INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
INNOVATION & LEADERSHIP

Engineering Graphics I

Unit - 4

Engineering Curves

As per Guidelines of Savitribai Phule Pune University (SPPU) First Year Syllabus (2015)

By
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ENGINEERING CURVES

Part- I {Conic Sections}

ELLIPSE

1.Rectangle Method

2.Basic Locus Method (Directrix – focus)

PARABOLA

1.Rectangle Method

2.Basic Locus Method (Directrix – focus)

HYPERBOLA

1.Basic Locus Method (Directrix – focus)

As per Guidelines of Savitribai Phule Pune University (SPPU) First Year Syllabus.

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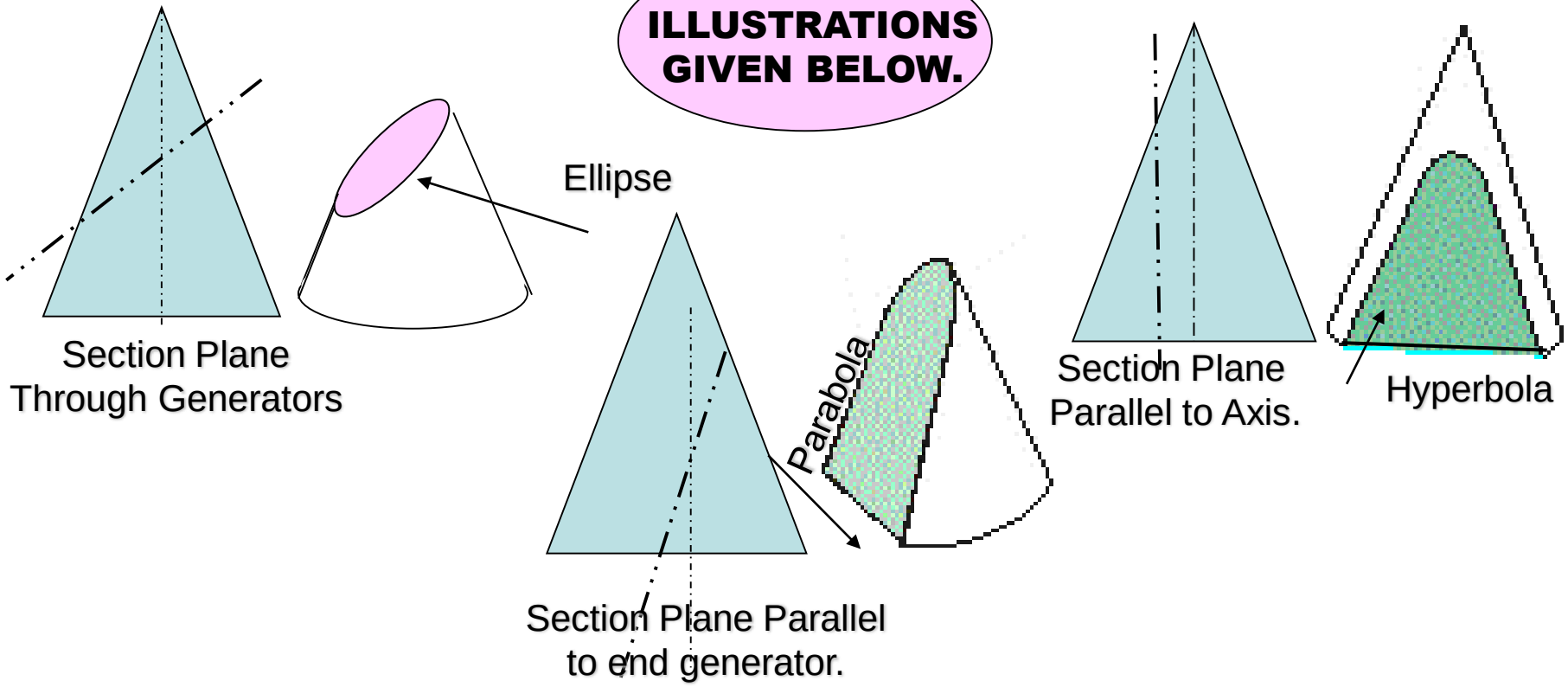
CONIC SECTIONS

ELLIPSE, PARABOLA AND HYPERBOLA ARE CALLED CONIC SECTIONS BECAUSE THESE CURVES APPEAR ON THE SURFACE OF A CONE WHEN IT IS CUT BY SOME TYPICAL CUTTING PLANES.

OBSERVE ILLUSTRATIONS GIVEN BELOW.



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ELLIPSE

BY RECTANGLE METHOD

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Problem :

Draw ellipse by **Rectangle** *method.*
Take major axis 100 mm and minor axis 70 mm long.

Steps:

1 Draw a rectangle taking major and minor axes as sides.

2. In this rectangle draw both axes as perpendicular bisectors of each other..

3. For construction, select upper left part of rectangle. Divide vertical small side and horizontal long side into same number of equal parts.(here divided in four parts)

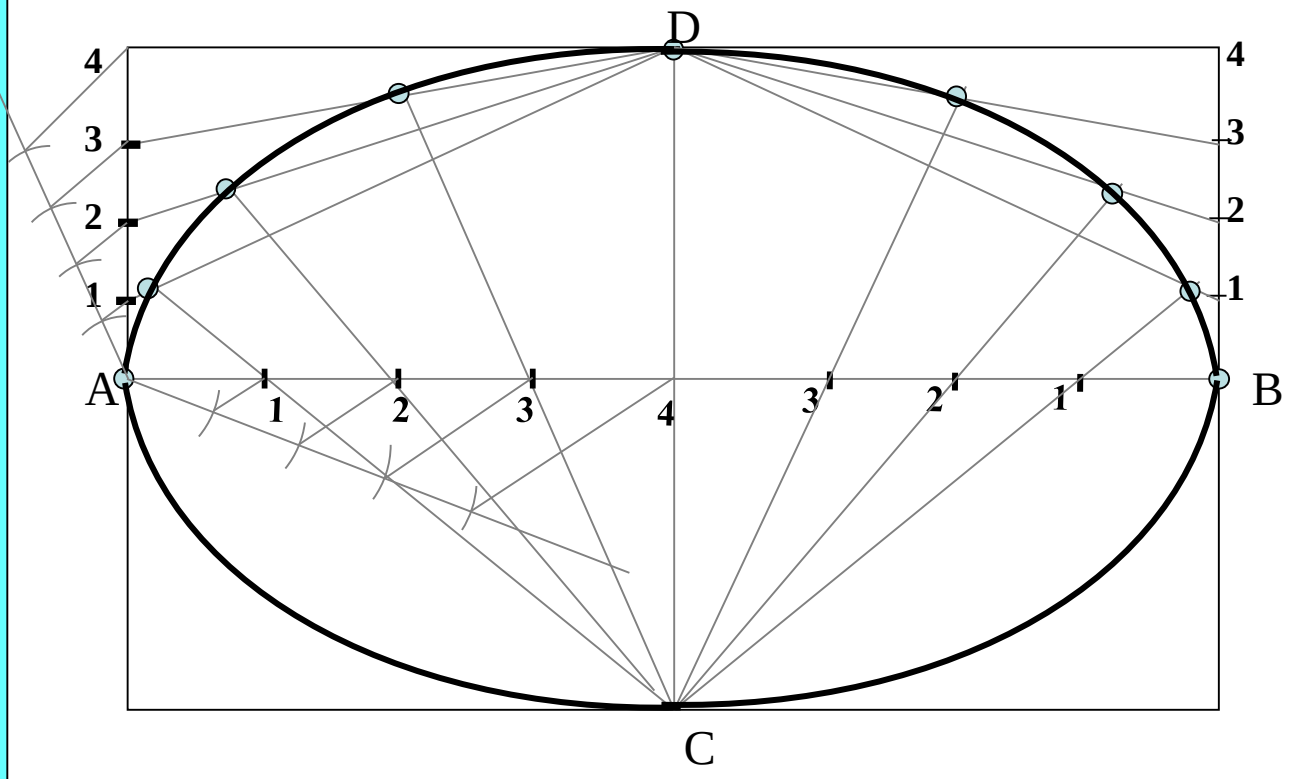
4. Name those as shown..

5. Now join all vertical points 1,2,3,4, to the upper end of minor axis. And all horizontal points i.e.1,2,3,4 to the lower end of minor axis.

6. Then extend C-1 line upto D-1 and mark that point. Similarly extend C-2, C-3, C-4 lines up to D-2, D-3, & D-4 lines.

7. Mark all these points properly and join all along with ends A and D in smooth possible curve. Do similar construction in right side part.along with lower half of the rectangle.Join all points in smooth curve.

It is required ellipse.



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PROBLEM* :-** POINT **F** IS 50 MM FROM A LINE **AB.**A POINT **P** IS MOVING IN A PLANE SUCH THAT THE ***RATIO OF IT'S DISTANCES FROM **F** AND LINE **AB** REMAINS CONSTANT AND EQUALS TO **2/3** DRAW LOCUS OF POINT **P.** **{ ECCENTRICITY = 2/3 }**

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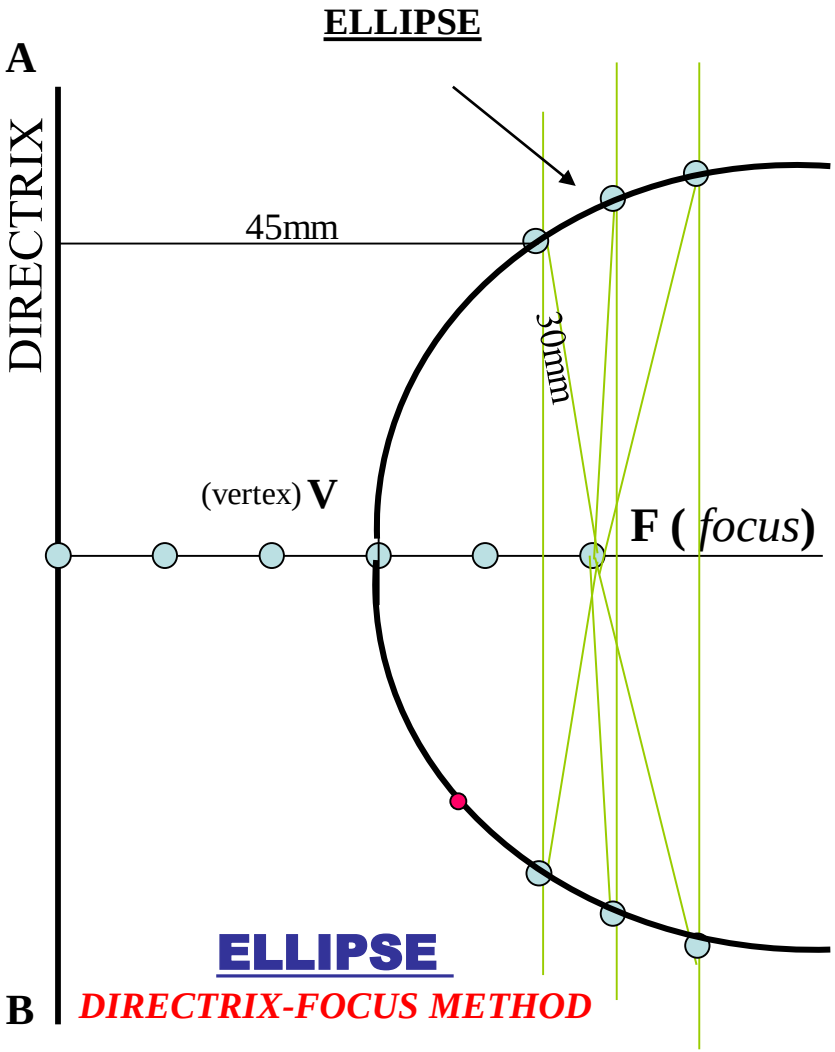
STEPS:

1 .Draw a vertical line AB and point F 50 mm from it.
2 .Divide 50 mm distance in 5 parts.
3 .Name 2nd part from F as V. It is 20mm and 30mm from F and AB line resp. It is first point giving ratio of it's distances from F and AB 2/3 i.e 20/30
4 Form more points giving same ratio such as 30/45, 40/60, 50/75 etc.
5.Taking 45,60 and 75mm distances from line AB, draw three vertical lines to the right side of it.
6. Now with 30, 40 and 50mm distances in compass cut these lines above and below, with F as center.
7. Join these points through V in smooth curve.

This is required locus of P.It is an ELLIPSE.



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PROBLEM : A BALL THROWN IN AIR ATTAINS 100 M HIEGHT AND COVERS HORIZONTAL DISTANCE 150 M ON GROUND. Draw the path of the ball (projectile)-

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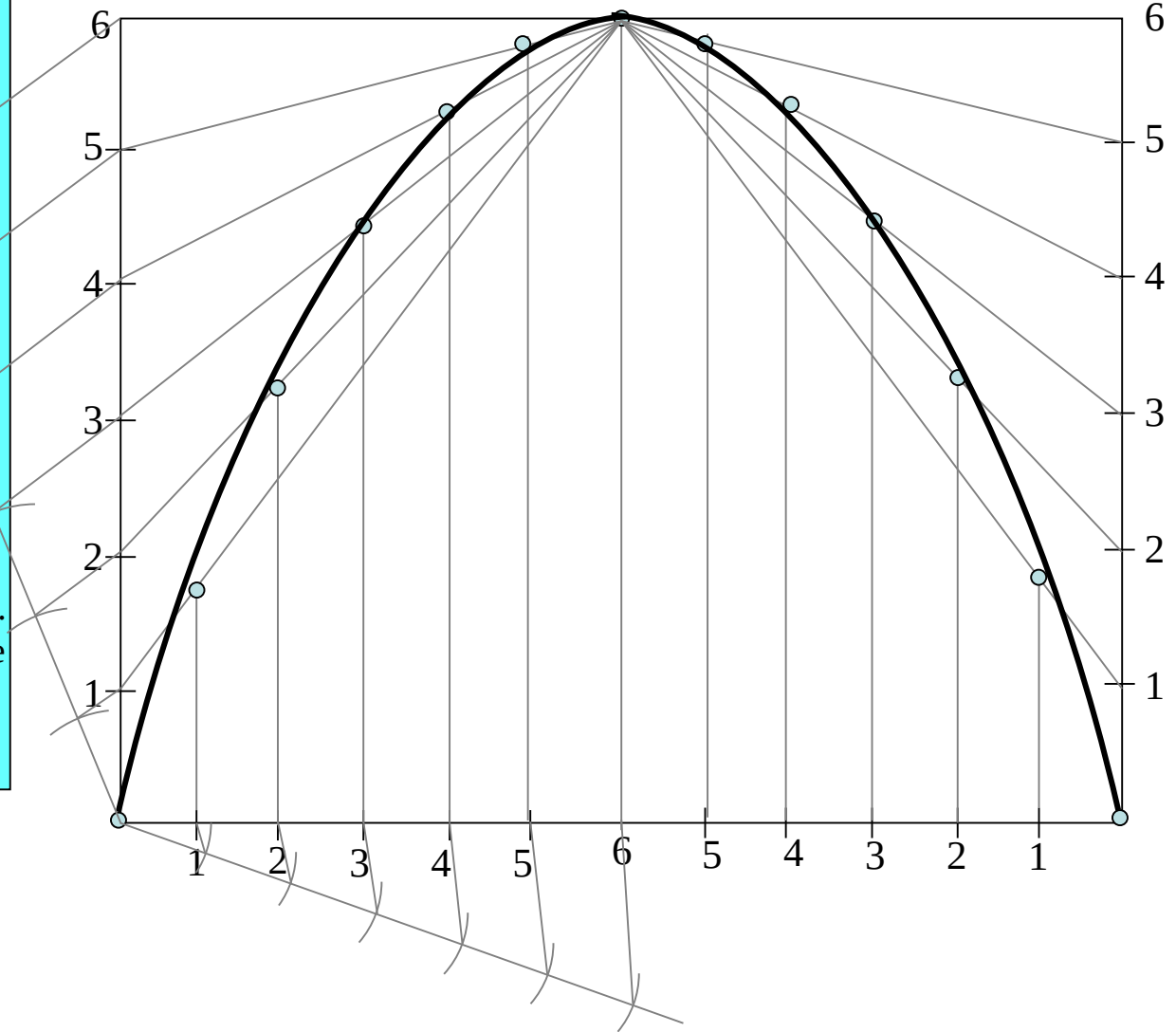
PARABOLA
RECTANGLE METHOD

STEPS:

1. Draw rectangle of above size and divide it in two equal vertical parts
2. Consider left part for construction. Divide height and length in equal number of parts and name those 1,2,3,4,5& 6
3. Join vertical 1,2,3,4,5 & 6 to the top center of rectangle
4. Similarly draw upward vertical lines from horizontal1,2,3,4,5 And wherever these lines intersect previously drawn inclined lines in sequence Mark those points and further join in smooth possible curve.
5. Repeat the construction on right side rectangle also.Join all in sequence. **This locus is Parabola.**



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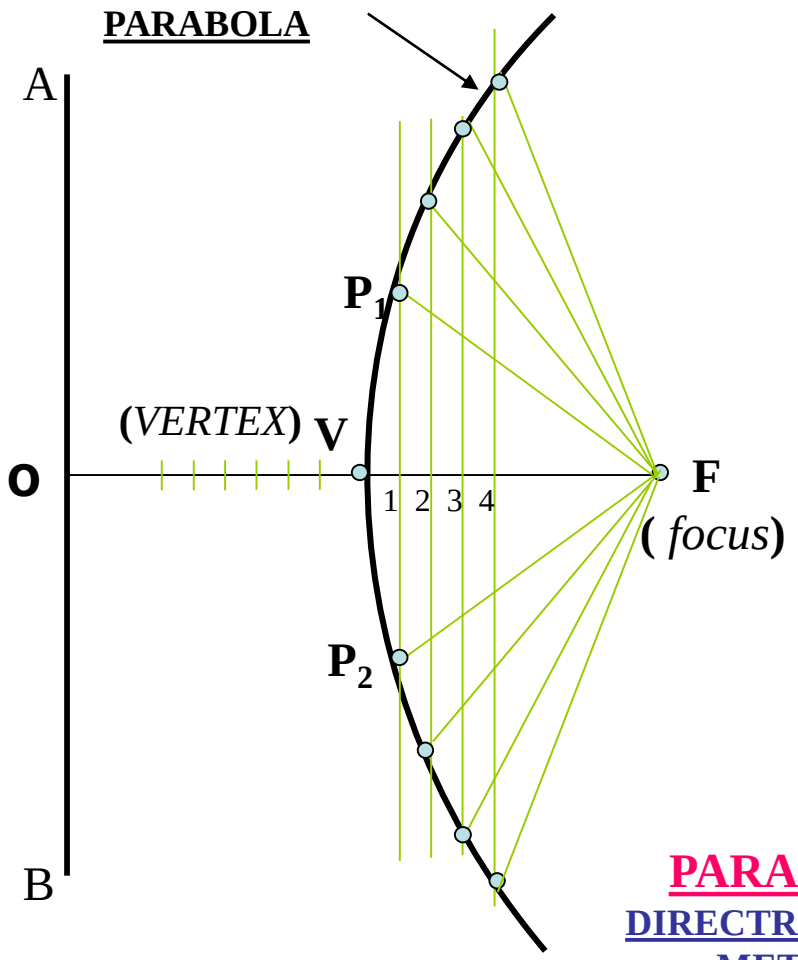
PROBLEM : Point F is 50 mm from a vertical straight line AB. Draw locus of point P, moving in a plane such that it always remains equidistant from point F and line AB.

SOLUTION STEPS:

1. Locate center of line, perpendicular to AB from point F. This will be initial point P and also the vertex.
2. Mark 5 mm distance to its right side, name those points 1,2,3,4 and from those draw lines parallel to AB.
3. Mark 5 mm distance to its left of P and name it 1.
4. Take O-1 distance as radius and F as center draw an arc cutting first parallel line to AB. Name upper point P_1 and lower point P_2. (FP_1=O1)
5. Similarly repeat this process by taking again 5mm to right and left and locate P_3P_4.
6. Join all these points in smooth curve.

It will be the locus of P equidistance from line AB and fixed point F.



PARABOLA

DIRECTRIX-FOCUS METHOD

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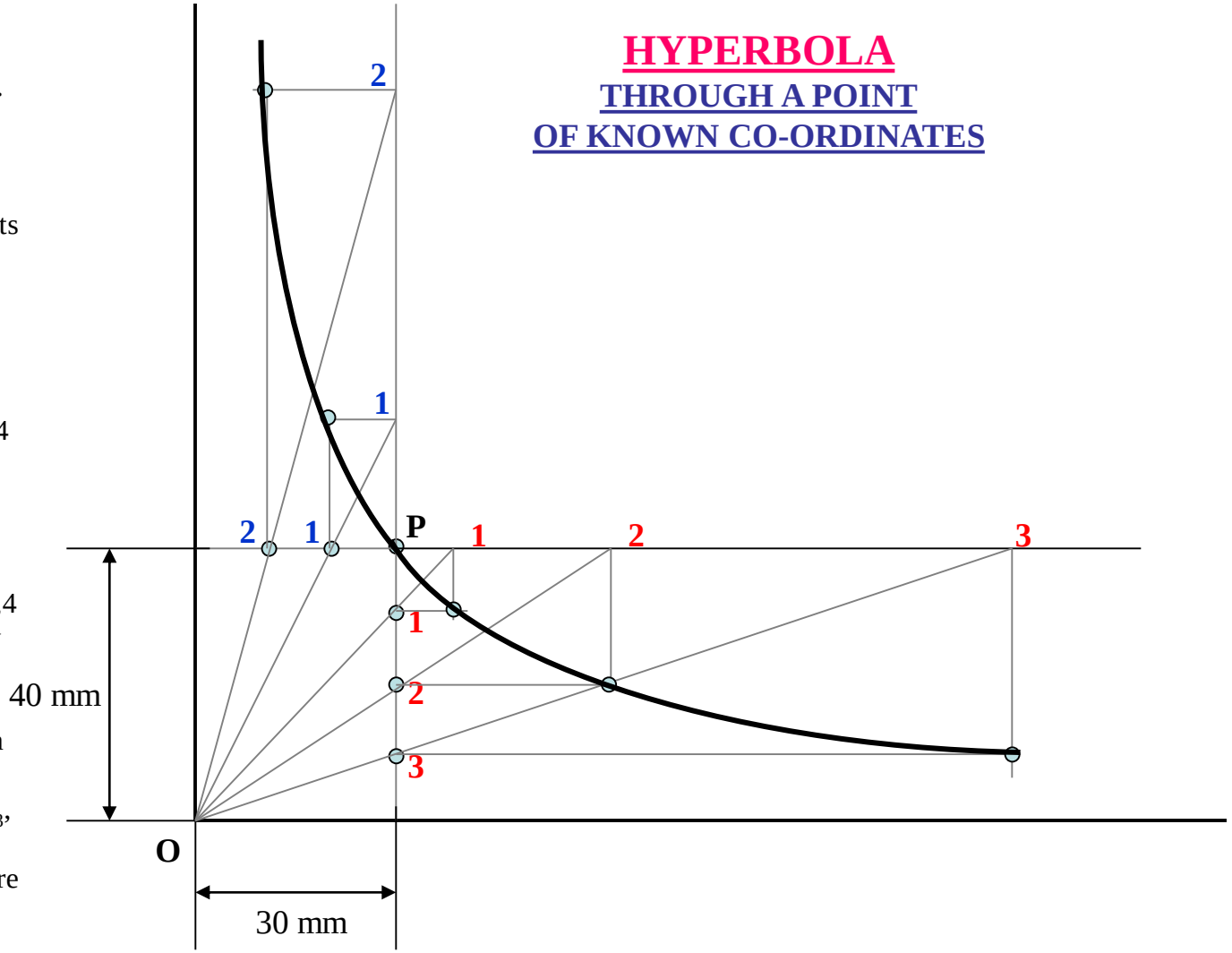
Problem : Point P is 40 mm and 30 mm from horizontal and vertical axes respectively.Draw Hyperbola through it.

HYPERBOLA
THROUGH A POINT OF KNOWN CO-ORDINATES

Solution Steps:

1) Extend horizontal line from P to right side.
2) Extend vertical line from P upward.
3) On horizontal line from P, mark some points taking any distance and name them after P-1, 2,3,4 etc.
4) Join 1-2-3-4 points to pole O. Let them cut part [P-B] also at 1,2,3,4 points.
5) From horizontal 1,2,3,4 draw vertical lines downwards and
6) From vertical 1,2,3,4 points [from P-B] draw horizontal lines.
7) Line from 1 horizontal and line from 1 vertical will meet at P_1.Similarly mark P_2, P_3, P_4 points.
8) Repeat the procedure by marking four points on upward vertical line from P and joining all those to pole O. Name this points P_6, P_7, P_8 etc. and join them by smooth curve.



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ENGINEERING CURVES

Part-II

INVOLUTE	CYCLOID	SPIRAL	HELIX
1. Involute of a circle	1. General Cycloid	1. Spiral of One Convolution.	1. On Cylinder

DEFINITIONS

CYCLOID:
IT IS A LOCUS OF A POINT ON THE PERIPHERY OF A CIRCLE WHICH ROLLS ON A STRAIGHT LINE PATH.

INVOLUTE:
IT IS A LOCUS OF A FREE END OF A STRING WHEN IT IS WOUND ROUND A CIRCULAR POLE

SPIRAL:
IT IS A CURVE GENERATED BY A POINT WHICH REVOLVES AROUND A FIXED POINT AND AT THE SAME MOVES TOWARDS IT.

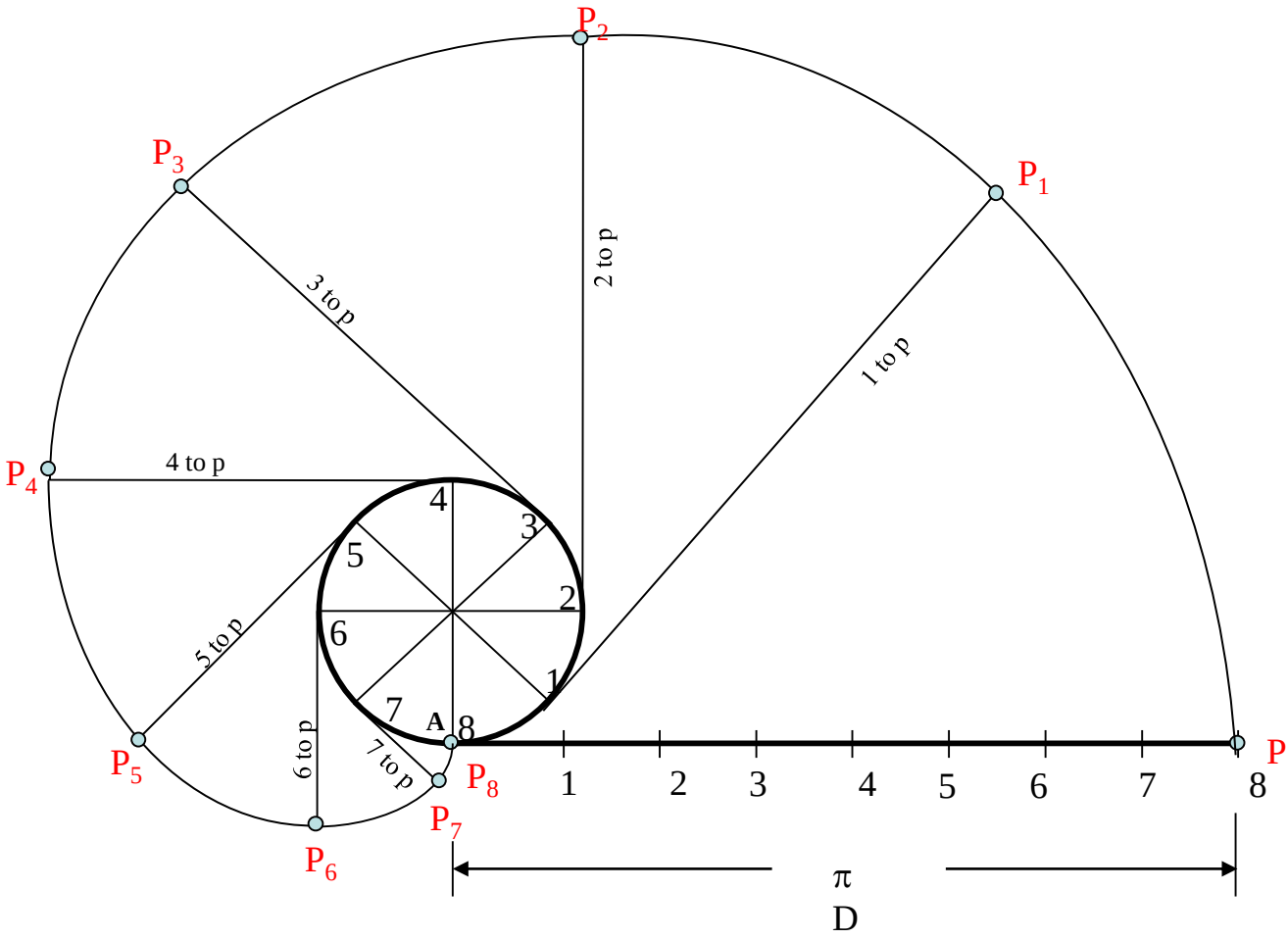
HELIX:
IT IS A CURVE GENERATED BY A POINT WHICH MOVES AROUND THE SURFACE OF A RIGHT CIRCULAR CYLINDER / CONE AND AT THE SAME TIME ADVANCES IN AXIAL DIRECTION AT A SPEED BEARING A CONSTANT RATIO TO THE SPPED OF ROTATION.
(for problems refer topic Development of surfaces)

Problem : Draw Involute of a circle.
String length is equal to the circumference of circle.

Solution Steps:

1) Point or end P of string AP is exactly πD distance away from A. Means if this string is wound round the circle, it will completely cover given circle. B will meet A after winding.
2) Divide πD (AP) distance into 8 number of equal parts.
3) Divide circle also into 8 number of equal parts.
4) Name after A, 1, 2, 3, 4, etc. up to 8 on πD line AP as well as on circle (in anticlockwise direction).
5) To radius C-1, C-2, C-3 up to C-8 draw tangents (from 1,2,3,4,etc to circle).
6) Take distance 1 to P in compass and mark it on tangent from point 1 on circle (means one division less than distance AP).
7) Name this point P1
8) Take 2-B distance in compass and mark it on the tangent from point 2. Name it point P2.
9) Similarly take 3 to P, 4 to P, 5 to P up to 7 to P distance in compass and mark on respective tangents and locate P3, P4, P5 up to P8 (i.e. A) points and join them in smooth curve it is an INVOLUTE of a given circle.

INVOLUTE OF A CIRCLE



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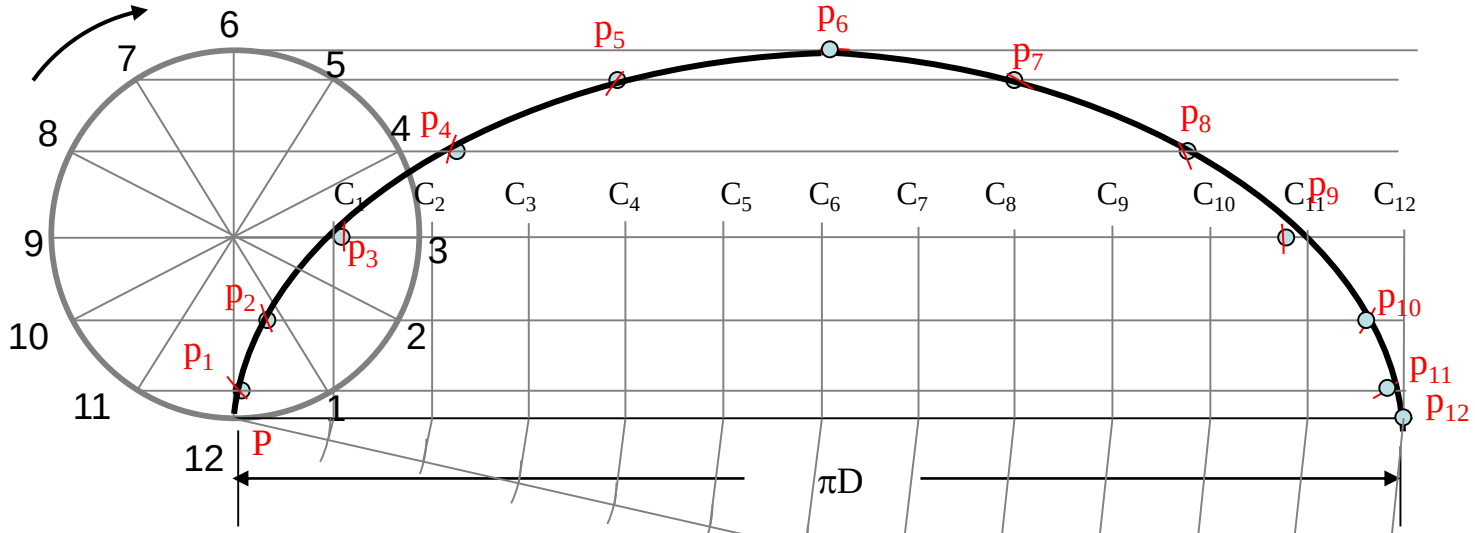
PROBLEM : DRAW LOCUS OF A POINT ON THE PERIPHERY OF A CIRCLE WHICH ROLLS ON STRAIGHT LINE PATH. Take Circle diameter as 50 mm



CYCLOID

Solution Steps:

1) From center C draw a horizontal line equal to πD distance.
2) Divide πD distance into 12 number of equal parts and name them C1, C2, C3__ etc.
3) Divide the circle also into 12 number of equal parts and in clock wise direction, after P name 1, 2, 3 up to 12.
4) From all these points on circle draw horizontal lines. (parallel to locus of C)
5) With a fixed distance C-P in compass, C1 as center, mark a point on horizontal line from 1. Name it P.
6) Repeat this procedure from C2, C3, C4 upto C12 as centers. Mark points P2, P3, P4, P5 up to P8 on the horizontal lines drawn from 1,2, 3, 4, 5, 6, 7 respectively.
7) Join all these points by curve. **It is Cycloid**.

Problem : Draw a spiral of one convolution. Take distance PO 40 mm.

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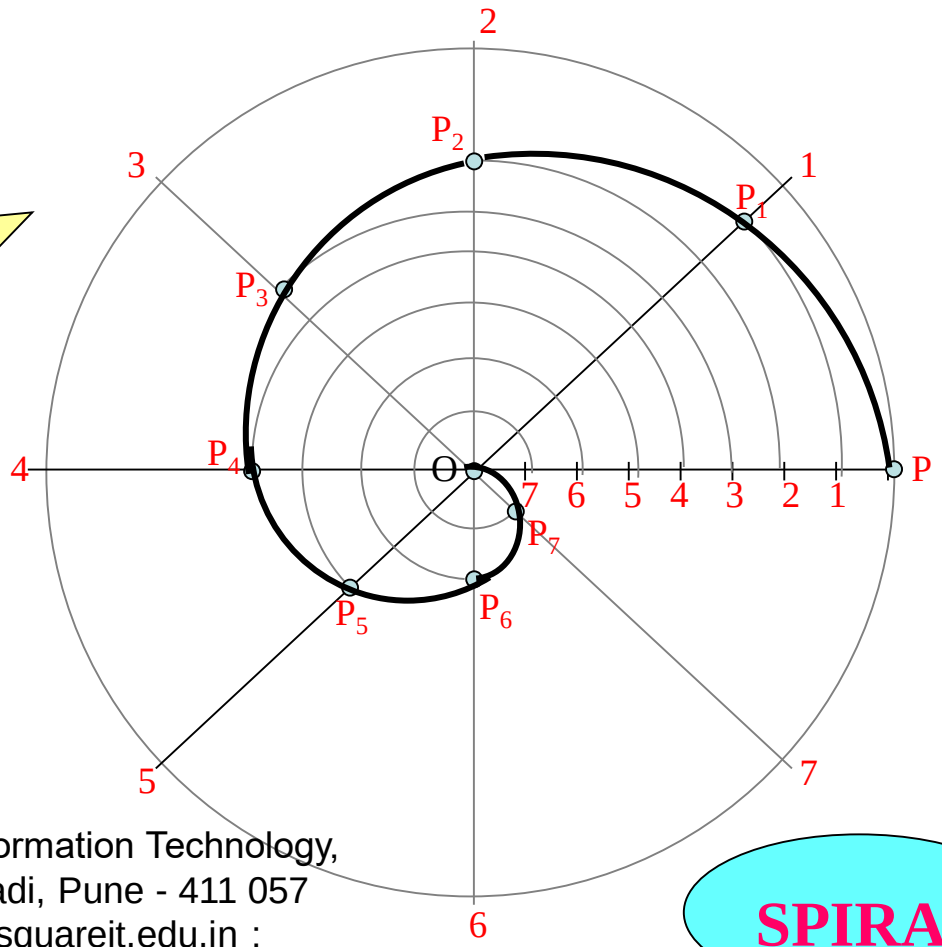
IMPORTANT APPROACH FOR CONSTRUCTION!
FIND TOTAL ANGULAR AND TOTAL LINEAR DISPLACEMENT AND DIVIDE BOTH IN TO SAME NUMBER OF EQUAL PARTS.

Solution Steps

1. With PO radius draw a circle and divide it in EIGHT parts. Name those 1,2,3,4, etc. up to 8
2. Similarly divided line PO also in EIGHT parts and name those 1,2,3,-- as shown.
3. Take o-1 distance from op line and draw an arc up to O1 radius vector. Name the point P_1
4. Similarly mark points P_2, P_3, P_4 up to P_8
   And join those in a smooth curve.
   It is a SPIRAL of one convolution.



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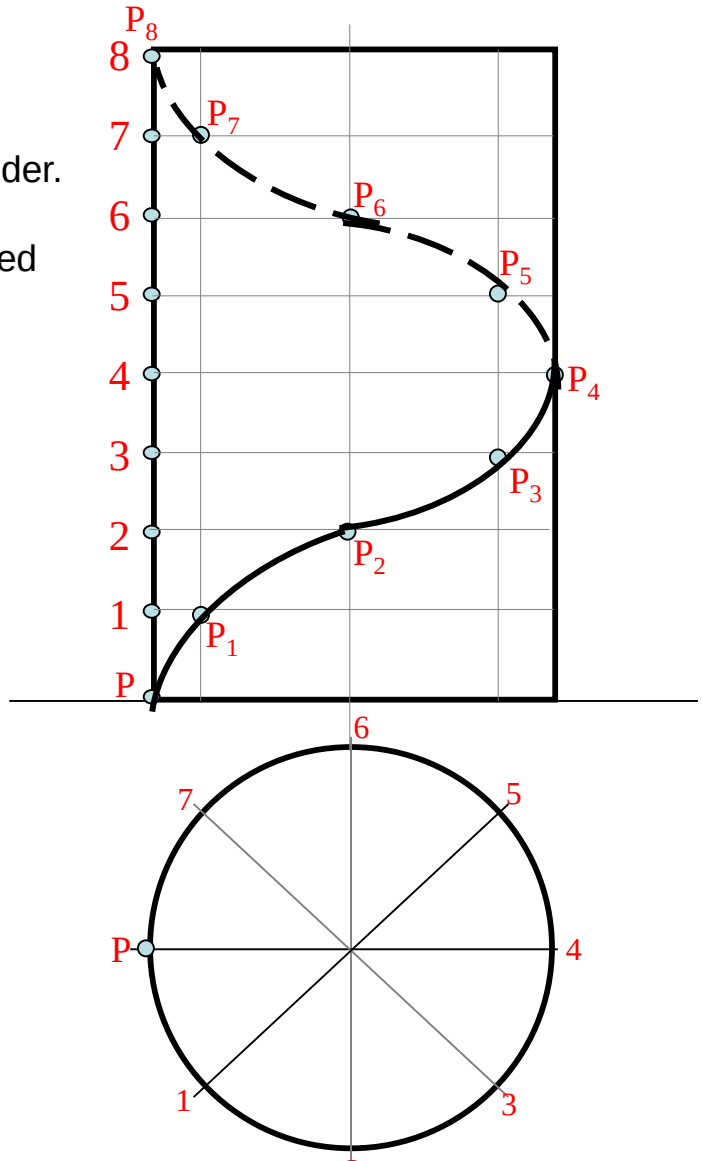
SPIRAL

HELIX
(UPON A CYLINDER)

PROBLEM: Draw a helix of one convolution, upon a cylinder.
Given 80 mm pitch and 50 mm diameter of a cylinder.
(The axial advance during one complete revolution is called
The *pitch* of the helix)

SOLUTION:

Draw projections of a cylinder.
Divide circle and axis in to same no. of equal parts. (8)
Name those as shown.
Mark initial position of point 'P'
Mark various positions of *P* as shown in animation.
Join all points by smooth possible curve.
Make upper half dotted, as it is going behind the solid
and hence will not be seen from front side.



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References

1. **N. D. Bhatt , Engineering Drawing , 50th Edition, Charotar Publications House.**
2. **M.B. Shah, B.C. Rana, Engineering Drawing, 2nd Edition, Pearson Publications.**
3. **K.C. John, Engineering Graphics for Degree, (2009), PHI Learning Private Limited.**

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THANK YOU

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