Course Plan & Evaluation Plan for II Semester B.Tech. Jan 2018
Subject : ENGINEERING GRAPHICS

1. Course Code	ME-111
2. Course Title	Engineering Graphics
3. L-T-P	1 3 0
4. Credits	4
5. Prerequesites	Nil
6. Teaching Department	Mechanical
7. Course Instructors	
S12 Section	Dr. Parthasarathy P & Dr. Poornesh Kumar K

8. Objectives of Course

a. Basics of orthographic and solid representation
b. Usage of drawing instruments
c. Annotations and Dimensioning of drawing
d. Drawing comprehension and representation
e. Development of Surfaces
f. Isometric representation of objects.

9. Skill development of the student expected from the course

a. Able to communicate through drawings
b. Drawing annotation and dimensioning skill
c. Pictorial representation of solids
d. Comprehension of solid objects from its drawing

11.References

Engineering Drawing - K.R.Gopalkrishna
Elements of Engineering Drawing - N.D.Bhat

12.Tutorials

Class work sheets - 13
Home work sheets - 13

13.Evaluation Plan

Class work sheets - 20%
Home work sheets - 10%
Mid Sem. Exam - 20%
End Sem. Exam - 50%

Department of Mechanical Engineering, NITK Surathkal
ME 111 Engineering Graphics
S12- II Semester, B.Tech., Dec 2018-May 2019

Class No.	Topics to be covered	Class work Sheet No	Home work Sheet No
1	Introduction, Use of Instruments, Lettering, Geometrical constructions	C1	H1
2	Dimensioning & Conventions Projections of Points in all 4Quadrants	C2	H2
3	Projections of line - simple positions & inclined to both planes	C3	H3
4	Projections of line inclined to both the planes(Continued)	C4	H4
5	Projections of line inclined to both the planes-Traces, Midpoint problems, Practical problems	C5	H5
6	Projections of Planes 1	C6	H6
7	Projections of Planes (Contd)	C7	H7
8	Projections of Solids inclined to one plane	C8	H8
9	Projections of Solids inclined to both planes (Change of position method)	C9	H9
10	Projections of Solids inclined to both planes (Auxiliary Plane Method)	C10	H10
11	Conversion of Isometric views to Orthographic views	C11	H11
12	Isometric Projection	C12	H12
13	Isometric Projection	C13	H13

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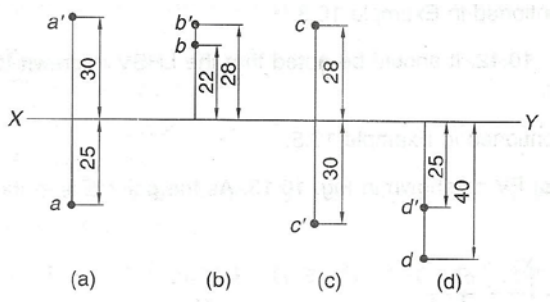
Projections of Points

1. A point is 30 mm behind VP, 30 mm above HP and 30 mm in front of right profile plane. Draw its projections.
2. A point is 35 mm below HP, 20 mm behind VP and 25 mm behind right profile plane. Draw its projections.
3. A point is 30 mm behind VP, in HP and 20 mm in front of left profile plane. Draw its projections.
4. A point P is 40 mm in front of VP, 50 mm above HP and 60 mm in front of right PP. Draw the three principal views of the point.
5. A point P is 40 mm above HP, 60 mm behind VP and 50 mm in front of right PP. Draw the three principal views of the point.
6. Draw the three principal views of a point P lying 70 mm behind VP, 60 mm below HP and 50 mm behind the left profile plane.
7. Draw the three principal views of a point P lying 65 mm below Hp, 70 mm in front of VP and 50 mm in front of the right plane.
8. A point is 30 mm in front of VP, 20 mm above HP and 25 mm in front of left PP. Draw its projections.
9. A point is 30 mm behind VP, 15 mm above HP and 25 mm in front of left profile plane. Draw its projections.
10. A point is 20 mm behind VP, 40 mm above HP and 25 mm in front of left profile plane. Draw its projections.
11. A point touches all the three principal planes of projections. Draw its projections.
12. Draw the projections of a point lying 20 mm above HP and is in the first quadrant when its shortest distance from the line of intersection of HP and VP is 40 mm. Also find the distance of the point from VP.
13. A point is lying in HP, 20 mm behind VP and 25 mm behind right profile plane. Draw its projections.
14. Draw the projections of a point lying in VP, and 25 mm below HP and 30 mm- behind left profile plane.
15. Draw the projections of the following points :
    a) A is 20 mm in front of VP and 30 mm above HP.
    b) B is 30 mm in front of VP and in HP.
    c) C is 40 mm behind VP and 20 mm below HP.
    d) D is 30 mm behind VP and 10 mm above HP.
    e) E is 40 mm in front of VP and 30 mm below HP.
    f) F touches both HP and VP.
16. Draw the projections of a point 30 mm in front of VP, in HP and 25 mm in front of left profile plane.
17. Draw the top, front and profile views of a point 40 mm in front of VP, 30 mm below HP and 25 mm in front of right profile plane.
18. A point lying 20 mm above the XY line represents the front views of two points E and F. The top view of E is 35 mm behind VP, and the top view of F is 40 mm in front of VP. Draw the projections of the two points and state their positions with reference planes and the quadrants in which they lie.
19. A point lying 20 mm below the XY line is the top view of three points P, Q and R. P is 25 mm below HP. The point Q is 35 mm above HP and the point R is in HP. Draw the projections of the three points and state their positions with the reference planes and the quadrants in which they lie.
20. A point lying 20 mm below the XY line is the front view of two points P and Q. P is 25 mm in front of VP. The point Q is 35 mm behind VP. Draw the projections of the two points and state their positions with the reference planes and the quadrants in which they lie.
21. The front and left views of a point are 40 mm above XY line and are at distances of 50 mm and 60 mm from X_1Y_1 line respectively. Draw the three views of the point. How far the point is in front of VP.
22. Draw the projections of the following points and identify the positions.



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Projections of Lines

Case I: A line is parallel to both HP and VP

1. Draw projections of a line PQ measures 70 mm is parallel to both HP and VP. The point P is 20 mm above HP and 15 mm in front of VP.

Case II: A line is perpendicular to HP and parallel to VP

2. Draw projections of a line MN measures 65 mm is perpendicular to HP and parallel to VP. The point M is 10 mm above HP and 20 mm in front of VP.

Case III: A line is perpendicular to VP and parallel to HP

3. A line PQ measures 60 mm is perpendicular to VP and parallel to HP. The point P is 15 mm above HP and 10 mm in front of VP. Draw its projections.

Case IV: A line is inclined to HP and parallel to VP

4. A line AB measures 65 mm is inclined at 30 ° to HP and parallel to VP. The point A is 10 mm above HP and 20 mm in front of VP. Draw its projections.

Case V: A line is inclined to VP and parallel to HP

5. Draw projections of a line MN measures 65 mm is inclined at 45° to VP and parallel to HP. The point M is 20 mm above HP and 10 mm in front of VP.

Case VI: A line is inclined to both HP and VP

6. A line PQ is inclined to HP at 30^0 and 45^0 to VP and measures 70 mm. The point P is 20 mm above HP and 15 mm in front of VP. Draw its projections.
7. Draw the projections of a line AB, l00 mm long inclined at 30^0 to HP and 45^0 to VP. The end A of the line is 20 mm above HP and 25 mm infront of VP. The line slopes upward forward right from A to B.
8. A line AB 80 mm long has its end A both in HP and VP, and inclined at 30^0 to HP and 45^0 to VP. Draw the projections of the line AB. Find the apparent inclinations of the top and front views with the XY line. Also measure the distance between the end projectors.
9. A line PQ 75 mm long has its end P in VP and the end Q in HP. The line is inclined at 30^0 to HP and 60^0 to VP. Draw its projections.
10. A line has its end A, 15 mm above HP and 10 mm infront of VP. The end B is 55 mm above HP and the line is inclined at 30^0 to HP. The distance between the end projectors when measured parallel to the XY line is 50 mm. Draw the projections of the line. Determine the true length of the line and its inclination with VP.
11. A line AB is 90 mm long. It is inclined at 45^0 to HP. Its front view measures 70 mm. The end A is 15 mm above HP and 25 mm in front of VP. The B end is higher than the end A. Draw the projections of the line AB. Determine: (i) its inclination with VP and (ii) the length of its top view.
12. The top view of a line PQ, 75 mm long measures 50 mm. The end P is 30 mm infront of VP and 15 mm above HP. The end Q is 15 mm infront VP and above HP. Draw the projections of the line PQ and find its true inclinations with HP and VP.
13. The top view pq of a straight line is 70 mm long and makes an angle of 60^0 with the XY line. The point Q is 10 mm in front of VP and 30 mm above HP. The difference between the distances of P and Q above the HP is 45 mm. Draw the projections. Determine its true length and true inclinations
14. A line PQ has its end P, 15 mm above HP and 10 mm in front of VP. The end Q is 55 mm above HP and the line is inclined at 30^0 to HP. The distance between the end projectors of the line when measured parallel to the line of intersection of HP and VP is 50 mm. Draw the projections of the line and find its inclination with VP.
15. The front view of a line 90 mm long is inclined at 45^0 to the XY line, a'b' being 65 mm long. a' is 15 mm above the XY line. The end A is in VP. Draw the projections of the line and find its inclinations with HP and VP.
16. A line having one of its end 10 mm above HP and 15 mm in front of VP is inclined at 30° to HP and 45^0 to VP. Its top view is 50 mm long. Draw the projections of the line and find out its true length.
17. The distance between the projectors passing through the end points of a line AB along the XY line is 40 mm. The end A is 20 mm above HP and 15 mm in front of VP. The end B is 45 mm in front of VP. The line AB appears to be 65 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
18. A line AB is 80mm long. The end A is touching VP and 10 mm above HP. The end B is 50 mm infront of VP and 40 mm above HP. Draw the projections of the line AB and find the distance between the end projectors

when measured parallel to the line of intersection of HP and VP. Also find the inclination of the line with HP and VP.

Case VII: A line with Arbitrary point

19. The mid point of a line AB is 60 mm above HP and 50 mm infront of VP. The line measures 80mm and is inclined at 30^0 to HP and 45^0 to VP. Draw its projections.
20. The projections of a line measuring 80 mm in the top view and 70 mm in the front view. The mid point of the line is 45 mm in front of VP and 35 mm above HP. One end is 10 mm in front of VP and nearer to it. The other end is nearer to HP. Draw the projections of the line, find the true length and true inclinations.
21. A line AB is 90mm long its midpoint M being 50mm above HP and 40 mm infront of VP. The end A is 20mm above HP and 10mm infront of VP. Draw its projections.
22. A line PQ measures 120mm, its top and front views measure 80mm and 96mm respectively. The line is tilted about a point R on the line which divides it in the ratio of 1:2. i.e., PR:RQ=1:2. The point R is at distance of 60mm from both the planes. Draw the projections. Find the distances of ends P and Q from HP and VP.
23. The end A of a line is 20mm infront of VP and 25mm above HP. The line is inclined 45^0 to HP. The front view length is 65mm. The top view of the line is inclined at 30^0 to VP. Draw the projections.
24. One end of the line AB is 15mm above HP and 10mm infront of VP. The line is inclined at 30^0 to VP and 45^0 to HP. The distance between end projectors is 40mm. Draw the projections.
25. A line AB is 75mm long. The top view ab of this line measures 50mm. The midpoint of this line is 60mm infront of VP and 75mm above HP. The end B is 40mm infront of VP. Draw the projections.

Case VII: Practical Problems

26. A room is 5 m X 3 m X 4 m high. An electric lamp is suspended vertically from the centre of the ceiling at a distance of 0.8m from it. Find the distance of the lamp from anyone of the ground corners and slope angle of the connecting line with the ground.
27. A room is 5 m long, 4 m wide and 4.5 m high. A fan is suspended vertically from the centre of the ceiling at a distance of 0.75 m from it. Find the distance of the fan from anyone of the ground corners and the slope angle of the connecting line with the ground.
28. A room is 5 m x 4 m x 3 m high. Determine graphically the length of the diagonal of the space choosing a suitable scale.
29. An auditorium of a college is having 100 m length, 50 m width and 20 m height. One of the light points is fitted at the centre of the roof, and its switch is kept on one of the side walls of the auditorium, 3.5 m above the floor and 10 m from one of the adjacent walls. Find the distance between the light point and its switch.
30. One end of a pole 4 meter long rests against a wall and the other on the top of a box. The box is 1 metre high. The pole makes 40^0 with the top of the box and 25^0 with the wall. Draw the projections and find the height of the end of the pole which rests against the wall. Scale 1:50.
31. A divider opened at 45° is so placed on the ground such that both the ends are equidistant from VP and the hinged end is 50 mm above the ground and nearer to VP. If the distance between the ends is 80 mm, draw the projections and determine the true lengths of the legs of the divider. Also determine the inclinations of each leg with the reference planes.
32. Three vertical poles AB, CD and EF are respectively 2 m, 4 m and 8 m long. Their ends B, D and F are on the ground and form the comers of an equilateral triangle of 5 m long sides Determine graphically the distances between the top ends of the poles, namely AC, CE AE, also the inclination of these with the ground. Scale 1 : 50.
33. A chimney of a boiler is 10 m high and 2 m in diameter. This chimney is supported by guy wires which appear in top view at 120° to each other. The ends of the wires are pegged to the ground at distances of 3 m, 4 m and 5 m from the centre of the chimney. The other ends the wire are connected to the top of the chimney. Find the length of the three guy wires.
34. A straight road going uphill from a point A due East to an another point B, is 4 km long and has a slope of 15°. Another straight road from B, due 30° East of North, to a point C is also 4 km long but is on a level ground. Determine the length and slope of the straight road joining the points A and C .Take a scale 1: 400.
35. Two oranges on a tree are respectively 1.8 meter and 3 metre above the ground, and 1.2 meter and 2.1 meter from a 0.3 meter thick wall but on the opposite sides of it. The distance between the ranges measured along the ground and parallel to the wall is 2.7 meter. Determine the real distance between the oranges. Use a suitable scale.

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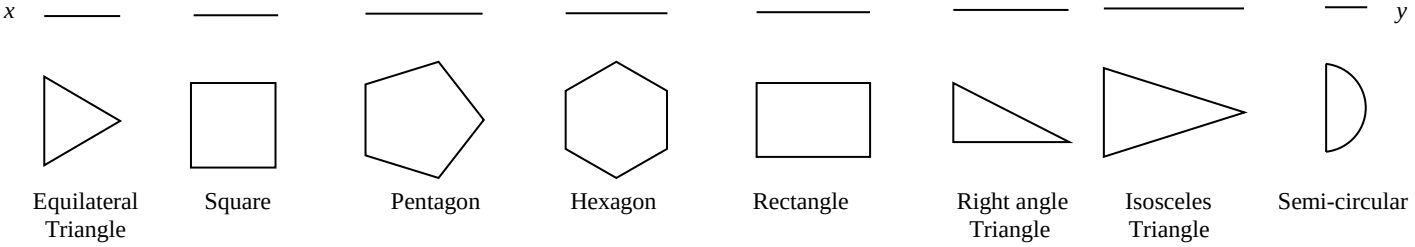
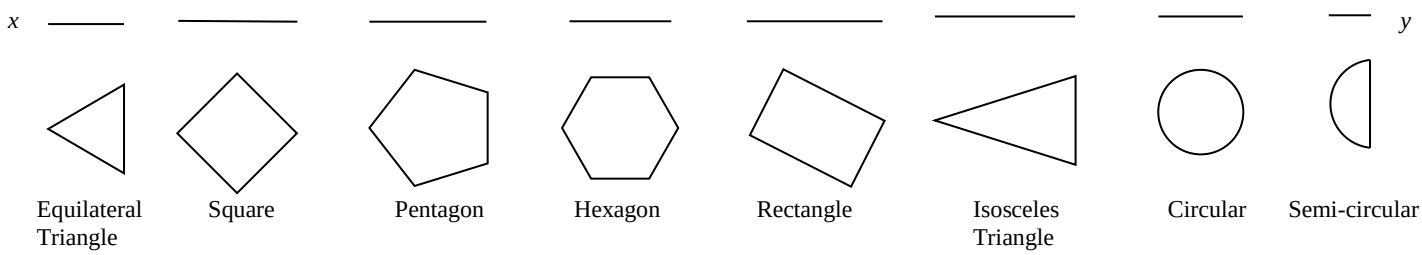
Projections of Plane Surfaces

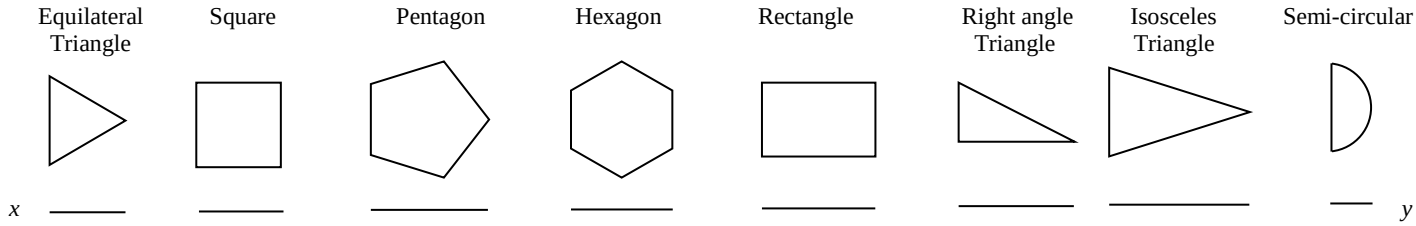
Case 1: Lamina is resting with one of its edges or sides on HP and its surface is inclined to HP:



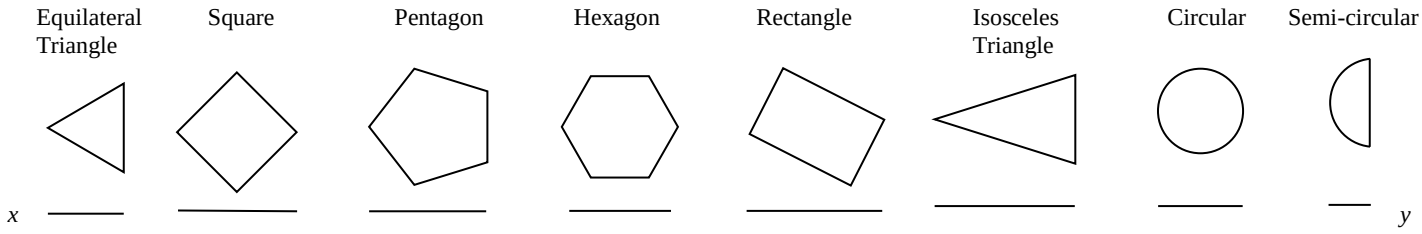
Case 2: Lamina is resting with one of its corners on HP and its surface is inclined to HP:



Case 3: Lamina is resting with one of its edges or sides in VP and its surface is inclined to VP:



Case 4: Lamina is resting with one of its corners in VP and its surface is inclined to VP:



Examples:

1. A triangular plane lamina of sides 40 mm is resting on HP with one of its corners touching it such that the surface of the plane lamina makes an angle of 60° with HP. If the side opposite to the comer on which the plane lamina rests makes an angle of 30° with VP, draw the top and front views in this position.
2. ABC is a thin triangular plate having the edges AB, BC and CA equal to 60 mm, 80 mm and 50 mm respectively. The edge AB rests on HP, and makes an angle of 30^0 VP. The plate is inclined to HP at 45°. Obtain the top and front views of the plate.
3. ABC is a triangle of sides AB = 75 mm, BC = 60 mm and CA = 45mm .The triangle is placed on HP such that its longest side AB is in VP and inclined at 30° to HP. Its surface makes an angle of 45° with VP. Draw its projections.
4. A 30°- 60° set-square of 150 mm shortest side is placed such that its longest side is in VP and 30^0 to HP. The surface of the set-square makes 45° with VP. Draw its projections.
5. An isosceles triangular plate 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 sides with one of its sides inclined at 45° to the XY line. Draw its top and front views.
6. The top view of a 45° set-square, with the side BC on HP and the side AB in VP, is a triangle abc. The side bc = 200 mm being perpendicular to the XY line and the angle bca = 25°. Draw the top and front views and measure the inclination of the set-square with HP.

7. Draw the top and front views of a square of 50 mm side placed on HP with one edge making 45^0 with VP and the surface of the square is inclined at 30^0 to HP.
8. A square PQRS of 40 mm side has its diagonal PR inclined at 45^0 to HP and the diagonal QS inclined at 30^0 to VP and parallel to HP. Draw its projections.
9. A square plate of 40 mm sides rests on HP each that one of the diagonals is inclined at 30^0 to HP and 45^0 to VP. Draw its projections.
10. A square lamina ABCD of 30 mm side rests on the corner C such that the diagonal AC appears to be at 30^0 to VP in the top view. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 45^0 with HP. Draw its top and front views.
11. A square plate 60 mm side is resting such that one of its sides lies both in HP and VP and the surface of the plate is inclined at 30^0 to VP.. Draw the top, front and right side views of the plate.
12. The top view of a square lamina is a rhombus of major diagonal 50 mm and minor diagonal 30 mm with the longer diagonal being parallel to both HP and VP. Draw the top and front views of the square lamina. What is the inclination of the surface of the lamina with HP and VP ?
13. A mirror 60mmx80mm is inclined to the wall at such an angle that its front view is a square of 60mm side. The longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.
14. A pentagonal plate with edge of 30 mm length is resting on HP on one of its edges. This edge is inclined to VP at 45° and the plate surface makes 30° angle with HP. Draw its projections.
15. A pentagonal lamina having edge 40 mm is placed such that the perpendicular bisector of one of the edges is inclined at 30° to HP and 45° VP. Draw the top and front views of the lamina.
16. A Pentagonal lamina of edges 25 mm is resting on HP with one of its corners such that the edge opposite to this corner is 20 mm above HP and makes an angle of 45^0 with VP.Draw the top and front views of the plane lamina in this position. Determine the inclination of the lamina with HP
17. A regular pentagon of 30 mm sides having one of its sides inclined at 30° to the XY line represents the top view of an irregular pentagonal lamina. The front view of the lamina is a straight line inclined at an angle of 45° with the XY line. Determine the true shape of the plane figure and measure the length of its sides.
18. A hexagonal plane of 30mm side rests on HP on one of its corner such that its surface is inclined at $50^0$to HP.Draw the projections of the plane when one of the sides is nearer to VP is inclined at 30^0 to VP.
19. A regular hexagonal lamina ABCDEF of sides 30 mm is lying in such a way that one of its sides touches both the reference planes. If the lamina makes 60° with VP, draw the projections of the lamina.
20. A hexagonal lamina of sides 30 mm is held with one of its comers on HP. Its plane is inclined at 60° to HP. Draw the projections of the lamina when two of its parallel sides appear perpendicular to the XY line in both the top and front views.
21. Draw the projections of a hexagonal plane of 30 mm side having one of its sides in VP and HP .The opposite edge is 20 mm in front of VP.
22. A hexagonal lamina of sides 25 mm rests on one of its sides on VP.The side opposite to the side on which it rests is 30 mm infront of VP and the side on which it rests makes 45^0 to HP.Draw its projection
23. Draw the projections of a circular plate of 50 mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45^0 to HP and the top view of the diameter AB making 30^0 with VP.
24. The top view of a diameter CD of a circular plane of diameter 100 mm is inclined at 45^0 to the XY line, the other diameter AB is inclined at 45^0 to HP. The diameters AB and CD are mutually Perpendicular. Draw the projections. Find the inclinations of the plane with respect to the planes of projection.
25. A circular lamina of 60 mm diameter is standing with one of its points on the rim on HP and the lamina inclined at 45^0 to HP. The diameter at right angles to the diameter passing through the point on which the lamina rests is parallel to VP. Draw its projections.
26. A Circular lamina inclined to VP appears in the front view as an ellipse of major axis 60 mm and minor axis 30 mm.The major axis is parallel to both HP and VP.One end of the minor axis is in both HP and VP.Draw the projections of the lamina and determine the inclinations of the lamina with HP and VP.
27. A semicircular lamina of 30 mm diameter rests on its diameter such that the surface of the lamina is inclined at 30^0 to HP and the diameter on which it rests is parallel to VP.
28. Draw the projections of a semicircular lamina of diameter 100 mm which stands on HP on one its diameter AB inclined at 45^0 to VP and the plane of the lamina is at 30^0 to HP. The end A being nearer to VP at a distance of 50 mm from it.

29. A triangular plane lamina of sides 40 mm is resting on HP with one of its corners touching it such that the surface of the plane lamina makes an angle of 60° with HP. If the side opposite to the comer on which the plane lamina rests makes an angle of 30° with VP, draw the top and front views in this position.
30. ABC is a thin triangular plate having the edges AB, BC and CA equal to 60 mm, 80 mm and 50 mm respectively. The edge AB rests on HP, and makes an angle of 30^0 VP. The plate is inclined to HP at 45°. Obtain the top and front views of the plate.
31. ABC is a triangle of sides AB = 75 mm, BC = 60 mm and CA = 45mm .The triangle is placed on HP such that its longest side AB is in VP and inclined at 30° to HP. Its surface makes an angle of 45° with VP. Draw its projections.
32. A 30°- 60° set-square of 125 mm longest side is so kept such that the longest side is in HP, making an angle of 30° with VP. The set-square itself is inclined at 45° to HP. Draw the projections of the set-square. Also draw the right profile view.
33. A 30°- 60° set-square of 150 mm shortest side is placed such that its longest side is in VP and 30^0 to HP. The surface of the set-square makes 45° with VP. Draw its projections.
34. An equilateral triangular lamina of 40 mm sides lies on one of its sides on HP. The lamina makes 45° with HP and one of its medians is inclined at 30° to VP. Draw its projections.
35. A triangular lamina of 35 mm sides rests of one of its comers on HP such that the median passing through the comer on which it rests is inclined at 30° to HP and 45° to VP.
36. A triangle ABC whose base BC rests on HP and makes an angle 40° with VP. The point A is 25 mm above HP and 20 mm infront of VP. The lengths of the sides of the triangle, AB, BC and CA are 40 mm, 50 mm and 60 mm respectively. Draw the top and front views of the triangle.
37. A triangular plate of 60 mm sides on HP on one of its sides which is parallel to VP and the surface of the plate is inclined to HP at 30°. Draw the projections
38. A thin triangular lamina having sides 60 mm, 70 mm and 115 mm is held in such a way that the smallest side is on HP and parallel to VP. The plane is inclined at 60° to HP. Draw the top and front views of the lamina.
39. ABC is an equilateral triangular plate of 40 mm sides. It is lying on its edge BC on HP which is making an angle of 45° with VP. The two edges AB and AC measure 30 mm in the top view. Determine the slope angle of the plate with HP. Draw its front view.
40. An isosceles triangular plate 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 sides with one of its sides inclined at 45° to the XY line. Draw its top and front views.
41. The top view of a 45° set-square, with the side BC on HP and the side AB in VP, is a triangle abc. The side bc = 200 mm being perpendicular to the XY line and the angle bca = 25°. Draw the top and front views and measure the inclination of the set-square with HP.
42. Draw the top and front views of a square of 50 mm side placed on HP with one edge making 45^0 with VP and the surface of the square is inclined at 30^0 to HP.
43. A square PQRS of 40 mm side has its diagonal PR inclined at 45^0 to HP and the diagonal QS inclined at 30^0 to VP and parallel to HP. Draw its projections.
44. A square plate of 40 mm sides rests on HP each that one of the diagonals is inclined at 30^0 to ' HP and 45^0 to VP. Draw its projections.
45. A square lamina ABCD of 30 mm side rests on the corner C such that the diagonal AC appear to be at 30^0 to VP in the top view. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 45^0 with HP. Draw its top and front views.
46. A square plate 60 mm side is resting such that one of its sides lies both in HP and VP and the surface of the plate is inclined at 30^0 to VP.. Draw the top, front and right side views of the plate.
47. The top view of a square lamina of side 60 mm is a rectangle of sides 60 mm X 20 mm with the longer side of the rectangle being parallel to both HP and VP. Draw the top and front views of the square lamina. What is the inclination of the surface of the lamina with HP and VP ?
48. The top view of a square lamina is a rhombus of major diagonal 50 mm and minor diagonal 30 mm with the longer diagonal being parallel to both HP and VP. Draw the top and front views of the square lamina. What is the inclination of the surface of the lamina with HP and VP ?
49. A rectangular lamina of sides 40 mm x 60 mm rests on HP on one of its longer edges. The lamina is tilted about the edge on which it rests till its plane surface is inclined to HP at 45°. The edge on which it rests is parallel to VP. Draw the projections of the lamina on VP, HP and the left profile plane.
50. A rectangular plate 70X40 mm has one of its shorter edge in VP and inclined at 40^0 to HP.Draw the projections , if its front view is a square of sides 40 mm.

51. A rectangular cardboard ABCD of edges AB = 55 mm and BC = 70 mm is placed such that the diagonal AC makes 60° with HP and the side AB makes 30° with VP. Draw its projections
52. A rectangular lamina of sides 60 mm x 90 mm resting on HP appears as a square in the top view. The 60 mm edges are parallel to both HP and VP. Draw its projections in this position and find its inclinations with HP and VP.
53. The front view of a rectangular lamina of sides 60 mm x 40 mm is a square of 40 mm side. Draw the top and front views. Determine the inclinations of the surface of the lamina with HP and VP.
54. A mirror 60 mm x 80 mm is inclined to the wall at such an angle that its front view is a square of 60 mm side. The longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.
55. A pentagonal plate with edge of 30 mm length is resting on HP on one of its edges. This edge is inclined to VP at 45° and the plate surface makes 30° angle with HP. Draw its projections.
56. A pentagonal lamina having edge 40 mm is placed such that the perpendicular bisector of one of the edges is inclined at 30° to HP and 45° VP. Draw the top and front views of the lamina.
57. A pentagonal plane figure of side 40 mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner which touches VP is at a height of 25 mm above HP. Draw the projections of the plane figure and determine the inclination of the plane figure with HP and VP and the distance at which the parallel edge lies from VP.
58. A pentagonal plane figure of side 40 mm is resting on one of its edges on VP with the corner opposite to that edge touching HP. This edge is parallel to HP and the corner which touches HP is 25 mm from VP. Draw the projections of the plane figure and determine the inclination of the plane figure with HP and VP and the distance at which the parallel edge lies from HP.
59. A pentagonal lamina of sides 30 mm is having a side both on HP and VP. The surface of the lamina is inclined at an angle of 60° with HP. Draw top front views of the lamina.
60. A regular pentagonal lamina of 30 mm sides is resting on one of its sides on HP while the opposite corner to this side of the lamina touches VP. If the lamina makes an angle of 60° with HP and 30° with VP, draw the projections of the lamina.
61. A Pentagonal lamina of edges 25 mm is resting on HP with one of its corners such that the edge opposite to this corner is 20 mm above HP and makes an angle of 45^0 with VP.Draw the top and front views of the plane lamina in this position.Determine the inclination of the lamina with HP

62. A regular pentagon of 30 mm sides having one of its sides inclined at 30° to the XY line represents the top view of an irregular pentagonal lamina. The front view of the lamina is a straight line inclined at an angle of 45° with the XY line. Determine the true shape of the plane figure and measure the length of its sides.
63. A regular hexagonal lamina of 30 mm side rests on one of its edges. The lamina makes 60^0 to HP and the edge on which it rests makes 60° to VP. Draw the projections.
64. A hexagonal lamina of 30 mm side rests on HP on one of its corner such that its surface is inclined at $50^0$to HP.Draw the projections of the lamina when one of the sides of the lamina nearer to VP is inclined at 30^0 to VP.
65. A regular hexagonal lamina ABCDEF of sides 30 mm is lying in such a way that one of its sides touches both the reference planes. If the lamina makes 60° with VP, draw the projections of the lamina.
66. Draw the top and front views of a hexagonal lamina of 50 side having two of its edges parallel to both the vertical and horizontal planes and one of its edges is 20 mm from each of the plane of projection. The surface of the lamina is inclined at an angle of 60° to the horizontal plane
67. A hexagonal lamina of 30 mm sides rests on HP with one of its corners touching VP and its surface Inclined at 45° to it. One of its edges is inclined to HP at 30°. Draw the front and top views of the lamina in its final position.
68. Draw the projections of a hexagonal lamina of sides 35 mm rests on one of its sides, the side on which it rests being parallel to VP and the surface of the lamina being inclined to HP at an angle of 40°.
69. A hexagonal plane figure of side 30 mm is resting on HP with a corner in VP and its surface making an angle of 30° with VP. The front view of the diagonal passing through that-corner is inclined at 40° to the reference XY line. Draw the projections of the plane figure.
70. A hexagonal lamina of sides 30 mm is held with one of its comers on HP. Its plane is inclined at 60° to HP. Draw the projections of the lamina when two of its parallel sides appear perpendicular to the XY line in both the top and front views.
71. Draw the projections of a hexagonal lamina of 30 mm side having one of its sides in VP and HP .The opposite edge is 20 mm in front of VP.
72. A hexagonal lamina of sides 25 mm rests on one of its sides on VP.The side opposite to the side on which it rests is 30 mm infront of VP and the side on which it rests makes 45^0 to HP.Draw its projection

73. Draw the projections of a circular plate of 50 mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45^0 to HP and the top view of the diameter AB making 30^0 with VP.
74. The top view of a diameter CD of a circular plane of diameter 100 mm is inclined at 45^0 to the XY line, the other diameter AB is inclined at 45^0 to HP. The diameters AB and CD are mutually Perpendicular. Draw the projections. Find the inclinations of the plane with respect to the planes of projection.
75. A circular lamina of 60 mm diameter is standing with one of its points on the rim on HP and the lamina inclined at 45^0 to HP. The diameter at right angles to the diameter passing through the point on which the lamina rests is parallel to VP. Draw its projections.
76. A Circular lamina inclined to VP appears in the front view as an ellipse of major axis 60 mm and minor axis 30 mm.The major axis is parallel to both HP and VP.One end of the minor axis is in both HP and VP.Draw the projections of the lamina and determine the inclinations of the lamina with HP and VP.
77. A semicircular lamina of 30 mm diameter rests on its diameter such that the surface of the lamina is inclined at 30^0 to HP and the diameter on which it rests is parallel to VP.
78. Draw the projections of a semicircular lamina of diameter 100 mm which stands on HP on one its diameter AB inclined at 45^0 to VP and the plane of the lamina is at 30^0 to HP. The end A being nearer to VP at a distance of 50 mm from it.

Department of Mechanical Engineering, NITK Surathkal
ME 111 Engineering Graphics
S12- II Semester, B.Tech., Dec 2018-May 2019

Projections of Solids

1. A cube of 30 mm side rests on HP such that one of its edges is in VP. This edge is inclined at 40^0 to HP. One of the faces containing that edge makes an angle of 40^0 with VP. Draw the top and front views of the cube.
2. A cube of 30 mm side rests on HP on one of its corners with a solid diagonal perpendicular to VP. Draw the top and front views of the cube.
3. Draw the projections of a triangular prism, base 40 mm side and axis 50 mm long rests with a corner of the base on HP such that the two base edges passing through the corner on which the prism rests are equally inclined to HP, and the base of the prism is inclined at 45^0 to HP and the axis of the prism is inclined at 30^0 to VP.
4. A triangular prism, base 40 mm side and 65 mm long rests on one of its longer edges on HP such that one of its rectangular faces containing the longer edge on which its rests is inclined at 20^0 to HP and is nearer to the observer. The axis is inclined at 30^0 to VP. Draw the top , front and right views.
5. A square prism of 30 mm side of base and height 60 mm rests with one of its edges of the base on HP such that the axis is inclined at 40^0 to HP and 30^0 to VP. Draw the top, front and right views of the prism when its leans to the right with the top end of the axis being nearer to the observer than its base end.
6. A triangular prism of 30 mm side of base and 70 mm height is resting on one of its edges of the base in such a way that the base makes an angle 40^0 with HP and the edge on which it is resting is at 30^0 with VP. Draw the projections of the prism.
7. A pentagonal prism of 40 mm side of base and height 70 mm is resting on a corner of its base on HP with a longer edge containing that corner inclined at 45^0 to HP and the vertical plane containing that edge and the axis is inclined at 30^0 to VP. Draw its projections.
8. A regular pentagonal prism lies with axis inclined at 60^0 to HP and 30^0 to VP. The prism is 80 mm long and has a face width of 25 mm. One of the corners of the top face is nearer to the observer and the remotest shorter edge is in VP. Draw the top and front views of the prism.
9. A pentagonal prism of 20 mm side of base and height 50 mm is suspended freely from a corner. The axis of the prism is inclined at 25^0 to VP such that the lower end of the axis of the prism is nearer to the observer. Draw its top and front views.
10. A hexagonal prism of base 30 mm side and axis 70 mm is resting with one of its sides of the base in VP and the axis is inclined at 30^0 to VP. Draw its projections when the side of the base which is in VP makes an angle of 45^0 to VP.
11. A hexagonal prism of 30 mm side of base and 70 mm height has one of its rectangular faces in VP and the edge of the base contained by that face makes an angle of 30^0 with HP. Draw the projections of the prism.
12. A hexagonal prism of 30 mm edge and 90 mm long rests on one of its rectangular faces on HP. The axis of the prism is parallel to HP and inclined to VP at 45^0. Draw the top and front views of the prism.
13. A hexagonal prism base 20 mm side and axis 40 mm long is placed with one of its base edges on HP such that the axis is inclined at 30^0 to HP and 45^0 to VP. Draw its projections.
14. A triangular pyramid 60 mm high and 40 mm edges of base rests with one of its base edges on HP. The axis of the pyramid is inclined at 30^0 to HP and the base edge on which the pyramid rests is inclined at 45^0 to VP. Draw its projections.
15. A tetrahedron of 70 mm edge is resting on one of its edges such that one of the faces containing the edge on which it is resting makes 45^0 with the horizontal plane and the edge on which it is resting makes 30^0 to the vertical plane. Draw its projections.
16. A square pyramid 60 mm high, side of square base 25 mm rests on one of its base edges on HP and then it is tilted about this edge until the axis makes an angle of 30^0 with HP and 45^0 with VP. Draw its projections.

17. A pentagonal pyramid, side of pentagon 30 mm and height 80 mm is resting on HP on one of its base edges such that the triangular face containing that edge is perpendicular to HP and parallel to VP. Draw the projections of the pyramid.

18. A pentagonal pyramid of base side 30 mm and height 65 mm rests on HP on one of its slant edges and its axis appears to be inclined at 45^0 to VP in the top view. Draw its top and front views.
19. A hexagonal pyramid of 30 mm side of base and 50 mm high rests with one of its corners of the base on HP with its axis inclined at 30^0 and 45^0 to HP and VP respectively. Draw its top, front and right views when the axis leans upwards left.
20. A hexagonal pyramid of base side 30 mm and axis 65 mm long is lying on VP on one of its slant edges. A plane containing this edge and the axis is perpendicular to VP and inclined at 45^0 to HP. In this position, draw the projections of the pyramid when the vertex of the pyramid is pointing upwards.
21. A hexagonal pyramid has base edges 40 mm long and height 90 mm. It lies with one of its triangular faces on HP with the center line of this face at 45^0 to the vertical plane, the apex being 30 mm in front of the vertical plane. Draw the top and front views of the pyramid.
22. A hexagonal pyramid, axis 60 mm and side of base 25 mm is resting with its apex on HP in such a way that the axis is inclined at 30^0 to HP and 45^0 to VP. The two mutually parallel edges of the base are parallel to HP. Draw its projections when the pyramid leans towards right.
23. A hexagonal pyramid base 30 mm side and axis 65 mm long, is freely suspended from a corner of its base. The projection of the axis on HP will be inclined at 30^0 to VP. The apex is away from VP than base and is on the left side of the base. Draw its top and front views.
24. A hexagonal pyramid, base 30 mm side and axis 60 mm long has one of its slant edges on HP such that two of its triangular faces containing the slant edge on which it rests are equally inclined to HP. The top view of the axis appears to be inclined at 45^0 to VP. Draw its projections when its base is nearer to the observer than its apex.
25. A cone of base 60 mm diameter and 70 mm high rests on its circular rim in such a way that one of its generators is perpendicular to HP. Draw its projections. The plane containing the vertical generator and axis is perpendicular to VP.
26. Draw the projections of a right circular cone of 60 mm base diameter and 80 mm height, when a generator lies in VP making an angle of 30^0 with HP.
27. A cone of base 60 mm diameter and axis 80 mm long rests on HP with its axis inclined at 45^0 and 30^0 with HP and VP respectively. Draw the top and front views of the cone.
28. A right cylinder is 70 mm diameter of base and height 80 mm. It rests such that the axis is inclined at 30^0 and 45^0 to HP and VP respectively. Draw its projections.
29. A cylinder of diameter of base 60 mm and 70 mm high rests with one of its generators on HP and the axis is inclined at 60^0 to VP. Draw its top and front views
30. Draw the top and front views of a right circular cylinder of base 45 mm diameter and 60 mm long when it lies on HP, such that its axis is inclined at 30^0 to HP and the axis appears to be perpendicular to the VP in the top view.

Unit 4 – Development of Surfaces

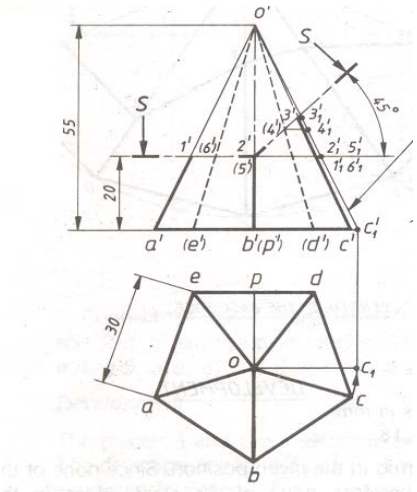
20 marks one question (Compulsory)

1. A vertical square prism 30 mm sides, 60 mm high having one of its rectangular faces leaning to the right at an angle of 30 degrees to VP, is cut by a cutting plane perpendicular to VP and inclined at 60 degrees to its axis. The cutting plane passes through the axis at the mid height of the prism. Develop the lower portion of the lateral surfaces of the prism.

2. A pentagonal prism 20 mm side of base and 50 mm high stands vertically with one of its rectangular faces parallel to VP and nearer to it. The vertical trace of a section plane inclined at 60 degrees to HP passes through one of the extreme comers of the top face of the prism. Develop the lower portion of the lateral faces of the prism so as to produce a one -piece development.

3. A vertical hexagonal prism of 30 mm side of base and axis 65 mm long has one of its rectangular faces parallel to VP and nearer to it. A circular hole of 40 mm diameter is drilled through the prism completely such that the axis of the hole bisects the axis of the prism at right angles and is perpendicular to VP. Draw the development of the prism showing the shape of the hole on it.

4. A Pentagonal pyramid of 30 mm edge of base and 55 mm high vertically rests with one of its base edges parallel to VP and nearer to it. It is cut by two section planes, both being perpendicular to VP. One of the section planes is horizontal and cuts the portion of the pyramid on the left of the axis at a height of 20 mm above the base of the pyramid. The other section plane inclined at 45 degrees to HP cuts the portion of the pyramid to the right of the axis passing through a point on it 20 mm above the base and leans upwards. Draw the development of the lateral surfaces of the lower portion of the pyramid.



5. A right regular hexagonal pyramid of 30 mm side of base and height 70 mm stands with its base on HP. A through circular hole of 30 mm diameter is drilled through the pyramid such that the axis of the hole is perpendicular to VP and intersects the axis of the pyramid 20 mm above the base. Draw the development of the lateral surface of the pyramid showing the true shapes of the holes formed on it.

6. A cone 40 mm diameter of base and height 50 mm rests with its base on HP. An isosceles triangular through slot having its axis perpendicular to VP and parallel to HP is cut through the cone such that the base of the slot is parallel to the base of the cone and 10 mm above it, and one of the sides of the slot is parallel to one of the end generators of the cone and the other side coincides with the other end generator of the cone, with the apex of the slot 15 mm from the apex of the cone. Show the shape of the slot in the top and front views, and development.

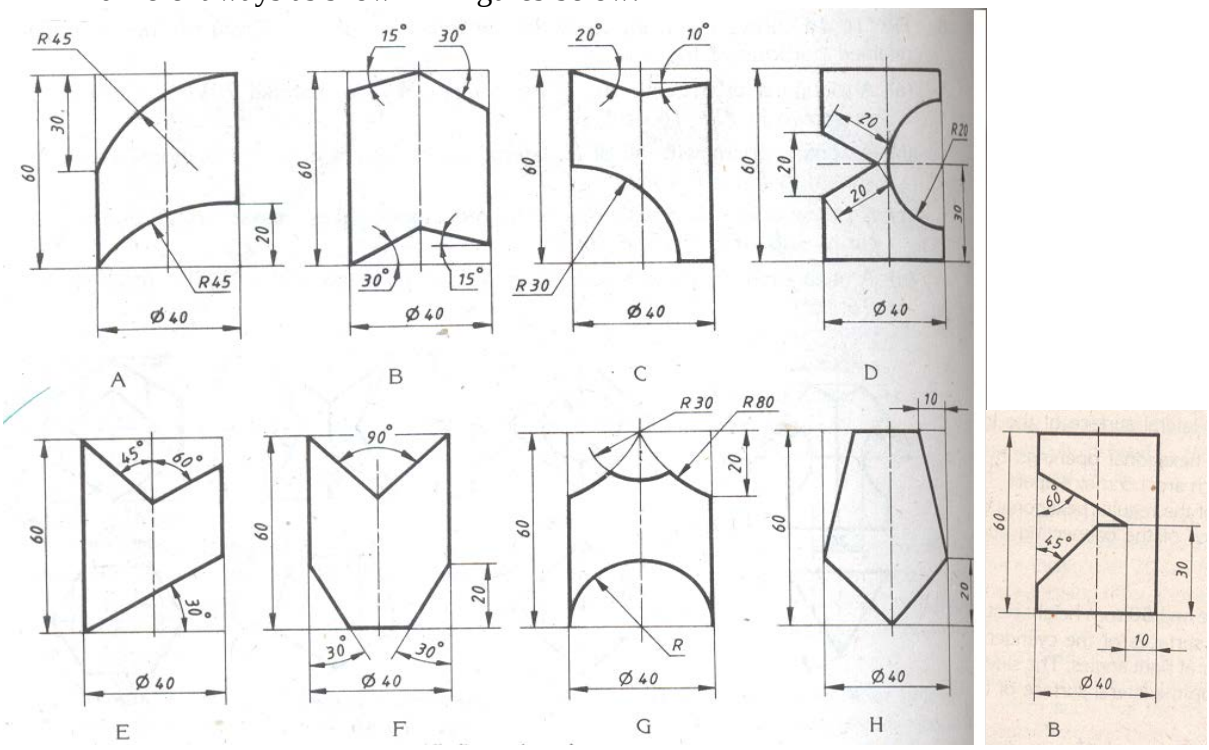
7. A frustum of a cone, 60 mm top diameter, 120 mm bottom diameter, and 75 mm high is cut with a through triangular hole of base 65 mm and altitude 45 mm. The base of the hole is 15 mm above the base of the cone and parallel to it. Draw the development showing the shape of the hole on it.

8. A pentagonal prism of 30 mm side of base and height 50 mm lies with its base on HP such that one of the rectangular faces is inclined at 30 degrees to VP. lt is cut by a section plane inclined at 60 degrees to HP and perpendicular to VP so as to pass through a point on the axis 30 mm above the base. Develop the truncated portion of the prism so as to produce a one-piece development.

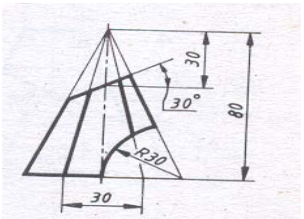
9. A, pentagonal prism .of 30 mm side of base and 65 mm long is placed with one of its rectangular faces on HP c1nd axis parallel to. VP. It is cut by a section plane perpendicular to VP and inclined at 30 degrees to HP bisecting the axis. Draw a one-piece development of the larger part of the cut prism.

10. A vertical pentagonal prism 30 mm side of base and height 60 mm has one of its rectangular faces parallel to VP and nearer to it. A through square hole of 25 mm sides is made in the centre of the prism such that the axis of the hole bisects the axis of the prism at right angles. The edges of the hole are equally inclined to HP. Draw the development of the prism showing the shape of the hole produced by it.

11. Develop the lateral surfaces of the cylinders of 40 mm diameter and height 60 mm cut in different ways as shown in Figures below.



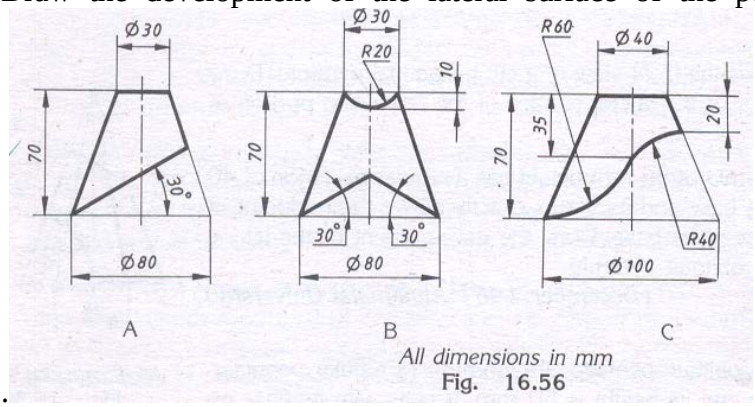
12. Fig. shows the front view of a cut hexagonal pyramid. Draw the development of the lateral surface of the remaining portion of the pyramid.



All dimensions in mm
Fig. 16.55

13. A cone, having a base diameter of 60 mm and length of axis 80 mm, is standing on its base on HP. It is cut by a plane which is perpendicular to both the HP and VP and passes at a distance of 15 mm from the axis of the cone. Draw the development of the lateral surface of the larger portion of the cone. In the full development of the lateral surface of the above cone, draw the chord joining the two ends of the arc. Let this line be PQ. Show this line in. the front and top view of the cone.

14. Draw the development of the lateral surface of the portion of the cones in Fig. A, B C



All dimensions in mm
Fig. 16.56

15. An equilateral triangle of 50 mm sides having a 20 mm diameter circle at its centre represents the front view of the cone with a circular hole in it. Draw the development of its lateral surface.

16. A funnel is to be made of sheet metal. The funnel tapers from 60 mm diameter to 30 mm diameter to a height of 25 mm and from 30 mm diameter to 20 mm diameter to a height of 50 mm. The bottom of the funnel is bevelled off to a plane inclined at 45 degrees to the axis. Draw the development of the funnel.

17. Draw the development of the joint shown in Fig.

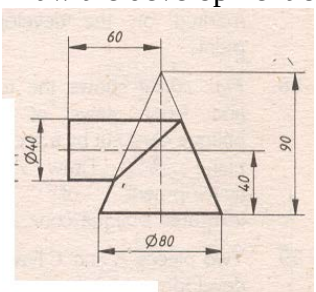


Fig. 16.58

Unit 5 – Isometric projection

20 marks one question (Compulsory)

1. A hexagonal prism of side of base 30 mm and 70 mm long has a square hole of sides 20 mm at the centre. The axes of the square hole and hexagonal prism coincide, and one of the faces of the

square hole is parallel to a face of the hexagon. Draw the isometric projection of the prism with the hole.

2. A pentagonal prism of 35 mm side of base and height 70 mm rests with its front two adjacent rectangular faces equally inclined to VP and nearer to the observer. A section plane perpendicular to VP and inclined at 450 to HP passes through a point on the axis 50 mm above the base of the prism. Draw the isometric projection of the truncated portion of the prism.

3. The frustum of a cone, base 50 mm diameter, top 30 mm diameter and height 40 mm is resting with its base on a cube of side 70 mm, such that their axes are in a line. A hemisphere of diameter 30 mm is placed centrally on the top face of the frustum of cone with its curved surface touching the top face of the cone. Draw the isometric projection of the arrangement.

4. A combination of the solids is formed as follows: A frustum of a cone 25 mm top diameter, 50 mm bottom diameter and 50 mm high is placed vertically on a cylindrical block of 75 mm diameter and 25 mm thick such that both the solids have the common axis. Draw the isometric projection of the combination of the solids.

5. A sphere of diameter 40 mm rests centrally on the top smaller end of a frustum of a hexagonal pyramid. The frustum of the pyramid has 25 mm sides at the top end, 40 mm sides at the base and is 80 mm high. Draw the isometric projection of the combination of the solids.

6. A hemisphere of 60 mm diameter with its flat circular face at the top is placed centrally on the top flat end of an another hemisphere of diameter 80 mm.Draw the isometric projection of the arrangement.

7. On a square prism of sides 70 mm and 25 mm high, an another square prism of 30 mm sides and 40 mm high is placed vertically and symmetrically. Draw the isometric projection of the combination of solids.

8. Draw the isometric projection of a vertical pentagonal hollow prism of 30 mm side of base outside, height 70 mm and thickness 6 mm when resting with two of its rectangular faces equally inclined to VP.

9. A hexagonal prism side of base 20 mm and length 60 mm, has a square hole of 10 mm sides and is resting on one of its rectangular faces. The axis of the hole coincides with that of the prism. Draw the isometric projection of the prism.

10. A square pyramid of height 70 mm and edge of base 40 mm rests symmetrically on a cube of edge 50 mm which itself is mounted on a cylinder of 80 mm diameter and 30 mm thickness. The axes of all three solids are in one line. Draw the isometric projection.
11. A cylinder of 50 mm diameter and 50 mm high is placed centrally on the rectangular face of a hexagonal prism of 50 mm sides and 70 mm long. Draw the isometric projection of the arrangement.
12. A regular pentagonal prism of its base edges 35 mm and axis 60 mm long is mounted centrally over a cylindrical block of 70 mm diameter and 15 mm thick. Represent the solids in isometric projection.

13. A cylindrical slab 75 mm diameter and 50 mm thick is surmounted by a cube of 40 mm side. On the top of the cube rests a square pyramid of altitude 40 mm and side of base 25 mm. The axes of the solids are in the same line. Draw the isometric projection.

14. A cylinder 60 mm in diameter and 30 mm in height is standing vertically on its base. It carries a cube of 30 mm side over it. On the top of the cube rests a square pyramid of height 50 mm and

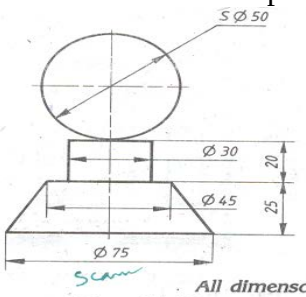
side of base 20 mm. The base edges of the pyramid are parallel to the horizontal edges of the cube and are equally inclined to VP. The axes of the three solids are in the same straight line. Draw the isometric view of the solid to the isometric scale.

15. A compound solid consists of a frustum of a cone and a hexagonal prism. The frustum of the cone is resting centrally on the top of the prism. .The frustum of the cone has the bottom base diameter 50 mm, top face diameter 30 mm and length of the axis is 80 mm. The sides of the hexagonal prism are 35 mm and the axis is 20 mm long. Draw the isometric projection of the compound solid.

16. Draw the isometric projection of a sphere of 60 mm diameter resting centrally on the top of a square prism of base 60 mm x 60 mm and height 20 mm.

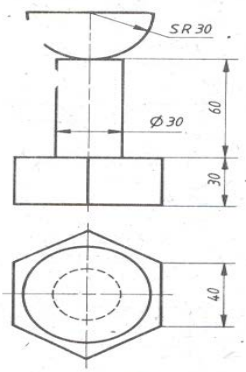
17. A hemisphere of 40 mm diameter is placed centrally on the top of a frustum of a hexagonal pyramid of 25 mm side of base and 15 mm side at the top, and the axis 40 mm long. The circular flat surface of the hemisphere is at the top. Draw the isometric projection of the solids.

18. Obtain the isometric projection of the composite solids shown in Figures below.



All dimensons in mm

Fig. 17.63



All dimensons in mm

Fig. 17.65

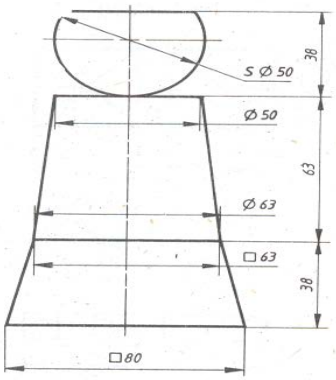


Fig. 17.66