

# ENGINEERING GRAPHICS

**Subject code: ME104ES**

**Regulations: R18-JNTUH**

**Class: I Year B. Tech CE & ME I Sem**



**Department of Science and Humanities**

**BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY**

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# ENGINEERING GRAPHICS (ME104ES)

## I. COURSE OVERVIEW:

Drawing is commonly used mode of communication in engineering industry as it is brief and clearer. Appropriate exposure to drawing helps the students to translate different ideas into practical applications. Acquisition of drafting skills as per standard conventions is used to make the drawing of a given object or component so that other's can understand and interpret the drawing as intended by the draftsman. Hence drawing is regarded as a pre-requisite for engineering graduates. Engineering drawing is a basic course for all undergraduate engineering programs. This course is introduced to provide the basic understanding of the fundamentals of Engineering Drawing, mainly visualization, graphics theory, standards and conventions of drawing, the tools of drawing and the use of drawings in engineering applications.

Engineering drawing is a two dimensional representation of three dimensional objects. A drawing worked out by an engineer, having engineering ideas, for engineering purpose, is known as Engineering drawing. It provides exact geometrical configuration for the construction and analysis of machines, structures or systems. It is the graphic language from which a trained person can visualize objects. Drawings prepared in one country may be utilized in any other country irrespective of the language spoken. Hence, engineering drawing is called the universal language of engineers. To convey the same meaning to everyone, drawing practice must follow the International Standards on code of practice for drawing as governed by International Organization for Standards (ISO) and Bureau of Indian Standards (BIS) in India.

The ability to interpret drawings is the most important requirement of all technical people in engineering profession. The potentialities of drawing as an engineer's language may be made use of as a tool for imparting knowledge and providing information on various aspects of engineering. Some of the applications of engineering drawing are building drawing for civil engineers, machine drawing and production drawing for mechanical engineers, circuit diagrams for electrical and electronics engineers, computer graphics for one and all.

## II. PREREQUISITE(S):

- Basic Geometry
- Knowledge about relationship between various units for measurement

## III. COURSE OBJECTIVES:

- To state basic concepts in engineering drawing.
- To explain about standard principles of orthographic projection of objects.
- To discuss about creating sectional views and pictorial views of solids.

## IV. COURSE OUTCOMES:

Towards the end of the course, it is expected that the student would be able to visualize the engineering component from any drawing sheet and have thorough understanding of various projection techniques.

Course Outcomes: After learning the contents of this course, the student would be able to,

Sl. No.	Description	Bloom's Taxonomy level
CO1.	<b>Explain</b> the basic principles of engineering graphics and their significance.	Understand (Level 2)
CO2.	<b>Use</b> drawing instruments including CAD software skillfully.	Apply (Level 3)
CO3.	<b>Prepare</b> working drawings to communicate the ideas and information.	Apply (Level 3)
CO4.	Read, understand and <b>interpret</b> the engineering drawings.	Apply (Level 3)
CO5.	<b>Transform</b> multi-views to isometric views and vice-versa.	Apply (Level 3), Analyze (Level 4)

#### V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Problem based Assignments/ Exam
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	Assignments/ Exam/ Case Studies
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignments/ Case Studies
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignments/ Case Studies
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1	Problem based Assignments/ Exam
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent	-	-

	responsibilities relevant to the professional engineering practice.		
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	-
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Assignments
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Assignments/ Exams/ Seminars
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	-
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Projects/ Case Studies

1: Slight (Low)      2: Moderate (Medium)      3: Substantial (High)      - : None

## VI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Program Outcomes

CO's	Program Outcomes (PO's)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1.	2	1	2	1	2	-	-	-	1	2	-	1
CO2.	2	1	3	1	2	-	-	-	2	3	-	1
CO3.	2	1	3	1	1	-	-	-	2	3	1	-
CO4.	2	2	2	1	1	-	-	-	2	3	1	-
CO5.	1	-	2	-	1	-	-	-	1	2	-	1
<b>Average (Rounded)</b>	2	1	2	1	1	-	-	-	2	3	-	1

## **VII. SYLLABUS:**

### **COURSE CONTENTS – AS PER JNTUH SYLLABUS:**

#### **UNIT – I: Introduction to Engineering Drawing**

Principles of Engineering Graphics and their significance, Conic Sections including the Rectangular Hyperbola – General method only, Cycloid, Epicycloids' and Hypocycloid. Scales – Plain & Diagonal.

#### **UNIT – II: Orthographic Projections**

Principles of Orthographic Projections – Conventions – Projections of Points and Lines. Projections of Plane regular geometric figures – Auxiliary Planes.

**UNIT – III: Projections of Solids:** Projections of Regular Solids – Auxiliary Views. **Sections and Sectional Views:** of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of sphere.

**UNIT – IV: Development of Surfaces:** Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid and Cone. **Intersection of Solids:** Intersection of – Prism vs Prism – Cylinder Vs Cylinder.

#### **UNIT – V: Isometric Projections & Conversion of Views**

Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical parts. Conversion of Isometric Views to Orthographic Views and vice-versa – Conversions

**Introduction to CAD: (For Internal Evaluation Weightage only):** Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package.

### **SUGGESTED BOOKS/RESOURCES:**

#### **TEXT BOOKS:**

1. Basant Agrawal and C M Agarwal, Engineering Drawing, 1<sup>st</sup> edition, Tata Macgraw Hill, 2008.
2. N D Bhatt, Engineering Drawing, 45<sup>th</sup> edition, Charotar Publications, 2011.

#### **REFERENCE BOOKS:**

3. M B Shah and B C Rana, Engineering Drawing, 1<sup>st</sup> edition, Pearson, 2009.
4. N S Parthasarathy and Vela Murali, Engineering Drawing, 1<sup>st</sup> edition, Oxford University Press India, 2015.
5. K Balaveera Reddy et al, Computer Aided Engineering Drawing, CBS Publishers.
6. K L Narayana and P Kannaiah, Text book on Engineering Drawing, 2<sup>nd</sup> edition, Scitech Publications, 2002.

#### **Additional Reading:**

Bureau of Indian Standards (BIS): SP-46, 2003

#### **NPTEL Web Course:**

<http://nptel.ac.in/courses/112103019/>

**GATE SYLLABUS:**

Not Applicable.

**IES SYLLABUS:**

Not Applicable.

**VIII. COURSE PLAN:**

Lecture No.	Week No.	TOPIC	Reference	
<b>UNIT – 1: Introduction to Engineering Drawing</b>				
1	1	Principles of Engineering Graphics and their significance	Book No. 1, 2	
2		Construction of Ellipse, Parabola – General Methods		
3	2	Construction of Ellipse and Parabola – Different Methods		
4		Construction of Hyperbola and Rectangular Hyperbola		
5	3	Construction of Cycloid, Epi-Cycloid		
6		Construction of Hypo-Cycloid and <b>*Involutes</b>		
7	4	Scales – Plain & Diagonal Scales		
8		<b>*Scales – Vernier scale</b>		
<b>UNIT – 2: Orthographic Projections in First Angle Projection</b>				
9	5	Principles of Orthographic Projections – Conventions	Book No. 1, 2	
10		Projection of Points		
11	6	Projection of Lines		
12		Projection of Lines		
13	7	Projection of Plane regular geometric figures		
14		Auxiliary Planes		
<b>UNIT – 3: Projections of Solids &amp; Sectional views</b>				
15	8	Projections of Regular solids - parallel to both planes & inclined to one plane and parallel to other plane		Book No. 1, 2
16		Projection of Regular Solids inclined to both the planes		
<b>I Mid Examinations</b>				
17	9	Projection of Regular Solids inclined to both the planes	Book No. 1, 2	
18		Projection of Regular Solids with auxiliary views		
19	10	<b>Sections and Sectional Views</b> of Right regular Solids – Prism, Cylinder, Pyramid, Cone		
20		Auxiliary Views – Sections of Sphere		
<b>UNIT – 4: Development of Surfaces &amp; Intersection of Solids</b>				
21	11	Development of Cylinders	Book No. 1, 2	
22		Development of Prisms		
23	12	Development of Pyramids and Cones		
24		Development of Frustum of solids		

25	13	<b>Intersections of Solids - Prism vs Prism</b>	
26		<b>Intersections of Solids - Cylinder vs Cylinder &amp; *Prism vs Cylinder</b>	
<b>UNIT – 5: Isometric Projections &amp; Conversion of Views</b>			
27	14	Principles of Isometric Projections, Isometric Scale – Isometric Views – Conventions. Isometric Views of Lines and Planes	Book No. 1, 2
28		Isometric Projection of Simple and Compound Solids	
29	15	Isometric Projection of Objects having Non Isometric lines	
30		Isometric Projection of parts with Spherical surface	
31	16	Conversion of Isometric Views to Orthographic Views and vice versa-conversions.	
32		Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package	
<b>II Mid Examinations</b>			

Topics covered beyond curriculum: Involutes, Vernier scale and Prism vs Cylinder.

### IX. QUESTION BANK: (JNTUH)

#### DESCRIPTIVE QUESTIONS:

Definitions of the different levels of cognitive skills in Bloom's taxonomy marked in descriptive questions (where the highest level in question bits is only marked) are as follows:

BLOOMS LEVEL	COGNITIVE SKILL	DEFINITION
Level-1 (L1) :REMEMBER	Knowledge	Recalling/Retrieving relevant terminology, specific facts, or different procedures related to information and/or course topics. (At this level, student remembers something, but may not really understand it fully.)
Level-2 (L2) :UNDERSTAND	Comprehension	Determining the meaning of instructional messages (facts, definitions, concepts, graphics etc.)
Level-3 (L3) : APPLY	Application	Carrying out or use previously learned information in another familiar situations or in problem solving
Level-4 (L4) :ANALYZE	Analysis	Breaking information into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. Analysis refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments
Level-5 (L5) :EVALUATE	Evaluation	Making judgment's based on criteria and standards, personal values or opinions
Level-6 (L6) : CREATE	Synthesis	Create or uniquely apply prior knowledge and/or skills to form a novel, coherent whole or original product or produce new and original thoughts, ideas, processes,...



## UNIT –I

### {Relates to CO1. and CO2.}

1. Discuss the significance of engineering drawing with practical examples. (L2)
2. Identify the precautions to be observed in using various drawing instruments. (L1)
3. Draw an ellipse in a parallelogram having sides 15 cm and 9 cm long and an included angle of 60 degrees. (L3)
4. A football kicked from ground reaches the ground travelling a horizontal distance of 35m. Maximum height reached by the ball is 18m. Trace the path of the ball and name the curve. (L3)
5. The foci of an ellipse are 80 mm apart and the minor axis is 60 mm. Draw the ellipse by foci method. (L3)
6. A circle of 40 mm diameter rolls on a horizontal line for one complete revolution without slipping. Trace the path of a point on the circumference of circle. Name the curve and draw Normal and Tangent from a point 30 mm from the center line. (L3)
7. The vertex of a hyperbola is 5 cms from directrix. Draw the curve if the eccentricity is  $3/2$ . Draw the normal and tangent at a point 50 mm from axis. (L3)
8. A circle of 30 mm diameter rolls on the concave side of generating circle of radius 30mm. Draw the path traced by a point on the generating circle for one complete revolution. (L3)
9. Trace the locus of the point on the circumference of the rolling circle of 40 mm diameter rolling on a circle of same diameter for one complete revolution. Name the curve. (L3)
10. Draw a circle of 40 mm diameter. The diameter AB is vertical with end A at top. Trace the curve generated by the end A when the circle rolls without slipping on a horizontal line for three-fourth rotation and then on the vertical line for its next half rotation. Name the curve traced by end A. (L3)
11. A stone is thrown from a 7 m high building, and at its highest flight the stone just crosses a 14 m high palm tree. Trace the path of the stone till it touches the ground. The distance between the building and the palm tree is 4 m. (L4)
12. Draw an ellipse by focus-directrix method when the distance of the focus from the directrix is equal to 60 mm and the eccentricity is  $2/3$ . (L3)
13. Draw the path traced out by a point on the circumference of a circle but opposite to the contact point. The circle rolls without slipping vertically downwards for the distance equal to its perimeter. The diameter of the circle is 40 mm. Name the curve. (L3)
14. Draw a parabola having a base of 80 mm and an axis equal to 80 mm by the tangent method. (L3)
15. In a triangle ABC, AB, AC, and BC are 100 mm, 55 mm and 70 mm respectively. Draw an ellipse and that A and B are foci, and C is a point on the curve. Find directrix and eccentricity of ellipse. (L3)
16. An inelastic string of 120 mm length has its one end attached to the circumference of a circular disc with a 50 mm diameter. Draw the curve traced out by the other end of the string when it is completely wound round the disc keeping the string always taut. Draw



- the tangent and normal to the curve at a point 70 mm from the centre of the circular disc. Name the curve. (L3)
17. A circle of 40 mm diameter rolls along a straight line without slipping. Draw a curve traced out by a point P on the circumference for one complete revolution of the circle. Name the curve and draw a tangent to the curve at a distance 35 mm from the straight line. (L3)
  18. A circle of 45 mm diameter rolls along a straight line without slipping. Draw a curve traced out by a point P on the circumference for one complete revolution of the circle. Name the curve and draw a tangent to the curve at a distance of 35 mm from the straight line. (L3)
  19. A circle of 50 mm diameter rolls along a straight line without slipping. Draw a curve traced out by a point on the circumference for  $1\frac{1}{2}$  revolutions of the circle. Name the curve. (L3)
  20. Construct a hypocycloid when the diameters of the rolling circle and directing circle are 40 mm and 180 mm respectively. Draw also a normal and tangent at a point 120 mm from the centre of the directing circle. (L3)
  21. A circle of 35 mm diameter rolls along a straight line without slipping. Draw a curve traced out by a point P on the circumference for one complete revolution of the circle. Name the curve and draw a tangent to the curve at a distance 25 mm from the straight line. (L3)
  22. Recognize the importance of RF and length of scale in construction of scales. (L2)
  23. Construct a diagonal scale of  $RF = 1/6250$  to read up to 1 kilometer and to read meters on it. Show a length of 653 meters on it. (L3)
  24. Draw a scale of 10 centimeters = 3 decimeters to show decimeters and meters. Show the lengths of 33 meters and 11 meters on it. (L3)
  25. Construct a diagonal scale to read up to  $1/100$  of kilometers having given the value of  $R.F. = 1/50,000$  and to measure up to 8 kilometers. Indicate on the scale, a distance of 6.76 kilometers. (L3)
  26. Construct a diagonal scale of  $R.F. = 1/50,000$  to show single meters and long enough to measure up to 500 meters. On the scale, indicate a distance of 467 meters. (L3)
  27. Construct a plain scale to show meters and decimeters, when 3 centimeters are equal to 2 meters and long enough to measure up to 5 meters. (L3)
  28. Construct a plain scale to show kilometers and hectometers when 25 centimeters are equal to 1 kilometer and long enough to measure up to 6 kilometers. Find R.F. and indicate, a distance of 5 kilometers and 6 hectometer of the scale. (L3)
  29. Draw a diagonal scale of 1:2.5 showing centimeters and millimeters and long enough to measure up to 20 centimeters. Show a distance of 13.4 cm on it. (L3)
  30. Construct a plain scale to compute time in minutes and distance covered by a train in km., when the train passes between two stations 240 km apart in four hours. The scale should have R.F.  $1/400000$ . Show the distance covered in 45 minutes on the scale. (L3)

31. Construct a diagonal scale to read meters, decimeters and centimeter and long enough to measure up to 5 meters when one meter is represented by 3 centimeter. Find R.F. and indicate on the scale, a distance of 4 meters, 7 decimeters and 6 centimeters. (L3)
32. Construct a diagonal scale of R.F = 1 : 32,00,000 to show kilometers and long enough to measure up to 400 km. Show on it a distance of 257 km on it. (L3)
33. Draw an involute of a circle of 35 mm diameter. Draw also a normal and tangent to it at a point 75 mm away from the centre of the circle. (L3)
34. Construct a Vernier scale of RF=1/500 to show decameters, meters and decimeters, and to measure up to 4 decameters. Show the lengths of 0.0393 km and 0.0001 km on it. (L3)
35. Draw a Vernier scale of 1:72 to read inches and long enough to measure 12 yards. Show the following distances on it: (i) 1 yard 1 foot and 1 inch, (ii) 7 yards 2 feet and 9 inches, and (iii) 10 yards 10 inches. (L3)
36. Draw a Vernier scale of RF =1/5 to read decimeters, centimeters and millimeters, and to measure up to 6 decimeters. Show the lengths of 5.73 dm, 2.99 dm and 0.49 dm on it. (L3)
37. The actual length of 300 m is represented by a line of 10 cm on a drawing. Draw a vernier scale to read up to 500 m. Mark on it a length of 367 m. (L3)

## Unit –II

### {Relates to CO1. and CO2.}

1. Define orthographic projection. (L1) Describe briefly the method of obtaining an orthographic projection of an object. (L2)
2. What is the convention of representing first-angle projection method? (L1) Explain the difference between the first-angle projection method and the third-angle projection method. (L2) Why second and fourth quadrants are not used in practice? (L4)
3. Two points A and B are in the H.P. the point A is 30 mm in front of the VP while B is behind the V.P. The distance between their projections is 75 mm and line joining their top views makes an angle of  $45^\circ$  with xy. Find the distance of the point B from the V.P. (L3)
4. A 75 mm long line AB has its end A 15 mm above the H.P. and 30 mm in front of the V.P. The front and top views make  $45^\circ$  and  $60^\circ$  respectively with the reference line. Draw its projections and determine its true inclinations with the reference planes. (L3)
5. A line EF 85 long has its ends 25 mm above HP and 20 mm in front of V.P. The top and front views of the line have lengths of 55 mm and 70 mm respectively. Draw the projections of the line and find its true inclinations with the V.P and H.P. (L3)
6. A line PQ is 75 mm long and lies in an auxiliary inclined plane which makes an angle of  $45^\circ$  with the H.P. The front view of the line measures 55 mm and the end P is in V.P and 20 mm above H.P. Draw the projections of PQ and find its inclinations with both the planes and their traces. (L3)
7. A line PQ, 64 mm long has one of its extremities 20 mm in front VP and the other 50 mm above HP. The line is inclined at  $40^\circ$  to HP and  $25^\circ$  to VP. Draw its top and front views. (L3)

8. A straight line AB of length 100 mm makes  $60^\circ$  with H.P. and  $30^\circ$  with V.P. A is 10 mm above H.P. and 20 mm in front of V.P. Both A and B are in same quadrant. Draw the front and top views of the line and locate H.T and V.T. (L3)
9. A vertical line AB 65mm long has its end A in H.P and 25 mm in front of V.P. A line AC 90 mm long is in H.P and parallel to V.P. Draw the projections of the line joining B and C and determine its inclination with H.P. (L3)
10. The end A of an 80 mm long line AB is 20 mm above the H.P. and B is 15 mm in front of the V.P. The line is inclined at  $30^\circ$  to the H.P. and its top view makes an angle of  $60^\circ$  with the V.P. Draw its projections and find its inclination with the V.P. (L3)
11. The end A of an 80 mm long line is 20 mm below the H.P. and 30 mm behind the V.P. It is inclined at  $60^\circ$  to the H.P. and  $30^\circ$  to the V.P. draw its projections if the other end lies in the first quadrant. (L3)
12. A 100 mm long line PQ is inclined at  $45^\circ$  to the H.P and  $30^\circ$  to the V.P. The point P is 10 mm below the H.P. and 25 mm in front of the V.P. Draw its projections and determines its traces, if the point Q lies in the second quadrant. (L3)
13. A line AB, 75 mm long is in second quadrant with the end, A in the HP and the end, B in the VP. The line is inclined at  $30^\circ$  to HP and at  $45^\circ$  to VP. Draw the projections of AB and determine its traces. (L4)
14. Line CD is in the second quadrant and has  $25^\circ$  inclination with HP, while the front view has  $30^\circ$  inclination with xy line and 60 mm length. If the end C is 12 mm above HP and the end D is 60 mm behind VP, draw its projections. (L3)
15. The end point C of an 80 mm long line CD is 15 mm above the H.P. and 10 mm in front of the V.P. The line is inclined at  $30^\circ$  to the H.P. and  $45^\circ$  to the V.P., and the other end point D lies in the second quadrant. Draw its projections and determine its traces. (L4)
16. The projection of a line AB has 35 degrees inclination in top view and 40 degrees inclination in the front view with an elevation length of 60 mm. If the end A is 10 mm below HP and B is 12 mm behind VP, draw the projections and locate the traces keeping the line in the third quadrant. (L4)
17. A 80 mm long line AB is inclined at  $45^\circ$  to the H.P and  $30^\circ$  to the V.P. Its end A is in the H.P. and 40 mm in front of the V.P. Draw its projections keeping the end B in the fourth quadrant. (L3)
18. A line AB 60 mm long has its end 'A' in both H.P and V.P. It is inclined at  $30^\circ$  to H.P and  $45^\circ$  to V.P. Draw the projections. (L3)
19. The midpoint of a straight line AB is 60 mm above HP and 50 mm in front of V.P. The line measures 80 mm long and inclined at an angle of 30 degrees to H.P and 45 degrees to V.P. Draw its projections. (L3)
20. The end A of a line AB is in H.P and 25 mm behind V.P. The end B is in the V.P. and 50 mm above H.P. The distance between the end projectors is 75 mm. Draw the projections of AB and determine its true length. (L3)

21. The end P of a straight line PQ is 20 mm above the H.P. and 30 mm in front of V.P. The end Q is 15 mm below the H.P. and 45 mm behind the V.P. If the end projectors are 50 mm apart, Draw the projection of PQ and determine the true length, traces and inclination with the reference planes. (L3)
22. The projections of the ends of a line AB are on the same projector. The end A is 30 mm below H.P and 15 mm behind V.P. The end B is 35 mm above H.P and 40 mm in front of V.P. Determine its true length, traces and the inclinations with the reference planes. (L4)
23. Both the HT and the VT of a line above XY line. The distance between the VT and the HT measured parallel to XY is 10 mm. The VT and the HT measured perpendicular to XY is 10 mm. The VT is nearer to the end of the line. The VT is 5 mm above XY and the HT 10 mm above XY. The straight line is 100 mm long. The VT is 10 mm from the nearest end of the line as measured parallel to XY. Draw the projections of the line. Also find the inclinations of the line with the HP and the VP. (L4)
24. The end A of a straight line AB is 10 mm from the VP and 20 mm from the HP. The end B is 30 mm from the VP and 40 mm from the HP. The VT of the line is 20 mm from the end A as measured parallel to XY. Draw the projections and find the TL and the inclinations of the line. (L3)
25. The HT and the VT of a straight line AB is below and above XY respectively. The distance between the HT and the VT as measured parallel to XY is 200 mm. The end B of the line is nearer to the VP than the end A. The view from above of the line makes  $30^\circ$  to XY. The end B is 10 mm from the VP and 20 mm from the HP. The distance between the end projectors of the line measures 50 mm parallel to XY. Draw the projections of the line. (L3)
26. The HT and VT and the end A of line coincides and lie on XY. The distance between the view from above and the view from the front of the end B of the line is 60 mm. The line is equally inclined to the VP and the HP. The distance between the projectors as measured parallel to XY is 40 mm. Draw the projections and find the TL of the line. (L4)
27. A line AB measures 100 mm. The projectors through its V.T and the end A are 40 mm apart. The point A is 30 mm below H.P and 20 mm behind V.P. The V.T is 10 mm above H.P. Draw the projections of the line and determine its H.T and inclinations with H.P and V.P. (L4)
28. Line PQ has 72 mm length in the front view and 66 mm length in the top view. The end P is 48 mm below HP and 40 mm behind VP, while the end Q is 12 mm below HP. Draw the projection of the line, locate the traces and determine the true length and inclinations of the line with the reference planes. (L4)
29. The front view of a line AB 80 mm long measures 55 mm while its top view measures 70 mm. End A is in both HP and VP. Draw the projections of the line and find its inclinations with the reference planes. Also locate the traces. (L4)
30. The front view of a line AB measures 65 mm and makes an angle of  $45^\circ$  with xy. A is in the H.P and the V.T of a line is 15 mm below the H.P. The line is inclined at  $30^\circ$  to the

- V.P. Draw the projections of AB and find its true length and inclination with the H.P. Also locate its H.T. (L4)
31. The front view of a line PQ measures 70 mm and makes an angle of  $30^\circ$  with the reference line. P is in the H.P. and the V.T of the line is 15 mm below the H.P. The line is inclined at  $45^\circ$  to the V.P. Draw its projections and find its true length, inclination with the H.P, and locate the H.T. (L4)
  32. The front view of line inclined at  $30^\circ$  to V.P is 65 mm long. Draw the projections of a line, when it is parallel to and 40 mm above H.P. and one end being 20 mm in front of V.P. (L3)
  33. The top view of a 75 mm long line AB measures 65 mm, while the length of its front view is 50 mm. Its one end A is in the H.P and 12 mm in front of the VP. Draw the projections of AB and determine its inclinations with the H.P and the V.P. (L4)
  34. An observer on the top of a tower 12 m high observes the angles of depression of two objects P and Q on the plane below to be  $15^\circ$  and  $40^\circ$  the direction of P being east and the direction of Q being south. Find the distance between P and Q. What is the inclination of a line to the ground which connects the midpoint of P and Q to the top of the tower? (L4)
  35. Four pegs are fixed one at each corner of a regular pentagon of 1500 mm side drawn on a flat ground. A post 5000 mm high is fixed erect on the blank corner of the pentagon. The tip of the post is connected to each peg by a tight rope. Find the TL and inclinations of each rope. (L4)
  36. Three pegs are arranged on a flat ground on the circumference of a circle of diameter 3 m. The pegs when joined by straight lines form an equilateral triangle. A post 6 m high is fixed vertically on the ground at the centre of the circle. The pegs are connected to the top of the post by tight ropes. Find the TL and inclination of all the ropes with the ground. (L4)
  37. Two pillars P and Q 10 m and 5 m high are separated by a distance of 80 m as seen in the view from the front as measured parallel to XY. In the view from the left they appear to be separated by a distance of 5 m as measured perpendicular to XY. A wire is tightly tied to the top ends of the poles P and Q. Find the TL of the wire. (L4)
  38. An isosceles triangular plane ABC with a 70 mm base and altitude 80 mm has its base in the H.P. and inclined at  $45^\circ$  to the V.P. The corners A and C are in the V.P. Draw its projections and determine the inclination of the plane with H.P. (L4)
  39. An isosceles triangle ABC with a 60 mm base AB and altitude 80 mm, has its base in the V.P. and inclined at  $30^\circ$  to the H.P. The corner A is 15 mm above the H.P. and the corner C is in the H.P. Draw the projections of the plane. (L3)
  40. A plate having shape of an isosceles triangle has base 50 mm long and altitude 70 mm. It is so placed that in the front view it is seen as an equilateral triangle of 50 mm side's, one side inclined at  $45^\circ$  to xy. Draw its top view. (L3)
  41. A square lamina is placed such that one of the corners is touching the VP and the diagonal through this is perpendicular to the VP and measures 60 mm. The other diagonal

- appear to be 40 mm in the view from above. Draw the projections and find the inclination of the plane to the ground. (L4)
42. A thin rectangular plate of sides, 60 mm  $\times$  30 mm has its shorter edge in V.P and that shorter edge is inclined at  $30^\circ$  to H.P. Project its top view if its front view is a square of 30 mm long. (L3)
  43. A rectangular lamina of 30 mm  $\times$  40 mm is resting on one of its sides in HP. Its surface is perpendicular to HP and inclined at  $30^\circ$  to V.P. Draw the projections. (L3)
  44. A thin pentagonal plate of 60 mm long edges has one of its edges in the H.P and perpendicular to V.P while its farthest corner is 60 mm above the H.P. Draw the projections of the plate. Project another front view on Auxiliary Vertical Plane (A.V.P) making an angle of  $45^\circ$  with V.P. (L3)
  45. A regular pentagon of 30mm side has one side on the ground and its plane is inclined at  $45^\circ$  to H.P and perpendicular to V.P. Draw the projections. (L3)
  46. A regular pentagon lamina of 30 mm side surface is inclined at  $30^\circ$  to U.P and side on which it rests of VP makes at angle of  $45^\circ$  to HP. Draw its projection by auxiliary plane method. (L3)
  47. Draw the projections of a regular hexagon of 25 mm side, having one of its sides in the H.P. and inclined at 60 degrees to the V.P., and its surface making an angle of 45 degrees with H.P. (L3)
  48. Draw the projections of a regular hexagonal lamina of 30mm side resting on one of its base edges on A.P with its plane perpendicular to H.P and inclined at  $45^\circ$  to V.P. (L3)
  49. A hexagonal plate of side, 40mm, is resting on a corner in VP with its surface making an angle of  $30^\circ$  with the VP. The front view of the diagonal passing through that corner is inclined at  $45^\circ$  to the line, xy. Draw the projections of the plate using auxiliary plane method. (L3)
  50. A regular hexagonal lamina with its edge 25 mm has its plane inclined at  $45^\circ$  to the H.P and lying with one of its edges in H.P. The plane of one of its diagonals is inclined at  $45^\circ$  to XY. The corner nearest to VP is 15 mm in front of it. Draw its projections. (L3)
  51. A regular hexagonal lamina of sides 40 mm is standing on a corner on the ground with the diagonal connecting this corner to the opposite corner being perpendicular to the ground. A centrally punched rectangular hole 20 mm  $\times$  40 mm with the shorter side parallel to the diagonal perpendicular to the ground appears to be a square in the view from the front. Draw the projections of the lamina. (L3)
  52. A regular hexagonal lamina of 30 mm sides is standing on a corner on the ground. The diagonal connecting this corner to the opposite corner is parallel to the VP, 50 mm from it and  $30^\circ$  to the ground. The plane of lamina makes  $30^\circ$  to the VP. Draw the projections on the three principal planes. (L3)
  53. A hexagonal plane with 35 mm side is resting on a side on the H.P., and inclined at  $45^\circ$  to the V.P. The surface of the plane is inclined at  $30^\circ$  to the H.P. Draw its projections using auxiliary plane method. (L3)



54. AB and CD are the two mutually perpendicular diameters of a circular lamina of diameter 50 mm. The lamina is standing on the point B on the ground with the surface making  $30^\circ$  to the ground. The diameter CD makes  $60^\circ$  to the VP. Draw the projections of the lamina. (L3)
55. A thin circular plate of 40mm diameter having its plane vertical and inclined at  $40^\circ$  to V.P. Its center is 30mm above H.P. and 35mm in front of V.P. Draw the projections. (L3)

### Unit –III

#### {Relates to CO1., CO2. and CO3.}

1. A triangular prism of base side 40 mm and height 50 mm has its axis inclined at 40 degrees to VP and has a base edge on VP, inclined at 50 degrees to HP. Draw its projections. (L3)
2. Draw the projections of a square prism of side of base 30mm and axis 60mm long resting on one of its base edges in H.P with its axis inclined at 30 degrees to H.P. and the top view of axis is 45 degrees to V.P. (L3)
3. A rectangular prism of base 40 mm x 30 mm and height 70 mm rests with its longer edge of the base on the VP. If the axis of the prism is inclined to VP at 30 degrees and the front view of the axis is inclined to the xy line at 45 degrees, draw the top and front views. (L3)
4. A pentagonal prism having base with a 30 mm side and a 75 mm long axis, has one of its rectangular faces on H.P. and the axis is inclined at 60 degrees to the V.P. Draw its projections. (L3)
5. A pentagonal prism of side of base 30 mm axis 70 mm is resting on one of its base edges in H.P. with its axis inclined at 45 degrees to H.P. The top view of the axis is inclined at 30 degrees to V.P. Draw the projections. (L3)
6. Draw the projections of a pentagonal prism, base 25mm side and axis 50 mm long resting on one of its rectangular faces on H.P., with the axis inclined at 45 degrees to V.P. (L3)
7. A hexagonal prism, having a base with a 30 mm side and a 70 mm long axis, has an edge of the base parallel to the H.P. and inclined at 45 degrees to the V.P. Draw its projections when its axis makes 60 degrees with the H.P. (L3)
8. A square pyramid with side of base 40 mm and height 80 mm is suspended freely from a point on a slant edge at distance of 20 mm from its apex. The top view of the axis of the pyramid is inclined at 30 degrees to the xy line. Draw the projections. (L3)
9. A square pyramid, with a base having a 50 mm side and a 60 mm long axis, has one its triangular face on the H.P. and a slant edge containing that face is parallel to the V.P. Draw its projections. (L3)
10. A pentagonal pyramid has an edge of the base in the V.P is inclined at 30 degrees to the H.P., while the triangular face containing that edge makes an angle of 45 degrees to the V.P. Draw the three views of the pyramid, if the edge of the base is 30 mm and that of axis is 80 mm. (L3)



11. A pentagonal pyramid side of base 30 mm and axis 60 mm long rests on one of its base edges on HP and making an angle of 30 degrees to V.P. Its axis makes an angle of 45 degrees with HP. Draw the projections. (L3)
12. A pentagonal pyramid, base 25 mm side and axis 50 mm long has one of its triangular faces in the V.P. and the edge of the base contained by that face makes an angle of 30 with the H.P. Draw its projections. (L3)
13. A pentagonal pyramid, having a base with a 30 mm side and a 70 mm long axis, has one of the corners on the ground with its axis inclined at 45 degrees to the H.P. A vertical plane containing the axis and that corner is inclined at 30 degrees to the V.P. Draw its projections. (L3)
14. The altitude of a regular pentagonal pyramid is 75 mm long. The distance between the center of the base to one of its corners is 30 mm. The apex of the pyramid is touching the HP, the VP and the right profile plane. One of the triangular faces is facing the ground. The axis is inclined at 45 degrees to the VP and 60 degrees to the ground. Draw the projections of the solid. (L4)
15. The base edge of a regular pentagonal pyramid measures 30 mm and the height of the pyramid is 60 mm. It is standing on its base on the ground with an edge of the base parallel to the VP. A corner of the base is nearer to the VP than the parallel edge. Draw the projections. Draw an auxiliary view from above on a plane which is inclined at 60 degrees to the XY line. (L3)
16. A hexagonal pyramid base 25 mm side and axis 55 mm long has one of its slant edges on the ground. A plane containing that edge and the axis is perpendicular to the H.P and inclined at 45 degrees to the V.P. Draw its projections when the apex is nearer the V.P than the base. (L3)
17. Draw the projections of a hexagonal pyramid of side of base 30 mm and axis 60 mm long resting on one of its base edges in H.P with its axis inclined at 30 degrees to H.P. and the top view of axis is 45 degrees to V.P. (L3)
18. Draw the projections of a cylinder of 40 mm diameter and axis 60 mm long resting on H.P on a point on its base circle with its axis inclined at 30 degrees to H.P and top view of axis making 45 degrees with V.P. (L3)
19. Draw the projections of a cone, with a 50 mm base diameter and a 70 mm long axis that is resting on a point of its base circle on the ground such that its axis is inclined at 30 degrees to the H.P. and the top view of the axis is inclined at 45 degrees to the V.P. (L3)
20. A right circular cone of base diameter 60 mm and height 80 mm is so placed that diameter KJ of the base is inclined at 50 degrees with HP and the other diameter LM of the base is parallel to both HP and VP. Draw the top and front views of the cone. The diameters KJ and LM are perpendicular to each other. (L3)
21. A right circular cone of base 50 mm diameter is situated such that the axis appears to be perpendicular to XY both in the HP and the VP. The axis measures 50 mm in the VP and

- 60 mm in the HP. The apex is nearer to the VP than the base. Neither the base nor the apex is touching the VP or the HP. Draw the projections of the object. (L3)
22. A right circular cone of base 40 mm diameter has the view from above and the view from the front in which the axis appears to be perpendicular to XY. The axis which is 80 mm long appears to be 50 mm long in the view from the front. The apex is touching the VP. Draw the projections of the cone. (L3)
23. A tetrahedron of edge 50 mm long is standing on one of its corners on the ground with one of the edges connected with this corner making 60 degrees with the ground and one of the triangular faces connected with this corner making an angle of 30 degrees with the VP. Draw the projection of the object. (L3)
24. A triangular prism with a 50 mm side and a 70 mm long axis lies on the H.P. on one of its rectangular faces with its axis inclined at 30 degrees to the V.P. It is cut by a horizontal section plane at a distance of 5 mm from the axis. Draw its front view and sectional top view. (L3)
25. A square prism of 42 mm side of base and 64 mm long rests on one of its long edges on HP, so that a rectangular face makes 30 degrees with HP and is perpendicular to VP. It is cut by a section plane parallel to HP and 6 mm above the axis. Draw the front view and sectional top view. (L3)
26. A square prism has its shorter edge in the VP. Its axis is parallel to the HP and is inclined at 50 degrees to the VP. The prism is cut by an AIP inclined at 45 degrees to the HP and passing through the midpoint of the axis. Draw the Front View, Sectional Top View, and Side View. The base side of the prism is 40 mm and its length of axis is 80 mm. (L3)
27. A square prism, base 35 mm side and axis 70 mm long has its base on H.P with its faces equally inclined to V.P. It is cut by a plane, perpendicular to V.P, inclined at 60 degrees to H.P and passing through a point on the axis 50 mm above the H.P. Draw the front view, top view and true shape of section. (L3)
28. A hexagonal prism, side of base 35 mm and height 75 mm is resting on one of its corners on H.P. with a longer edge containing that corner inclined at 60 degrees to the H.P. and rectangular face parallel to the V.P. A horizontal section plane cuts the prism into two halves. Draw the sectional top view of the cut prism and front view. (L3)
29. A hexagonal prism, base 26 mm side and axis 80 mm long, is lying on one of its rectangular faces upon HP, with its axis inclined at 20 degrees to VP. It is cut by a plane perpendicular to HP, inclined at 45 degrees to VP and passing through the midpoint of the prism as well as making 65 degrees with the axis. Draw the sectional front view, top view and true shape of the section. (L4)
30. A pentagonal pyramid with a 55 mm base and a 90 mm slant height has its base on the HP with a side of base perpendicular to the VP. It is cut by a section plane whose VT is inclined at 60 degrees to XY and intersecting the axis at 40 mm from its base. Draw the Front View, Sectional Top View, Sectional Side View, and the true shape of the section. (L3)

31. A square pyramid of base 35 mm axis 70 mm long has its base on H.P with all edges of base equally inclined to V.P. It is cut by a section plane perpendicular to V.P, inclined at 45 degrees to H.P and passing through a point 20 mm below the apex. Draw sectional top view, side view and true shape of section. (L3)
32. A pentagonal pyramid base 30 mm side and axis 60 mm long lying on one of its triangular faces on the HP with the axis parallel to VP. A vertical section plane who's H.T bisects the top view of the axis and makes an angle of 30 degrees with reference line cuts the pyramid removing its top part. Draw the top view, sectional front view and true shape of the section. (L3)
33. A hexagonal pyramid, base 32 mm side and axis 70 mm long, rests upon its base on the ground with two of its base edges parallel to VP. It is cut by a combination of section planes, perpendicular to VP and parallel to HP for the left half and then inclined upwards to an angle of 45 degrees for the right half. If the horizontal part of the cutting plane is located at 20 mm height from the base, draw the sectional top views of the pyramid. (L3)
34. A cylinder is resting on its base upon HP. It is cut by a plane inclined at 60 degrees to HP, cutting the axis at a point 20 mm from the top. If the diameter of the cylinder is 50 mm and length is 70 mm, draw the projections of the sectioned cylinder and the true shape of the section. (L3)
35. A cylinder, 65 mm diameter and 90 mm long have its axis parallel to the H.P and inclined at 30 degrees to V.P. It is cut by a vertical section plane in such a way that the true shape of the section is an ellipse having a major axis, 75 mm long. Draw its sectional front view and true shape of the section. (L3)
36. A cylinder of base 40 mm diameter and height 60 mm is standing on one of the points on the base circle and the base makes 30 degrees to the ground and the axis is parallel to the V.P. The axis leans towards the right. The object is cut by a section plane such that the view from the right shows the true shape of the section. The top most portion of the section is 50 mm above the ground. Draw the true shape of the section and also find the inclination of the section plane with the V.P and H.P. (L3)
37. A cylinder has its axis horizontal and inclined at 60 degrees to the V.P. An AVP cuts it such that the true shape of the section is an ellipse with a major axis of 100 mm and a minor axis of 65 mm. Draw the top view, sectional front view, and true shape of the section. The length of the cylinder is 105 mm. (L3)
38. The true shape of the section of a cylinder resting on the rim on the ground, the axis inclined to the ground and parallel to the VP is a rectangle 15 mm by 60 mm. The longer edge is inclined at 30 degrees to the ground line. The lowest corner of this rectangle is 12 mm above the ground. Draw the sectional view from the front and find the inclinations of the section plane with respect to the reference planes. (L4)
39. A cone 50 mm diameter 70 mm axis rests on its base in HP. It is cut by a section plane perpendicular to V.P, inclined at 45 degrees to HP and cuts the axis at a point 25 mm

- from the apex. Draw its front view, sectional top view, sectional side view & true shape of section. (L3)
40. A cone of 50 mm diameter and axis 60 mm long rests with its base on H.P. It is cut by a section plane perpendicular to H.P. and inclined at 60 degrees to V.P. and at a distance of 10mm from the axis. Draw the sectional front view and true shape of section. (L3)
  41. A cone of base 40 mm diameter and height 60 mm is standing on one of the points on the base circle and the base makes 30 degrees to the ground and the axis is parallel to the VP. The axis leans towards the left. The object is cut by a section plane such that the view from the left shows the true shape of the section. The topmost portion of the section is 40 mm above the ground. Draw the true shape of the section and also find the inclination of the section plane with the VP and the HP. (L4)
  42. A cone with a base diameter of 75 mm and a slant height of 75 mm is resting on a point on the circumference of the base on the H.P. The axis of the cone is inclined at 45 degrees to the H.P. and parallel to the V.P. The cone is cut by a section plane whose HT passes through the midpoint of the axis and is seen parallel to an extreme generator in the top view. Draw the top view, sectional front view and true shape of the section of the cone. Assume that the apex of the cone is removed. (L3)

#### Unit –IV

##### {Relates to CO1, CO2, and CO3.}

1. A pentagonal prism having a base with 30 mm side and 65 mm long axis, is resting on its base in the H.P. with a rectangular face parallel to the V.P. It is cut by a section plane perpendicular to the V.P., inclined at 30 degrees with the H.P., and passing through a point on the axis, 25 mm from one of the bases. Draw the development of its lateral surface. (L3)
2. A pentagonal prism of base edge 30 mm and height 70 mm is placed with one of its rectangular faces on the ground and the axis parallel to the VP. It is cut by a section plane perpendicular to the VP and inclined at 30 degrees to the ground. It passes through the mid-point of the axis. Develop the remaining surface of the object. (L3)
3. A square pyramid, base 50 mm side and axis 75 mm long, is resting on H.P on one of its triangular faces, the top view of the axis making an angle of 30 degrees with V.P. It is cut by a horizontal section plane, the V.T of which intersects the axis at a point 6 mm from the base. Draw the front view, sectional top view and the development of the sectioned pyramid. (L3)
4. A cylinder with a 50 mm base diameter and a 70 mm long axis is resting on its base in the H.P. It is cut by an auxiliary inclined plane whose V.T. is inclined at 30 degrees with the H.P. and passes through top end of one of the extreme generators. Draw the development of the lateral surface of the retained solid. (L3)
5. A cone, base 65 mm diameter and axis 75 mm long, is lying on H.P on one of its generators with the axis parallel to V.P. A section plane which is parallel to V.P cuts the

- cone 6 mm away from the axis. Draw the sectional front view and the development of the surface of the remaining portion of the cone. (L3)
6. A right circular cone, 70 mm base and 70 mm height, rests on its base on the ground plane. A section plane perpendicular to VP and inclined at 30 degrees to HP cuts the cone, bisection its axis. Draw the development of the lateral surface of the cone. (L3)
  7. A triangular prism of base edge 30 mm and height 70 mm stands on one of the corners on the ground. The two edges connected with this corner make equal inclinations with the HP. The longer edge connecting the corner makes 30 degrees to the HP. A section plane perpendicular to the VP and inclined at 60 degrees to the HP cuts the object. The section plane passes through the mid-point of the axis. Draw the development of the surface of the object. (L3)
  8. Draw the development of the lateral surface of the truncated triangular pyramid resting on H.P with one of its edges perpendicular to V.P and is cut by a plane inclined at 30 degrees to H.P and the plane is passing through the axis at a distance of 20 mm from the vertex. The edge of the base is 30 mm and the length of the axis is 40 mm. (L3)
  9. Draw the development of the lateral surface of the truncated right circular cylinder of diameter 44 mm and height 70 mm. The tube is placed on HP. A section plane, passing through the geometrical centre of the top face of the tube, perpendicular to VP and inclined at 45 degrees to HP, cuts off the top portion of the tube. A similar section plane making an angle of 30 degrees to HP in the opposite direction cuts the axis at a height of 14 mm from the base. (L4)
  10. A cone with a 60 mm base diameter and a 70 mm axis is resting on its base in the H.P. A section plane parallel to both the H.P. and V.P. cuts the cone at a distance of 12 mm from the axis. Draw the development of the retained cone. (L3)
  11. The view of a square pyramid from the front is an isosceles triangle ABC with BC parallel to the ground line.  $BC = 40$  mm,  $AB = AC = 70$  mm. The section plane appears as a straight line inclined at 45 degrees to the base BC. The edge view of the section plane intersects AC at a height of 10 mm above BC. The edge view of the section plane leans towards the left. Draw the development of the surface of the object. (L3)
  12. Draw the development of the lateral surface of a right regular hexagonal prism of 24 mm base edge and 56 mm height. An ant moves on its surface from a corner on the base to the diametrically opposite corner on the top face, by the shortest route along the front side. Determine and sketch the path of elevation. (L4)
  13. A hexagonal prism of height 60 mm stands on its base on the ground with one of its rectangular faces being perpendicular to the VP. A groove starting from one of the corners on the base travels around the prism and ends up at a corner on the top face which is directly above the starting point. The groove has to be made on a shortest possible route. The distance of the groove from the starting point to the finishing point is 150 mm. Draw the view of the prism from the front clearly showing the route of the groove. (L3)

14. A square prism having a base with a 40 mm side and a 60 mm long axis stands on its base on the H.P. with its vertical faces equally inclined to V.P. A circular hole with 50 mm diameter is drilled centrally through the prism such that the axis of the hole is perpendicular to the V.P. Draw the development of the lateral surface of the prism. (L3)
15. A vertical hexagonal prism of 25 mm side of base and axis 60 mm has one of its rectangular faces parallel to VP. A circular hole of 40 mm diameter is drilled through the prism such that the axis of the hole bisects the axis of the prism at right angle and is perpendicular to VP. Draw the development of the lateral surface of the prism showing the true shape of the hole in it. (L3)
16. A hexagonal prism of 25 mm base edge and height 60 mm is standing on its base on the ground and two adjacent edges of the base make equal inclinations to the VP. A hole in the object appears to be an ellipse in the view from the front with the major axis situated along the view of the axis from the front. The midpoint of the axis as appears in the view from the front coincides with the midpoint of the major axis. The major axis is 50 mm and the minor axis 30 mm. Draw the development of the surface of the object. (L3)
17. A pentagonal pyramid of base edge 25 mm and height 50 mm rests on its base on the ground with one of its base edges being perpendicular to the VP. A Circular hole of diameter 30 mm is made in the pyramid whose axis is perpendicular to the VP and 20 mm above the base of the pyramid. The axis of the hole intersects the axis of the pyramid at right angles to it. Draw the development of the surface of the pyramid. (L3)
18. A cone of base diameter 50 mm and height 70 mm is resting on its base on the ground. A square hole of 15 mm sides passes through the object. The axis of the hole and the cone intersect and are at right angles to each other. One of the shorter edges of the hole is parallel to and 10 mm above the base. Draw the development of the surface of the object. (L3)
19. A right circular vertical cylinder of 44 mm diameter and height of 60 mm rotates uniformly. A plotter pen tip moves vertically at uniform speed on the surface of the cylinder from the bottom to the top, so it moves 60 mm while the cylinder completes one rotation. Draw the line marked on the cylinder in the front view and measure the true length of it. (L4)
20. A vertical pentagonal prism base 50 mm side is completely penetrated by a horizontal square prism, base 35 mm side so that their axis are 6 mm apart the axis of the horizontal prism is parallel to the V.P while the faces of both prisms are equally inclined to the V.P. Draw the projections of the prisms showing lines of intersection. (L3)
21. Two equal prisms, whose ends are equilateral triangles of 40 mm side and axes 100 mm long, intersect at right angles. One face of each prism is on the ground. The axis of one of the prisms makes 30 degrees with the V.P. Draw three views of the solids. (L3)
22. A square prism of base 50 mm side and height 125 mm stands on the ground with a side of the base inclined at 30 degrees to the V.P. It is penetrate by a hexagonal prism of base 30 mm and length 125 mm, whose axis is parallel to both the H.P. and the V.P. and



- bisects the axis of square prism. Draw the projections showing fully the curves of intersection. (L3)
23. A square pipe of 40 mm side has a similar branch of 25 mm side. The axis of the main pipe is vertical and is intersected by the axis of the branch at an angle of 45 degrees. All the faces of both the pipes are equally inclined to the V.P. Draw the projections of the pipes, showing lines of intersection. Also develop the surfaces of both the pipes. (L3)
  24. A square prism base 50 mm side and a 100 mm length having its axis perpendicular to the V.P. is penetrated by a square prism having base side 40 mm and length 120 mm. The axis of the penetrating square prism is parallel to the H.P. and inclined at 15 degrees to the V.P., and the axis of two prisms is 8 mm apart. Draw the two views of the square prisms showing the lines of intersection. (L3)
  25. A cylinder of 75 mm diameter standing on its base on HP is completely penetrated by another cylinder of 55 mm diameter with their axes intersecting at right angle. Draw the projections showing the lines of intersection, assuming that the axis of the smaller cylinder is parallel to VP. (L3)
  26. A cylinder resting on its base on the H.P. is penetrated by another cylinder with their axes bisecting at right angles. Draw the projections of the combination and show the curves of intersection. Consider the vertical cylinder having a 60 mm base diameter while the penetrating cylinder has a 50 mm base diameter. (L3)
  27. A horizontal cylinder of 40 mm diameter 120 mm length penetrates a vertical cylinder of 60 mm diameter 120 mm height. The axes of the cylinders intersect each other. Draw the curves of intersection. (L3)
  28. A vertical cylinder of 80 mm diameter is completely penetrated by another cylinder of 60 mm diameter their axis bisecting each other at right angles. Draw their projections showing curves of penetration, assuming the axis of the penetrating cylinder to be parallel to the V.P. (L3)
  29. A vertical cylinder of 60 mm diameter of the base is penetrated by an object whose true section is an ellipse of major axis 60 mm and minor axis 40 mm. The axis of this object is parallel to both the HP and the VP and intersects the axis of the vertical cylinder at right angles. The major axis is parallel to the VP and the minor axis is parallel to the HP. Draw the curves of intersection. (L3)
  30. A horizontal cylinder of 30 mm diameter penetrates a vertical cylinder of 60 mm diameter. The axes of the objects are 15 mm apart. Draw the curves of intersection. (L3)
  31. A right circular cylinder of base diameter 60 mm and 80 mm high is resting on its base on the ground. A horizontal cylinder of base diameter 40 mm penetrates the first cylinder. The axes of the objects are 10 mm from each other. Draw the curves of intersection. (L3)
  32. A vertical cylinder of 50 mm diameter and height 120 mm is penetrated by a horizontal cylinder of same size and same length. The axis of the horizontal cylinder is parallel to



- V.P and is 7 mm away from the axis of vertical cylinder. Draw the projections showing the curves of intersection. (L3)
33. A horizontal circular hole of 50 mm diameter is drilled through a vertical cylinder of 80 mm diameter and 120 mm length. The axis of the hole is parallel to V.P. 10 mm in front of the axis of the cylinder. Draw the views of the cylinder with the curves of intersection. (L3)
  34. A cylinder of 75 mm diameter and 125 mm height stands on its base on the ground. It is penetrated centrally by a cylinder, 50 mm diameter and 125 mm long, whose axis is parallel to H.P, but inclined at 30 degrees to V.P. Draw the projections showing the curves of intersection. (L3)
  35. A cylinder with a 60 mm diameter and a 100 mm length has its axis perpendicular to the VP. Another cylinder with a 44 mm diameter and a 120 mm length penetrates the first cylinder. The axis of the penetrating cylinder is parallel to the HP, inclined at 15 degrees to the VP, and 8 mm away from the axis of the first cylinder. Draw the two views of the cylinders showing the curves of intersection. (L3)
  36. A vertical pipe, 75 mm diameter and 150 mm long, has two branches, one on each side. The horizontal branch is of 60 mm diameter while the other is of 50 mm diameter and inclined at 45 degrees to the vertical. Assume the axis of 50 mm branch and the main pipe to be in the same plane, and that of 60 mm branch at 6 mm from the axis of the main pipe and parallel to the V.P. Draw the views of the pipe showing curves of intersections. Draw the developments of three pipes, assuming suitable lengths. (L4)
  37. A square prism of base 50 mm side and height 125 mm stands on the ground with the side of its base inclined at 30 degrees to V.P. It is penetrated by a cylinder, 50 mm diameter and 125 mm long, whose axis is parallel to both H.P and V.P and bisects the axis of the prism. Draw the projections showing fully the curves of intersection. (L3)
  38. A triangular prism, having base with a 60 mm side and a 100 mm long axis, is resting on its base on the H.P. with a nearer face parallel to the V.P. It is penetrated by a cylinder with a 50 mm diameter and a 90 mm long axis. The axis of the cylinder is parallel to both the reference planes and 15 mm away from the axis of the prism towards observer. Draw the projections of the combination and show the curves of intersection. (L3)
  39. A cylinder with a 50 mm diameter base and a 70 mm height is resting on its base on the HP. It is intersected by a triangular prism of 35 mm sides whose axis is parallel to both the reference planes and is offset by 5 mm from the cylinders axis. Draw the three views and show the curves of intersection. (L3)
  40. A hexagonal prism of base edge 25 mm is inclined at 60 degrees to the ground. Two adjacent base edges are equally inclined to the ground. This prism penetrates vertical cylinder of 80 mm base diameter. The axes of the objects intersect each other and both are parallel to the VP. Draw the curves of intersection. (L3)

## Unit –V

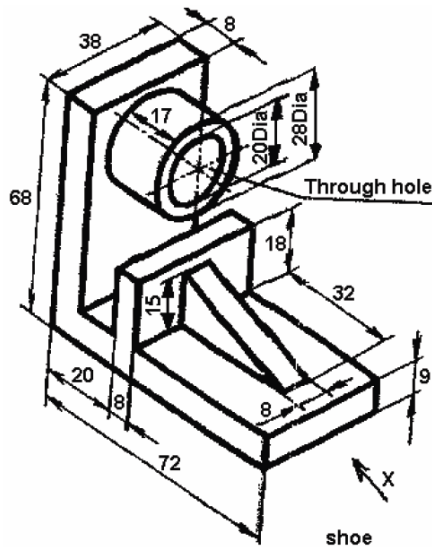
### {Relates to CO1., CO2., CO3., CO4. and CO5.}

1. Define isometric projection. (L1). Differentiate between isometric projection and isometric view. (L4)
2. Construct Isometric Scale. (L3)
3. Draw an isometric view of a hexagonal prism having a base with 25 mm side and 65 mm long axis which is lying on its face in the HP with axis parallel to both HP and VP. (L3)
4. Draw an isometric view of a pentagonal prism having a base with 30 mm side and 60 mm long axis, resting on its base in H.P. with a face parallel and nearer to the V.P. (L3)
5. Draw the isometric view of a hexagonal prism of side of base 26 mm and height 64 mm, resting upon its base on HP and a rectangular face is parallel to VP. (L3)
6. A pentagonal pyramid of height 60 mm and side 28 mm is resting on HP, keeping its axis vertical and one edge of the base parallel to VP. Draw isometric view of the solid. (L3)
7. Draw the isometric view of a cylinder of 60 mm height and diameter 44 mm, lying on one of its generators on HP with the axis perpendicular to VP. Select the origin of the isometric axes suitable to get the front view on the right isometric plane. (L3)
8. A cylindrical block of base, 60 mm diameter and height 90 mm, standing on the H.P. with its axis perpendicular to the H.P. Draw its isometric view. (L3)
9. A hexagonal prism of base edge 30 mm and height 70 mm long is resting on its rectangular face on the ground with its axis parallel to the VP. A square prism of 20 mm base edge and height 40 mm rests on its base on the top rectangular face of the hexagonal prism. The axis of the square prism intersects and bisects the axis of the hexagonal prism when produced. One of the base edges of the square prism is parallel to the VP. Draw an isometric projection of the set up. (L3)
10. A pentagonal prism of base edge 30 mm and 70 mm long is resting on one of its longer edges on the ground. The rectangular faces connected with the edge on the ground make equal inclinations with the ground. The axis of the prism is inclined at 60 degrees to the VP. A section plane perpendicular to the VP and inclined at 45 degrees to the ground cuts the object by passing through the mid-point of the axis. Draw the isometric view of one of the cut pieces of the object. The cut portion should be visible to the observer in the isometric view. (L4)
11. A square pyramid of 2 cm side and height 60 mm is placed centrally on the top of a square prism of 60 mm side and height 40 mm. Draw the isometric projection of the combination of solids. (L3)
12. A square pyramid of side of base 2 cm and height 4 cm is placed centrally on the top of the cylindrical block of 60 mm diameter and height 40 mm. Draw the isometric view of the combination. (L3)
13. A cube with a 60 mm side has square holes of 30 mm side, cut through from all the six faces. The sides of the square holes are parallel to the edges of the cube. Draw the isometric view of the cube. (L3)

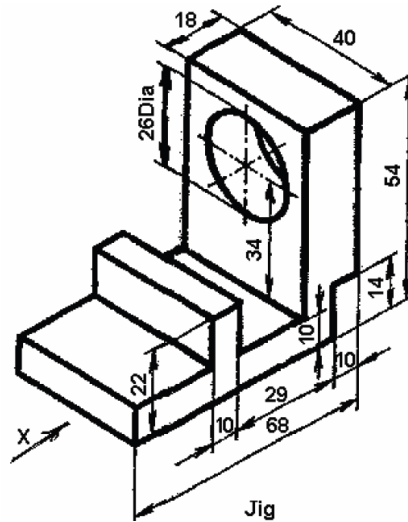
14. A hexagonal prism with a 30 mm base and 45 mm axis has an axial hole with a 30 mm diameter. Draw its isometric projection. (L3)
15. A hexagonal prism of base 30 mm side and 70 mm long has a square hole of sides 20 mm at the center. The axis of square hole coincides with the axis of hexagon. Draw the isometric view of the prism with hole. (L3)
16. A frustum of a cone with its base diameters of 60 mm in front and 40 mm at the back, length of axis being 75 mm, is having its axis perpendicular to VP. Draw its isometric projection. Give all dimensions. (L3)
17. Draw an isometric projection of a frustum of the pentagonal pyramid with a 40 mm base side, 20 mm top side, and 35 mm height resting on its base in the H.P. (L3)
18. Draw the isometric projection of a frustum of hexagonal pyramid side of base 40mm and side of top face is 20 mm and height 60 mm. (L3)
19. A frustum of a regular hexagonal pyramid, base side 28 mm, top side 16 mm and height of frustum 60 mm is having a base side parallel to VP and axis perpendicular to HP. Draw its isometric projection and give all dimensions. (L3)
20. Draw the isometric projections of a frustum of a pentagonal pyramid which is resting on one of its base corners on the ground with the axis inclined at 45 degrees to the ground and parallel to the VP. The two adjacent base edges connected with the corner on the ground make equal inclinations with the ground. The base edge measures 30 mm, the top edge measures 20 mm. The height of the frustum of the pyramid is 40 mm. (L3)
21. A right circular cone of base diameter 40 mm and height 60 mm is resting on one of the points on the circumference of the base circle on the ground with the axis making 30 degrees to the ground. The axis is parallel to the VP. The object is cut by a section plane parallel to the HP and perpendicular to the VP. The section plane bisects the axis. Draw the isometric projection of the object. (L3)
22. A sphere of 60 mm diameter is intersected by a cylinder of 30 mm diameter. The axis of the cylinder passes through the centre of the sphere. The tip of the axis of the cylinder is 70 mm from the centre of the sphere. Draw the isometric projection of the objects when the axis of the cylinder is parallel to both the VP and the HP. (L3)
23. A triangular prism of 50 mm base edge and height 80 mm is resting on its base on the ground with one of its rectangular faces parallel and nearer to the VP. A square prism of base edge 25 mm and 80 mm long interpenetrates the triangular prism. The axes of the two objects intersect at right angles to each other. Both the axes are parallel to the VP. Two adjacent longer faces of the square prism are equally inclined to the V.P. Draw the isometric view of the objects. (L4)
24. A cylinder of base diameter 50 mm and 70 mm long is placed with the axis parallel to the both the VP and the HP. It is cut by a section plane perpendicular to the VP and inclined at 60 degrees to the HP. It passes through a base circle along its diameter. Draw an isometric projection of the object such that the cut portion is visible to the observer. (L4)

25. A cylinder of diameter 50 mm base and 70 mm height is resting upon its base on HP. A section plane of 60 degrees inclination to HP cuts the axis of the cylinder at a height of 55 mm from the base. Draw the isometric view of the cylinder showing the sectioned surface. (L4)
26. A hexagonal prism having base with a 30 mm side and a 70 mm long axis is resting on its base on the H.P. with a side of base parallel to the V.P. It is cut by an A.I.P. making 45 degrees with the H.P. and bisecting the axis. Draw its isometric projection. (L4)
27. A hollow square prism of 70 mm height is resting on its base on the ground with one of the base edges parallel to the VP. Outside dimensions of the base are 50 mm and 30 mm. It is cut by a section plane inclined at 30 degrees to the VP and 60 degrees to the ground. The section plane is perpendicular to the profile plane. The lowest portion on the prism which the section plane passes through is 20 mm above the base. Draw an isometric view of the larger piece of the prism remaining over after it is being cut. The cut portion should be visible to the observer. (L4)
28. A square pyramid of 50 mm base edge and height 70 mm is resting on its base on the ground with one of the base edges being parallel to the VP. It is cut by a horizontal plane which intersects and cuts axis at a distance of 50 mm from the base. Another square pyramid whose base exactly coincides with the cut portion of the first pyramid and whose height is 50 mm is placed on the first pyramid. Draw the isometric projection of the pyramids. (L4)
29. A sphere with a 50 mm diameter rests centrally over a cube with a 60 mm side. Draw its isometric projection. (L3)
30. A pentagonal prism of base edge 30 mm and 50 mm long rests on its longer edge on the ground with the face opposite to this edge parallel to the ground. A cube of 25 mm edge rests on this face on one of its faces. Two adjacent base edges of the cube make equal inclinations to one of the longer edges of the face parallel to the ground. A sphere 30 mm diameter rests centrally on the top of the cube. Draw the isometric projections of the arrangement of the solids. (L3)
31. A hemisphere of diameter 84 mm is having its circular face parallel to HP on the upper side. A regular pentagonal prism of base side 24 mm and height 55 mm is resting centrally on it, with a base side, away from the observer, parallel to VP and their common axis perpendicular to HP. Draw its isometric projection. Give all dimensions. (L3)
32. A hemisphere of diameter 84 mm is having its circular face, parallel to HP on the upper side. An equilateral triangular prism of base side 40 mm and length 50 mm, with its axis perpendicular to VP, is resting centrally on it, on one of its rectangular faces. Draw its isometric projection. Give all dimensions. (L3)
33. The frustum of a sphere with a 60 mm diameter and frustum circle with a 40 mm diameter is used as a paper weight. Draw its isometric projection. (L3)
34. List the main functions of a CAD system. (L1)
35. Explain about functional keys used in AutoCAD. (L2)

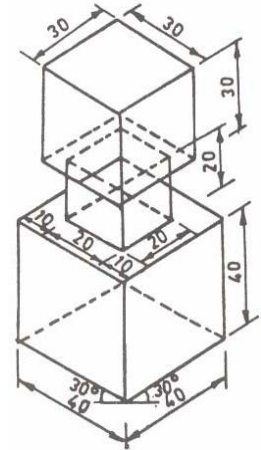
36. Write about any two types of AutoCAD tool bars and explain about 5 commands in each of it. (L2)
37. Explain the difference between COPY and MOVE. (L2)
38. Draw the front, top and both side views of the isometric projection given in figure. All dimensions are in mm. (L3)



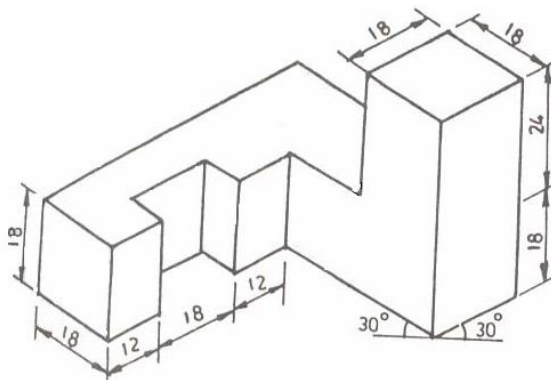
a)



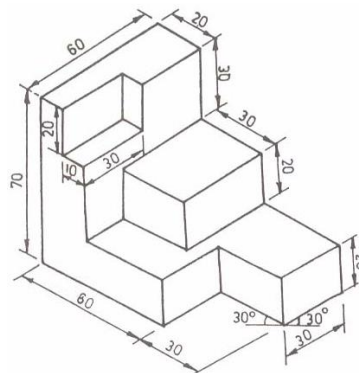
b)



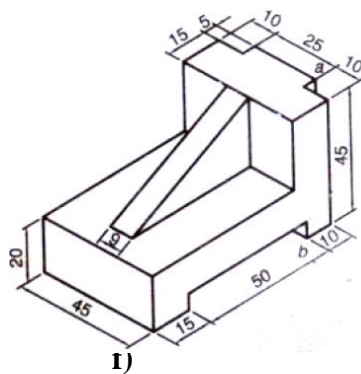
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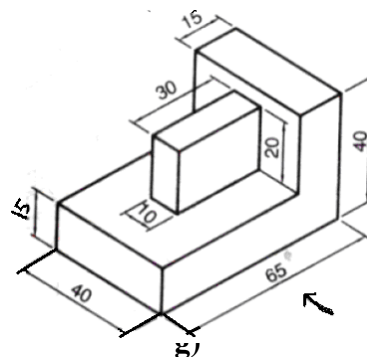
d)



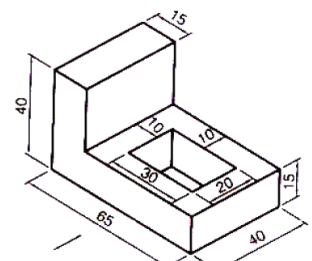
e)



f)

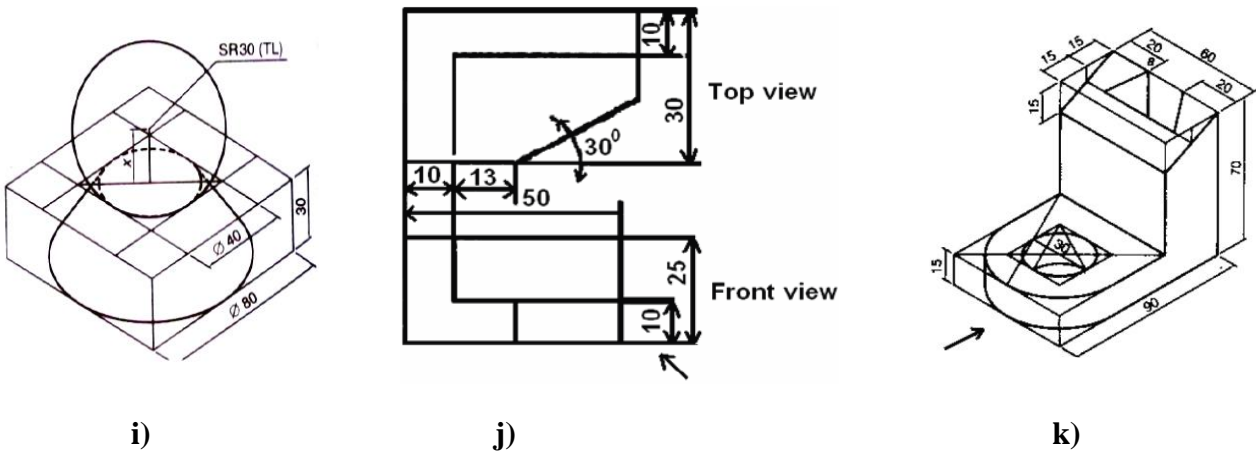


g)

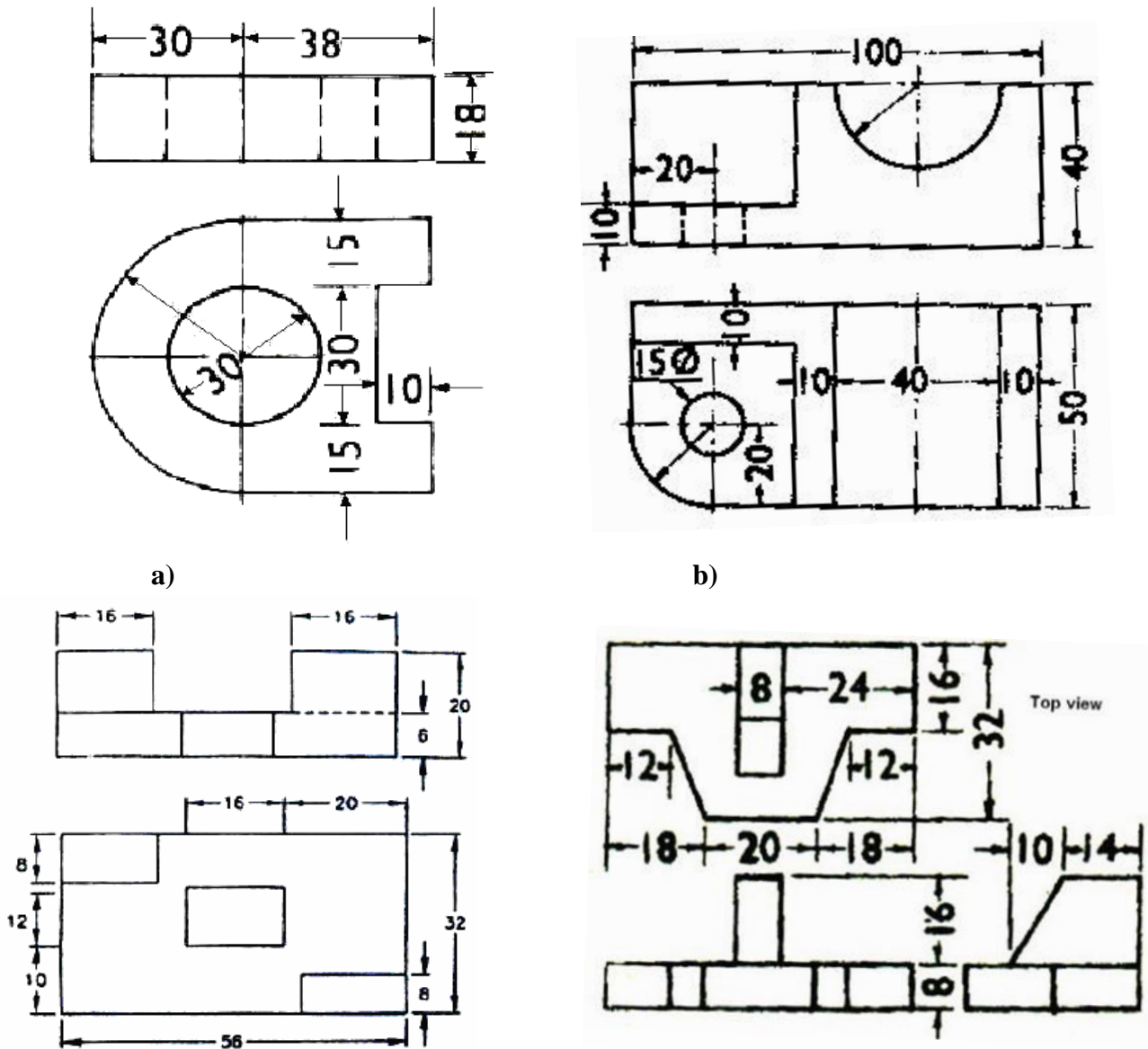


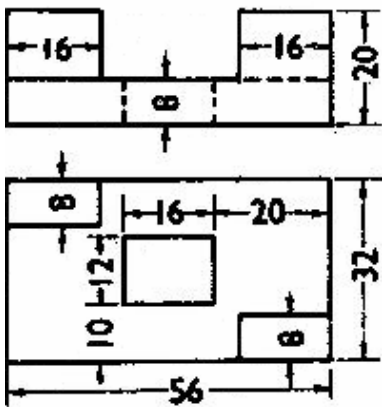
h)



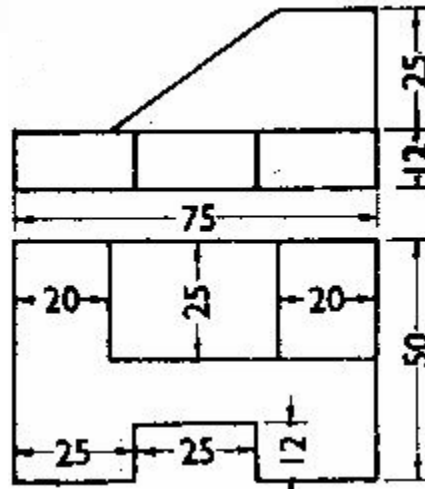


39. Draw the isometric view of the object given multi-views. All dimensions are in mm. (L3)

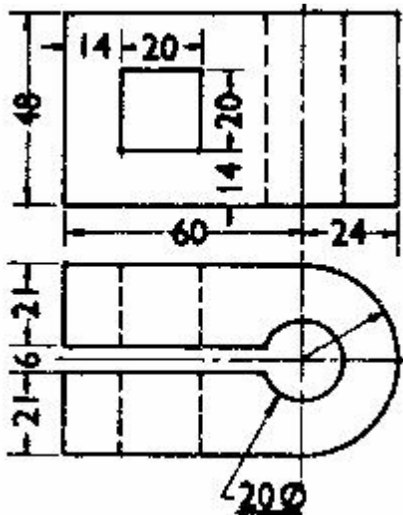




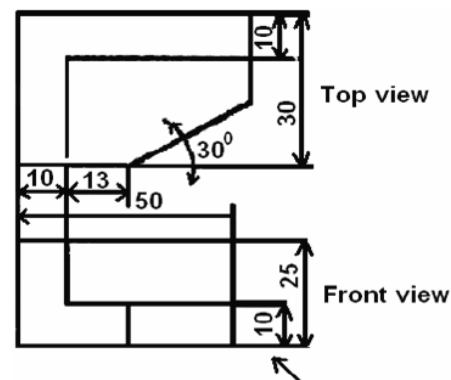
e)



f)



g)



h)

40. Draw above 2D figures using different commands from “Draw” and “Modify” tool bar and give its dimensions in AutoCAD. (L3)

#### X. WEBSITES:

1. <https://academy.autodesk.com/curriculum/introduction-engineering-graphics-and-visualization-design>
2. <https://freevideolectures.com/course/3420/engineering-drawing>
3. <http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html>
4. [https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-2009/related-resources/drawing\\_and\\_sketching/](https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-2009/related-resources/drawing_and_sketching/)
5. <http://www.engd.com.au/>
6. <http://www.design-technology.info/IndProd/drawings/>
7. <http://engg-drawing.blogspot.in/>



### **XI. EXPERT DETAILS:**

1. Prof K L Narayana, SVU, Tirupati
2. Prof P Kannaiah, SVU, Tirupati
3. Prof K Venkata Reddy, C R Engg. College, Tirupati
4. Prof. N Shiva Prasad, IIT, Chennai
5. Dhananjay A Jolhe, Asst Prof., VNIT, Nagpur
6. Dr. C M Agarwal, MANIT, Bhopal
7. Basant Agarwal, MANIT, Bhopal
8. Prof. V M Panchal, University of Baroda, Vadodara
9. Prof. P S Robi, IIT, Guwahati
10. Prof. Gary R Bertoline, Purdue University, West Lafayette, Indiana

### **XII. JOURNALS (National & International):**

1. Journal of Engineering Drawing
2. Engineering Design Graphics Journal
3. Journal of Engineering Graphics
4. Journal of Graphic Engineering and Design
5. Journal of Industrial Design and Engineering Graphic

### **XIII. LIST OF TOPICS FOR STUDENT SEMINARS:**

- |                             |                                       |
|-----------------------------|---------------------------------------|
| 1. Orthographic Projections | 5. Scales                             |
| 2. Isometric views          | 6. Construction of engineering curves |
| 3. Sectioning of views      | 7. Principles of AutoCAD              |
| 4. Development of surfaces  |                                       |

### **XIV. CASE STUDIES / SMALL PROJECTS**

1. For any given real object, constructing the Multi-views and Isometric views
2. Reading the given drawing and constructing the Isometric view
3. Construction of scales for real maps
4. Performing Half and Full Sectioning for given multi-view
5. Construction of curves of intersection of any given object like AC Duct, Funnel, etc
6. Preparation of wooden models
7. Preparation of models in AutoCAD