BASIC ENGINEERING DRAWING



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Unit - 1 Basic Civil Engineering

1.1 - DRAWING INSTRUMENTS AND THEIR USES



1.2 - LINES, LETTERING AND DIMENSIONING

 STRAIGHT LETTERS & NUMBERALS

 ABCDEFGHIJKLMNOPORSTUVWXYZ

 1234567890

 INCLINED LETTERS & NUMBERALS

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"Believe in yourself and the world will be at your feet"

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DRAWING INSTRUMENTS AND THEIR USES

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Learning Objectives

At the end of this lesson you shall be able to

- State the importance of drawing.
- List the drawing instruments.
- Use different drawing instruments.
- Follow precaution in the use of instruments.

1.1.1 Introduction

To produce a best standard product, all the technical personnel (Engineers to Craftsmen) must have a sound knowledge in Engineering drawing. Because Engineering drawing is the language with different types of lines and alphabet. Technical personnel in any industry including craftsman are expected to communicate anything concerning a part or a component by drawings involving lines, symbols, abbreviations, etc.

1.1.2 Drawing - Definition

A drawing is a graphic representation of an object or a part of it and is the

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result of the creative thought by an engineer or technician. Drawing is classified into three types.

Types of Drawing

- 1. Art Drawing.
- 2. Geometrical Drawing.
- 3. Engineering Drawing.
- 1. Art Drawing: Drawing of objects like trees, animals, hills and natural sceneries on the paper is called as "Art Drawing".
- 2. Geometrical Drawing: Drawing of geometrical shapes like square, rectangle, triangle, cylinder, sphere, etc., on the paper is called "Geometrical Drawing".
- **3. Engineering Drawing**: Drawing of Engineering objects like buildings, machines, electricity, etc., on the paper is called "**Engineering Drawing**".

1.1.3 Drawing Instruments

There are so many drawing instruments used to draw a drawing in a simple and accurate way. They are :

- 1. Drawing Board
- 2. T-Square

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- 3. Set Squares
- 4. Protractor
- 5. Mini Drafter
- 6. Clinograph
- 7. French Curves
- 8. Scale
- 9. Compass (Bow Compass, Large Compass)
- 10. Divider
- 11. Drawing Pencils
- 12. Pencil Eraser
- 13. Drawing Sheet

1.1.3.1 Drawing Board





Drawing Board with Stand

Drawing board is one of the main equipment of Draughtsman. It is used for supporting the drawing paper for making drawings. It is rectangular in shape. It is made of well seasoned wooden strips of about 25mm thick, free from knots and



Drawing Instruments | Basic Engineering Drawing

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S.No.	Designation	Drawing- Sheet Size to be used	Size of the Board in mm (Length, Breadth, Thickness)
1	D0	A0	$1500 \times 1000 \times 25$
2	D1	A1	$1000 \times 700 \times 25$
3	D2	A2	$700 \times 500 \times 15$
4	D3	A3	$500 \times 350 \times 15$

Standard Size of Drawing Boards as per IS 1444-1989

warping. It should be softer enough to allow insertion and removal of drawing pins. Two battens are fastened to the board by screws, in slots. They prevent warping and at the same time permit expansion and contraction of the strips due to the change of moisture in the atmosphere.

One of the shorter edges of the drawing board is provided with an "Ebony edge" (hard wood) fitted perfectly straight, on which the stock of the 'T' square moves. It projects about 4 to 5mm from the board. While working, the ebony edge (working edge) side is to be placed to the left side on a table or castle at a convenient height and slope.

Now-a-days the drawing boards are available with laminated surfaces. The flatness can be checked by placing a straight edge on its surface. If no light passes between them, the surface is perfectly flat.

1.1.3.2 T-Square

It is T - shaped made of wellseasoned wood, or plastic material. It has two parts, namely the head and the blade. One edge of the blade is the working edge. The blade is screwed to this head such that the working edge is at right angle to head.



The	standard	size of	T-Squares
	as per IS	1360 -	1989.

S.No	Designation	Blade Length in mm
1.	T ₀	1500
2.	T ₁	1000
3.	T ₂	700
4.	T ₃	500

The T-Square can move up and down direction only.

The T-Square is used to draw horizontal lines, parallel lines and to guide/hold the setsquares, stencils, etc.

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1.1.3.4 Protractor

Protractor is an instrument used for measuring angles. It is semi-circular in shape and is made of celluloid (or) plastic.

The angles are marked in the circumferential edge at 10° interval both clockwise and anti-clockwise direction. The line joining 0° and 180° is called base of the Protractor.

Protractor With Scale



Parallel line or Straight Edge

T-Square with Set Squares and

Drawing Board

transparent celluloid (or) plastic. They are

two in number, each having one corner

with 90°. The set square with 30°-60°

of 25cm long and 45° of 20cm long is

convenient for use. Set squares sometimes lose their accuracy due to internal strains.

are

madeup

of

1.1.3.3 Set Squares

squares

So they should be tested periodically.

Set

30°–60° Set Square 45° Set Square

Drawing Instruments | Basic Engineering Drawing





Protractor can also be used to divide a circle into equal parts.

1.1.3.5 Mini Drafter:





Parts of Mini-Drafter



A drafting machine is used by professional draughtsmans to prepare drawings. It combines the functions of T – Square, set square, scales, clinograph and protractor. The miniature version of the drafting machine known as "**Minidrafter**". It is used for drafting by students.

One end of the mini drafter is clamped by means of a clamping screw (c.s.) to the longer edge of the drawing board. At its other end, an adjustable knob (k) having protractor (P) markings is fitted. Two Scales of transparent celluloid, set at right angles to each other are attached to the knob.

In short, the mini drafter is used for different drafting operations like, to draw horizontal, vertical and inclined lines, parallel and perpendicular lines and also for measuring lines and angles.

1.1.3.6 Clinograph

An adjustable set square which changes angular measurement is known as clinograph. These are made-up of transparent plastic (or) celluloid. Clinograph can be adjusted to any required



Who invented drafting machine?

The drafting machine was invented by Charles H. Little in 1901. He founded the universal drafting Machine Company in Cleveland, Ohio to manufacture and sell the instrument.

Search link: Htttp://en.m.wikipedia.org>wiki>drafting machine.



angle by using the degrees given at the centre and fixed firmly after adjustment by using a screw provided. With T square, clinograph is used to draw parallel lines to any inclined line.





Clinograph

1.1.3.7 French Curves:

French curve is made of transparent celluloid or plastic. It is used to draw irregular curved lines. It is available in different sizes and shapes. French curve is also inscribed in the setsquares. French curve is used to draw non-circular curves, which cannot be drawn with a compass.



French Curve Models

1.1.3.8 Scale

The Scale is made up of wood, transparent celluloid (or) plastic. Metric (or) British system of measurement is

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Flexi Curve

There is an instrument named as flexi curve which is used to draw

irregular continuous curved lines in architectural drawings.

Search link: http://www.sciencedirect.com>pii.



marked on the edge of the scale. Generally the size of scale we are using is 300mm length, 30mm breadth and 1mm thick. The measurement are graduated in 1:1 scale.

ACTIVITY 1

Prepare a drawing using irregular curved lines with the help of French curves and flexi curve.

1.1.3.9 Compass

- Compass is used to draw circles and arcs.
- Large Compass is used to draw circles from 30mm to 120mm diameter.
- Bow Compass is used for drawing small circles upto 30mm diameter.



Instrument Box Set



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Large Compass



Bow Compass

1.1.3.10 Divider

The divider has two legs hinged at the upper end. It is provided with steel pins at both the lower ends.

Dividers are used for

- Dividing curved or straight lines into any number of equal parts.
- Transfering dimensions from one part of the drawing to another part.



Setting dimensions from the scale to the drawing.

1.1.3.11 Drawing Pencils

Drawing pencils are different from ordinary pencils and are in grades HB,H, 2H, etc. Grade HB denotes medium soft. Grades H, 2H etc, denote the degree of hardness in increasing order. Grades B, 2B, etc., denote the degree of softness in increasing orders. There are 18 numbers of quality drawing pencils. The grade of the pencil is decided by the amount of graphite mixed with clay.

Uses:

HB Soft Grade – used for drawing border lines, lettering and freehand sketching.

H Medium Grade – used for drawing visible outlines and visible edges.

2H Hard Grade – used for construction lines, Dimension lines, Leader lines, extension lines, centre lines, hatching lines and hidden lines.

Drawing Instruments | Basic Engineering Drawing

NOTE: Never use ordinary cheap quality pencils on your drawing sheet.



Keep your pencil sharp: A dull pencil produces fuzzy lines. Only a sharp pencil produces black and sharp lines that sparkle with clarity. Lead is sharpened to conical point (or) chisel edge by rubbing on an emery paper. Conical point is used for lettering and freehand sketching. Chisel edged pencil is used for drawing lines.

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Micro-tip pencils

Micro-tip pencils / clutch pencils with 0.5mm thick leads of grades HB, H and 2H are preferred than wooden pencils, as they need no sharpening.



Microtip Pencils



What is the birth place of pencil?

Germany was the birth place of the first mass produced pencils in 1662.

The discovery of a large graphite deposit in Borrowdale, England in 1564.

Later, the graphite was inserted into hollowed – out wooden sticks and thus the wood cased pencil was born at Nuremberg, Germany

Search link: http://en.m.wikipedia.org>swiki>pencil. www.historyofpencils.com

1.1.3.12 Pencil Eraser

Pencil eraser ('it is not rubber' call it 'eraser') is used to erase unwanted lines, etc. A non-dusting good quality eraser should be used.





Pencil Eraser

1.1.3.13 Drawing Sheet

Drawing sheets are of two types:

- Mill made paper
- Hand made paper.

Mill Made Papers are most commonly used for regular work and are available in different sizes and rolls .



Mill Made Paper

Hand-Made Papers have rough surfaces, pale in color and not used for regular work, but meant for charts.



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Eraser

In, 1770 English engineer 'Edward Nairne' developed the first widely

marketed 'rubber eraser.' Until that time it was known as 'gum elastic'





Hand Made Paper

Sizes of Drawing Sheets: The drawing sheets are designated by symbols such as A0, A1, A2, A3, A4 and A5. In which A0 being the largest.

Drawing Instruments | Basic Engineering Drawing

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Designation	Trimmed Size in mm	Untrimmed Size in mm	
A ₀	1189×841	1230×880	
A ₁	841 × 594	880 × 625	
A ₂	594×420	625×450	
A ₃	420 × 297	450 × 330	
A ₄	297 × 210	330 × 240	
A ₅	210×148	240 × 165	

Standard Size of Drawing Sheets

Layout and Folding of Drawing Sheet (IS 10711:2001)



Prepare an album by collecting the picture of all drawing instruments.

Basic Engineering Drawing | Drawing Instruments

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Model Questions

PART I (1 Mark)

Choose the correct answer

1. Drawing related to natural sceneries is

• • • • • • • • •

- a. Art drawing
- b. Geometry drawing
- c. Engineering drawing
- d. Civil drawing
- 2. The drawing related to building is
 - a. Art drawing
 - b. Geometry drawing
 - c. Civil drawing
 - d. Engineering drawing
- 3. With the help of protractor and set square are used.
 - a. Scale

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- b. Clinograph
- c. T-square
- d. Drafter
- 4. The length of $30^{\circ}-60^{\circ}$ set square is
 - •••••
 - a. 30 cm
 - b. 35 cm
 - c. 15 cm
 - d. 25 cm
- 5. The lines are equally divided with the help of
 - a. Divider
 - b. Compass
 - c. Set squares
 - d. Protractor



- 6. The quality of pencil used to draw object line is
 - a. 2H
 - b. 3H
 - c. HB
 - d. H
- 7. The total number of quality drawing pencil is
 - a. 6
 - b. 12
 - c. 18
 - d. 3
- 8. Combined instrument of T-square, set squares, protractor and scale is
 - a. Mini drafter
 - b. French curves
 - c. Compass
 - d. Clinograph

PART II (3 Marks)

Answer in one or two sentences

- 9. What is meant by Engineering drawing?
- 10. Mention any three instruments to draw the drawing.
- 11. What are the instruments used to draw curves?
- 12. What is the use of compass?
- 13. Mention any two prescribed sizes of drawing board.

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PART III (5 Marks)

Answer shortly

- 14. Draw the sketch of a drawing board and mention its parts.
- 15. What are the uses of 'T-squares'?
- 16. Describe the protractor with a neat sketch.

PART IV (10 Marks)

Answer in detail

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17. Describe the mini drafter with a neat sketch.

(a).8 (b).7 (b).8 (a).2 (b).4 (c).2 (c).2 (c).1

erswers

Basic Engineering Drawing | Drawing Instruments

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1.2

LINES, LETTERING AND DIMENSIONING

Learning Objectives

At the end of this lesson you shall be able to

- State the types of line
- Explain the application of different types of lines
- Understand the lettering style
- Define dimensioning
- Dimension the drawings as per standard specification

1.2.1 Introduction

Lines: In Engineering drawing, several lines are followed to define the shape of an object. Each and every line has its individual name and sense. All the types of lines and how each and every lines are used in Engineering drawing is discussed in this lesson.

1.2.2 Types of Lines

- 1. Object line or Outline.
- 2. Hidden lines or Dotted lines.
- 3. Centre Line.

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- 4. Dimension line.
- 5. Arrow heads.
- 6. Extension line (or) Projection line.
- 7. Leader Line.
- 8. Cutting plane line.
- 9. Sectional line (or) Hatching line.
- 10. Short break line.
- 11. Long break line.
- 1. **Object Line (or) Outline:** When we see an object, the visible edges and their surface boundaries are drawn in a

Line Types

thick

thin

- Object LinesHidden Lines
- Center Lines
- Phantom Lines
- Dimension Lines Extension Lines Leader Lines
- Cutting Plane line
- Sections Hatching
- Break Lines



thick

i Sistema	VISIBLE LINE
	HIDDEN LINE
	CENTER LINE
	DIMENSION & EXTENSION LINES
	SHORT BREAK LINE
	LONG BREAK LINE
	PHANTOM LINE
	CUTTING PLANE LINES
	VIEWING- PLANE LINES

drawing by using this lines to show the shape of the object. H pencil is used for drawing, object line/outline. It should be dark and at the same time thin.

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- 2. Hidden Lines (or) Dotted Lines: These lines are used to show the hidden planes and hidden edges of an object. The length of this line may be 2mm to 3mm. The interval between the lines should be 1mm. The point of intersection of these lines with the outlines (or) another hidden line should be clearly shown.
- 3. **Centre Line**: The centre point of arc, circle are denoted by this line. The axes of symmetrical geometrical objects like cylinder sphere and cone are denoted by this line. Construction of this line is with uniform interval of alternative lengthy line and small line. Interval is 1mm length of the line is 9 to 12mm and small lines in 1.5mm
- 4. **Dimension Line (D.L)** This line is a continuous narrow line drawn parallel to the edge or surface whose measurement should be shown. It should be placed outside the view. Sometimes in unavoidable situation it may be placed inside the view.



Dimension line is placed at least 12 mm away from the outline of the drawing. It is terminated by arrows at its end.

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5. Arrow Heads: At both ends of the dimension line, the arrows are marked. Arrow marks are drawn as per the sketch shown. But same type of arrow mark should be used in a sketch .The angle between the arrow mark may be 15° to 90°.

Where space is too small for an arrowhead, the oblique stroke (drawn as a short line inclined at an angle of 45°) or a dot may be substituted as shown in fig.



6. Extension Line (or) Projection Line: It is a continuous narrow line drawn perpendicular to the outline to be dimensioned and without leaving a gap from the portion. It is drawn extending slightly beyond the dimension line about 2 mm.



7. Leader Line:

Leader line is a continuous narrow line, connecting dimensional value or

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note with the corresponding feature on the drawing. It is drawn at 30°, 45° or 60° with the horizontal and it should be drawn radially to indicate the radius or diameter of a circle or an arc.



1.2.3 Lettering

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Letters and numerals are used in Engineering drawing to specify the measurement of object and description of that object. H or HB pencils are used to write letters and numerals.

Capital letters are generally used in engineering drawing. But small letters recommended by international standard are also used.

To write letters and numerals, drawing instruments should not be used, as fastness cannot be achieved and also takes more time. Generally letters and numerals are written in two methods.

- 1. Vertical Type
- 2. Inclined Type

Vertical Type: In vertical type of lettering, the letters and numerals should be written perpendicular to the horizontal level.



Inclined Type: In this type letters and numerals should be inclined to 75° to horizontal level.



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1.2.4 Dimensioning

Method of describing the shape and measurement of an object in engineering drawing is called "**Dimensioning**". So many lines, letters, numerals and symbols are used in this dimensioning.



1.2.5 Methods of Dimensioning Method-I: Aligned System

In Aligned method of Dimensioning the dimension line should be continuous and dimension should be placed in the middle of the dimension line without touching it.



Dimensional values are marked so that they can be read either from the bottom or from the right hand side of the drawing. The above figure shows the method of placing dimensional values at different positions on the dimension lines.

Angular Dimensions: Angular dimensions are oriented as in the following figure



Marking Angles from Baseline



Marking Angles Continuously

Method-II: Unidirectional System

In unidirectional method of dimensioning the dimension line should be cut at center and dimensions should be placed in the middle of dimension lines as shown in the fig below.

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NOTE:

- > All dimensions should be noted in mm.
- Only one method of dimensioning should be used in a drawing.
- If the dimension value is less than 1, a zero is placed before the decimal point, example 0.5 and not .5
- Decimal point in a dimension should be written in line with the bottom line of the dimension value, example 0.5 and not 0 `5
- Abbreviation for millimetres is not 'mms' but 'mm' only.

S1. No	DIMENSIONING RULE	INCORRECT	CORRECT
1	Place the dimensions outside the views.	60 50 50	<u>60</u>
2	Location of holes should be dimensioned in top views.	40	

1.2.6 Principles of Dimensioning

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3	A circle should be dimension by its diameter using the symbol Ø.		
4	Dimensions to the hidden lines of a view should be avioded.		
5	Arrange a chain of dimensions in a continuos line.		
6	Larger dimensions should be placed out side the shorter one.		
7	Overall dimension should be placed out side of the intermediate dimensions.		35 35 100
8	Dimension figures should be approximately centered between the arrow heads.	40	▲ 40 →

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Ø30

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9 An axis line or outline should never 25 be used as dimension 30 30 line. But the axis line may be used as extension line. 25 Centre line should not 10 be used as a dimension line. 60 60 11 Do not repeat the same dimension in 40 40 different views. 40 40 Dimension line 12 10 should be drawn 10 atleast 12 mm away from the outline and from each other. 13 Arrowheads should touch the Projection lines. Ø10, 25 DEEP 14 Notes should always Ø10, 25 DEEP be written horizontally. 30 15 Dimensions should be given to finished surfaces rather than rough surfaces. 30

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1.2.7 Exercise On Dimensioning:

Example – 1: Read the dimensioned drawing as shown in figure. Redraw the figure in full size. Dimension it as per BIS code. The following mistakes of dimensioning are noted as shown in figure.





- 1. Most of the dimensions are placed inside the drawing. Place them outside the drawing.
- 2. Some of the dimension lines are crossing each other. It is not permitted.
- Diameter of the circle is wrongly given as 30 Ø
- 4. Axis of the circle is not shown correctly.

Example – 2 : Redraw the figure in full size. Mark the dimensions as per BIS.





- 1. Many dimensions are placed inside the drawing. Mark them outside the drawing.
- Dimension (50) Line is crossing the dimension (45) line. Also, dimensions (45) line and dimension (30) line cross each other. Also , dimension (50) and dimension (35) line cross each other. Dimension lines should not cross other dimension lines.
- 3. Dimensional value (50) should be placed in the middle of the dimension line.
- 4. Centre lines of both the holes should be drawn. Distance between center lines should be marked.
- Diameters of the holes are not shown properly. Follow the convention of repeated features for the two holes using leader line and Notes (2xØ 20 or 2 holes Ø 20) written horizontally.
- Extensions of outlines of the drawing are wrongly used as dimension (35 and 15) lines.
- Dimension (15) line between outside the circles and also the dimension (10) line between the outline of the circle and outline of the drawing are not permissible.
- 8. Overall measurements should be given. But only overall width of the drawing is shown. Mark the overall length too.

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Example – 3 : Redraw the figure to half size. Dimension it as per BIScode.

NOTE : Draw the figure to half size (scale 1:2) Mark actual dimensions on the drawing.



1. Dimension (12) is wrongly marked, since the outline of the object is used as dimension line.

An outline or a centreline should never be used as a dimension line. However, a centre line may be extended to serve as an extension line.

- 2. Series of dimensions (45, 45 and 12) are not in a continuous line, which is not proper. They should be arranged on a continuous line.
- 3. The longer dimension (180) is wrongly placed inside the shorter dimension (75)
- 4. Arc dimension (R23) is wrongly marked as (Ø 46)

- 5. Angle (60°) is not properly dimensioned in both the places. The same should be placed by either of the two methods.
- 6. Unit of dimension mm is marked near the dimensional values (75 and 180), which is not correct. A foot-note stating "ALL DIMENSIONS IN mm" is written in a prominent place near the title block.



ACTIVITY 4





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Model Questions

PART I (1 Mark)

Choose the correct answer

- 1. letters are generally used in engineering drawing.
 - a. Capital b. Slanting
 - c. Inclined d. Small
- 2. Generally, the letters and numerals are written in methods.
 - a. 5 b. 4 c. 3 d. 2
- 3. The letters are inclined to to the horizontal plane.

a. 50° b. 75° c. 60° d. 45°

- 4. The angle between the arrow mark may be.....
 - a. 15° to 90°
 - b. 20° to 50°
 - c. 10° to 30°
 - d. 5° to 15°

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PART II (3 Marks)

Answer in one or two sentences

- 5. Write any four types of lines.
- 6. What is dimensioning?
- 7. Define Arrow heads.
- 8. Define oblique stroke.

PART III (5 Marks)

Answer shortly

- 9. Write briefly about any two types of lines with sketch
- 10. Define hidden line and centre line



PART IV (10 Marks)

Answer in detail

- 11. Describe the method of dimensioning in aligned system with sketch.
- 12. Describe the method of dimensioning in unidirectional system with sketch.
- 13. Draw the given figure in full size and dimension it as per BIS code.



Incorrect

(a).¹/₄ (d).² (b).² (b).¹

:srswers: