

AIM

To develop graphic skills in students.

OBJECTIVES

To develop in students graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

Concepts and conventions (Not for Examination)**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING**15****Curves used in engineering practices:**

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES**14**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations
– Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS**15**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**15**

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones –
Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**15**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 75 PERIODS**TEXT BOOKS:**

N.D. Bhatt, “Engineering Drawing” Charotar Publishing House, 46th Edition, (2003).

REFERENCES:

- K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).
M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).
Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

Publication of Bureau of Indian Standards:

- IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

- There will be five questions, each of either or type covering all units of the syllabus.
All questions will carry equal marks of 20 each making a total of 100.
The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
Whenever the total number of candidates in a college exceeds 150, the University Examination in that college will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

DRAWINGS:

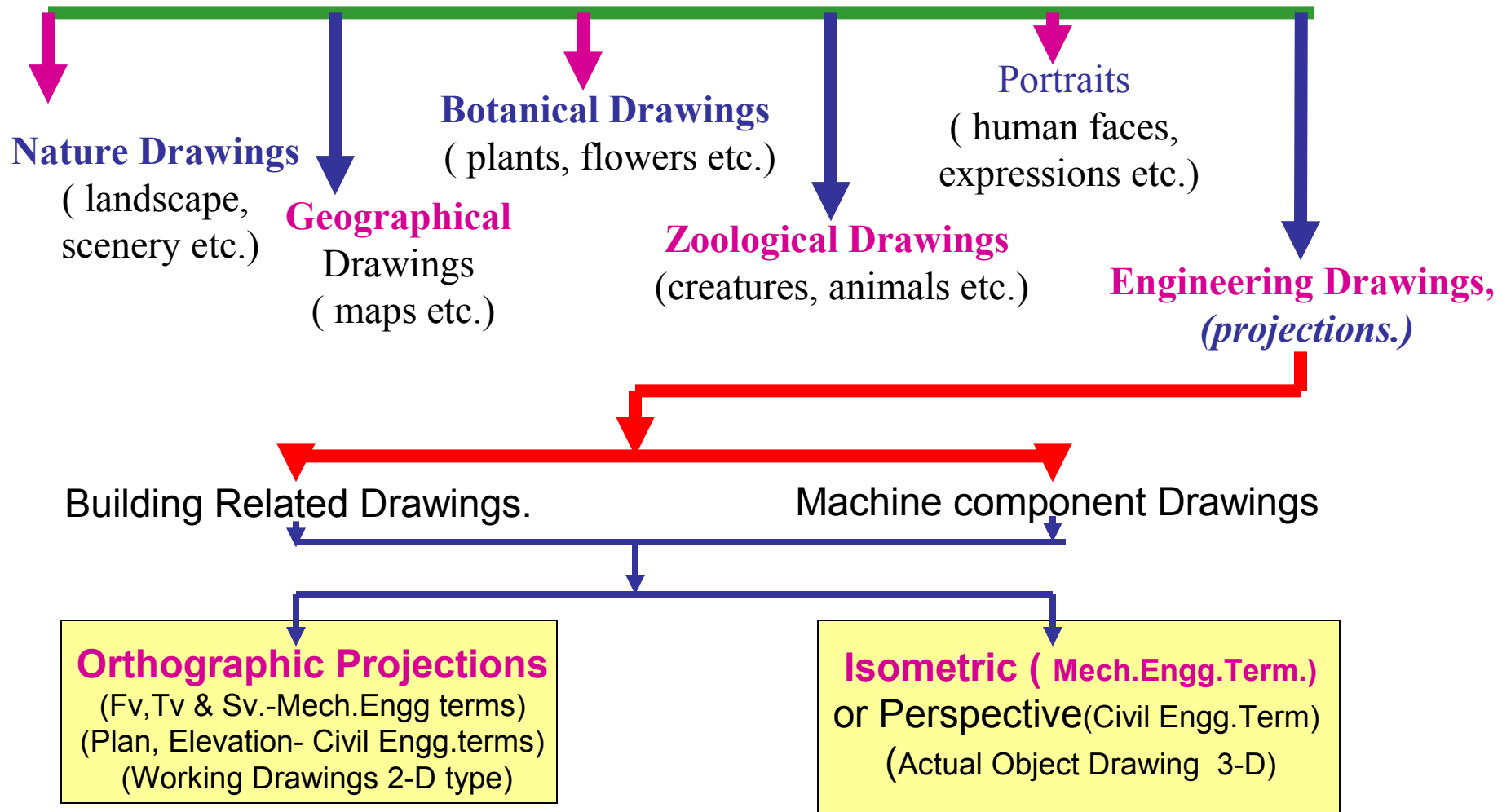
(A Graphical Representation)

The Fact about:

**If compared with Verbal or Written Description,
Drawings offer far better idea about the Shape, Size & Appearance of
any object or situation or location, that too in quite a less time.**

*Hence it has become the Best Media of Communication
not only in Engineering but in almost all Fields.*

Drawings (Some Types)



Basics:

♣ **Drawing:** 2D or 3D views of an object without the purpose of manufacturing it. It is done manually or with the aid of a computer.

♣ **Engineering Drawing:** 2D or 3D views of an object with the purpose of manufacturing it. It is done manually.

♥ **Note:** In 2D view (Orthographic projection), one view is not enough to get all the details of the object. So it is necessary to draw the front view, top view, bottom view, right side view and left side view.

♣ **Engineering Graphics:** 2D or 3D views of an object with the purpose of manufacturing it. It is done with the aid of a computer.

♣ **Drawing sheet:** Drawing paper is in the form of sheet or roll. Trimmed drawing paper is called as drawing sheet. The designations of drawing sheet are : A0, A1, A2, A3 and A4.

Designation	Dimension , mm	
	Length	Breadth
A2	594	420
A3	420	297



850

Sheet Metal



♣ **Compass:**

- ♥ Bow compass is used for drawing small circles **up to 30 mm diameter**. In this, the inclined cut of the lead is turned inside as shown in the figure.

Note: Pro-circle can also be used for drawing small circles up to 30 mm diameter.



BOW COMPASS

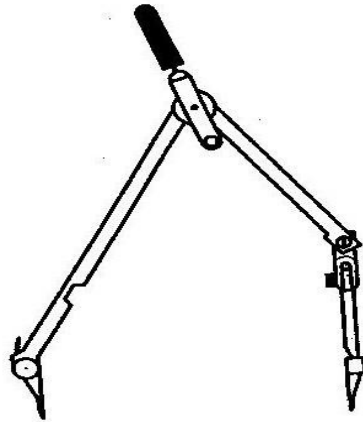
- ♥ Large compass is used to draw circles from **30 mm to 120 mm diameter**. In this the inclined cut of the lead is turned outside as shown in the figure.



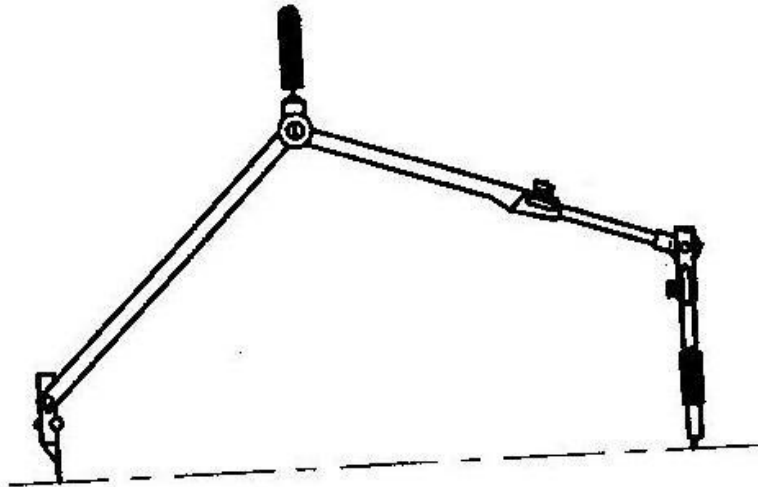
LARGE
COMPASS

- ♥ Up to 120 mm diameter, circles can be drawn with the legs of the compass kept straight.

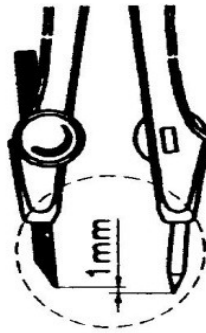
- ♥ For drawing larger circles both the legs must be bent at their knee joints, so that they are perpendicular to the surface of the paper. For drawing circles of **120 to 300 mm diameter** both the needle point leg and the pencil leg should be bent at the knuckle joints so as to be perpendicular to the surface of the paper.



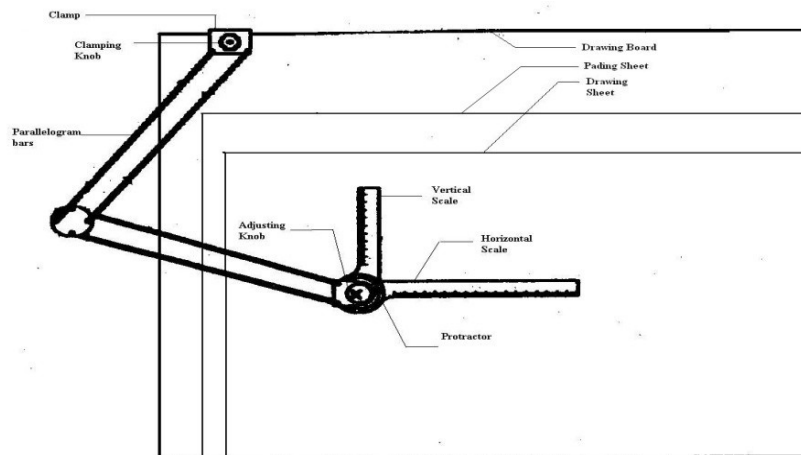
- ♥ For drawing larger circles **of more than 300 mm diameter**, lengthening bar attachment is used. For this, the lower part of the pencil leg is detached and lengthening bar is inserted in its place. The detached part is then fitted at the end of the lengthening bar.



- ♥ In any compass the pencil / lead should project 1 mm less than the needle point as shown in the figure.



- ♥ While taking measurements using compass / divider, place the compass / divider such that it is inclined by 45° to the surface of the paper.
- ♣ The bottom horizontal edges of drawing board, padding sheet and drawing sheet should coincide as shown in the figure. The right vertical edges of drawing board, padding sheet and drawing sheet should coincide as shown in the figure. Use double sided tape instead of cello tape.



♣ **How to fix the mini drafter on the drawing board?**

♥ A miniature of drafting machine is mini drafter.

♥ The mini drafter should be positioned on the top left hand side of the drawing board such that the scales (horizontal and vertical) of the mini drafter covers the drawing space fully.

Note : The longer scale of the mini drafter should be horizontal and called as horizontal scale. The shorter scale of the mini drafter should be vertical and called as vertical scale.

♥ Loose the adjusting knob and clamping knob.

♥ The horizontal scale of the drafter should be aligned with the top horizontal edge of the drawing sheet. Also, make the mark in the drafter to coincide with 0° in the protractor.

♥ Holding the horizontal scale of the drafter in this position, tight the adjusting knob first and then tight the clamping knob.

♥ Now the mini drafter can be used to draw horizontal and vertical lines. After drawing inclined lines, make the horizontal scale (or vertical scale) of the drafter to align with any previous horizontal line (or vertical line) and tight the adjusting knob.

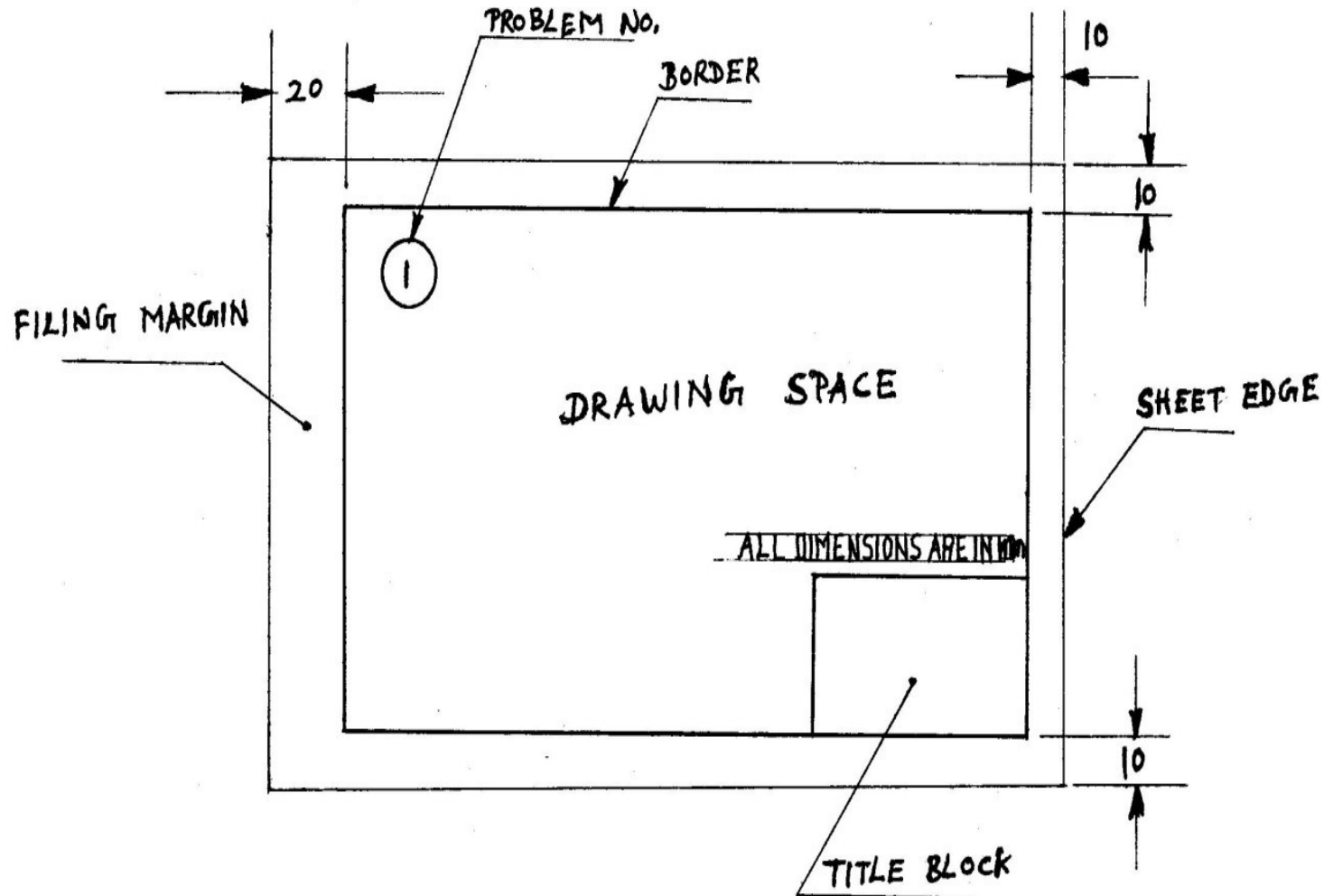
♣ **How to take angles using mini drafter ?**

♥ For taking angles from the vertical line, rotate the vertical scale of the mini-drafter clockwise or anti clockwise to the required angle and draw the inclined line using vertical scale.

♥ For taking angles from the horizontal line, rotate the horizontal scale of the mini-drafter clockwise or anti clockwise to the required angle and draw the inclined line using horizontal scale.

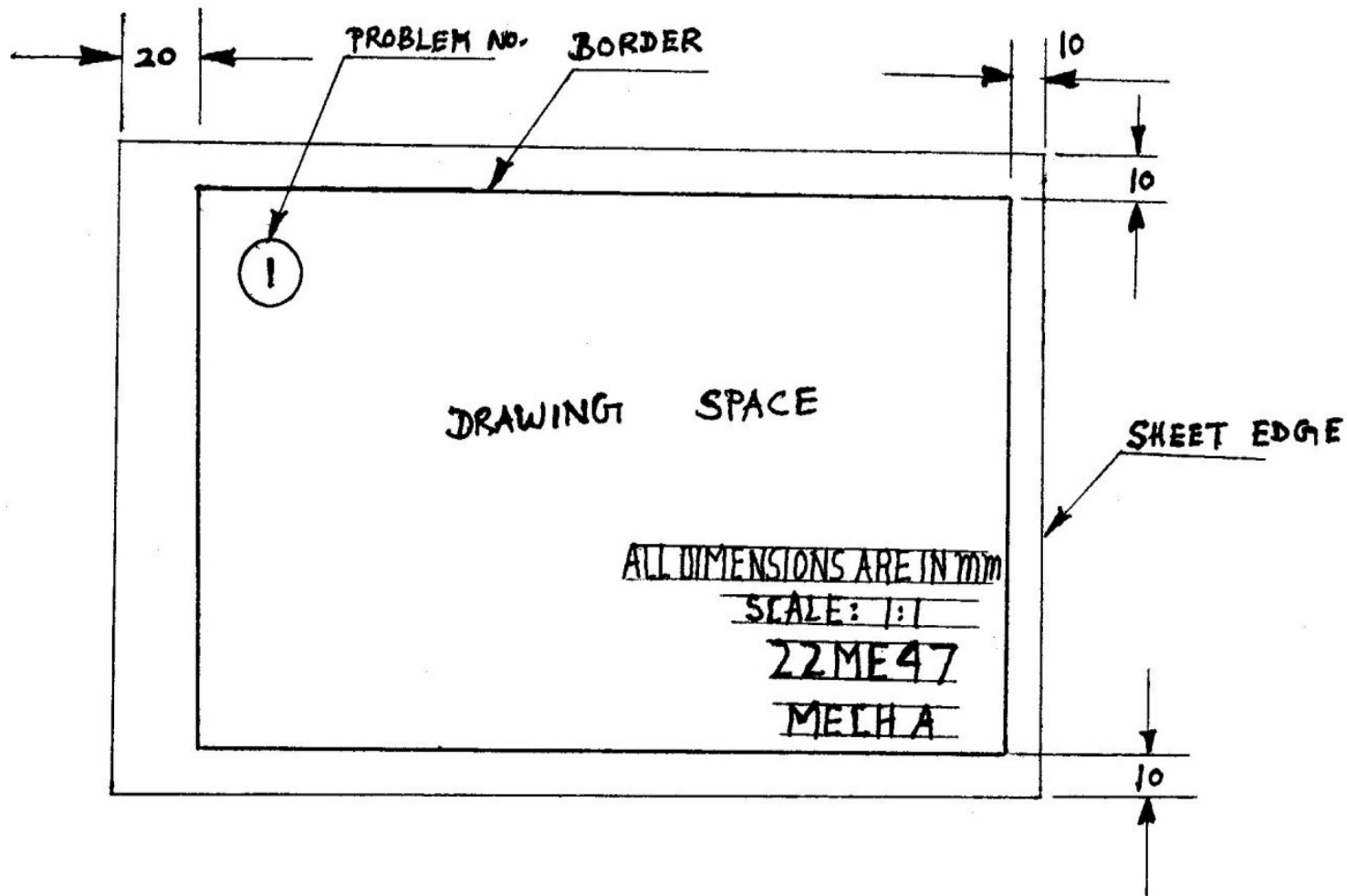
♣ **Layout of A2 size drawing sheet for assignment work:**

- ♥ Title block is necessary and fold the drawing sheet(six fold) as given below.
- ♥ “ALL DIMENSIONS ARE IN mm” should be written above the title block.
- ♥ If any different scale is used write that beneath the corresponding problem.



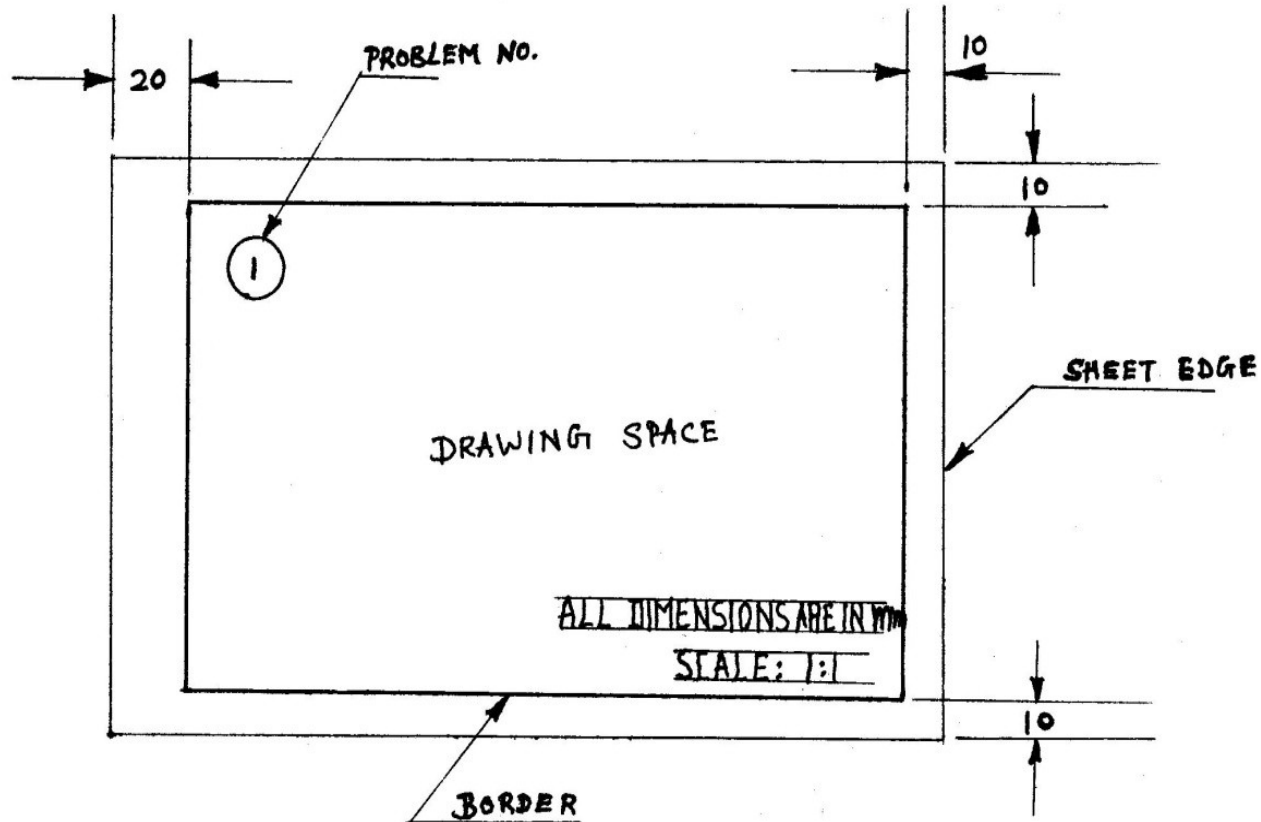
♣ **Layout of A3 size drawing sheet for Unit and Model exams:**

- ♥ Title block is not necessary. Write your roll no., branch and section **with pen** at the bottom right end of the drawing sheet. For that take size 7 mm. Fold the drawing sheet in the middle (one fold) such that your roll no. is visible.
- ♥ Write "ALL DIMENSIONS ARE IN mm" and Scale: 1 : 1 above your roll no. For that take size 5 mm. **If any different scale is used write that beneath the corresponding problem**



♣ **Layout of A3 size drawing sheet for university exams:**

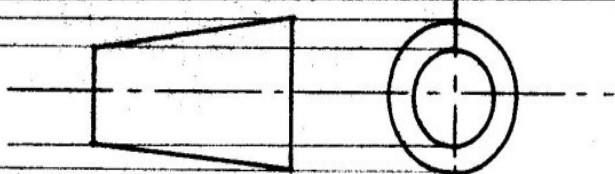
- ♥ 5 sheets will be given. Title block is not necessary. Write your registration no. etc., only in the paper provided in front and not in the drawing sheets. It is not necessary to fold the drawing sheets.
- ♥ Write "ALL DIMENSIONS ARE IN mm" and Scale: 1 : 1 at the bottom right end of all the sheets. For that take size 5 mm. **If any different scale is used write that beneath the corresponding problem.**



- ♣ The left side 20 mm is given for filing and binding purposes. Border line is a very thick line which serves as a frame for the drawing sheet.

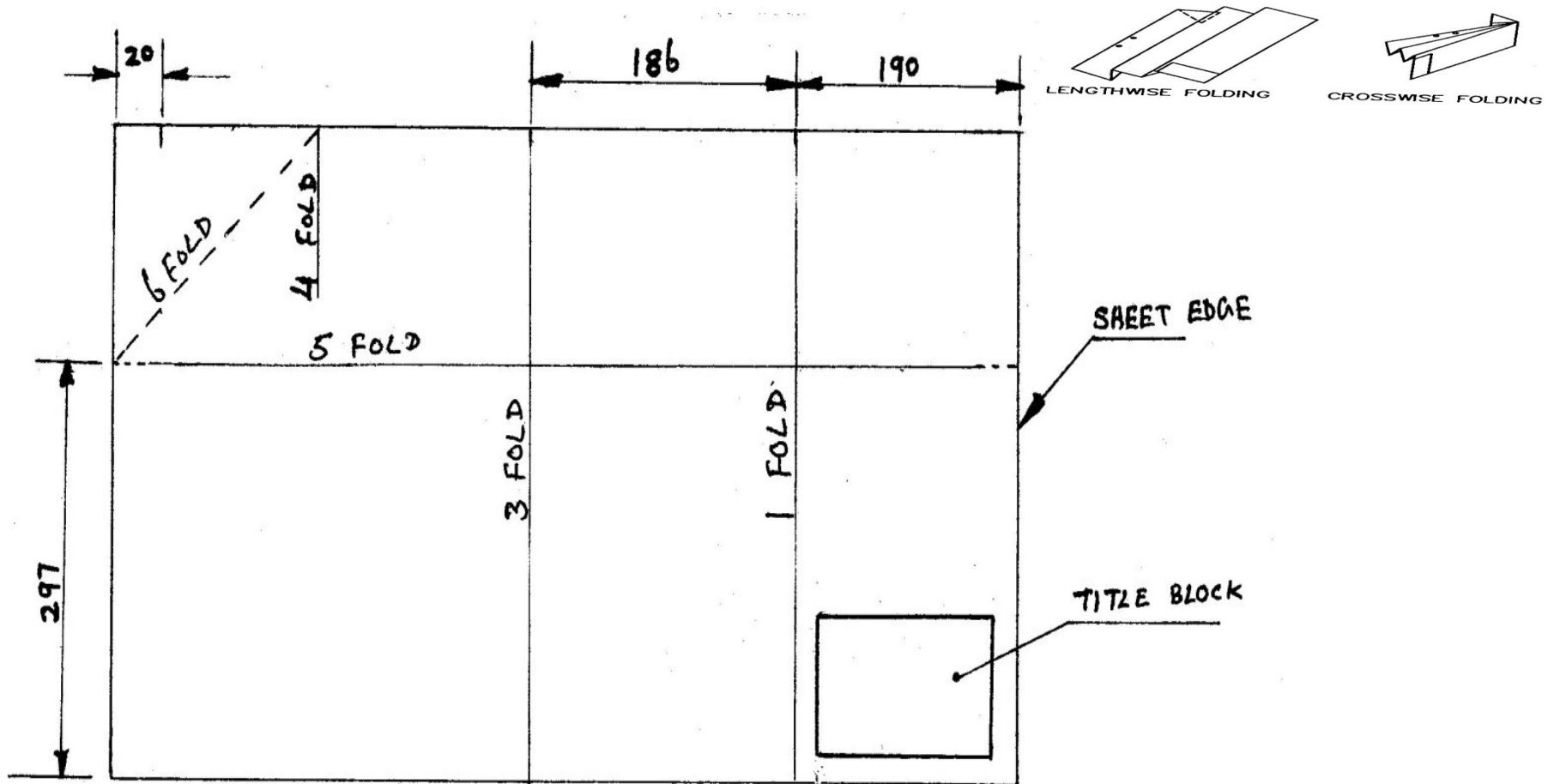
♣ **Title block for assignment work:**

- ♥ For title of the drawing take size 7 mm. For others take size 5 mm.
- ♥ If more than one drawing sheet is used for a particular TITLE OF THE DRAWING, sheet no. is n/p, where n is the sheet no. and p is the total no. of sheets. i.e. if for projections of lines 2 sheets (not pages) are used, then sheet no. is 1/2 and 2/2.
- ♥ The symbol for first angle projection is drawn.
- ♥ **Write your name, roll no., branch and section with pen.**

<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 5px;">80</div> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 10px;">30</div> <div style="margin-bottom: 10px;">15</div> <div>15</div> </div> </div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">B. RAMESH</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">PROJECTIONS OF</div> <div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">LINES</div>		
	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">ROLL NO: 22 ME 47</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">SCALE: 1:1</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">DATE: 01.10.06</div>	
	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">CLASS: MECH A</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">SHEET NO: 1/1</div> <div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">FACULTY:</div>		
	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">SJLE</div>			
	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">75</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">50</div>	<div style="border-bottom: 1px solid black; display: inline-block; width: 100%;">170</div>	

♣ **How to fold the A2 size drawing sheets for assignment work?**

- ♥ Mark 190 mm from the right edge of the drawing sheet. Mark 186 mm from the previous mark. Mark 20 mm from the left edge of the drawing sheet.
- ♥ Mark 297 mm from the bottom edge of the drawing sheet on the reverse side.
- ♥ Coincide the first fold with third fold to get second fold. Coincide the third fold with the border line which is 20 mm to the right of left edge of drawing sheet to get fourth fold. Fifth and sixth folds are back folds.
- ♥ All larger size drawing sheets i.e. A0, A1, A2 and A3 are folded to A4 size sheet.



- ♣ Drawing pencils are made in many grades. The grade HB denotes medium soft. The grades H, 2H, 3H ...9H denotes the degree of hardness (of graphite lead) in an increasing order. So, the darkness of the line made by the pencil goes on decreasing. Similarly, grades B, 2B, 3B...7B denotes the degree of softness (of graphite lead) in an increasing order. So, the darkness of the line made by the pencil goes on increasing.
- ♣ The grade of the pencil / lead is decided by the amount of graphite mixed with clay. That is, more amount of graphite mixed with less amount of clay increases the softness of the pencil / lead and thereby increases the darkness of the line and vice versa.
- ♣ For better understanding of any object, it is essential to differentiate the various types of lines.

HB pencil (Very thick line) → Border, Title block, Arrow head and Free hand sketch.

H pencil (Thick line) → Final projections, Hidden edges, Lettering (Alphabets & Numbers)

2H pencil (Thin line) → Reference lines, Projectors, Construction lines, Dimension lines, Extension lines, Leader lines, Section lines and Centre lines(axis).

Use micro tip pencil to get neat drawings. Use micro tip pencil (0.5 mm lead of grade H) to replace H and 2H wooden pencils. While using the above micro tip pencil care should be taken to differentiate thick and thin lines. For very thick line use micro tip pencil (0.5 mm lead of grade HB).

Note: Micro tip pencils, otherwise known as clutch pencils or mechanical pencils, with 0.5 mm thick leads of different grades viz. HB, H and 2H are preferred than wooden pencils, as they need no sharpening.

♣ How to draw axis?

Axis should be drawn as a long-dashed dotted thin line as shown below.

Axis should extend beyond the boundary of a figure by a short distance.

♣ Scale:	Drawing size : Actual size	
	1 : 1	→ Full size scale
	2 : 1, 3 : 1, ... 100 : 1, ...	→ Enlargement scale
	1 : 2, 1 : 3, ... 1 : 100, ...	→ Reduction scale

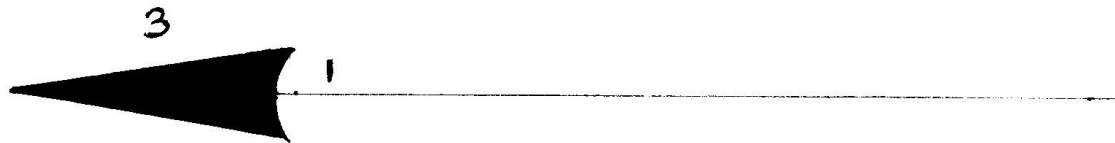
Note : ♥ Whatever the scale may be, the angle remains the same.

♥ Whatever the scale may be, only the actual size should be mentioned in the drawing while dimensioning.

♥ If you use enlargement scale or reduction scale mention that beneath the corresponding problem. Eg. SCALE : 2 : 1

♣ Usage of mini drafter is a must.

♣ For drawing arrow heads remember the ratio 3 : 1. It doesn't mean 3 mm : 1 mm. Shade the closed arrow head with HB pencil. Always draw the arrow heads proportionate to the space available between the extension lines.



Lettering:

- ♥ In an engineering drawing, it is necessary that the drawing of a component should accompany with some written details, to convey the technical information such as name of the company, part details, information regarding the component, manufacturing process, scale etc. Representing the above **particulars** and **sizes** of a component on an engineering drawing is known as **Lettering**.

Note: Lettering includes both alphabets and numbers.

- ♥ Lettering should be done with free hand and not with drawing instruments.
- ♥ Both vertical and inclined letters are in use.
- ♥ In an engineering drawing all the letters must be in upper-case and lower-case letters are used for abbreviations.
- ♥ The scale (other than full size scale) and required answers should be written (with H pencil) beneath the corresponding problem taking the size of letters (use vertical capital letters) as 5 mm.
- ♥ Alphabets and numbers should be obtained in single stroke of the pencil.

A B C D E F G H I J K L M N O P Q

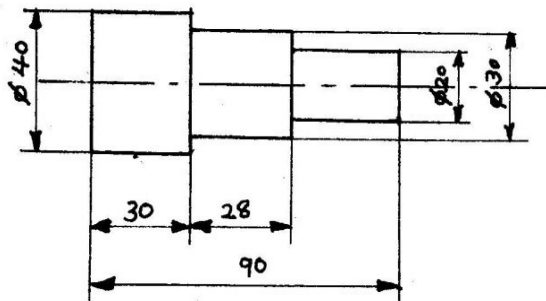
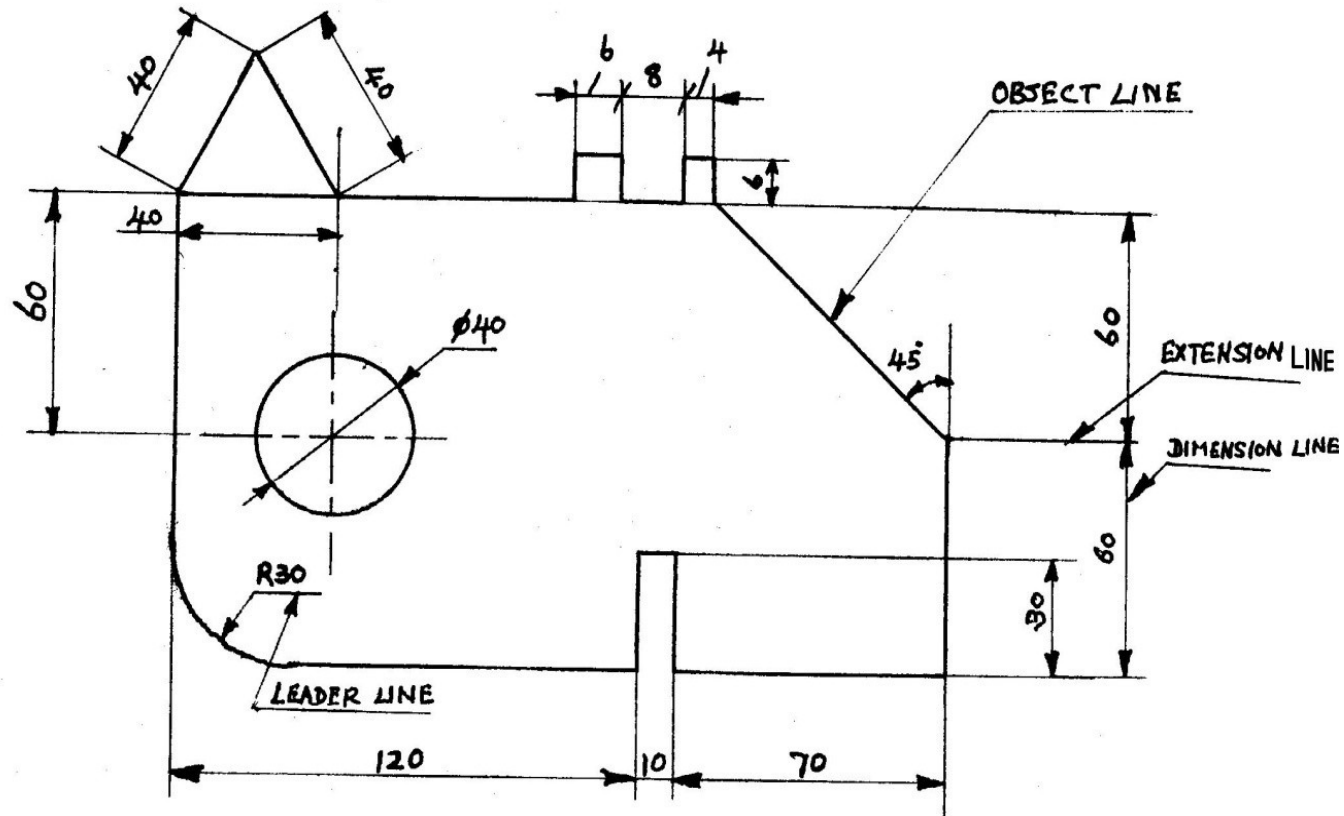
R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r

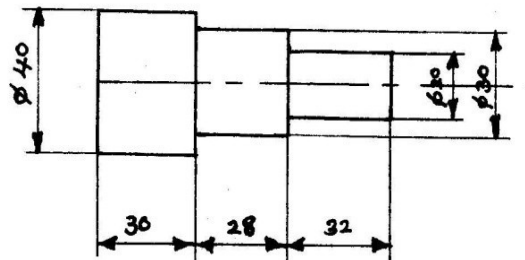
s t u v w x y z

0 1 2 3 4 5 6 7 8 9

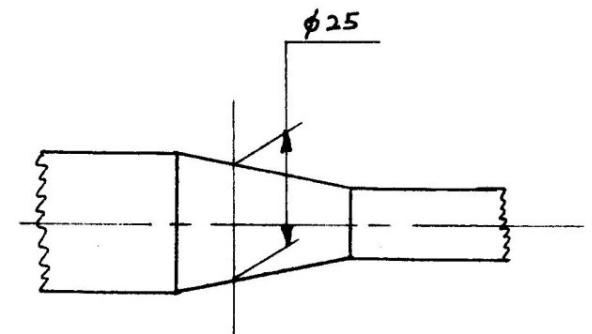
- ♣ The following figures illustrates the Aligned system of dimensioning:



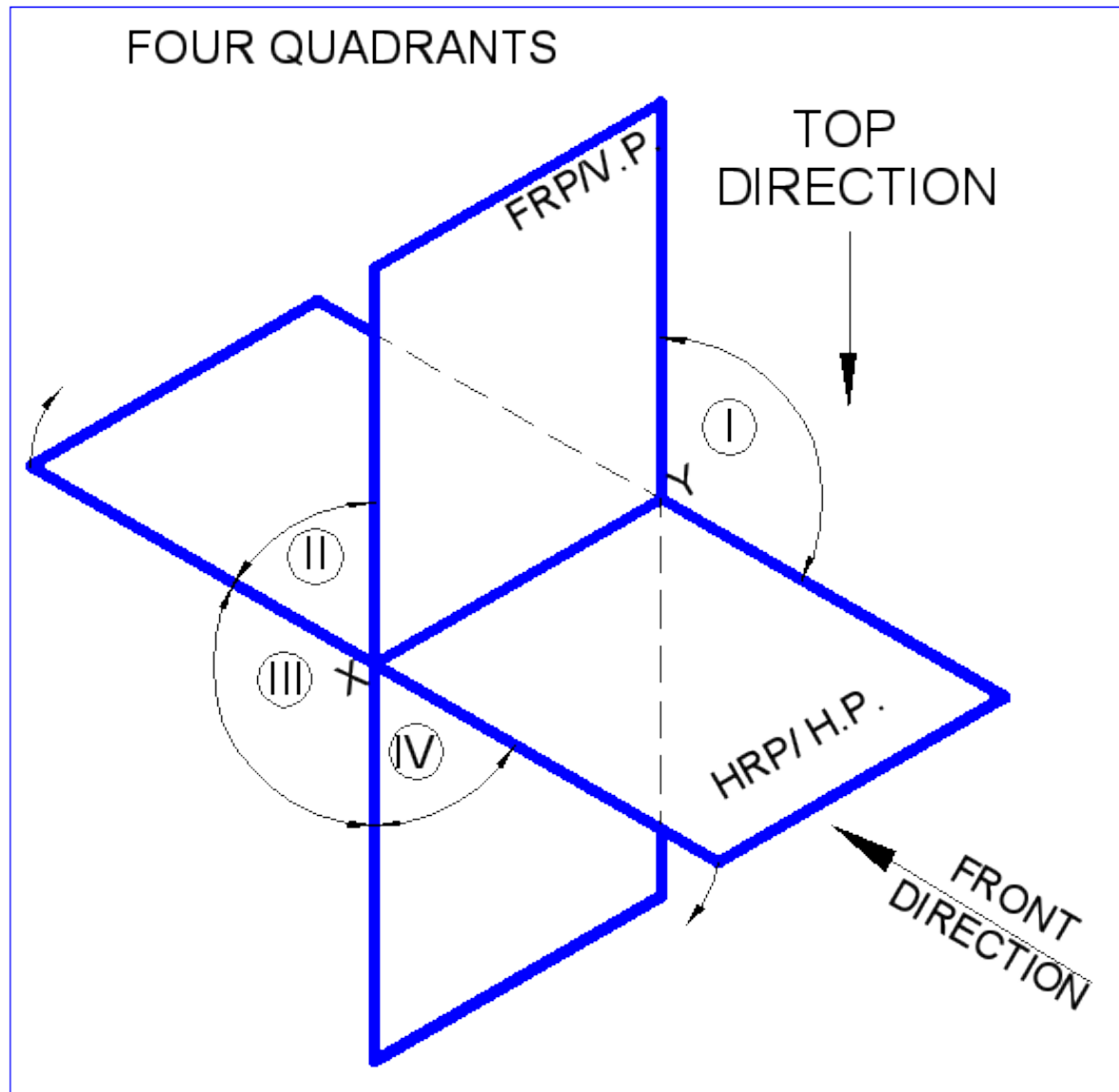
PARALLEL DIMENSIONING

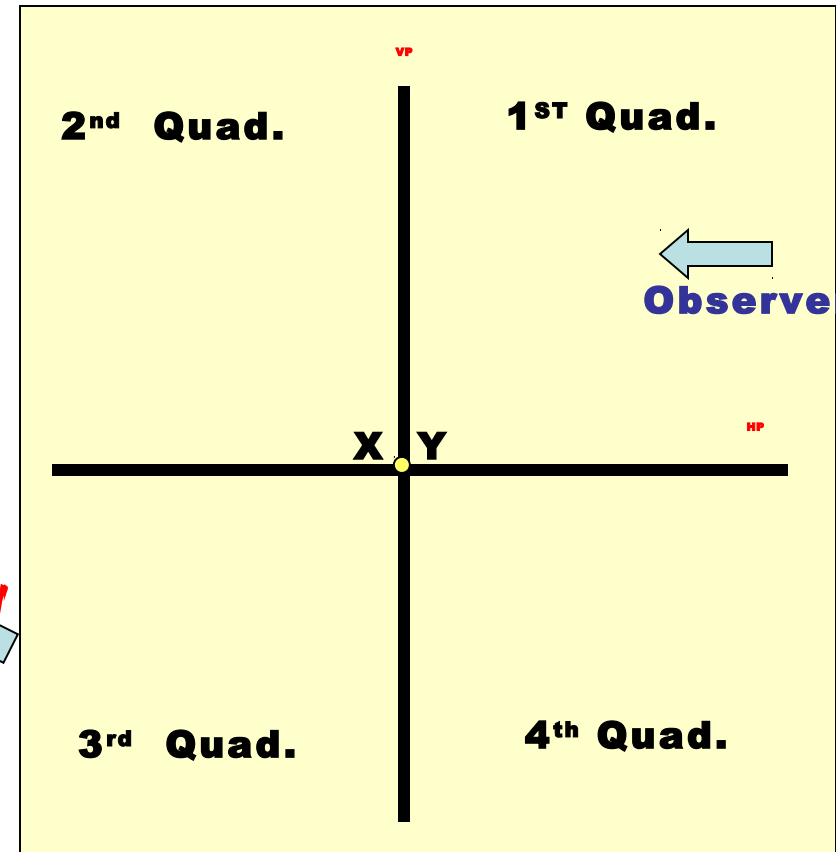
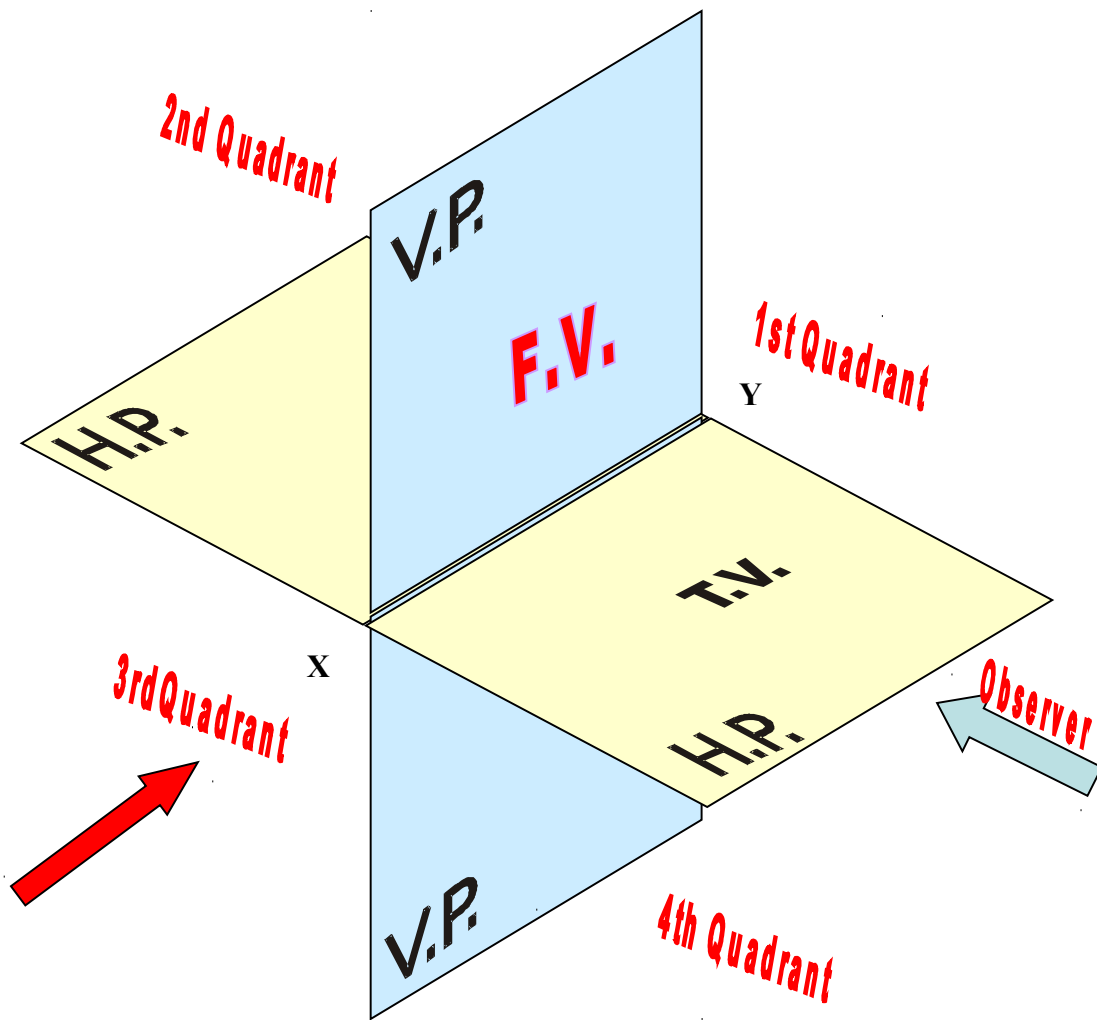


CHAIN DIMENSIONING



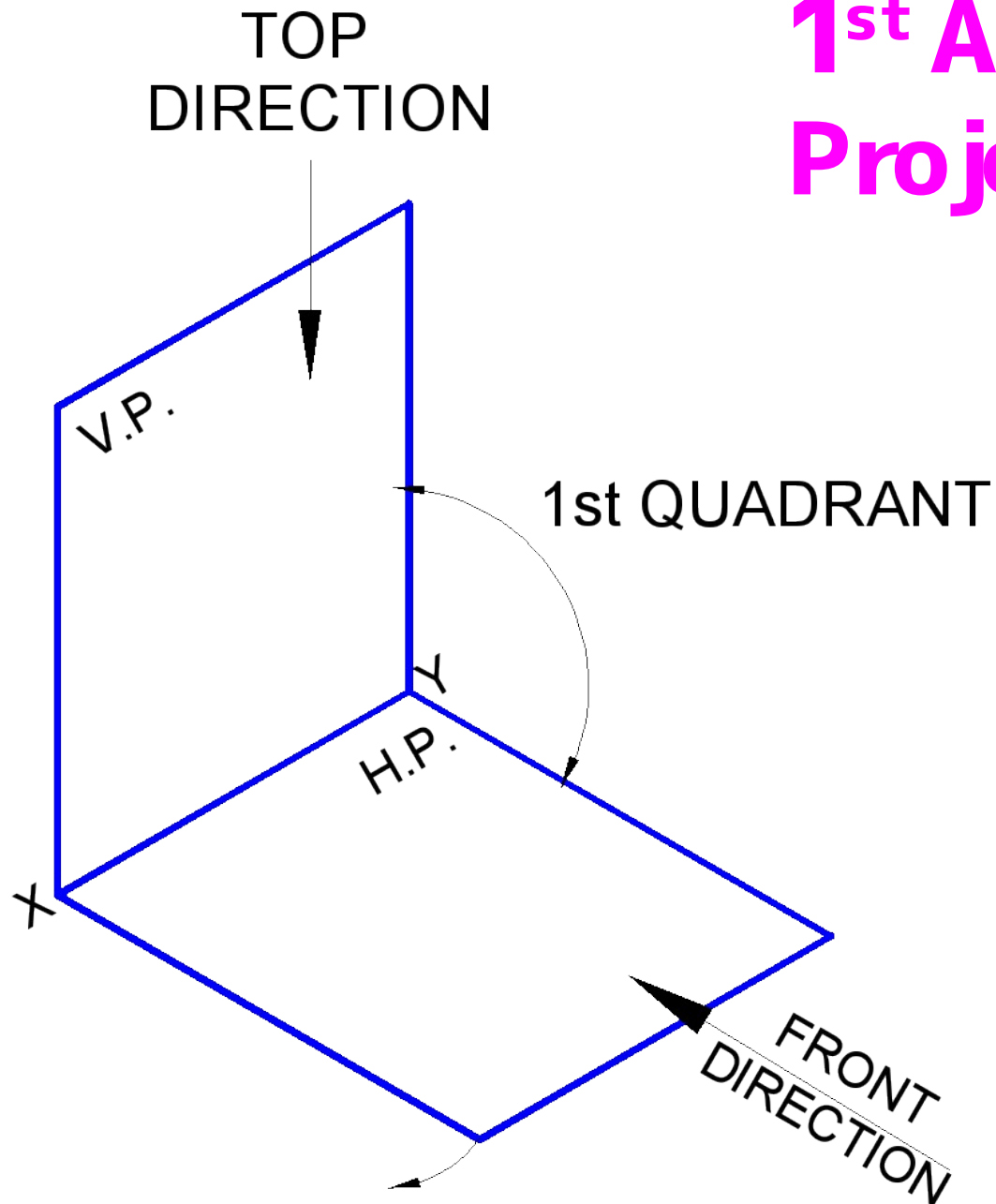
4 QUADRANT THEORY





**THIS QUADRANT PATTERN,
 OBSERVED ALONG X-Y LINE (IN RED ARROW DIRECTION)
 WILL EXACTLY APPEAR AS SHOWN ON RIGHT SIDE AND HENCE
 IT IS FURTHER USED TO UNDERSTAND ILLUSTRATION PROPER**

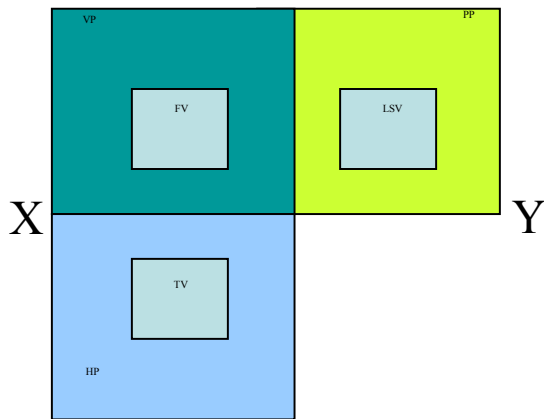
1st ANGLE Projection



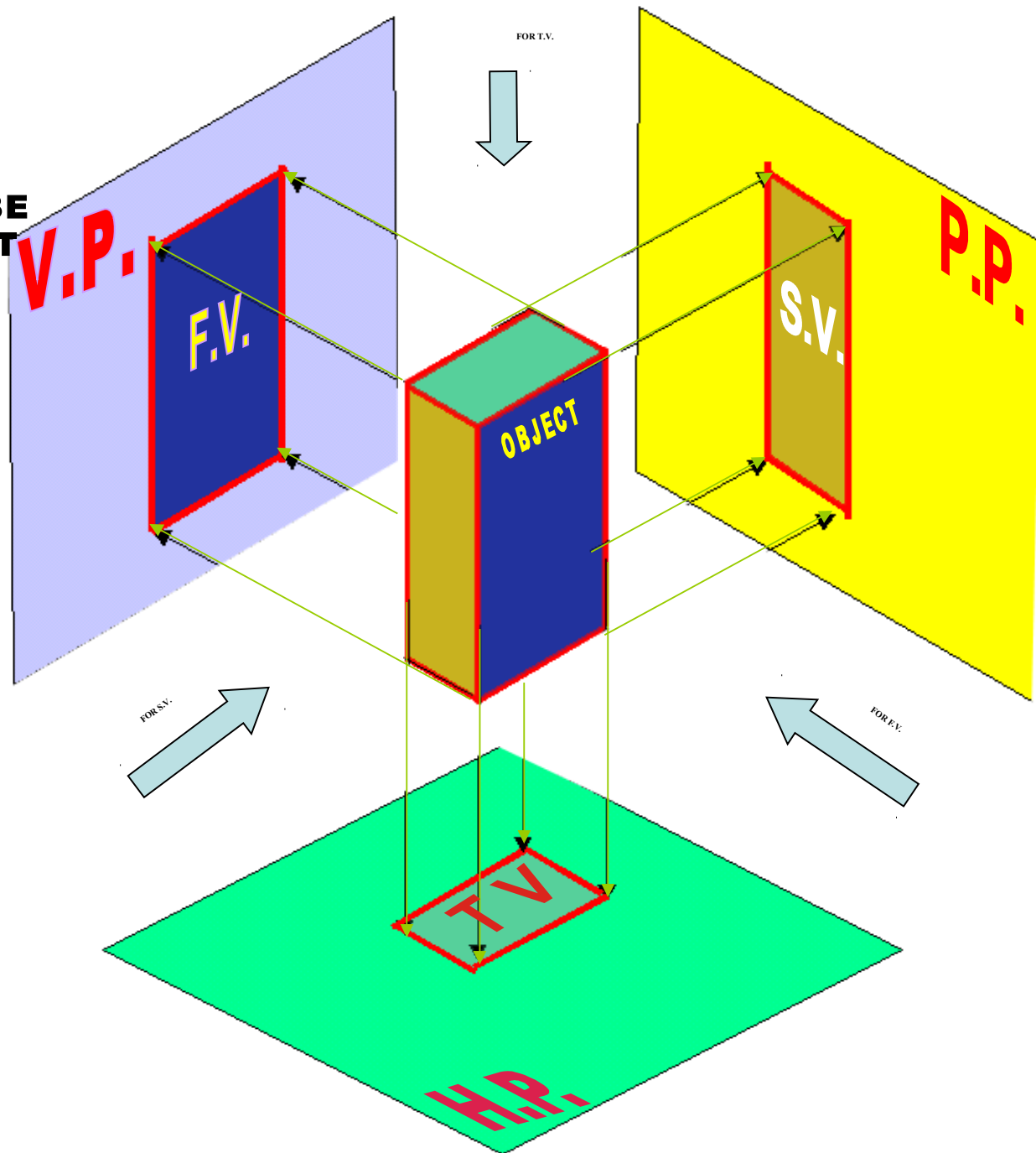
FIRST ANGLE PROJECTION

**IN THIS METHOD,
THE OBJECT IS ASSUMED TO BE
SITUATED IN FIRST QUADRANT
MEANS
ABOVE HP & INFRONT OF VP.**

**OBJECT IS IN BETWEEN
OBSERVER & PLANE.**



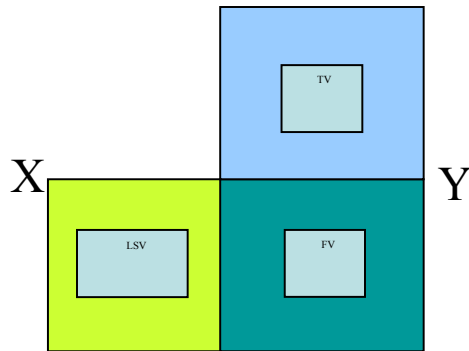
**ACTUAL PATTERN OF
PLANES & VIEWS
IN
FIRST ANGLE METHOD
OF PROJECTIONS**



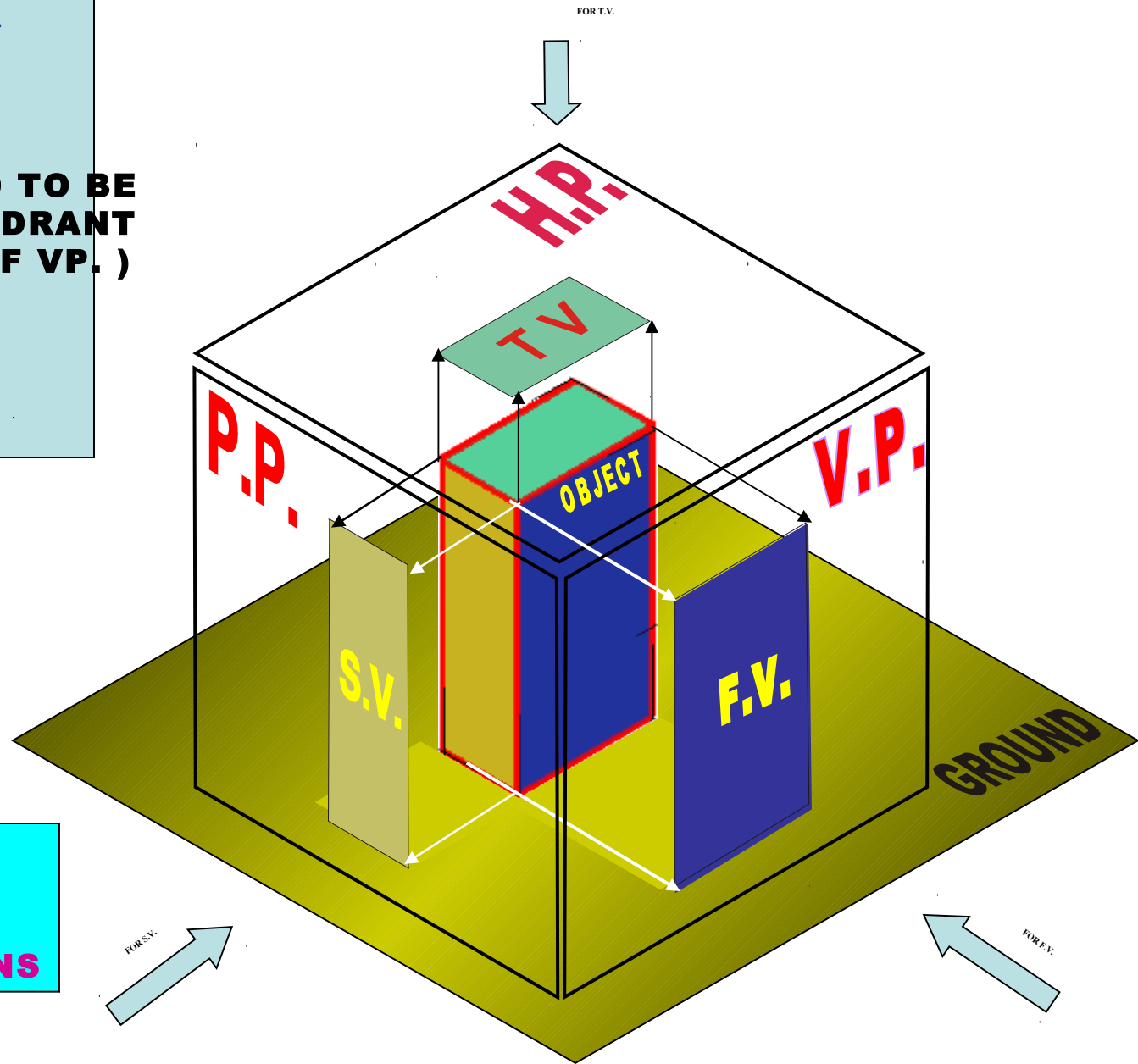
THIRD ANGLE PROJECTION

**IN THIS METHOD,
THE OBJECT IS ASSUMED TO BE
SITUATED IN THIRD QUADRANT
(BELOW HP & BEHIND OF VP.)**

PLANES BEING TRANSPARENT
AND IN BETWEEN
OBSERVER & OBJECT.



**ACTUAL PATTERN OF
PLANES & VIEWS
OF
THIRD ANGLE PROJECTIONS**



THEORY OF PROJECTION

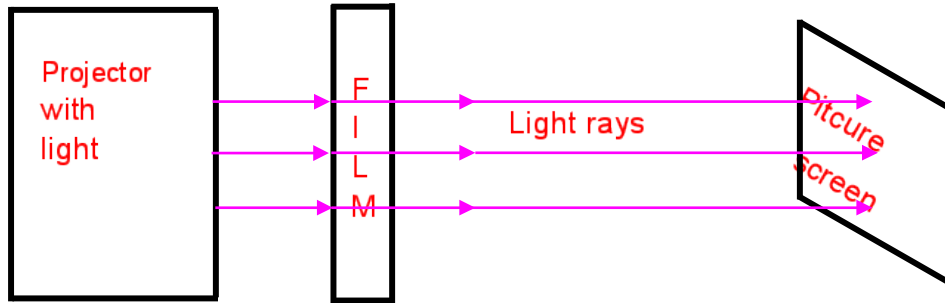
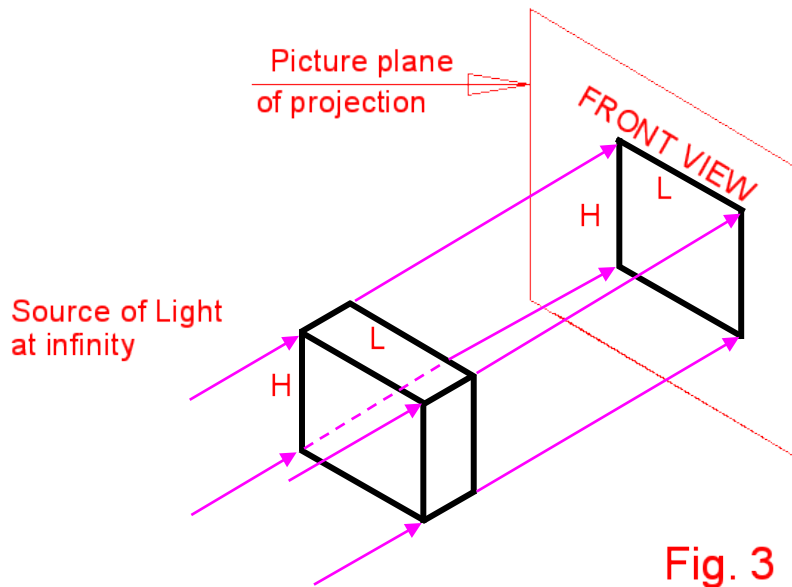
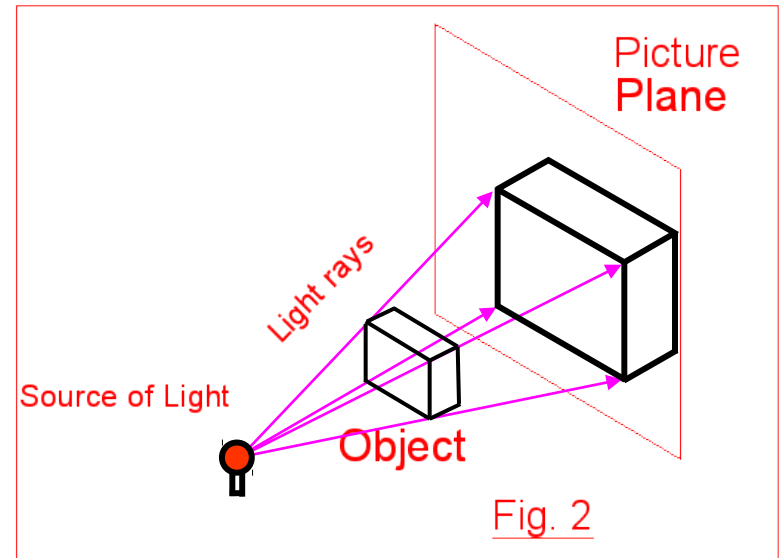


Fig. 1 DISPLAY OF FILM



- ♣ **Projection:** Assume the visual rays from the eye of the observer touch the boundaries of an object and proceed further to penetrate a plane. A line or a smooth curve joining the penetration points is called as the projection of the given object. Normally the object is between the observer and the plane.
- ♣ **Plane of projection:** The plane used for projecting the given object is called as the plane of projection.
- ♣ **Projectors:** They are the rays of sight containing the point and meeting the corresponding plane of projection.
- ♣ **Orthographic projection:** If the projectors drawn from the object are perpendicular (orthogonal) to the projection plane and are parallel to each other, then, such a projection is called orthographic projection. The observer is assumed to be at an infinite distance from the object in order to get parallel and perpendicular projectors. The orthographic projections has the same size as that of the object.

♣ **Difference between first angle projection and third angle projection methods:**

Sl.No.	First angle projection method	Third angle projection method
1.	The object is placed in the first quadrant and the projections are obtained.	The object is placed in the third quadrant and the projections are obtained.
2.	The top view is below the front view. Right side view is drawn to the left of the front view and vice versa.	The top view is above the front view. Right side view is drawn to the right of the front view and vice versa.
3.	The object is kept between the observer and the principal plane of projection.	The projection plane lies between the object and the observer. The projection planes are assumed to be transparent.
4.	Each projection shows the view of that surface which is farthest from the plane concerned.	Each projection shows the view of that surface which is nearest to the plane concerned.

♣ In third angle projection method for eg., right side view is drawn to the right of front view where as in first angle projection method right side view is drawn to the left of front view which is more easier to interpret the drawing and understand the object. So, first angle projection method is preferred rather than third angle projection method.

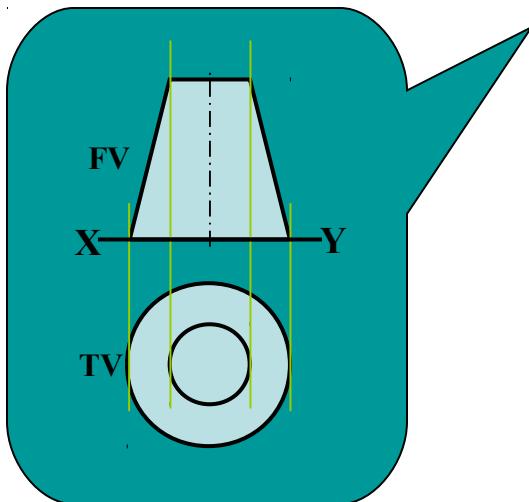
♣ In second angle projection, both the top and front views appear above the reference line. If the object is kept in the fourth quadrant, both the top and front views appear below the reference line. Thus, showing the projections on a flat surface becomes inconvenient. Hence the second and fourth quadrants are not preferred.

Methods of Drawing Orthographic Projections

First Angle Projections Method

Here views are drawn
by placing object
in **1st Quadrant**

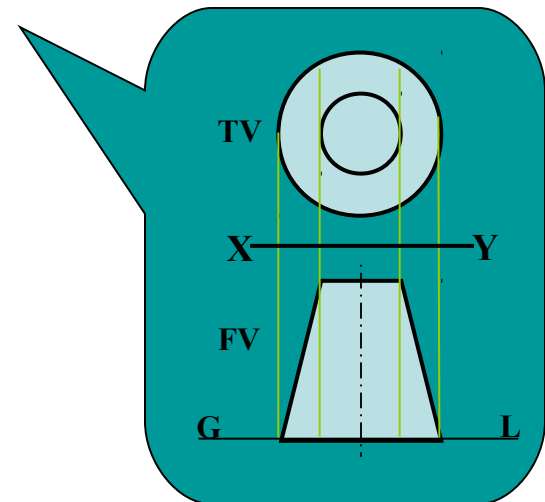
(Fv above X-y, Tv below X-y)



Third Angle Projections Method

Here views are drawn
by placing object
in **3rd Quadrant**.

(Tv above X-y, Fv below X-y)



SYMBOLIC
PRESENTATION
OF BOTH METHODS
WITH AN OBJECT
STANDING ON HP (GROUND)
ON IT'S BASE.

NOTE:-

HP term is used in 1st Angle method
&
For the same
Ground term is used
in 3rd Angle method of projections