INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY
Department of Mechanical Engineering

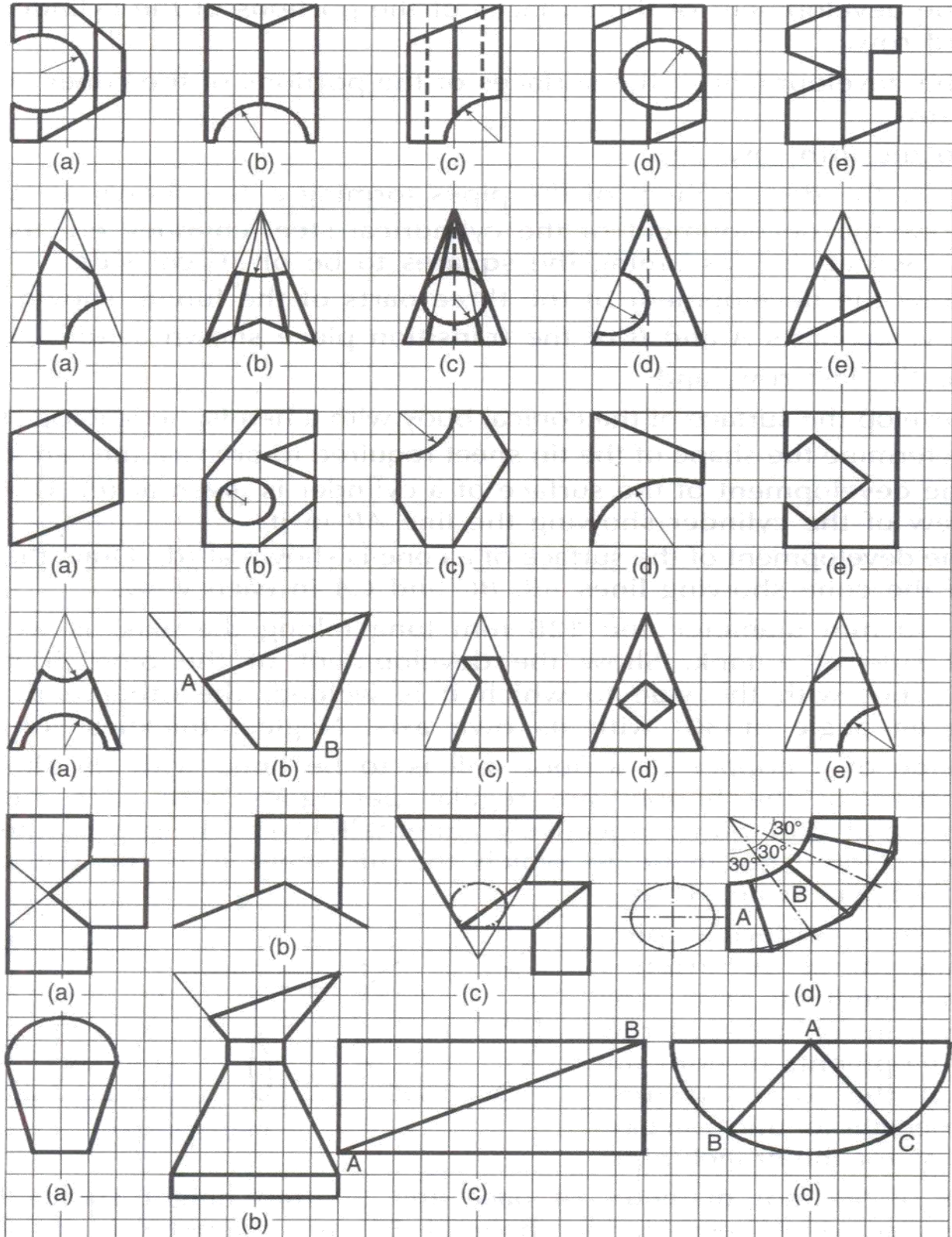*ME-119 Engineering Drawing & Graphics*   *2015-16 Semester II*

Sheet 8a: Development of Surfaces

Note:

- *Practice all problems roughly before coming to the Drawing Session.*
- *For more details of the exercises in this sheet, refer Chapters 15 of the text book (N. D. Bhatt, Engineering Drawing, 50th Ed.).*
- *Scale the drawings suitably.*
- *All problems carry equal weightage.*
- Refer to the figure given at the last page for problems 1 to 8. Assume each square to be of 10 mm side.

1. Draw the development of the surfaces of the portions of the following prisms, front views of which are shown in the top row:
   I.   A hexagonal prism having a face parallel to the V.P. [Fig. (a)]
   II.   A hexagonal prism having two faces perpendicular to the V.P. plane. [Fig. (e)]

2. Draw the development of the surfaces of the portions of the following pyramids, front views of which are shown in the second row:
   I.   A hexagonal pyramid having a side of base parallel to the V.P. [Fig. (b)]
   II.   A square pyramid having all sides of the base equally inclined to the V.P. [Fig. (e)]

3. Draw the development of the surfaces of the portions of the cylinder shown in Fig. (c) and Fig. (e), in the third row.

4. Draw the development of the surfaces of the portions of the cones shown in Fig. (c) and Fig. (e), in the fourth row

5. Refer to the fifth row, and
   I.   Draw the development of the pipes forming a Tee shown in Fig. (a).
   II.   Draw the development of the cylindrical chimney kept on the roof in Fig. (b).

6. Refer fifth row. Draw the three parts of the funnel shown at Fig. (c).

7. Refer to the sixth row. Draw the shape of the tin sheet required to prepare the can shown at (b).

8. Refer to the sixth row.
   I.   The development of a cylinder is given at (c). Draw the front view of the cylinder showing the line AB in it.
   II.   The development of the surface of a cone is shown at (d). Draw the projections of the cone showing the lines AB, BC, CA in each view.

9. A pentagonal pyramid is kept on the ground on its base, with a base edge parallel to the vertical plane. Height of pyramid is 40 mm and side of base is 20 mm. Draw the development for the two cases (for each case, the cutting plane is wide enough to cut the entire width at all points it crosses in the front view): (i) The cutting plane is vertical starting from the base and passing through the centre of the edge parallel to VP, cutting up to a height of 10 mm from the base after which it changes direction perpendicularly and moves to the right till it comes out of the pyramid. (ii) The cutting plane is at an angle of 60 degrees to the base and passes through the left end of the edge parallel to the VP. The top part is removed.

10. A pipe 40 mm in diameter and 120 mm long (along the axis) is welded to the vertical side of a tank. Show the development of the pipe, if it makes an angle of 60 degrees with the side to which it is welded, the other end of the pipe makes an angle of 30 degrees with its own axis. Neglect thickness of the pipe.

11. The inside of a hopper of a floor mill is to be lined with a tin sheet. The top and bottom of the hopper are regular pentagons with each side equal to 450 mm (top side) and 300mm (bottom side). The height of the hopper is 450 mm. One of the slant faces of the hopper will have a circular hole of 100 mm diameter at its center to accommodate a pipe. Draw the shape to which the tin sheet is to be cut so as to fit the hopper (Scale 1:10). What are the lengths of the slant edges of the hopper?

12. A 50 mm diameter cylindrical pipe branches off at 90 degrees from a 75 mm dia cylindrical pipe. The side branch is such that its lower edge is tangential to the bottom edge of the main pipe if seen from the front (in the front view, the main pipe is just a circle of 75 mm diameter). Draw the top and front view and then draw the developments of both the pipes. Assume the length of the bigger pipe to be 100 mm with the joint at the center. The branch can be drawn of a suitable length.

13. A cone of 90 mm diameter of base and 90 mm height stands on its base on the ground. A semi- circular hole of 50 mm diameter is cut through the cone. The axis of the hole is horizontal and intersects the axis of the cone. It is 30 mm above the base of the cone. The flat surface of the hole contains the axis of the cone and is perpendicular to the VP. Draw three views of the cone and also develop the surface of the cone.

14. A cylinder is standing on its base on the HP. A pentagonal hole is cut through the cylinder. A flat face of the hole is perpendicular to HP. The axis of the hole is perpendicular to the VP and bisects the axis of the cylinder. The base diameter and height of the cylinder are 70 mm and 90 mm respectively. The hole has a face width of 30 mm. Draw the development of the cylinder.

15. Draw a square pyramid resting with base on HP and one of the base edges making a 30 degrees angle with VP. Base side is 50 mm and height is 90 mm. The pyramid is cut by 2 planes, of which one plane passes through the rightmost base vertex and makes an angle of 20 degree with the base (HP). The lower portion is removed. The second cutting plane is a circular cut as seen in the front view. The apex of the pyramid is the center of the cut and its radius is 50 mm; which removes the entire top portion. Draw the top and front views of the pyramid and the development of the surface.

16. A circus tent is in the form of an octagonal pyramid resting on an octagonal prism. The height of the tent is 15 m, of which the prism height is 5 m. The base of the tent has to be inscribed in a circle of 120 m diameter. Two of the octagonal faces of the prism have entrances, which are rectangular in shape (width 1.5 m, height 2 m) with a semi-circular top. Draw the views of the tent (with two octagonal faces parallel to VP). Develop the lateral surface of the tent. Take a scale of 1:100.

(a)   (b)   (c)   (d)   (e)

(a)   (b)   (c)   (d)   (e)

(a)   (b)   (c)   (d)   (e)

(a)   (b)   (c)   (d)   (e)

(a)   (b)   (c)   (d)

(a)   (b)   (c)   (d)

<u>Sheet 8b: Intersection of Surfaces</u>

Note:

- *Practice all problems roughly before coming to the Drawing Session.*
- *For more details of the exercises in this sheet, refer Chapters 16 of the text book (N. D. Bhatt, Engineering Drawing, 50th Ed.).* → *book (N. D. Bhatt, Engineering Drawing, 50th Ed.).*
- *Scale the drawings suitably.* the base initially
- *All problems carry equal weightage.*

1. A square prism (base side = 60 mm, height = 100 mm) stands on its square base in HP such that all faces are equally inclined to VP. A horizontal square prism (base side = 35 mm, axis length = 120 mm) penetrates the vertical prism. The axis of the horizontal prism is parallel to both VP and HP, and is 12 mm away from the mid-point of the axis of the vertical prism. A lateral face of the horizontal prism makes 30 degrees with the HP. Draw the projections of top view, front view and the left side view.

2. A hexagonal pyramid (base side = 40 mm, height = 90 mm) is resting on the HP on its base with two opposite sides of the base parallel to the VP. A square prism (base side = 35 mm, length = 100 mm) intersects it such that the axis of the prism is perpendicular to VP and faces are equally inclined to HP. The two axes intersect at a point 35 mm from the base of the pyramid. Draw three views of the assembly and show the line of intersection clearly in the top and side views.

3. A pentagonal prism (50 mm base side and 80 mm height) stands on the ground on its base. A vertical face of the prism is parallel to the VP and nearer to the observer. A horizontal cylinder (diameter = 60 mm, length = 100 mm) intersects it, with axis parallel to VP and bisecting the axis of the prism at right angles. Draw three projections and show the curve of intersection.

4. A cone (80 mm diameter and 80 mm height) is resting on one of its generators on the HP. A square prism (side 24 mm, height 100 mm) passes vertically through it and lies on its square face (on the HP), such that the axis of the prism intersects the axis of the cone at the midpoint (of the cone). The faces of the prism are equally inclined to the VP. Draw three projections and show the intersection curve.

5. A triangular prism of 60 mm base side and 100 mm length penetrates a sphere of diameter 80 mm. A lateral face of the prism is parallel to the HP and the edge opposite to that face passes through the uppermost point of the sphere. The axis of the prism is perpendicular to the VP. The prism comes out equally from both sides of the sphere. Draw the projections and show the curve of intersection.

6. A triangular pyramid (64 mm base side and 80 mm height) is resting on the ground with one base edge parallel to VP (and closer to it). A cylinder of 36 mm diameter and 90 mm length passes through the pyramid. The axis of the cylinder is parallel to the axis of the pyramid, but 10 mm away from it (closer to VP). Draw the necessary views and show the curve of intersection.

7. A square pyramid (40 mm base, 64 mm height) is resting on its base on the HP, with all base edges equally inclined to the VP. A cone (base diameter = 40 mm, height = 70 mm) pierces into the pyramid such that the axis of the cone is parallel to both HP and VP and its midpoint intersects the midpoint of the pyramid axis at right angles. The cone is then removed so that only the hole remains in the pyramid. Draw three views of the pyramid and show the shape of the hole in each view.

8. A square pyramid (45 mm base, 60 mm height) has its base parallel to the HP. All sides of the base are equally inclined to the VP. A sphere of diameter 40 mm partially penetrates the pyramid such that the center of the sphere is at the midpoint of the slant edge (right side) parallel to the VP. The sphere is then removed and the depression created by the sphere remains. Draw the three views of the pyramid.

9. Two cylinders of diameter 60 mm and length 120 mm intersect each other. One of the cylinders is vertical with base resting on the ground while the other cylinder is horizontal. An extreme generator of each cylinder passes through the mid-point of the other cylinder's axis. Draw the three views of the cylinders.

10. A vertical cone (80 mm base diameter and 100 mm height) is penetrated by a horizontal cylinder with a diameter of 45 mm and length 100 mm. The axis of the cylinder is 30 mm above the base of the cone, parallel to the VP and is 5 mm away from the axis of the cone. Draw three views showing the curve of intersection.

11. A cone (base diameter = 100 mm, height = 125 mm) is kept with its base on the ground. Another cone (base diameter = 50 mm, height = 100 mm) pierces it. The axis of the second cone is parallel to both HP and VP; it is 6 mm away from the axis of the vertical cone and is 40mm above the base of vertical cone. Equal amount of the axis of the horizontal cone come out on either side of the vertical cone. Draw top, front and left side views.

12. A cone (base diameter =70 mm, height = 80 mm) is intersected by a sphere of diameter 70 mm. The center of the sphere is 40 mm from the base and 22 mm from the axis of the cone. The plane containing the center of the sphere and the axis of the cone is parallel to the VP. Draw three views of the solids.

13. Two cones equal in all respects (base diameter = 60 mm, height = 80 mm) intersect each other. The apex of one cone touches the base of the other. The axes are parallel and 15 mm apart. The plane containing the axes is parallel to the VP. Draw the three views of the cones showing the curve of intersection.