

A Laboratory Manual for
Engineering Graphics(EGE)
(22003)

Semester- I

Diploma in Engineering
(EJ/IS/IF/CM)



BharatiVidyapeeth Institute of Technology
Navi Mumbai



BharatiVidyapeethInstitute of Technology

Navi Mumbai

Certificate

This is to certify that, Mr./ Ms.Roll No. of first Semester Diploma in Engineering of BharatiVidyapeeth Institute of Technology Navi Mumbai (Inst. code:) has satisfactorily completed the term work in the subject of Engineering Graphics (17001) for the academic year 20.... to 20.....as prescribed in the MSBTE curriculum.

Place:

Enrollment No. :

Date:

Exam. Seat No.:

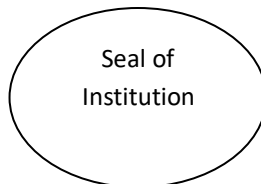
Sign:

Name:

Subject Teacher

Head of the Department

Principal



LIST OF EXPERIMENTS AND PROGRESSIVE ASSESSMENT FOR TERWORK(TW)D-3

ACADEMIC YEAR 20 - 20

Course & code :-

Sub & Code :

Name of Candidate :

Enrollment No :

Roll No :

Marks :

Max : Min :

**Name of
Faculty :**

Sr. No.	Practical Exercise	Date of performance	Date of submission	Marks obtained	Signature
1	Draw horizontal, vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/ drafter				
2	Draw alphabets and numerical (Vertical only) (do this exercise in sketch book)				
3	Draw regular geometric constructions figure (do this exercise in sketch book) (fig. given by teacher)				
4	Draw orthographic projection of the given object by first angle projection method.				
5	Draw orthographic projection of the given object by first angle projection method.				
6	Draw orthographic projection of the given object by first angle projection method.				
7	Draw orthographic projection of the given object by first angle projection method				
8	Draw orthographic projection of the given object by first angle projection method.				
9	Draw orthographic projection of the given object by first angle projection method.				
10	Draw orthographic projection of the given object by first angle projection method.				

11	To draw isometric view from the given orthographic views				
12	To draw isometric view from the given orthographic views				
13	To draw isometric view from the given orthographic views				
14	To draw isometric view from the given orthographic views				
15	To draw isometric view by using isometric scale from the given orthographic views				
16	To draw a Hex head Nut				
17	To draw different types of machine screw				
18	To draw different types of threads.				
19	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD				
20	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD				
21	Draw basic 2D entities like: Circular and rectangular array using AutoCAD				
22	Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD				
23	Draw basic branch specific components in 2D using AutoCAD				
24	Draw complex branch specific components in 2D using AutoCAD (Print out should be a part of progressive assessment)				

OBJECTIVES:

To study the objectives of drawing.

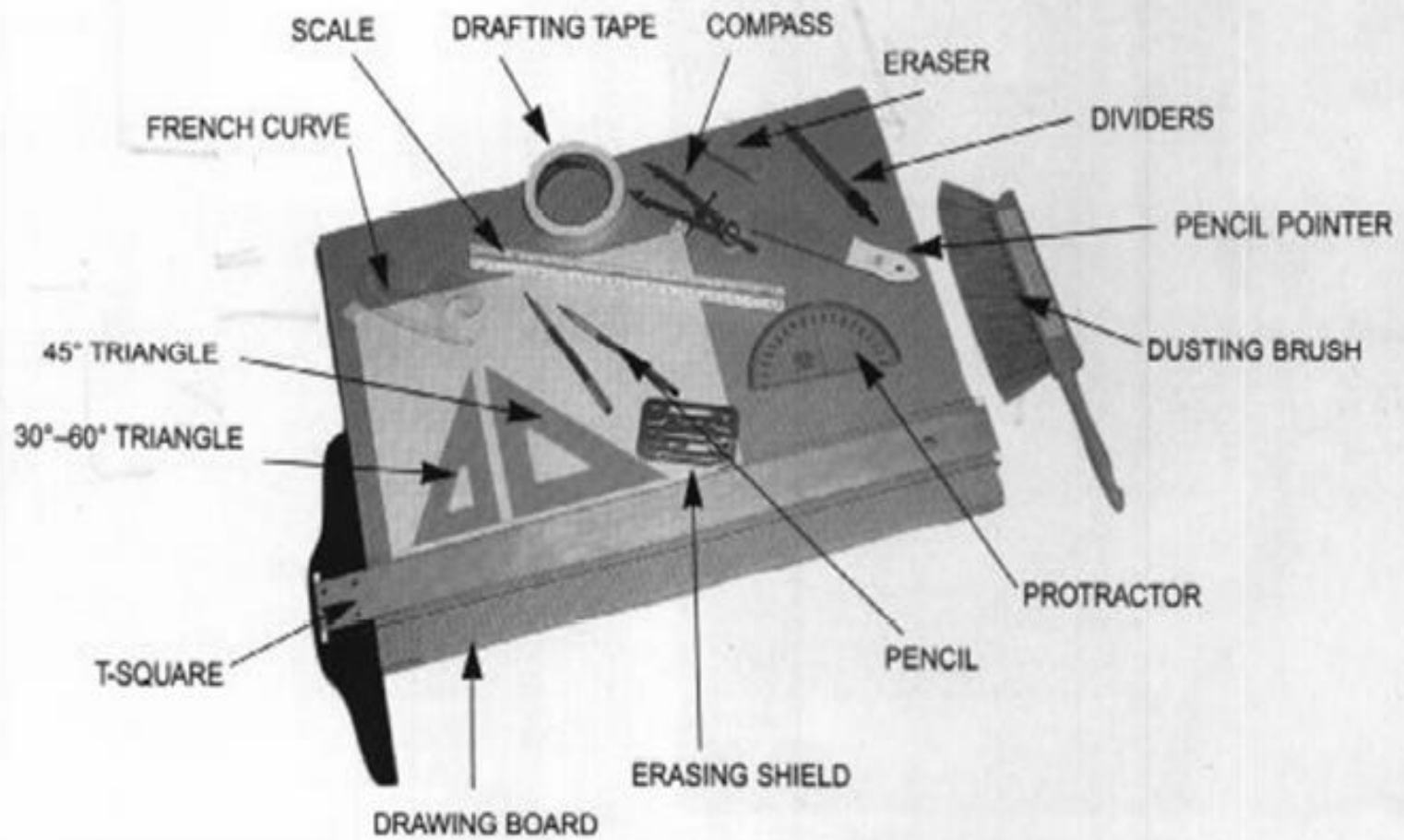
To identify the drawing instruments and study their uses.

To make some drawings using the drawing equipment.

DRAWING OBJECTIVES:

The following are the drawing objectives that students should try to attain:

1. **Accuracy:** No drawing is useful if it is not accurate. Therefore, an engineer or designer must acquire the habit of accuracy to achieve success in professional employment.
2. **Speed:** Time is money and so there's no demand for a slow drafter, engineer or technician in industry; so, what one needs to focus on is speed. However, it cannot be attained by hurrying; rather it comes with study and practice.
3. **Legibility:** Drafters, technicians and engineers must remember that a drawing is a means of communication to others, and that it must be clear and legible to serve its purpose well. Care should be given to details, especially to lettering.
4. **Neatness:** if a drawing is to be accurate and legible, it must also be clean. Untidy drawings are the result of sloppy and careless methods and will be unacceptable to an instructor or employer.



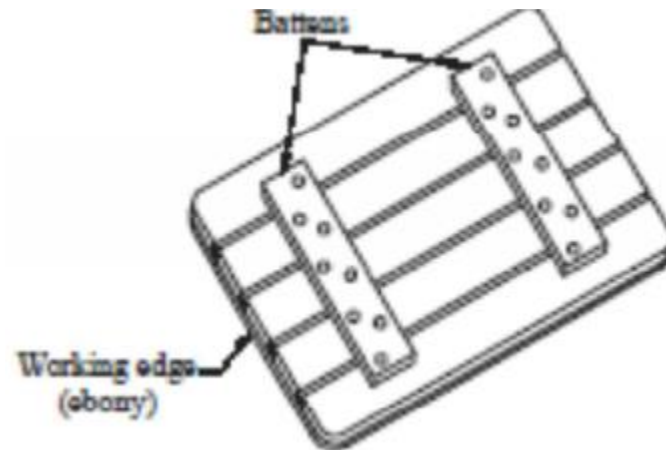
DRAWING INSTRUMENTS AND THEIR USES:

Drawing Instruments are used to prepare neat and accurate Drawings. To a greater extent, the accuracy of the Drawings depends on the quality of instruments used to prepare them. The following is the list of Drawing Instruments and other materials required.

- a) Drawing Board
- b) T-square or Drafter (Drafting machine)
- c) Set Squares
- d) Protractor
- e) Drawing Instrument Box
- f) Drawing Sheet
- g) Drawing Pencils
- h) Drawing Pins/Clips/Tape
- i) French curves

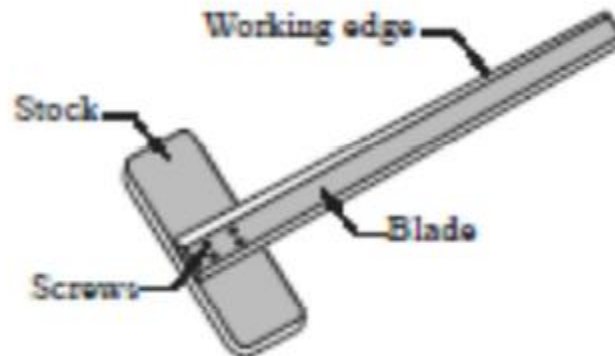
Drawing Boards: It is rectangular in shape and is made of strips of well-seasoned soft wood about 25mm thick. It is cleated at the back by two battens to prevent warping. One of the edges of the board is used as a working edge, on which the T-square is made to slide. It should, therefore be perfectly straight. For a right-hander the left-hand side of the board is the working edge whereas the opposite is true for the left-handers.

If the left edge of the drawing table top has a straight edge and if the surface is hard and smooth, a drawing board then becomes unnecessary and the same drawing table can be used as a board provided the drawings are fastened on it with a drafting tape and it is also recommended to have a back-up sheet placed between the drawing and the table top.



T-Squares: It is a technical drawing instrument used by draftsmen primarily as a guide for drawing horizontal lines on a drafting table. It is made of a long strip called the blade, fastened rigidly at right angles to a shorter piece called the head or the stock. The upper edge of the blade and the inner edge of the head are working edges and must be straight. The working edge of the head must not be convex or the T-square will rock when the head is placed against the board. The blade should have transparent edges and should be free of nicks along the working edge.

Testing and correcting T-squares: to test the working edge of the head, see if the T-square rocks when the head is placed against a straight edge, such as a drawing board working edge that has already been tested and found true. If the working edge is not straight, the T-square should be replaced. To test the working edge of the blade, draw a sharp line very carefully with a hard pencil along the entire length of the working edge; then turn the t-scale over and draw the line again along the same edge. If the edge is straight, the two lines will coincide; otherwise, the space between the lines will be twice the error of the blade. it is difficult to correct a crooked T-square blade, and if the error is considerable, it may be necessary to discard the T-square and obtain another.



Set squares: Set squares are generally made from Plastic or celluloid material. They are triangular in shape with one corner, a right angle triangle. They are used for drawing all straight lines except the horizontal lines which are usually drawn with the T-square. Vertical lines can be drawn with T-square and the set square. In combination with the T-square, lines at 30° or 60° angle with vertical or horizontal lines can be drawn with 30° - 60° set square and at 45° with 45° set square. The two set squares used simultaneously along with the T-square will produce lines making angles of 15° , 75° , 105° etc. Parallel straight lines in any position, not very far apart, as well as lines perpendicular to any line from any given point within or outside it, can be drawn with the two squares.

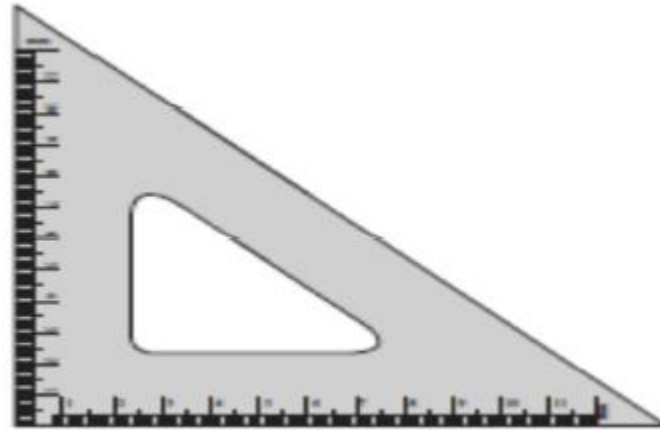


Fig. 1A.4. 45° Set Square

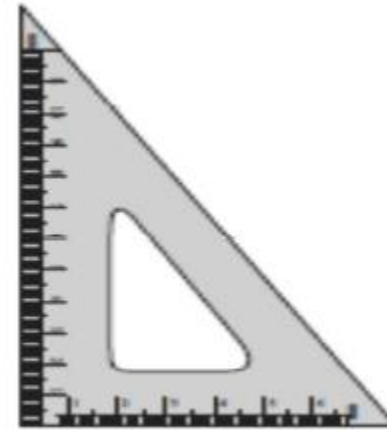
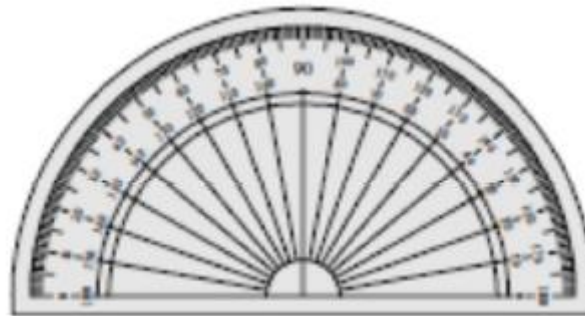


Fig. 1A.5. 30°-60° Set Square

Protractor: it is flat and circular or semi-circular in shape. The commonest type of protractor is semi-circular and of about 100mm diameter. Its circumferential edge, graduated to 1° divisions, is numbered at every 10° interval and is readable from both the ends. The diameter of the semi-circle is called the base of the protractor and its center point is marked by a perpendicular line. The protractor is used to draw or measure such angles as cannot be drawn using a set square. Also, a circle can be divided into any number of parts by means of a protractor.



Drawing Instrument Box: It consists of the following:

- a) Large size compasses,
- b) Large size divider,
- c) Small size bow pen, bow divider, and
- d) Lengthening bar

Drawing sheet:

They are available in many varieties and good quality paper with smooth surface should be selected for Drawings which are to be preserved for longer time. Recommended sizes of Drawing Sheets are given below:

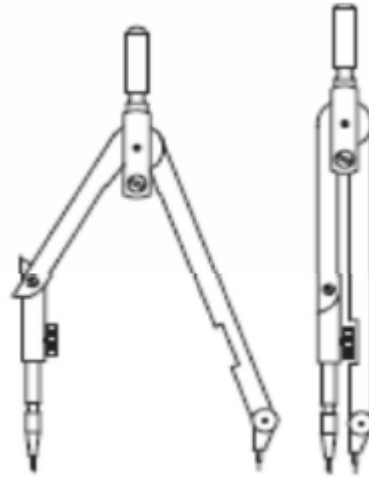
Standard sizes of drawing sheet

Designation	Size (mm)	Designation	Size (mm)
A0	1189 × 841	A3	420 × 297
A1	841 × 594	A4	297 × 210
A2	594 × 420	A5	210 × 148

Drawing Pencils: The accuracy and appearance of a Drawing depends on the quality of Pencil used to make it. The grade of a Pencil lead is marked on the Pencil. HB denotes medium grade. Increase in hardness is shown by value put in front of H such as 2H, 3H etc., Softer pencils are marked as 2B, 3B, and 4B etc. A Pencil marked 3B is softer than 2B and Pencil marked 4B is softer than 3B and so on. Beginning of a Drawing may be made with H or 2H. For lettering and dimensioning, H and HB Pencils are used. The final fair work however, may be done with harder pencils like 3H and upwards. For freehand sketching, where considerable erasing is required to be done, soft-grade pencils such as HB should be used.

Drawing Pins/clips/ tape: These are used to fix the drawing sheet on the Drawing board.

Compass: It is used for drawing circles and arcs of circles. The compass has two legs hinged at one end. One of the legs has a pointed needle fitted at the lower end whereas the other end has provision for inserting pencil lead. Circles up to 120mm diameters are drawn by keeping the legs of compass straight. For drawing circles more than 150 mm radius, a lengthening bar is used. It is advisable to keep the needle end about 1mm long compared to that of pencil end so that while drawing circles, when the needle end is pressed it goes inside the drawing sheet by a small distance (approximately 1mm).



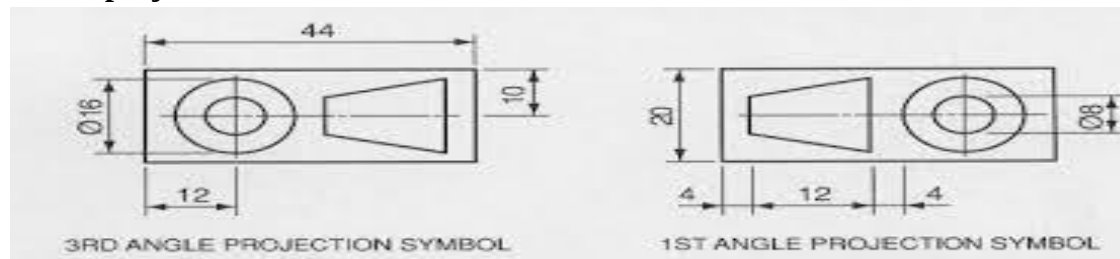
French Curves: Drawing mechanical curves other than circles or circular arcs generally requires the use of an irregular or French curve. An irregular or French curve is a device for the mechanical drawing of curved lines and should not be applied directly to the points or used for purpose of producing an initial curve. These are made in various shapes, some of which have been shown in the figure below. Some set squares also have these curves set in their middle.



Type of Lines and their application

Illustration	Application
Thick 	Outlines, visible edges, surface boundaries of objects, margin lines
Continuous thin 	Dimension lines, extension lines, section lines leader or pointer lines, construction lines, boarder lines
Continuous thin wavy 	Short break lines or irregular boundary lines – drawn freehand
Continuous thin with zig-zag 	Long break lines
Short dashes, gap 1, length 3 mm 	Invisible or interior surfaces
Short dashes 	Center lines, locus lines Alternate long and short dashes in a proportion of 6:1,
Long chain thick at end and thin elsewhere 	Cutting plane lines

Symbols for method of projection



Exercise 1:

Draw horizontal, vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/ drafter.

Exercise 2:

Draw alphabets and numerical (Vertical only) (do this exercise in sketch book)

Exercise 3:

- a) Draw regular geometric constructions figure (do this exercise in sketch book) (fig. given by teacher)

b) Draw regular geometric constructions figure (do this exercise in sketch book) (fig. given by teacher)

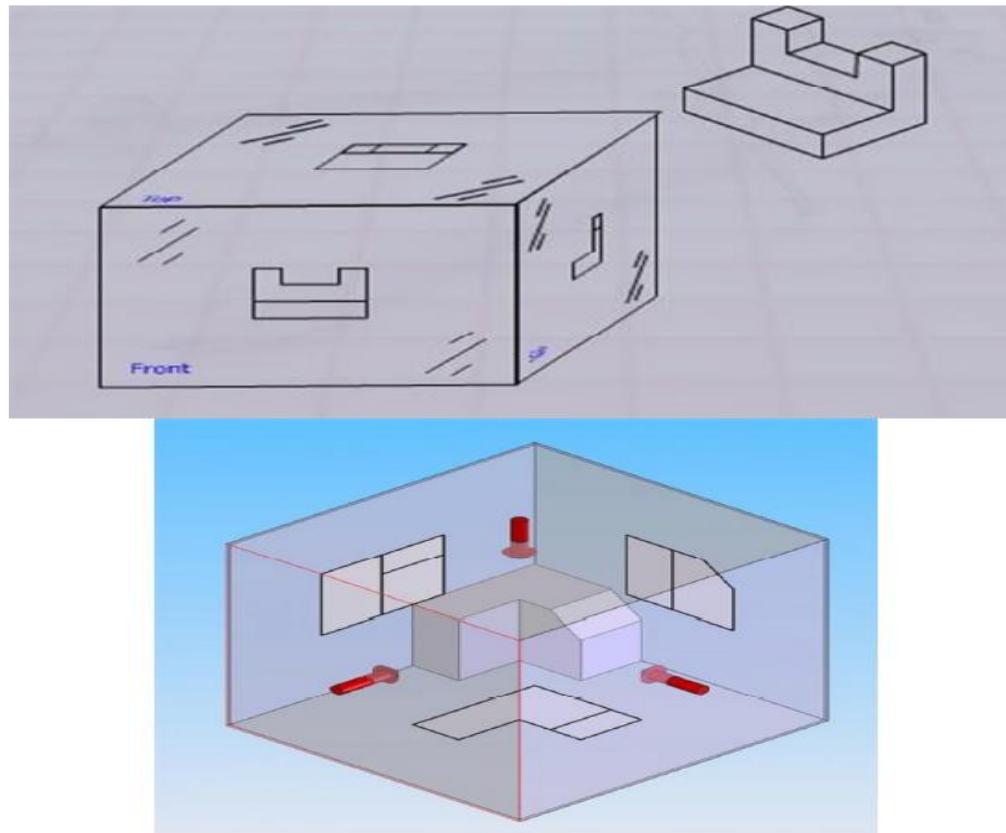
Orthographic projection

OBJECTIVES:

To draw orthographic views of the given machine parts by first and third angle projection methods

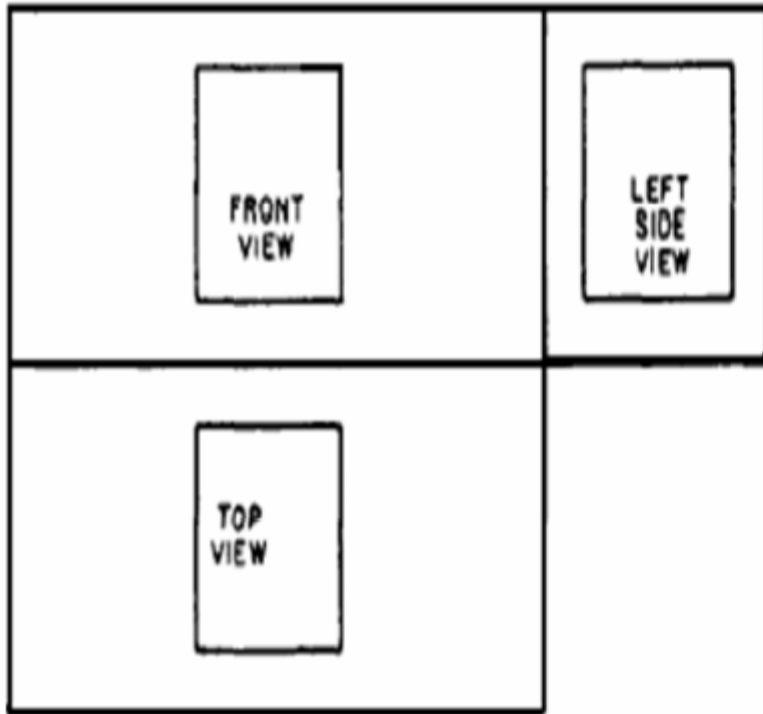
Orthographic projection

Orthographic projection refers to a 2-D representation of a 3-D object in a view that shows only one side at a time. Most orthographic drawings occur in multi-drawing sets in order to depict each side, top and bottom view. Professions in design and construction use these types of drawings to inform the viewer of layout, size and shape.

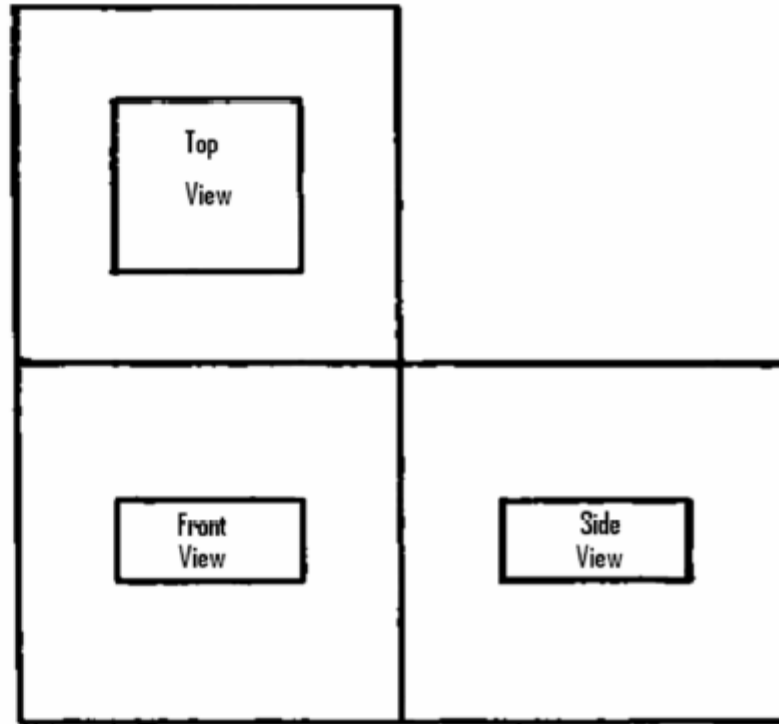


Methods of Orthographic Projection

There are two ways of drawing in orthographic - *First Angle* and *Third Angle*. They differ only in the position of the top, front and side views.



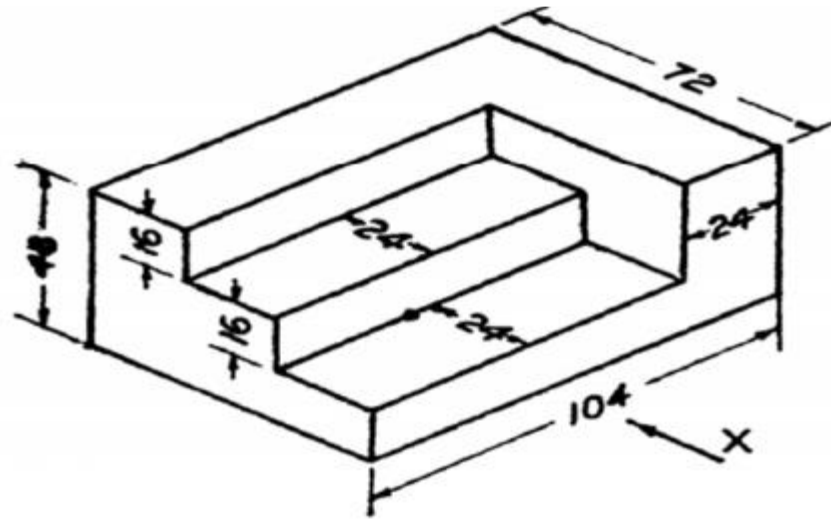
First angle orthographic projection



Third angle orthographic

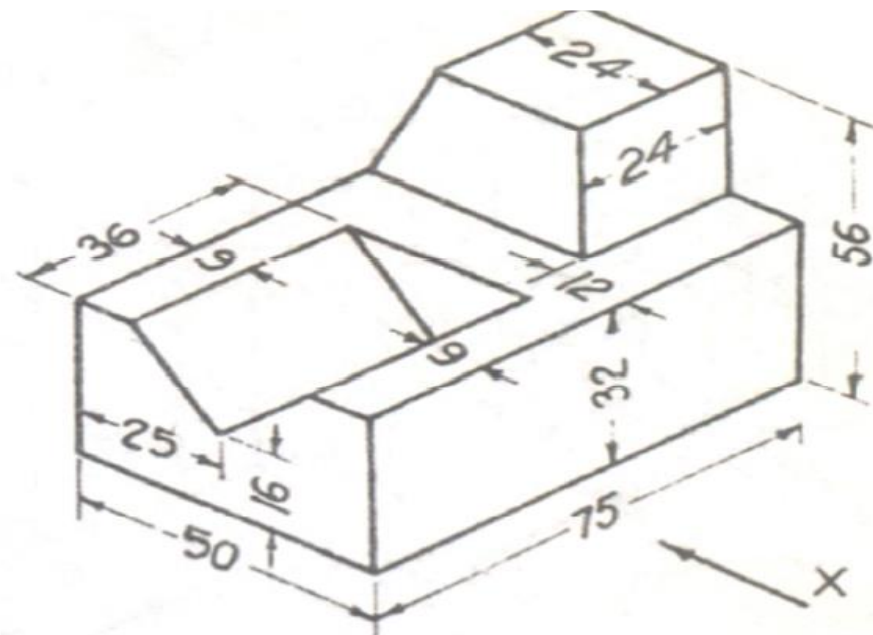
Exercise 4:

Draw orthographic projection of the given object by first angle projection method.



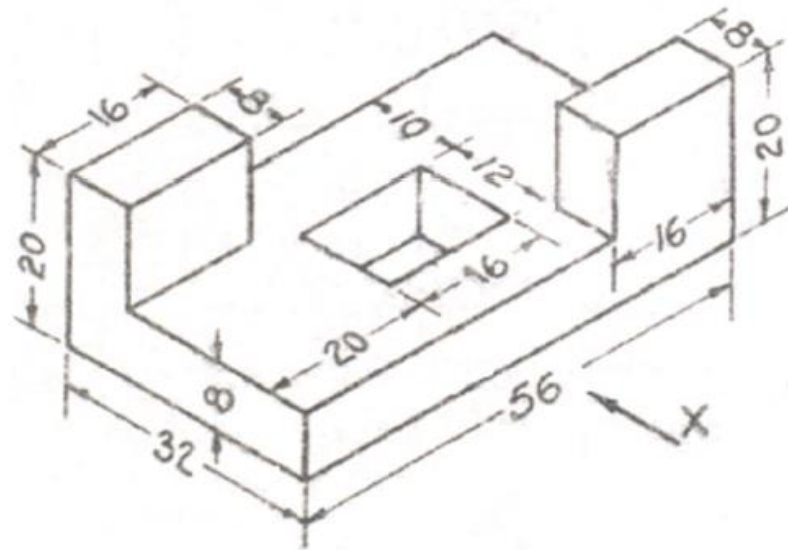
Exercise 5:

Draw orthographic projection of the given object by first angle projection method.



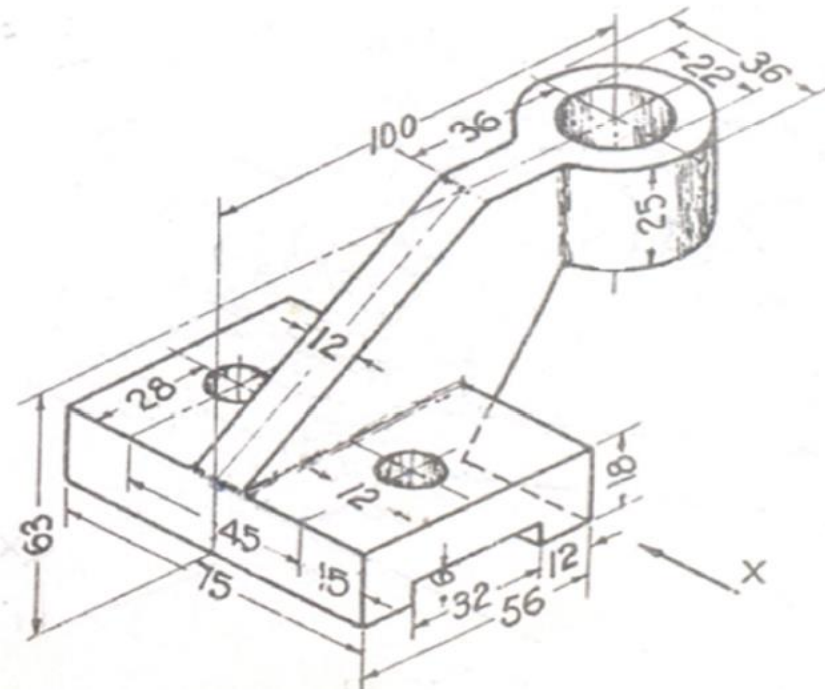
Exercise 6:

Draw orthographic projection of the given object by first angle projection method.



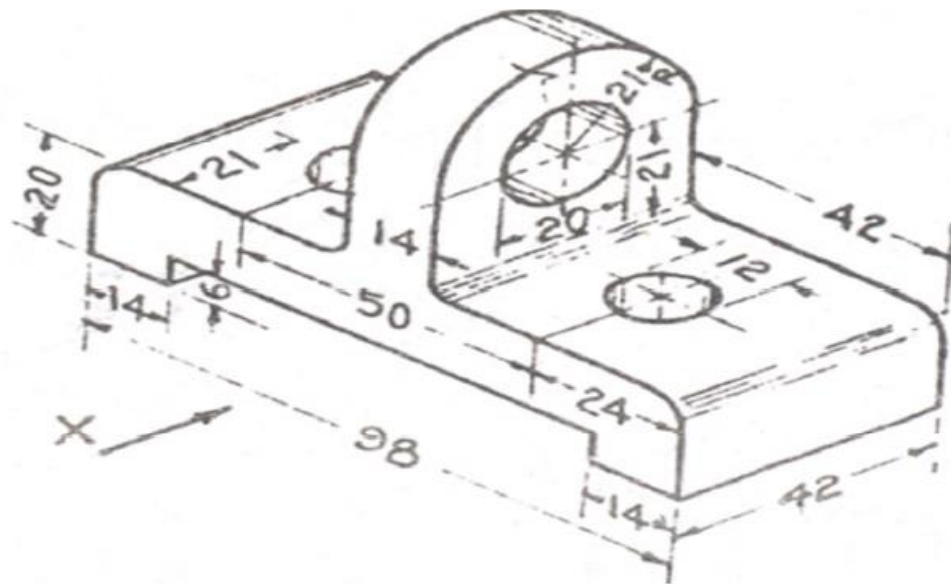
Exercise 7 :

Draw orthographic projection of the given object by first angle projection method.



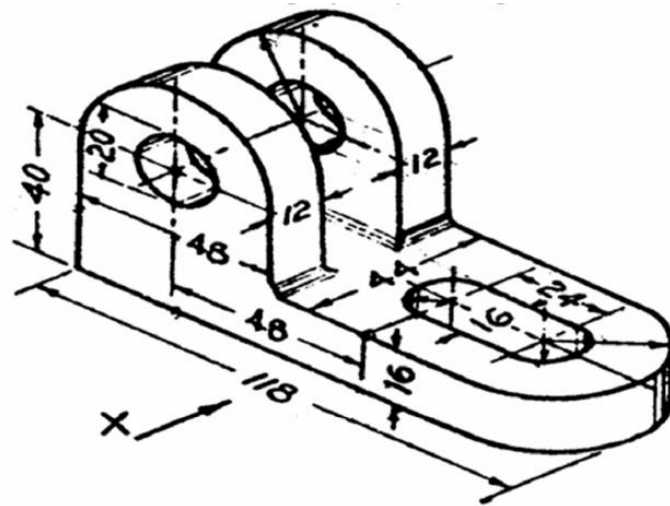
Exercise 8 :

Draw orthographic projection of the given object by first angle projection method.



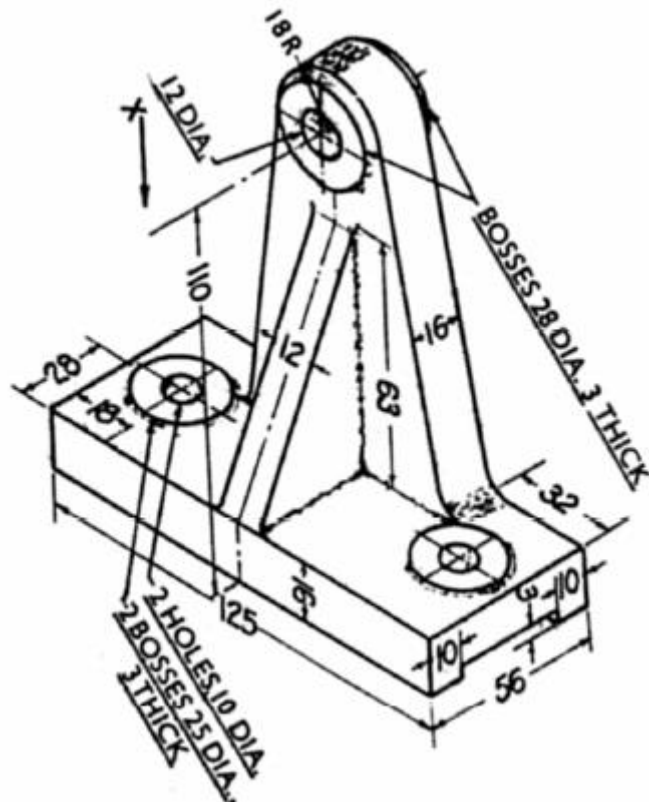
Exercise 9 :

Draw orthographic projection of the given object by first angle projection method.



Exercise 10 :

Draw orthographic projection of the given object by first angle projection method.



Isometric Projection

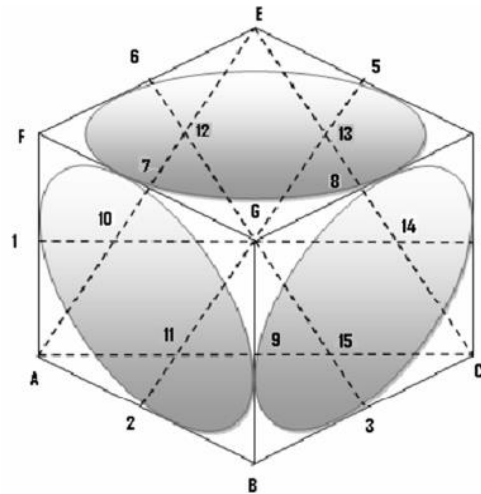
OBJECTIVE:

To draw circles in oblique and isometric cubes

a) To draw circles in an isometric cube

Steps of construction:

1. Draw an isometric cube (30°) each of whose sides measures 10 cm. Name all its vertices as A, B, C etc.
2. Bisect AF at point 1. Extend this bisector with the help of T-square, passing through G and bisecting CD at 4.
3. Join A to C bisecting BG at 9.
4. Similarly bisect AB at point 2. Extend this bisector with the help of T-square, passing through G and bisecting ED at 5.
5. Join A to E bisecting FG at 7.
6. Bisect BC at point 3. Extend this bisector with the help of T-square, passing through G bisecting EF at 6.
7. Join C to E bisecting DG at 8.
8. On face ABFG with center 10 and radius 1-10 draw an arc 1-7. Repeat this step with center 11.
9. With center A and radius A-7 draw an arc 7-9. Repeat this step with center G. An ellipse is obtained.
10. Complete the two ellipses on the remaining faces with the same method.

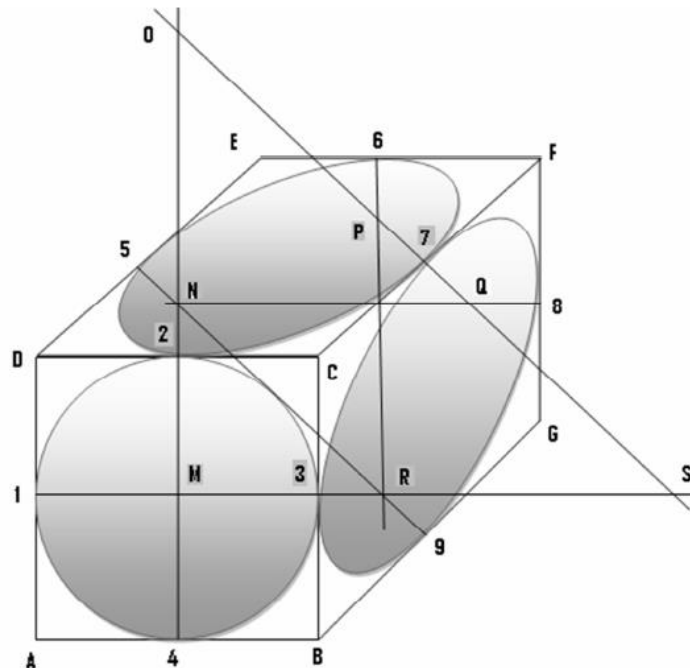


b) To draw circles in an isometric cube

Steps of construction

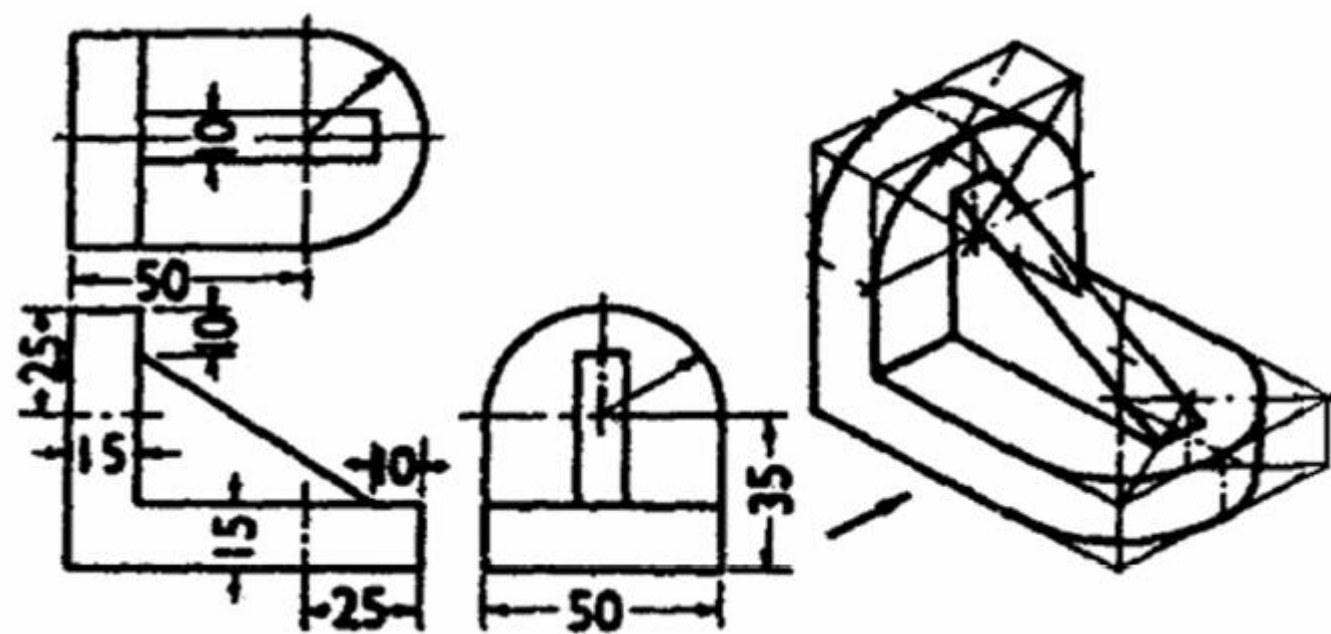
1. Draw an oblique cube (45°) each of whose sides measures 10 cm. Name all its vertices as A, B, C etc.
2. Draw bisectors of all sides of the cube and mark the bisecting points as 1, 2, 3 etc.
3. Join 1-3 and 2-4 intersecting at M and extend them.

4. With center M and radius M-1, draw a circle.
5. Join 5-9 intersecting the extended lines at N and R.
6. With the help of a T-square, draw a horizontal line from 8 extending towards left meeting N.
7. With the help of a set-square, draw a perpendicular from 6 on R.
8. With center N and radius N-9 and N-5, draw arcs 8-9 and 2-5 respectively.
9. Similarly with center R and radius R-5 and R-3, draw arcs 5-6 and 3-9 respectively.
10. With the help of a 45° set-square, draw a line through 7 intersecting the extended lines at O, P, Q and S.
11. With center O and radius O-2 draw an arc 2-7. Similarly with center S and radius S-3 draw an arc 3-7.
12. With center P and radius P-6 draw an arc 6-7. Similarly with center Q and radius Q-7 draw an arc 7-8.



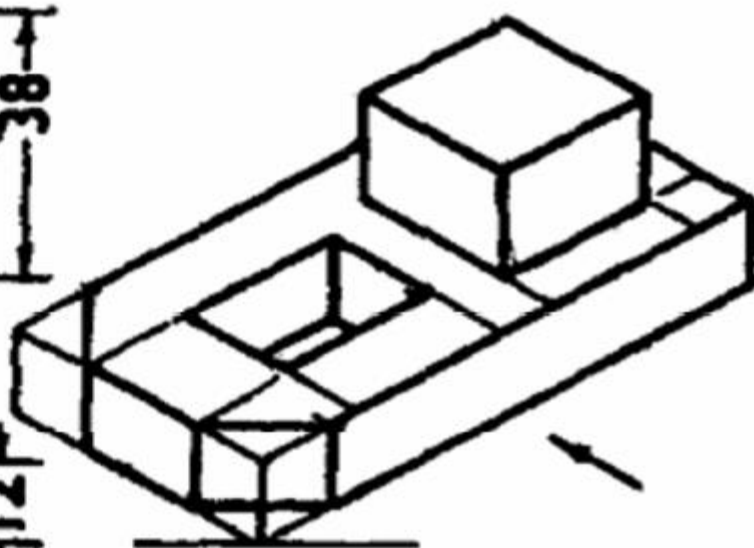
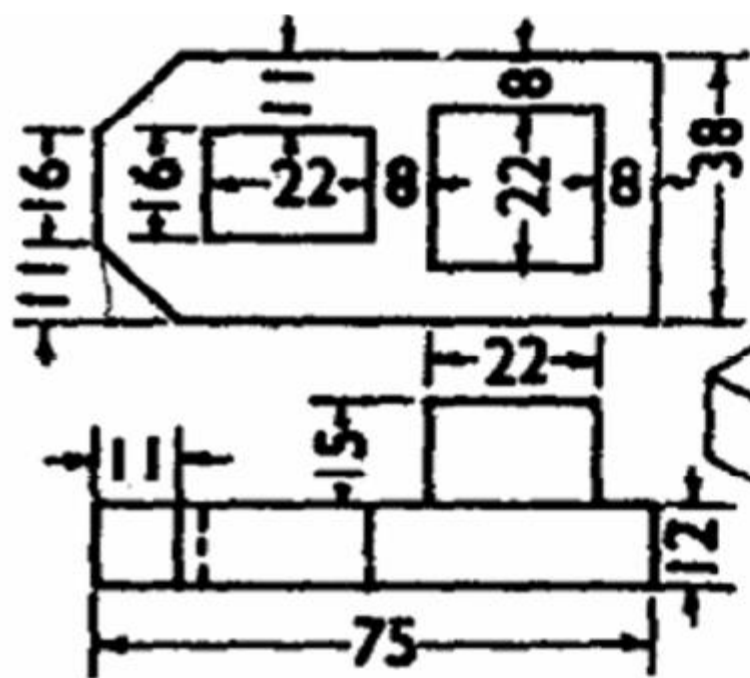
Exercise 11 :

To draw isometric view from the given orthographic views



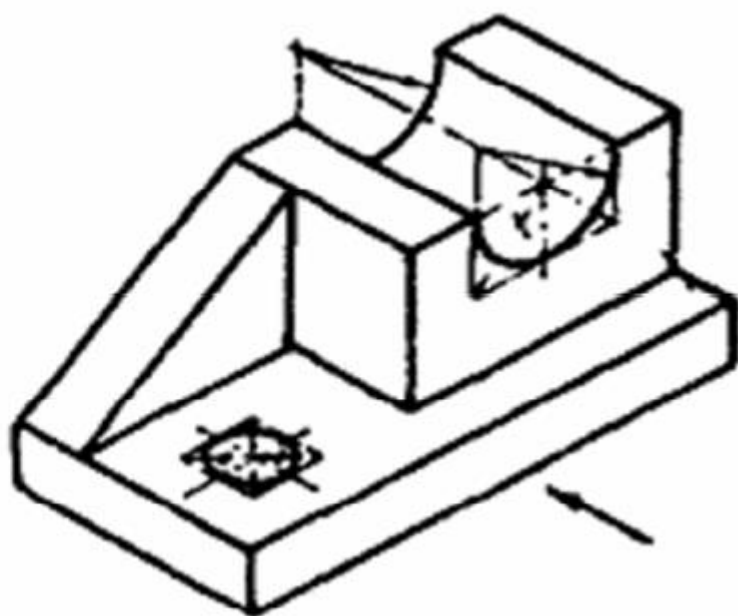
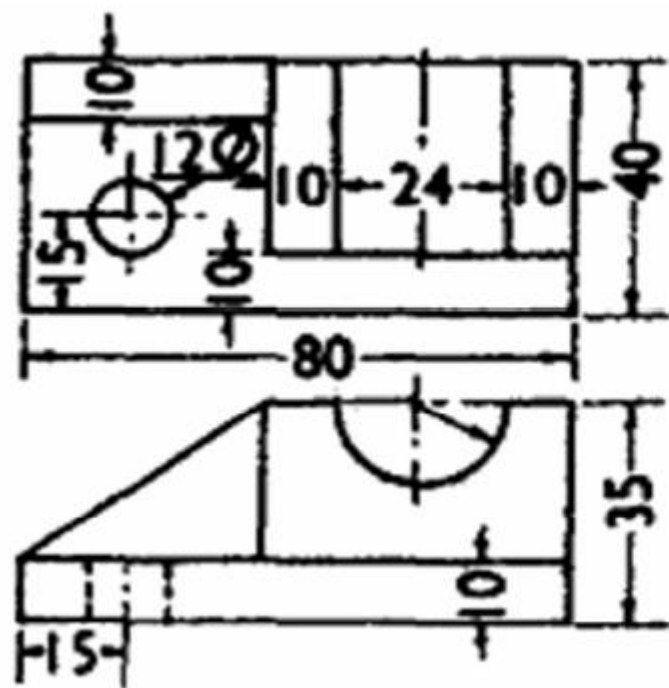
Exercise 12 :

To draw isometric view from the given orthographic views



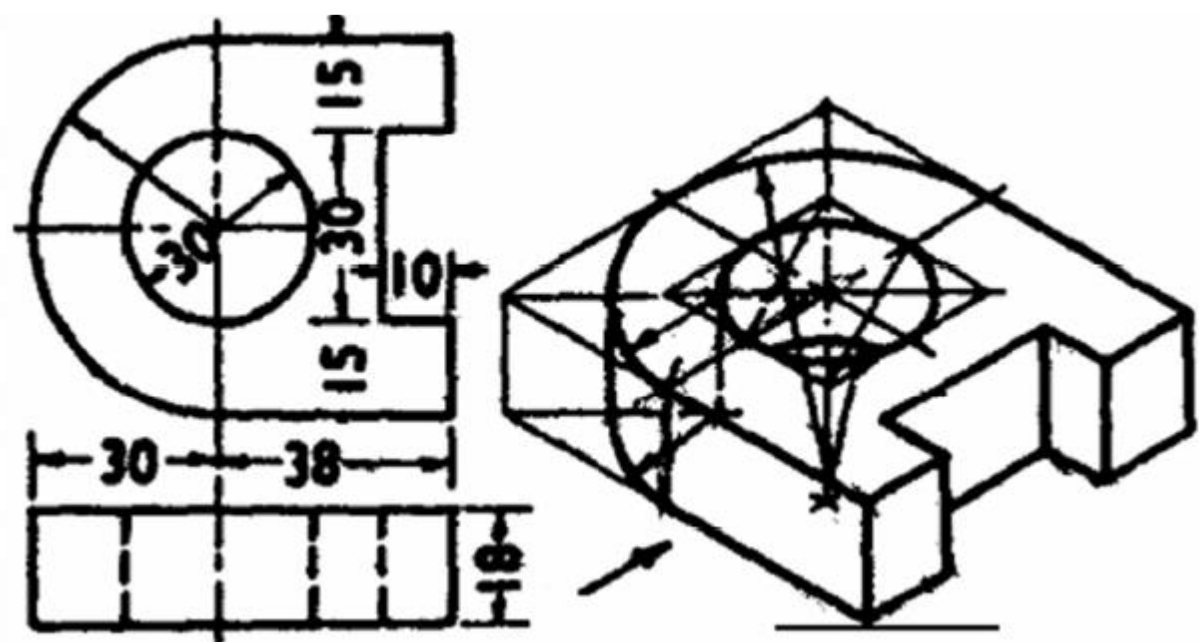
Exercise 13 :

To draw isometric view from the given orthographic views



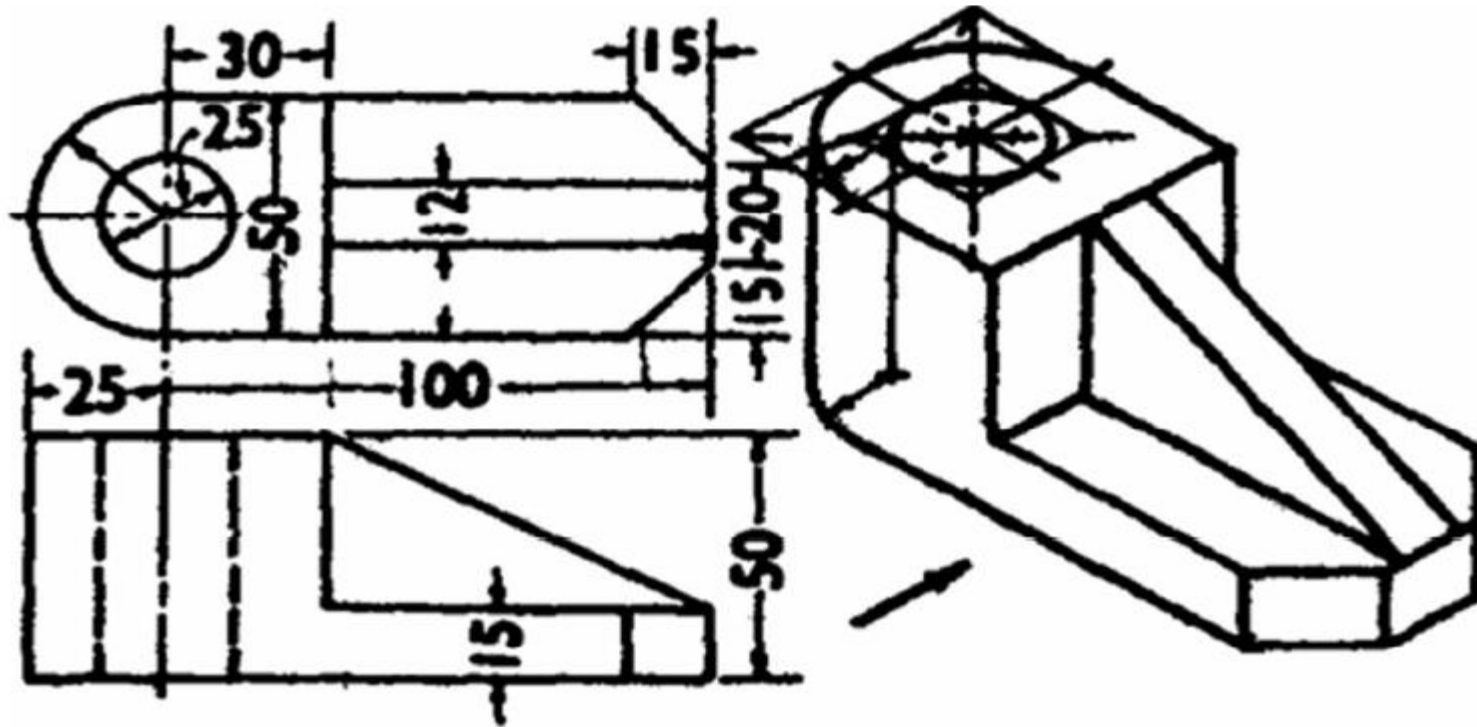
Exercise 14 :

To draw isometric view from the given orthographic views



Exercise 15 :

To draw isometric view by using isometric scale from the given orthographic views



Free hand sketches

OBJECTIVE:

To draw thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements.

Nuts:

A nut is a mechanical threaded device used on the ends of bolts, studs and machine screws. Various types of nuts are used for different applications. The most common types are hex and square nuts.

Bolts: A mechanical threaded device with a head on one end and threads on the other end. Bolts are paired with nuts.

Studs: A rod that is threaded on both ends and joins two mating parts. A nut may be used on one side.

Cap screws: A mechanical threaded device with a head on one end and threads on the other end. They join two mating parts and have longer threads than bolts. They can be made with slotted heads.

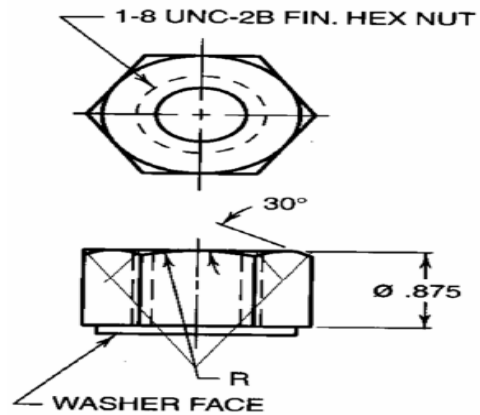
Machine screws: A mechanical threaded device with a head on one end and threads on the other end. The threaded end may screw into a mating part, or may be used with a nut. A machine screw is similar to cap screw, but it is normally smaller.

Rivets

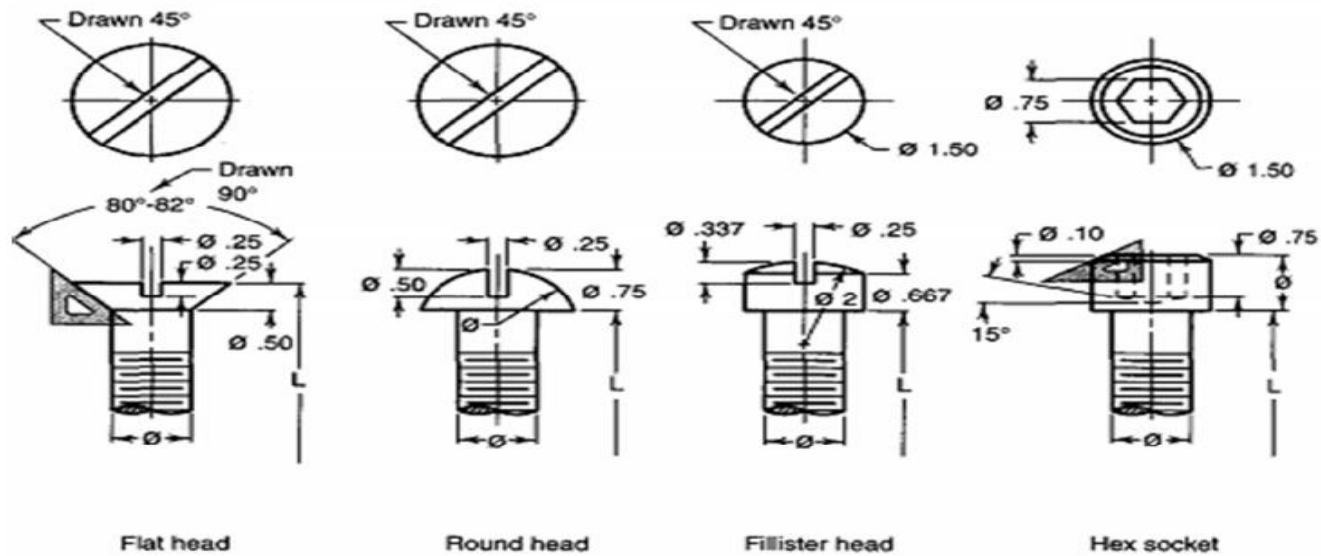
Rivets are metal pins with a head and are used to attach assembled parts permanently. Rivets are available in a variety of head styles. They are generally used on sheet metal, such as the skin of an aircraft attached to the frame, or ship parts. The hole for the rivets are drilled or punched, then rivet is held in place with a tool called dolly, while the other end of the rivet is hammered, pressed or forged in place.

Exercise 16 :

a) To draw a Hex head Nut

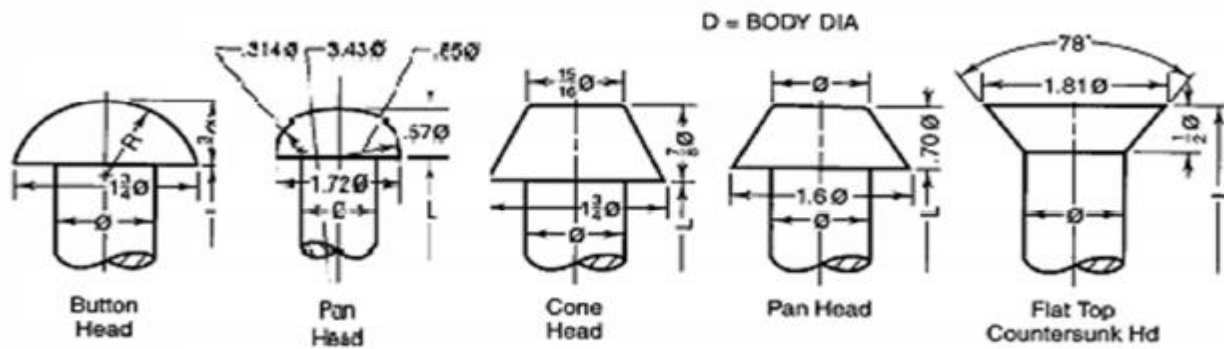


b) To draw different types of cap screws

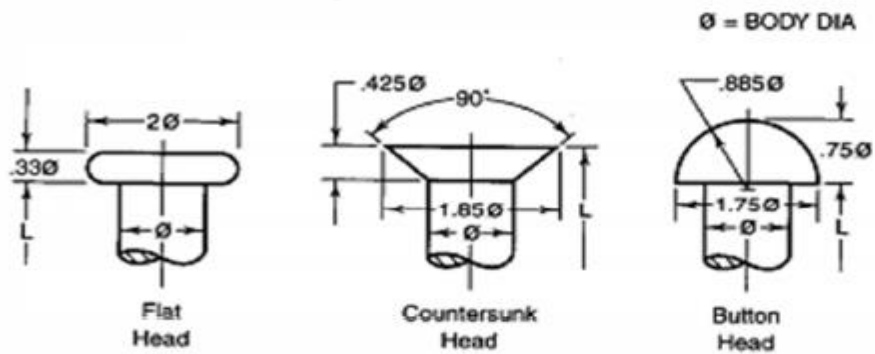


Exercise 17 :

To draw different types of machine screw



Large Rivet Proportions

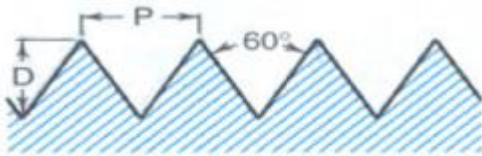


Small Rivet Proportions

Threads:

Sharp V

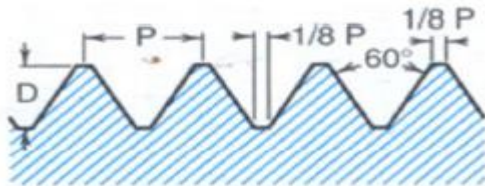
The 60 degree Sharp-V thread was originally called the United States Standard thread, or the Sellers thread. For purposes of certain adjustments, the Sharp-V thread is useful with the increased friction resulting from the full thread face. It is also used on brass pipe work.



(A) Sharp V

American National

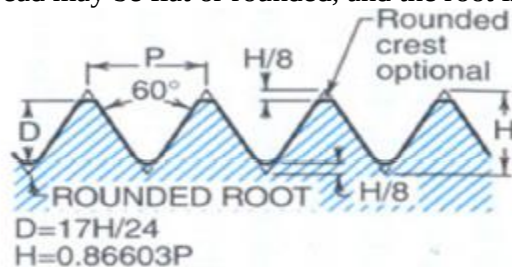
The American National thread with flattened roots and crests is a stronger thread. This form replaced the Sharp-V thread for general use and is still used for existing design.



(C) American National

Unified (External)

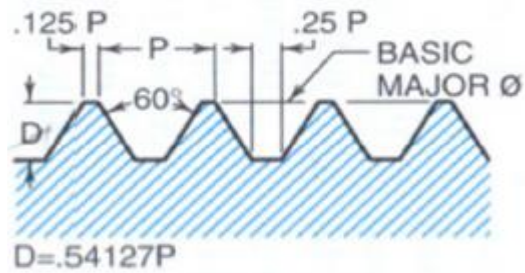
The Unified thread is the standard thread agreed upon by the United States, Canada, and Great Britain in 1948. The crest of the external thread may be flat or rounded, and the root is rounded; otherwise, the thread form is essentially the same as the American National.



(D) Unified (external)

Metric

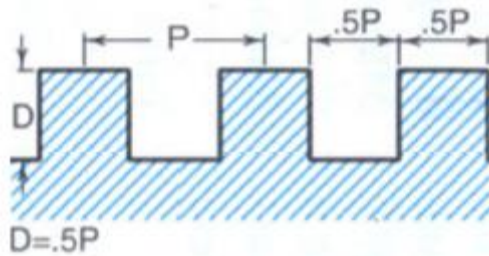
The metric thread is the new standard screw thread agreed upon for international screw thread fasteners. The crest and root are flat, but the external thread is often rounded when formed by the rolling process. The form is similar to the American National and the Unified threads but with less depth of thread.



(E) Metric

Square

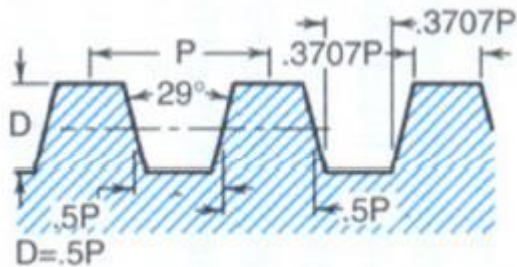
The Square thread is theoretically the ideal thread for power transmission, since its face is nearly at right angles to the axis, but owing to the difficulty of cutting it with dies and because of other inherent disadvantages, such as the fact that split nuts will not readily disengage, the square thread has been replaced to a large extent by the Acme thread. The square thread is not standardized.



(F) Square

Acme

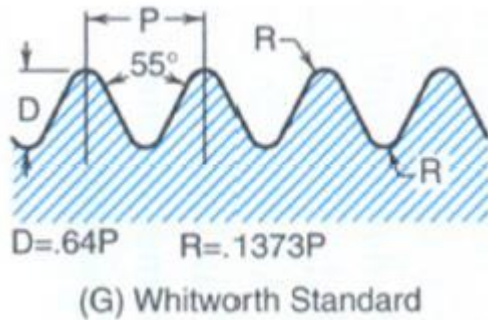
The Acme thread is a modification of the square thread and has largely replaced it. It is stronger than the square thread, is easier to cut, and has the advantage of easy disengagement from a split nut, as on the lead screw of a lathe.



(H) Acme

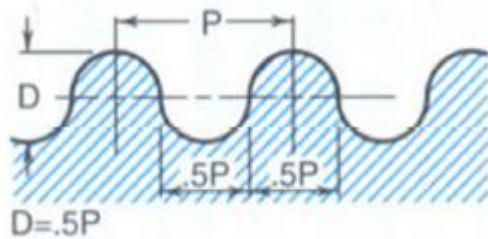
Whitworth Standard

The Whitworth thread has been the British standard and is being replaced by the unified thread. Its uses correspond to those of the American National thread.



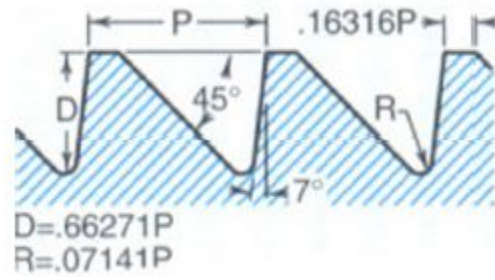
Knuckle

The knuckle thread is usually rolled from sheet metal but is sometimes cast, and is used in modified forms in electric bulbs and sockets, bottle tops and the like.



Buttress

The buttress thread is designed to transmit power in one direction only and is used in the breech locks of large guns, in jacks, in airplane propeller hubs, and in other mechanisms.



Exercise 18 :
To draw different types of threads.

Introduction

Computer Aided Drafting (CAD)

Computer Aided Drafting can be done by using the graphic commands available in High Level languages(HLL) like BASIC, FORTRAN, PASCAL, C and C++ .

CAD is an important industrial art extensively used in many applications, including automotive, ship building, and aerospace industries, industrial and architectural design, prosthetics, jewellery designing and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called Digital content creation (DCC)

Advantages of using CAD:

- Increases efficiency of your drawings
- Time saving
- Accurate, precise, & immediately alterable

Disadvantages of using CAD:

- Financially costs more per license
- Must and should have computer basic knowledge irrespective of concept

CAD is divided in many types

- 2D
- 3D
- Orthographic
- Isometric
- Perspective

AutoCAD Commands

Command	Keystroke	Icon	Menu	Result
Line	Line / L		Draw > Line	Draw a straight line segment from one point to the next.
Circle	Circle / C		Draw > Circle > Center, Radius	Draws a circle based on a center point and radius.
Erase	Erase / E		Modify > Erase	Erases an object.
Print	Print / Plot Ctrl+P		File > Print	Enables the Print/Plot Configuration Dialog Box
Undo	U (Don't use 'Undo' for now)		Edit > Undo	Undoes the last command.
Rectangle	RECTANGLE / REC		Draw > Rectangle	Draws a rectangle after you enter one corner and then the second.
Multi Lines	MLINE / ML	No Icon	Draw > Multiline	Draw parallel lines based on the parameters you define.
Trim	TRIM / TR		Modify > Trim	Trims objects to a selected cutting edge.
Extend	EXTEND / EX		Modify > Extend	Extends objects to a selected boundary edge.
Offset	OFFSET / O		Modify > Offset	Offsets an object (parallel) by a set distance.
Object Snaps	OSNAP / OS / F3	CLICK 	Tools > Object Snap Settings	Brings up the OSNAP dialog box.

ICON	SETTING		ICON	SETTING
	Endpoint			Perpendicular
	Midpoint			Tangent
	Center			Nearest
	Node			Apparent Intersection
	Quadrant			Parallel
	Intersection			None
	Extension			Osnap Setting
	Insertion Point			Temporary Tracking Point
				Snap From

RIGHT TO LEFT	CROSSING SELECTION	GREEN (with a dotted outline)	SELECTS ANY OBJECT THAT EITHER CROSSES THE BOUNDARY OR IS INSIDE IT
LEFT TO RIGHT	WINDOW SELECTION	BLUE	SELECTS ON OBJECTS THAT ARE COMPLETELY WITHIN THE BOX

Command	Keystroke	Icon	Menu	Result
Move	Move / M		<u>M</u> odify > M <u>ove</u>	Moves an object or objects
Copy	Copy / CP		<u>M</u> odify > C <u>opy</u>	Copies object(s) once or multiple times
Stretch	Stretch / S		<u>M</u> odify > S <u>tretch</u>	Stretches an object after you have selected a portion of it
Mirror	Mirror / MI		<u>M</u> odify > M <u>irror</u>	Creates a mirror image of an object or selection set
Rotate	Rotate / RO		<u>M</u> odify > R <u>otate</u>	Rotates objects to a certain angle
Fillet	Fillet / F		<u>M</u> odify > F <u>illet</u>	Creates a round corner between two lines
Chamfer	Chamfer / CHA		<u>M</u> odify > C <u>hamfer</u>	Creates an angled corner between two lines
Array	Array / AR		<u>M</u> odify > A <u>rray</u>	Creates a repeating pattern of the selected objects
Layer	Layer / LA		<u>F</u> ormat > L <u>ayer</u>	Starts the Layer and Linetype property dialog box
Text	Text	No icon	<u>D</u> raw > S <u>ingle Line Text</u>	Creates a single line of text
Dimension	Dim	Many	<u>D</u> imension > (pick one)	Dimensions previously drawn objects
Scale	Scale / SC		<u>M</u> odify > S <u>cale</u>	Proportionately resizes (or scales) objects

Exercise 19 :

Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD

Exercise 20 :

Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD

Exercise 21:

Draw basic 2D entities like: Circular and rectangular array using AutoCAD

Exercise 22:

Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD

Exercise 23:

Draw basic branch specific components in 2D using AutoCAD

Exercise 24:

Draw complex branch specific components in 2D using AutoCAD (Print out should be a part of progressive assessment)