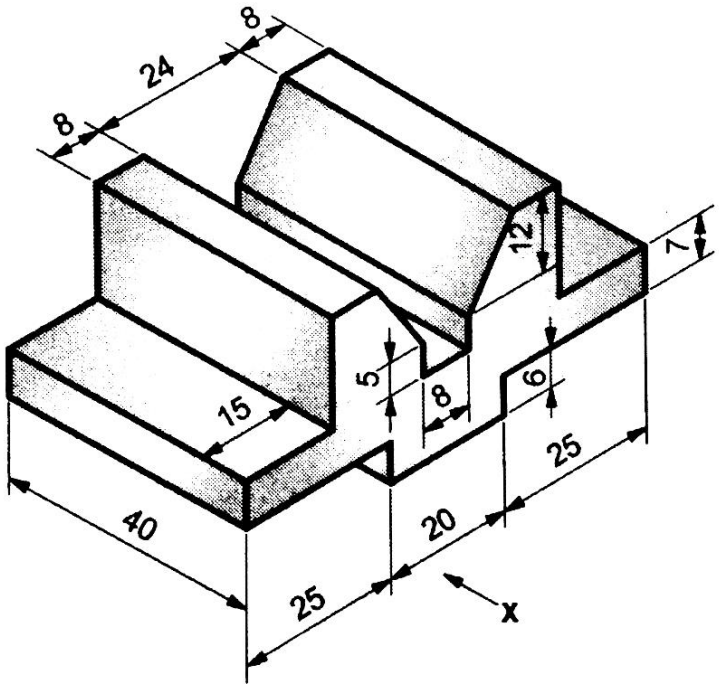
Draw the following views using first angle projection method:
(a) Front view (b) Top view (c) LHSV



Problem – A2

Draw the following views using third angle projection method:

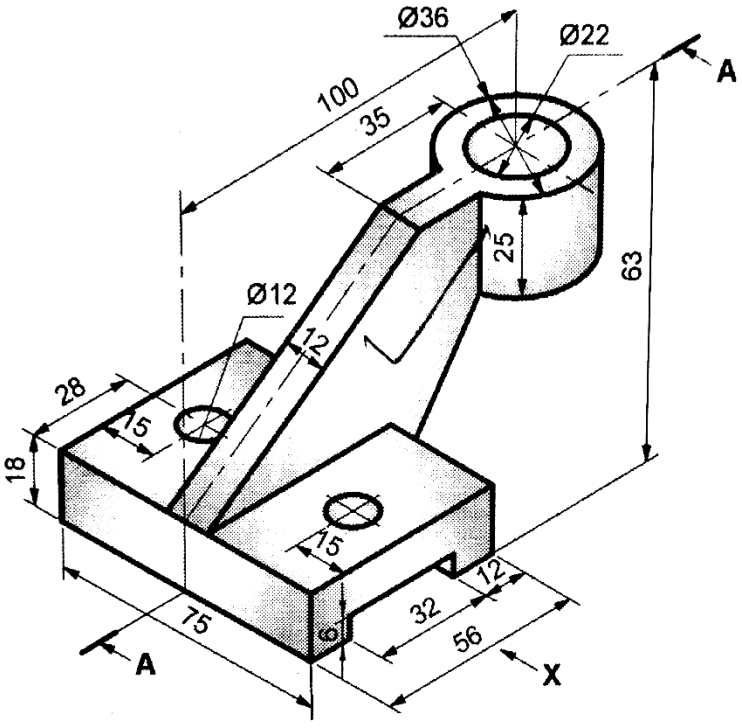
(a) Front view (b) Top view (c) LHSV



Problem – A3

Draw the following views using first angle projection views:

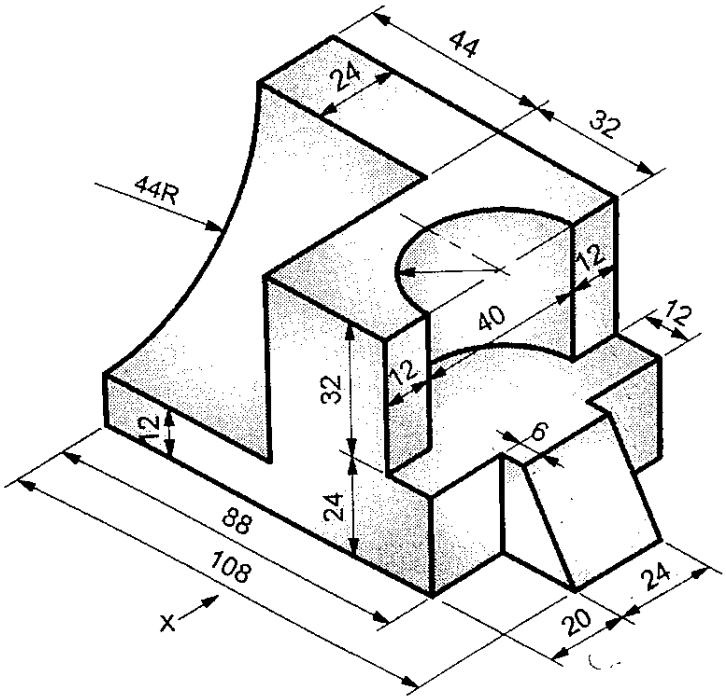
(a) Full sectional Front view (b) Top view (c) LHSV



BATCH B

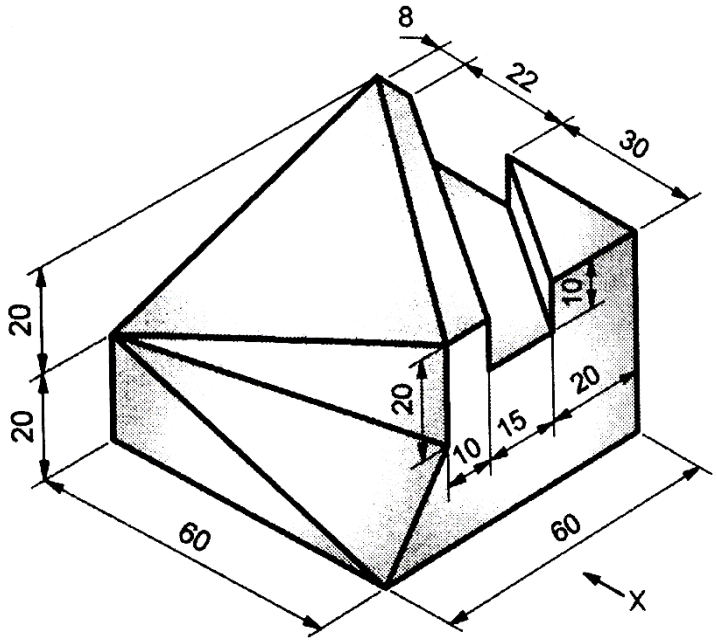
Problem – B1

Draw the following views using first angle projection method:
(a) Front view (b) Top view (c) RHSV



Problem – B2

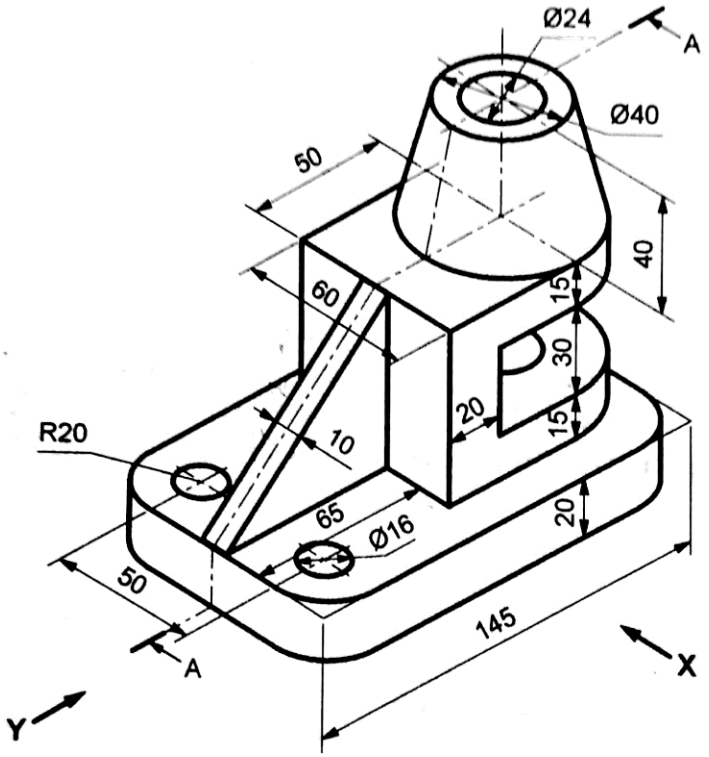
Draw the following views using third angle projection method.
(a) Front view (b) Top view (c) LHSV



Problem – B3

Draw the following view using First angle projection method:

(a) Full sectional front view from X (b) Top view and (c) LHSV from Y

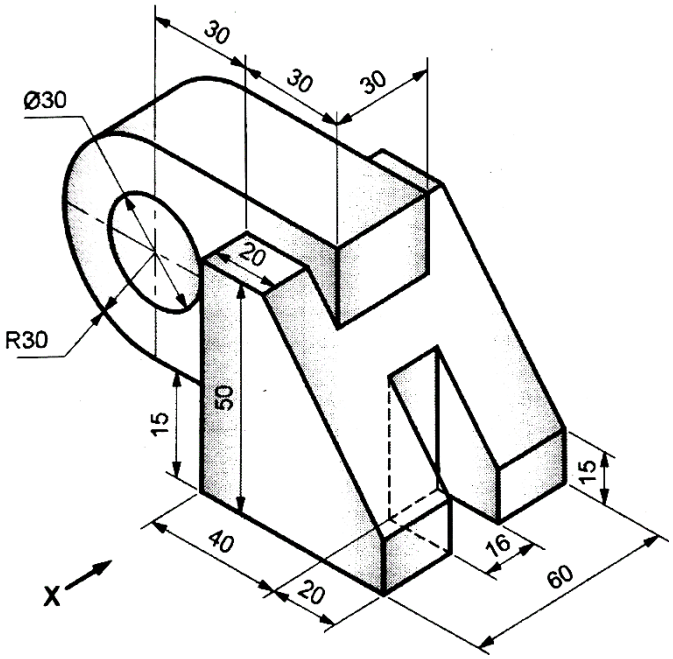


BATCH C

Problem – C1

Draw the following views using Third angle projection method.

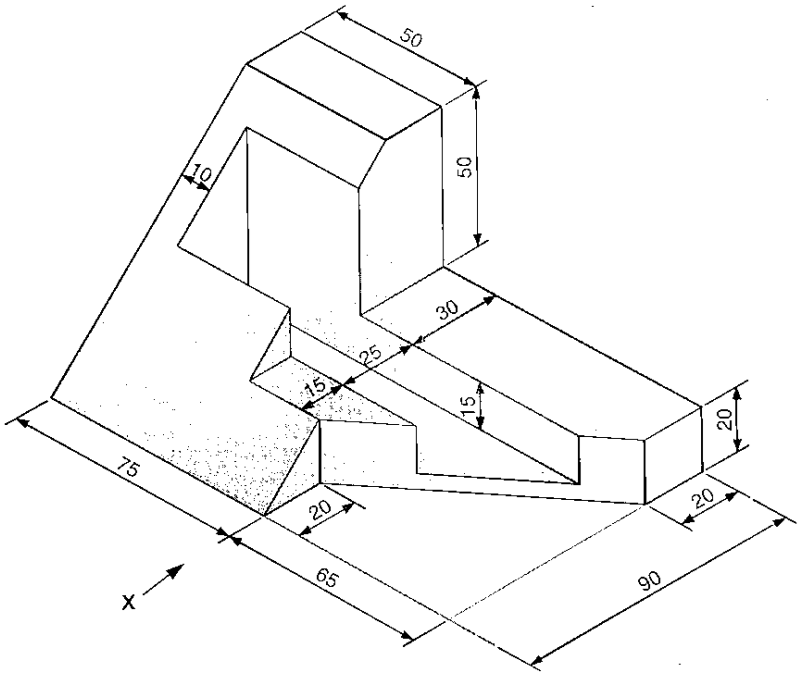
(a) Front view (b) Top view (c) RHSV



Problem – C2

Draw the following views using First angle projection method.

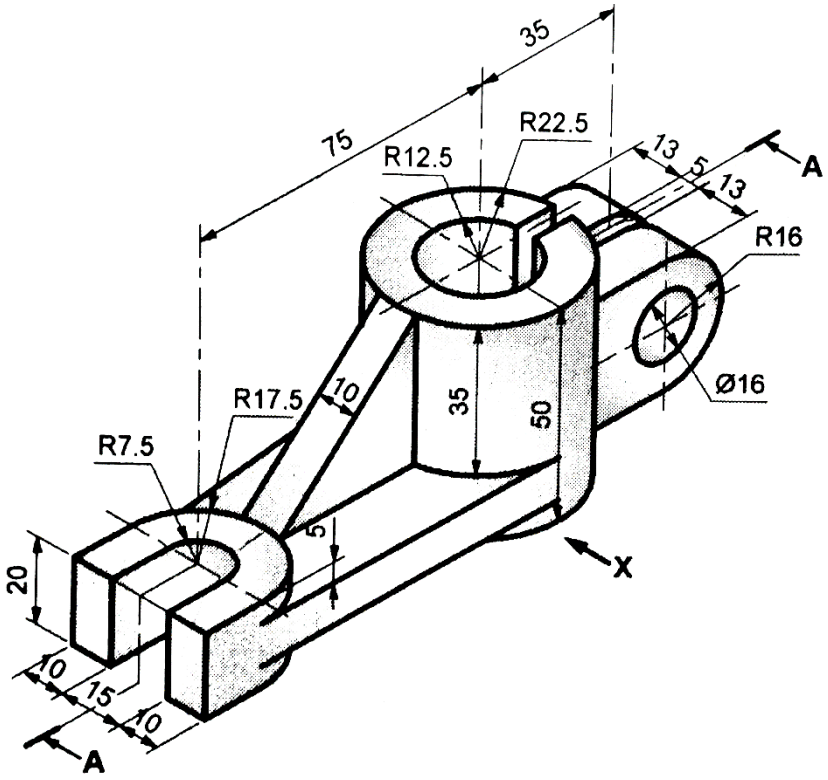
(a) Front view (b) Top view (c) RHSV



Problem - C3

Draw the following view using First angle projection method:

(a) Full sectional front view (b) Top view (c) LHSV

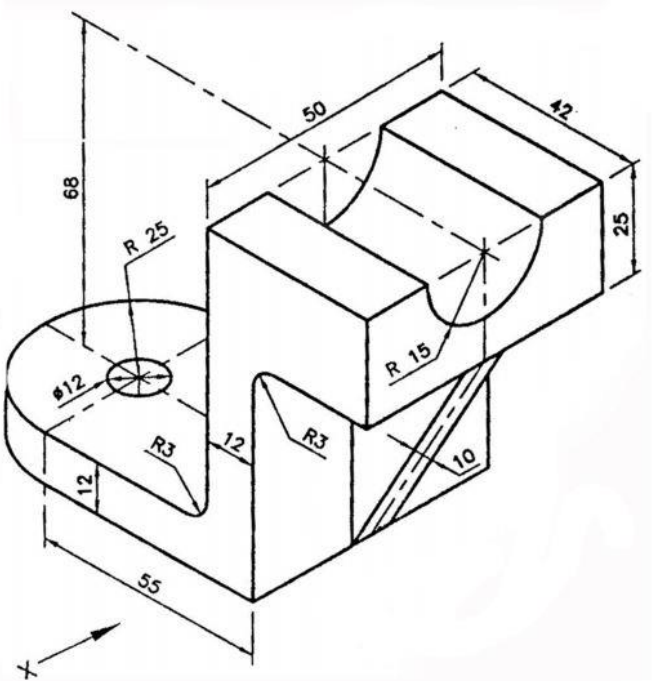


BATCH D

Problem – D1

Draw the following views using First angle projection method.

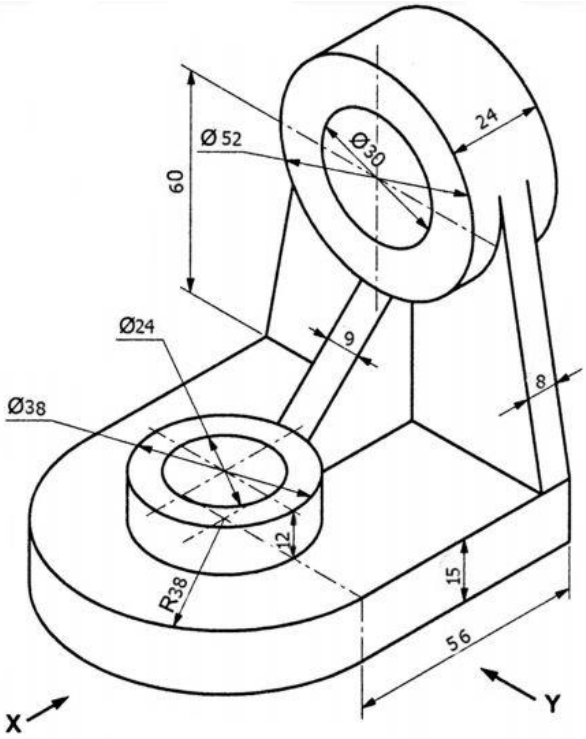
(a) Front view (b) Top view (c) RHSV



Problem – D2

Draw the following views using Third angle projection method.

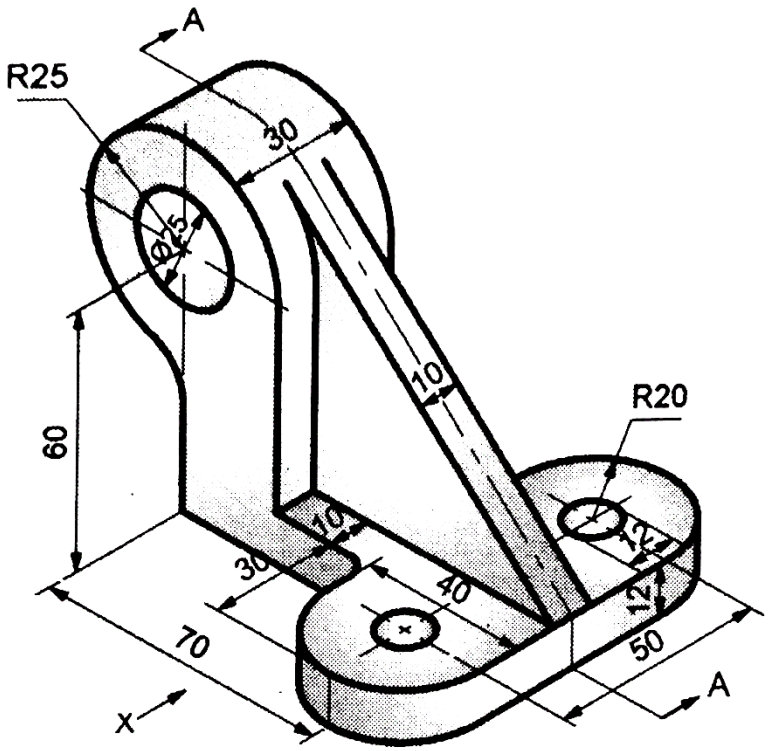
(a) Front view (b) Top view (c) RHSV



Problem – D3

Draw the following view using First angle projection method:

(a) Full sectional front view (b) Top view (c) RHSV



EXERCISE 5
PROJECTIONS OF LINE

Objective:

To get the projections of a straight line inclined with both the reference planes.

Relevance:

Students will be able to imagine the position of a line in space and also be able to find the true length and true inclinations of the line with both the reference planes.

BATCH A

1. A line AB 75 mm long is inclined at an angle of 45^o to HP and 30^o to VP. One of its end point A is HP as well as VP. Determine the apparent inclination with VP.
2. A line AB has its end A 15 mm above HP and 10 mm in front of VP. The end point B is 60 mm above HP. The distance between the end projectors is 55 mm. The line is inclined to HP by 25^o. Draw the projections and find its inclination with VP and the true length of line AB.
3. Plan & Elevation of 80 mm long line AB, measures 65 mm and 55mm respectively. End A is 15 mm above HP & 10 mm in front of VP. Draw its projections & determine its inclinations to the reference planes when the point B lies in (a) First quadrant (b) Third quadrant.
4. A line AB, 80 mm long is inclined at 45^o to HP and 30^o to VP. Its midpoint C is in VP and 15 mm above HP. The end A is in the third quadrant and B in the first quadrant. Draw the projection of the line.

BATCH B

1. A line PQ 75 mm long is inclined at an angle of 40^o to HP and 30^o to VP. One of its end point P is HP as well as VP. Determine the apparent inclination with VP.
2. The top view and front view of a line AB measures 70 mm and 58 mm respectively. The line AB is inclined at an angle of 35^o to HP. The end A is 15 mm above HP and 12 mm in front of VP. The other end B is also in the first quadrant. Draw the projections of the line AB. Find its true length and inclination with the VP.
3. The top view of a 75 mm long line AB measures 50 mm. Point A is 50 mm in front of VP and 15 mm below HP. Point B is 15 mm in front of VP and is above HP. Draw the front view of line AB and find its inclinations with HP and VP.
4. A straight-line AB is inclined to the H.P. by 30^o and to the V.P. by 60^o, if true length of line is 100 mm find lengths of plan and elevation of the line and draw the projections.

BATCH C

1. A line AB, 70 mm long is inclined at an angle of 45^o to the HP and 30^o to the VP. Its end point A is on the HP and 25 mm in front of VP. Draw the projections of the line AB assuming it to be in the first quadrant.
2. A line AB is 90 mm long and makes an angle of 45^o with the HP. The front view of the line measures 65 mm and the end point A is in the VP and 20 mm above HP. Draw the projection of AB and find its inclinations with both planes.
3. The front view of a line AB is 50^o inclined to XY line & measure 55 mm long while its top view is 60^o inclined to xy line. If end A is 10 mm above HP & 15 mm in front of VP. Draw the projections and Find the true length of the line & its true inclination with HP & VP.
4. The 80mm long line PQ is inclined at 30^o to VP and Front view is inclined at 40^o. Draw the projection of line when point P is located 25mm above HP and 15mm in front of VP and point Q is in 3rd quadrant.

BATCH D

1. A line PQ is 80 mm long. It is inclined at an angle of 45^o to the HP and 30^o to the VP. The end P is 20 mm above HP and 30 mm in front of VP. Draw Projection s of line PQ.
2. A line MN is 110 mm long has its end M 10 mm above HP and 20 mm in front of VP. Draw the projections of the line MN if its inclination with VP is 25° and the inclination of its top view with VP is 45°. Also determine the inclination of the line with H.P.
3. The front view of a line AB, 90 mm long, measures 65 mm. front view is inclined to XY line by 45^o. Point A is 20 mm below HP & on VP. Point B is in third quadrant. Draw the projection and find inclination of line with HP and VP.
4. A line AB contains a point C on it such that the ratio of the distance of the CB:AC is 2:1. The end A is 20 mm above HP and it is in first quadrant. And the other end B is in VP. The point C is 35 mm above HP. The line is inclined with the HP at an angle 30^o. The elevation length of the line AB is 70 mm. Draw the projection of the line AB.

EXERCISE 6
PROJECTIONS OF PLANE

Objectives:

To get the projections of planes inclined with both the reference planes.

Relevance:

Students will be able to imagine the position of a plane in space and also be able to find the true shape and true inclinations of the plane with both the reference planes.

BATCH A

1. A square plate of side 60 mm is held on a corner of its base on the HP. Plate is inclined to the HP such that the plan of it is rhombuses with a diagonal of 30 mm. determine the angle it makes with HP. The other diagonal is inclined at 45º VP. Draw the projection of the plate.
2. An isosceles triangular plate ABC has its base 45 mm and altitude 60 mm. It is so placed that the front view is seen as an equilateral triangle of 45 mm side and (i) base is inclined at 450 to HP, (ii) side is inclined at 300 to HP. Draw its plan when its corner A is on HP.
3. A pentagonal plate of side 50 mm has a central equilateral triangular hole of 40 mm sides, with the side of a plate and that of triangular hole parallel to each other. The plate is kept on the HP on this side, the side being inclined at 30o to the VP. Determine the angle of a plate with the HP. If the highest point of a plate is 40 mm from the HP and draw its projection.

BATCH B

1. ABCDE is a regular pentagonal plate, of 40 mm sides. It has its corner A on the HP. The plate is inclined to the HP such that the plan length of edges AB & AE is 35 mm. The side CD is parallel to both the reference planes. Draw the projections of the plate & find its inclinations with HP.
2. A semicircular plate of 80 mm diameter has its straight edge in the VP and inclined at 450 to the HP. The surface of the plate makes an angle of 300 to VP. Draw its projections.
3. A rectangular lamina of size 50×40mm has coaxial circular hole of 30mm diameter. It is resting on HP with the shorter edge perpendicular to VP. The surface of lamina is inclined at 35 degrees to HP. Drawn the three views.

BATCH C

1. A hexagonal plate is resting on one of its side on H.P. The side on which it rests makes an angle of 45^0 with V.P. and the plate makes an angle of 30^0 with H.P. Draw the projections of the plate.
2. A $30^0 – 60^0$ set square has its shortest side 50 mm long and is in the HP. The top view of Set Square is an isosceles triangle and the hypotenuse of the setsquare is inclined at an angle of 40^0 with the VP. Draw the projections of the setsquare and find its inclinations with the HP.
3. ABCD is a rhombus of diagonals AC = 110 mm and BD =70 mm. Its corner A is in the H.P. and the plane is inclined to H.P. such that the plan appears to be a square. The plan of diagonal AC makes an angle of 20 degrees to the V.P. Draw the projections of the plane and find its inclination with H.P.

BATCH D

1. A circular plane of 60 mm diameter is resting on HP on a point A of its circumference. The plane is inclined at 30^0 to the HP. The diameter AB of the plane makes an angle of 45^0 with the VP. Draw the projection of circular plane.
2. A hexagonal plane of 30 mm side has one of its side on H.P. The side on which it rests makes an angle of 45^0 with V.P. and the plate makes an angle of 45^0 with H.P. Draw the projections of the plane.
3. ABC is an equilateral triangle of side 60 mm long. Its corner A is on HP and side BC is 20 mm above HP. Draw the projections of the triangle when side BC is inclined to VP at an angle of $50^{0.}$

EXERCISE 7
PROJECTIONS OF SOLIDS

Objective

To learn about different types of solids and get their projections when they are in different positions with respect to the H.P. and the V.P.

Relevance

Students will be able to imagine the position of a given solid in space and learn to draw its views from different directions.

BATCH A

1. A frustum of a square pyramid with side of base 60 mm, side of top 30 mm and height 50 mm is resting on the HP on one of its trapezoidal faces. Draw the projections of the frustum when axis is contained by a vertical plane making an angle of 45^0 with VP.
2. A hexagonal prism is resting on one of its side of base 30mm, such that axis 60mm is inclined at 45^o to H.P and the side on which it is resting is inclined at 30o to V.P. Draw the projections.
3. A cylinder base 50 mm and axis length 70 mm, is kept on HP on a point of its base circle in such a way that its axis makes an angle of 30 degrees with HP. Draw the projection of the cylinder when plan of axis is making 45 degrees to XY line.

BATCH B

1. A Cube of 50 mm long edges is resting on HP on one of its corners, with one of its body diagonals parallel to HP and inclined at 45^0 to VP. Draw the projections of the cube.
2. A Pentagonal Pyramid has a height of 60 mm and the side of a base 30 mm. The pyramid rests with one of the sides of a base on the HP such that the triangular face containing that side is perpendicular to the HP and makes an angle of 30° with the VP. Draw its projections.
3. A Cone of base diameter 60 mm and height 90 mm is resting on HP on the point of the periphery of the base. The axis of the cone makes 60^0 with HP and 30^0 with the VP. Draw the projections of the cone, when the apex is nearer to the observer.

BATCH C

1. A pentagonal prism side of base 30 mm and axis length 50 mm is resting on one corner of its base on the HP. The longer edge contains that corner is inclined at 45^0 to HP. The axis of the prism makes an angle of 30^0 to VP. Draw the projection of solid.
2. A Tetrahedron of 60 mm long edge stands on one of its edges in the HP with its base making an angle of 35° with the HP. the edge of the tetrahedron in the HP makes an angle of 35° to the VP. Draw the projections of the tetrahedron.

3. A cone base diameter 50 mm and axis length 60 mm, is kept on VP on a point of its base circle in such a way that if its apex is 50 mm in front of VP. Draw the projection of cone when elevation of axis is making 45° to XY line. Keep apex of cone on HP.

BATCH D

1. A square pyramid, side of base 50 mm and height 64 mm, is freely suspended from one of the corners of the base. Draw its projection when vertical plane containing the axis makes an angle of 45° to VP.
2. Draw the projection of a cone, base 44 mm diameter and axis 50 mm long, when it is resting on the HP on a point of its base circle with the axis making an angle of 45° with HP and 30° with VP.
3. A pentagonal prism rests on one of its edges of the base on HP with its axis inclined at 45° to the HP. The top view of the axis is inclined at 30° to the VP. Draw the projections of the prism, assuming the edge of the base to be 30 mm and axis 70 mm long.

EXERCISE 8

SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES

Objective:

To learn to draw sectional views of different solids cut by section planes in different positions. To learn to draw the development of surface of cut solids.

Relevance:

The students will be able to decide the shape of sections when the solid is cut by a cutting plane in different positions with respect to the reference planes. Also, they will be able to decide the shape of a fibre or metal sheet to cover a cut solid completely.

BATCH A

1. A hexagonal pyramid of the base side 30 mm and axis 70 mm long is resting on HP with its base on it and one of the sides of the base parallel to VP. The axis of the pyramid is 40 mm away from the VP. It is cut by a plane inclined at 30^0 to VP and 90^0 to HP. The plane is 15 mm away from axis and nearer to the observer. Draw the top view, sectional front view and true shape of the section.
2. A cone of base diameter 80 mm and 90 mm height is resting on the HP on its base. It is cut by an AIP in such a way that the true shape of the cut surface is a parabola of 55 mm axis length. Draw the front view, sectional top view and the true shape of the section.
3. A cylinder, 40mm diameter and 70 mm height, is resting on its base on H.P. it is cut by plane passing through a point 50 mm from the base and inclined at 40° to H.P. A through hole, of 20 mm diameter, is drilled at 30 mm above the base. Develop the lateral surface of the cylinder.

BATCH B

1. A square prism, side of the base 50 mm and axis length 120 mm has a longer edge (120 mm side) on the ground and parallel to VP. A rectangular face containing that face is inclined at 60^0 to the ground. The prism is cut by an AIP inclined at 30^0 with ground and passing through a point on the axis 45 mm from one end. Retaining the larger part, draw its front view, sectional top view and true shape of the section.
2. A pentagonal pyramid, side of base 40 mm and height 75 mm is resting on HP on one of its edge of the base with axis parallel to VP and inclined to HP by 60^0. A horizontal cutting plane passing through the highest corner of the base cuts it. Draw sectional plan and elevation of the pyramid.
3. A right circular cone having the diameter of base 40 mm and the axis length 80 mm is resting on its base on H.P. It is cut by an A.I.P. inclined at 45^0 to H.P. The cutting plane passing through a point on the axis, which is at 40 mm from the cone. Draw the development of the lateral surface of the cone retaining the portion containing the base.

BATCH C

1. The true section of a vertical square prism cut by an inclined plane is a rhombus of 40 mm and 80 mm long diagonals. The plane cuts one of its longer edges at a height of 20 mm from the base. Find the inclination of the cutting plane with the HP and draw the front view, sectional top view and true shape of the section.
2. A cylinder, base diameter 30 mm and axis length 50 mm resting on HP on its base. It is cut by an AIP inclined at 45^0 to HP. Cutting plane passing through a point on the axis 12 mm below top face. Draw front view, sectional top view, sectional side view and true shape of the section.
3. A square pyramid, sides of base 30 mm and axis length 50 mm is kept on the H.P. on its base with all sides of base equally inclined to V.P. It is cut by a plane inclined at 45° to H.P., perpendicular to V.P. and bisecting the axis. Develop the surfaces of pyramid.

BATCH D

1. A square pyramid, base 45 mm side and axis 70 mm long has its base in HP and all edges of the base are equally inclined to the VP. It is cut by a section plane perpendicular to VP and inclined at 45^0 to HP such that it bisects the axis. Draw its sectional top view, sectional side view and true shape of the section.
2. A cylinder of 50 mm diameter of base 75 mm length of axis, has one of its ends on the HP. it is cut by an A.I.P. in such a way that the true shape of the section is an ellipse of largest possible major axis. Draw the sectional plan, true shape of the section and find inclination of the section plane with the HP.
3. A pentagonal prism, side of base 35mm and height 70 mm, is resting on HP on its base with one of the edges of the base inclined at 450 to the VP. It is cut by an AIP inclined to HP by 450 passing through a point on the axis 20 mm from top end of the axis. Draw the development of the cut prism.

EXERCISE 9
AUTO-CAD DRAWING

Objective:

To learn to draw basic commands in Auto CAD software.

Relevance:

The students will be able to learn the integration of computer software for Engineering Graphics and to apply this new knowledge for creative engineering design projects.
AutoCAD

What is AutoCAD?

- AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk.
- AutoCAD was first released in 1982. It was the first CAD software running on personal computers. Before AutoCAD most cad programs were not popular and most of the work was done on a drawing board.
- It is related to software that can improve the designing process related to different fields. Often it is involved in making designs of infrastructure, technology, automobiles, and much more. With the help of AutoCAD, design anything or everything.

AutoCAD Commands

This is the list of some of the most basic commands in AutoCAD which every AutoCAD user should know.

Sr. No.	Command	Shortcut	Description
1	Line	L/ LINE	Create a simple line
2	Circle	C/ CIRCLE	Create a circle
3	Polyline	PL/ PLINE	Make a polyline
4	Rectangle	REC/ RECTANGLE	Create a rectangle
5	Hatch	H/HATCH	Opens hatch and gradient dialogue box
6	Chamfer	CHA/ CHAMFER	Add slanted edges to sharp corners of objects
7	Fillet	F/ FILLET	Add rounded corners to the sharp edges of objects
8	Trim	TR/ TRIM	Trim a shape or line
9	Extend	EX/EXTEND	Extend a selection
10	Offset	O/OFFSET	Offset a selection
11	Dim-style	D/DIMSTYLE	Opens dim-style manager

Exercise

1) Explain the following 2D drawing entities with the help of sketch
   - Line
   - Arc
   - Polyline
   - Ellipse
   - Polygon
   - Extend
2) All students need to prepare one 2D AutoCAD Drawing of any one of the objects drawn in Orthographic Projection (Exercise 4) with proper Dimensioning and affix in a sheet.