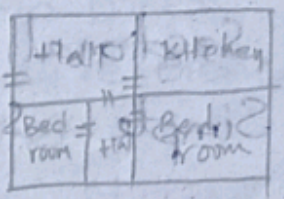
28/02/24 Engineering Graphics

ENGINEERING DRAWING IS THE LANGUAGE OF ENGINEERS



Syllabus:

Course objectives:

1) To bring awareness that Engineering drawing is the language of Engineers
2) To impart basic knowledge and skills required to prepare Engineering drawings.
3) To develop the Engg imagination Essential for Successful design

Course outcomes:

At the end of the course, the students will be able to

1) Apply principles of drawing to Construct polygons and Engineering Curves (K_3)
2) Apply principles of Autographic projections to draw the projections of points and lines. (K3)
3) Apply principles of drawing to draw the projections of planes.

4) Apply principles of drawing to draw projections of Solids. (K3).

5) Apply principles of drawing to draw Sectional views and pictorial view of Simple Solids (K3).

UNIT-1

Geometrical Constructions and Engineering Curves

→ Introduction to Engineering drawing, lines, lettering and dimensioning, Geometrical Constructions and Constructing regular polygons by general methods

→ Engineering Curves

Parabola, Ellipse and Hyperbola by general method (eccentricity method only), Cycloidal Curves, involutes, tangent and normal for each Curve

UNIT-2

orthographic projections

Introduction to orthographic projection, projections of a point situated in any one of the four quadrants

Projections of straight lines

projections of st.lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane, projections of st.line inclined to both reference plane

UNIT-3

projections of planes

Regular planes, perpendicular to one reference plane and parallel to other, planes ⊥ to one reference plane and inclined to the other reference plane, planes inclined to both the reference planes

UNIT-4

Projections of Solids

Types of solids, polyhedra and solids of revolution, projections of solids in simple positions, axis ⊥ to horizontal plane, axis ⊥ to vertical plane and axis parallel to both the reference planes, projection of solids with axis inclined to one reference plane and parallel to another plane.

UNIT-5

Sections of Solids:

Sections and sectional fuse of right and regular solids, prism, Cylinder, pyramid and Cone, true shape of section

Isometric projection:

Introduction to Isometric projection and Isometric projection of Simple right and regular solids, prism, Cylinder, pyramid and Cone.

Computer Graphics:

Creating 2D and 3D drawings of Objects and transformations using Autocad (not for End Examination)

Textbooks:

1) Engg Drawing by N.P. Bhatt
2) Engg Drawing by K. Venu Gopal, B. Raghu Raja B. Prabhu Raja

Reference Books:

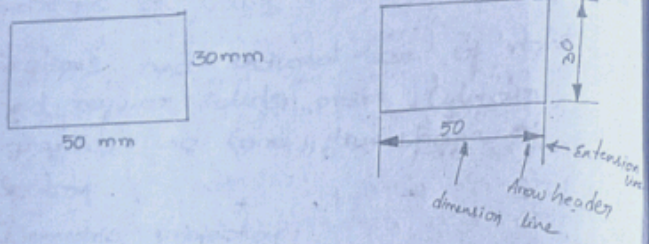
1) Engg drawing by K.L. Narayana
2) Engg Graphics for Degree by K.C. John
3) Engg Graphics by P.I. Varthese
4) Engg Drawing by Agarwal & Agarwal

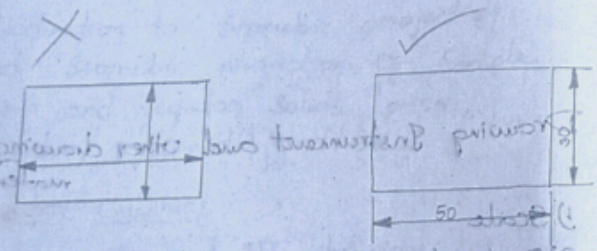
Drawing Instrument and other drawing materials

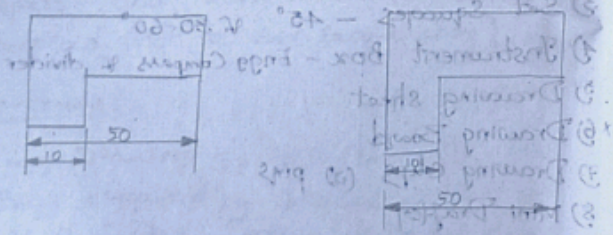
1) Scale
2) Protractor
3) Set Squares – 45° & 30°-60°
4) Instrument Box – Engg Compass & divider
5) Drawing sheet
6) Drawing Board
7) Drawing Clips (or) pins
8) Mini Drafter
9) Pencils – 2H, H, HB
10) Sharpner
11) Eraser
12) Small Napkin
13) French Curves

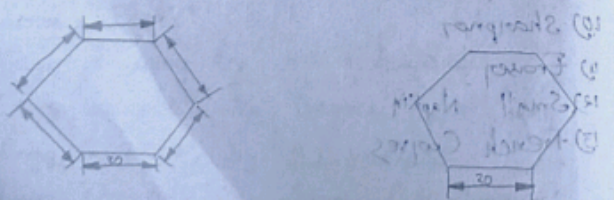
1/3/24

Dimensioning:

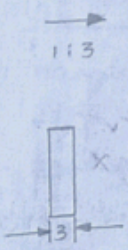




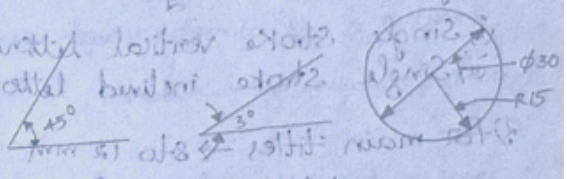




Arrow head:



the length of the arrowhead may be taken as three times the width



placing of dimensions:

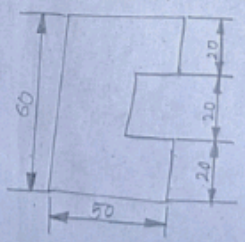
1) All the dimensions should be detailed in drawing.
2) Show the dimensions outside the diagram.
3) Dimension lines should not cross each other.
4) Same dimensions should not be repeated.

Placing of dimensions:

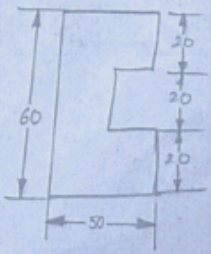
The two systems of placing dimensions are

1) Aligned System.
2) Unidirectional System

(1) Aligned System



(2) Unidimensional System



Lettering :

1) Always use capital letters.

Single stroke lettering :

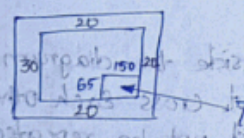
i) Single stroke vertical lettering ✓

ii) Single stroke inclined lettering ✗

2) For main titles → 8 to 12 mm

Sub-titles → 3 to 6 mm

Boarder lines :



Title Block :

CURVES		
D. NIVEDITHA		
SR.K.R.ENGG.COLLEGE		
I/IV CSD	01-03-2024	
REGD.NO: 16	SHEET NO:	

UNIT-1

GEOMETRICAL CONSTUCTIONS

1) Triangle :

It is a plane figure formed by 3 st. lines

Eg : Equilateral, isosceles, scalene (unequal sides)

2) Quadrilateral :

It is a plane figure formed by 4 st. lines.

Eg : Square, rectangle etc.

3) Polygons :

It is a plane figure formed by more than 4 st. lines.

Eg : i) pentagon (5 sides)

ii) Hexagon (6 sides)

iii) Heptagon (7 ")

iv) Octagon (8 ")

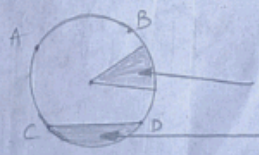
v) Nanogon (9 ")

vi) Detagon (10 ")

Regular polygon (all are equal sides)

irregular polygon (all sides are unequal)

4) Circle :



Arc (AB)

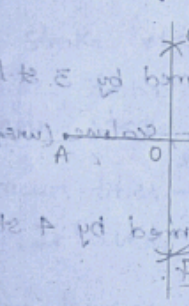
Chord (CD)

Sector

Segment

Problems:

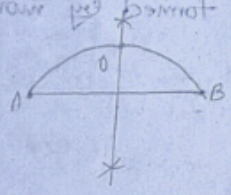
① To bisect a given line



$OA = OB = \frac{1}{2} AB$

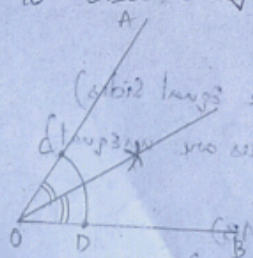
CD bisects AB at right angle

② To bisect a given angle



Arc AD = Arc DB

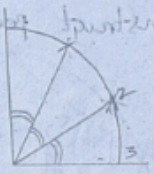
③ To bisect a given angle



$\angle AOE = \angle BOE = \frac{1}{2} \angle AOB$

with any convenient distance as radius draw arcs i.e., (D) from C & D draw arcs with same radius (or) any radius

④ To trisect a given right angle



⑤ Divide a ∠le into 12 Equal parts

Method I using protractor $\frac{360}{12} = 30°$

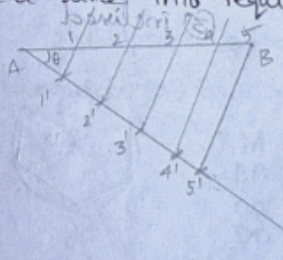
method 2 using trisection method

⑥ Divide a ∠le into 8 equal parts

$\frac{360}{8} = 45°$

Using protractor

⑦ Divide a line into required no. of equal parts



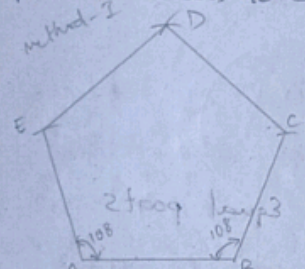
$\theta < 45°$

with convenient radius draw required no. of parts arcs

Polygons:

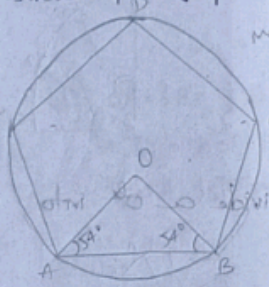
8) Special methods to Construct pentagon

Method-1



draw AB
perpn = 108°
AB length, EC pt given
from E V C draw D

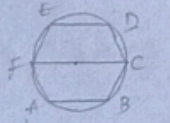
Method II



draw AB
BA-circle
AB radius, in arcs @ E V C
from C & E arc @ D

9) Special method: Constructing a Hexagon

1) Two sides horizontal:



radius of circle : side of Hexagon

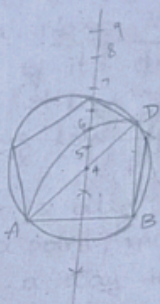
side-circle
polygon

2) Two sides vertical:

3) Inclined

1) diameter
2) angle

General method (to draw any polygon)



→ draw side AB
→ draw line BD
→ BC length AB
→ join AD
→ bisect AB
→ bisect AG

AB radius arc from B

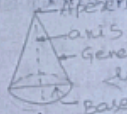
6/3/24

ENGineering Curves:

26/4/2024

locus: A locus is the path of a point which moves in space

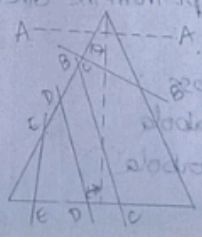
Cone:



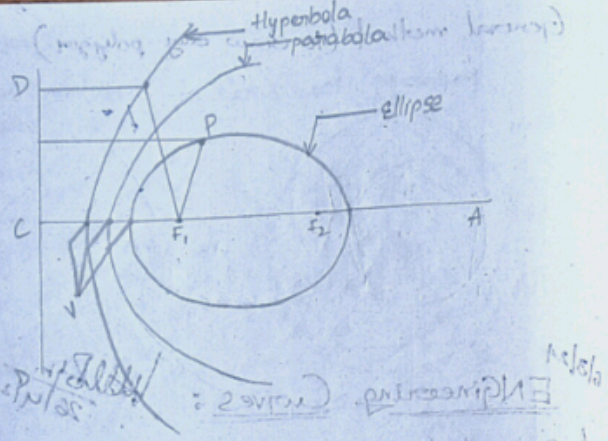
Conic sections:

The sections obtained by the intersection of a right circular cone by a cutting plane in different positions relative to the axis of the cone are called Conics (or) Conic Sections.

1) Circle 2) Ellipse 3) parabola 4) Hyperbola
5) Rectangular (or) Equilateral Hyperbola.



AA gives Circle
BB gives Ellipse
CC gives parabola
DD gives Hyperbola
EE gives rectangular (or) Equilateral Hyperbola



Directrix (DD):
The fixed st. line is called directrix

Focus (F):
The fixed point is called focus

Axis (CA):
The line passing through the focus and perpendicular to the directrix is called axis

Vertex (V):
It is the point at which the conic cuts its axis

Eccentricity (E):
The ratio $\frac{\text{distance of the moving pt from the focus}}{\text{distance of the moving pt from the directrix}}$ is called Eccentricity.

$e = \frac{VF}{VC}$

$e < 1$ for Ellipse
$e = 1$ for parabola
$e > 1$ for Hyperbola

Ellipse:
Ellipse is the locus of a point moving in a plane in such a way that the ratio of its distance from a pt 'F' to the fixed st. line 'DD' is a constant and is always less than 1.

(or)

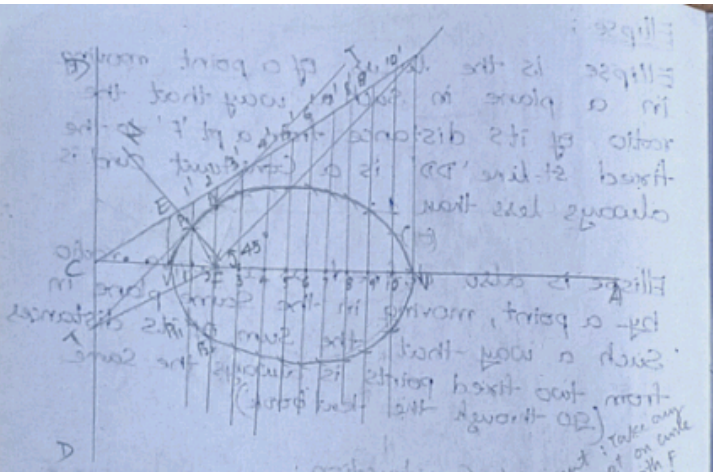
Ellipse is also defined as a curve ratio by a point, moving in the same plane in such a way that the sum of its distances from two fixed points is always the same.
(go through the text book)

Methods of Construction:
1) Eccentricity method
2) Arcs of circles method
3) Rectangular (or) oblong method.
4) Concentric circles method.
5) Parallelogram method.

1) Eccentricity method:

Problem:

(1) Construct an ellipse when the distance b/w the focus and the directrix is 50 mm and the eccentricity is $\frac{2}{3}$. Draw the tangent and normal at any point on the curve.



Given CF = 50 , $e = \frac{2}{3}$

$\frac{VF}{VC} = \frac{2}{3}$

Divide CF into 5 Equal parts

From VE = VF

Centre : F

Radius : 1-1'
2-2'
⋮ ⋮
10-10'

Parabola :

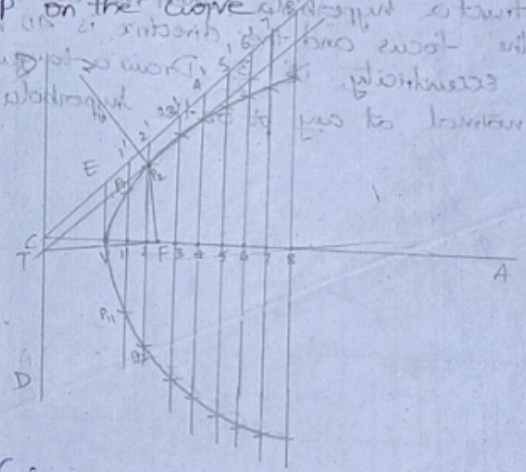
Parabola is the locus of a pt moving in a plane in such a way that the ratio of its distance from a fixed point 'F' to the fixed st. line 'DD' is a Constant and is always Equal to '1'.

Methods of Construction :

1) Eccentricity method
2) rectangular method
3) Tangent method

Eccentricity method :

① Construct a parabola when the distance b/w focus and the directrix is 50 mm. Draw tangent and Normal at any point 'P' on the curve.



Given CF = 50

for parabola

$e = 1$

$\frac{VF}{VC} = 1$

VF = VC

VE = VF

Centre : F

radius : 1-1'
2-2'
⋮ ⋮
8-8'

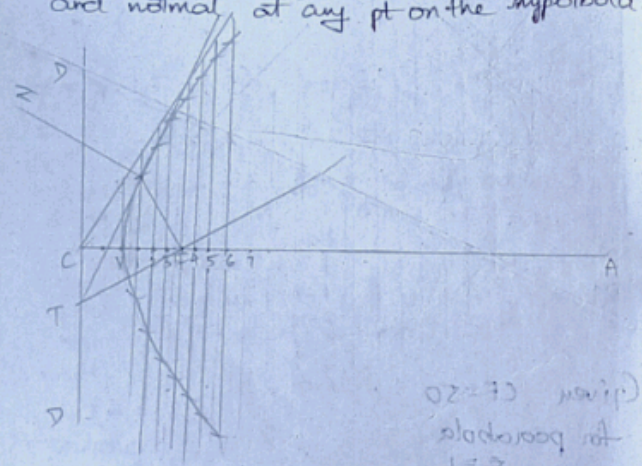
Hyperbola:

Hyperbola is the locus of a point moving in a plane in such a way that the ratio of its distance from a fixed point 'F' to the fixed st. line 'DD' is a constant, ie; $e > 1$

Eccentricity method

Problem:

① Construct a hyperbola when the distance b/w the focus and the directrix is 40 mm and eccentricity is $\frac{3}{2}$. Draw a tangent and normal at any pt on the hyperbola.



Given CF = 40 $e = \frac{3}{2}$

$\frac{VF}{VC} = \frac{3}{2}$

Divide CF into 5 Equal parts

VE = VF

Centre: F

Radius: 1-1', 2-2', ... 8-8'

problem:

A fixed point is 75mm from a fixed st. line draw the locus of a point P moving such a way that its distance from a fixed st. line is (a) twice its distance from the fixed point. (b) Equal to its distance from the fixed point.

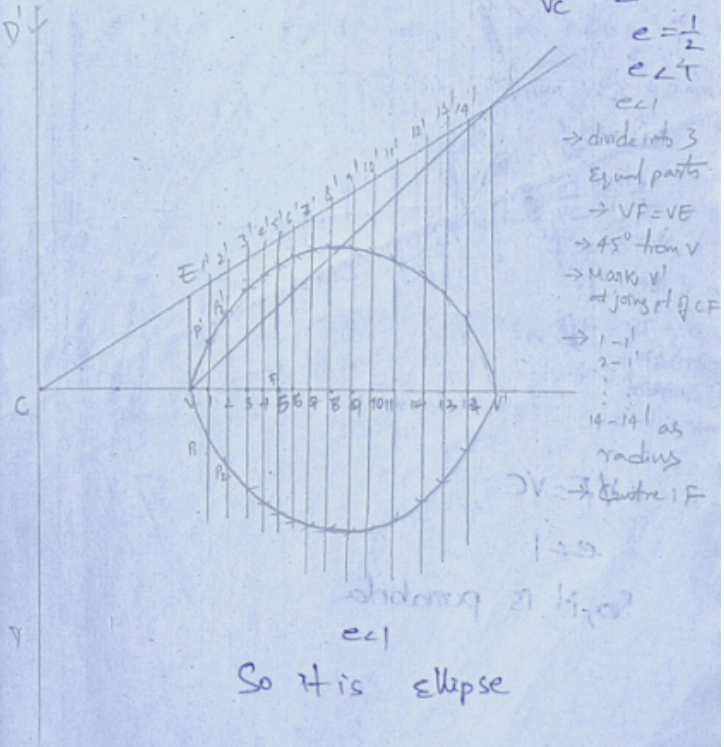
(a) Name the Curves.

Given CF = 75 mm

$e = \frac{VF}{VC}$

$VC = 2VF$

$\frac{VF}{VC} = \frac{1}{2}$



$e = \frac{1}{2}$

$e < 1$

$e < 1$

→ divide into 3 Equal parts

→ VF = VE

→ 45° from V

→ Mark V' at joining pt of CF

→ 1-1', 2-2', ... 14-14' as radius

→ Centre: F

So it is ellipse

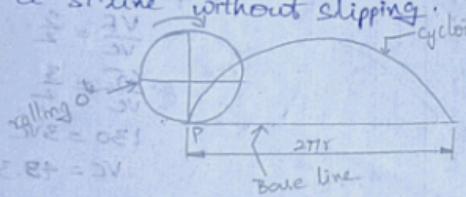
Cycloidal Curves:

A Cycloidal Curve is traced by a fixed pt on the circumference of the ckle which roles without slipping along a fixed st. line (or) a circle.

1. Cycloid
2. Epi Cycloid
3. Hypo Cycloid

① Cycloid:

Cycloid is a curve traced by a pt on the circumference of the ckle which roles along a st. line without slipping.



Q) A coil of 40mm diameter roles over a horizontal table without slipping. A pt on the circumference of the coil is in contact with the table surface in the begining and after one complete revolution. Draw the Cycloidal path traced by the point. Draw a tangent and normal at any pt on the curve.

Radius CP

draw $P_1 P_2 P_3 \ldots$

from $C_1 C_2 C_3$ as Centre

draw ckle of radius

base line = 2πr

ckle 12 parts

bl 12 parts

draw hor pts to

draw vertical lines

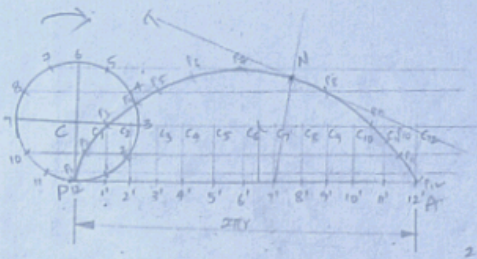
up to curve

Normal: Take 1 pt on curve

CP as radius from the

drawn arc taken pt

It is N to tangent



5.14 × 40

000

12 56 X

12.5.6 0

12.5.6

2 × 3.14 × 20

40 × 3.14

② Epi Cycloid:

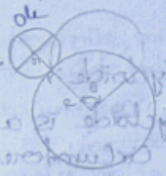
Epi Cycloid is a curve traced by a pt on the circumference of a ckle which roles without slipping on the outside of another ckle

$\theta = 360° \times \frac{r}{R}$

θ → Angle subtended by the ckle

r → Radius of the RC

R → Radius of DCH



Q) Draw an Epi Cycloid of rolling ckle 40mm diameter, which roles outside another ckle (base ckle) of 150 mm diameter for 1 revolution. Draw a tangent and normal at any pt on the curve.

Sol $\theta = 360 \times \frac{r}{R}$

$= 360 \times \frac{20}{75}$

$\theta = 96°$

12 Equal parts

→ draw arc of 'R', join PKO

→ Extend OP

→ draw ckle of 'r', touching the arc

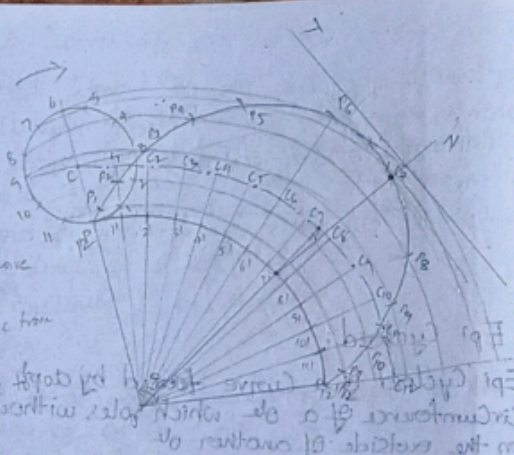
→ Small ckle V the arc 12 Eq parts

→ OG as radius draw Concentric arc

→ draw Centre arc with 1cc hand, mark $C_1 C_2 \ldots$

→ Extend 0-1', 0-2' ... lines upto locus of centre

→ CP as radius, from C_1 draw arc on 1' as small ckle, C_2 from arc on 2 as small ckle

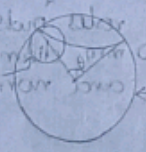


Normal:
→ Taking any curve
→ Cp as radius
→ draw the arc from tangent pt

(3) Hypo Cycloide:

Hypo Cycloide is a curve traced by a pt on the circumference of the dle which roles without slipping on the inside of another circle

$\theta = \frac{r}{R} \times 360$

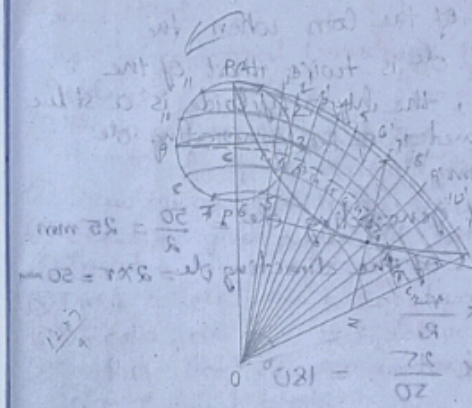


(8) Draw an hypo cycloide of a dle of 40 mm diameter which roles inside another dle of 200 mm diameter for one revolution. Draw a tangent and normal at any pt on it.

r = 20
R = 100

72°

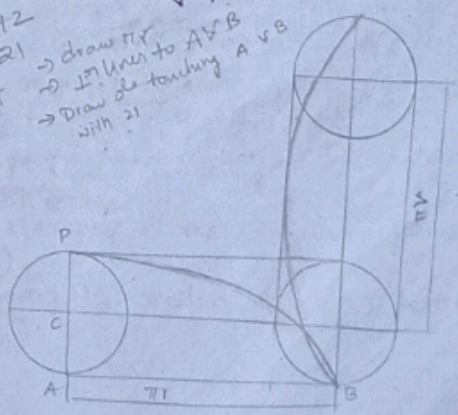
20 dle



Q) A dle of 42 mm diameter rolls on the horizontal line. Draw the curve pt traced out by a pt 'R' on the circumference for one half revolution of the dle. for the remaining half revolution the dle roles on the vertical line. The pt 'R' is vertically above the centre of the dle in the stooting position.

D = 42
r = 21
$\pi r = 65.94$

→ draw πr
→ ⊥ lines to A & B
→ Draw dle touching A & B with 21



⑨ Slope and of the Coin when the diameter of the dle is twice that of the generating dle, the hypo cycloide is a st.line Take the diameter of the generating dle Equal to 50 mm.

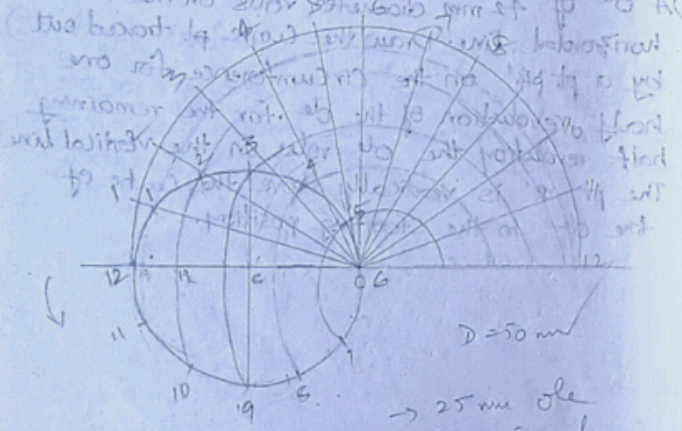
Given radius of generating dle = $\frac{50}{2}$ = 25 mm

R = radius of the directing dle = 2×r = 50 mm

$\theta = 360 \times \frac{r}{R}$

$= 360 \times \frac{25}{50} = 180^\circ$

NP. Bhatt 19-121



Sheet NO-1

Topic: Geometrical Constructions

Problems:

① Draw a line AB of length 90 mm and divide it into 4 Equal parts by using bisection method.

② Draw an arc its radius = 60 mm and bisect it.

③ Bisect a given angle AOP with 45°

④ Trisect a given right angle

⑤ Divide a dle into 8 Equal parts

⑥ Divide a dle into 12 Equal parts (use method-1 & 2)

⑦ Draw a line AB, 90 mm long and divide it into 8 Equal parts

⑧ Draw a pentagon with 30 mm side. (use method 1 & 2)

⑨ Draw a Hexagon with 30 mm sides
- a) Side Horizontal
- b) Two sides vertical
- c) Inclined at two sides 25°

⑩ By using General method Construct Heptagon and octagon of side 30 mm

⑪ Inscribe a regular polygon of any no. of sides, in a given circle, pentagon & radius of dle = 40 mm

⑫ To describe a regular Hexagon about a given dle radius of the dle = 30 mm

⑬ Write the following Sentence in single stroke Vertical lettering.
- a) Engineering drawing is the language of Engineers (8 to 12 mm)
- b) Good drawing is spoiled by poor lettering (3 to 6 mm)

Sheet NO-2.1
Topic: Curves (2D)
Exercise-6-problem NO-1

Sheet No. -2.2
Topic: Cycloidal Curves
problems 1 to 5 in class notes

Sheet No. -2.3
Topic:
class notes problems

Involute:

It is a curve traced out by an end of a piece of thread unwound from a de (of) a polygon, the thread being kept tight.

It may also be defined as a curve traced out by a point in a st.line which rolls without slipping along a de (of) a polygon

Problem:

(1) Draw an involute of a given Square, Pentagon & Hexagon.

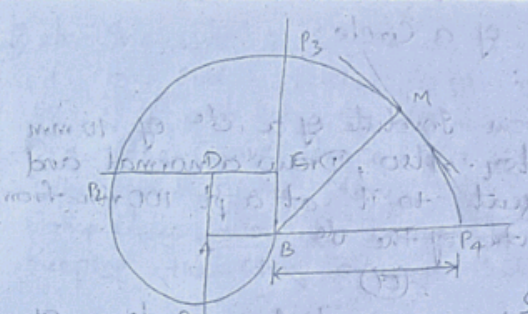
In Square;

$P_1 \longrightarrow$ A Centre & AB as radius

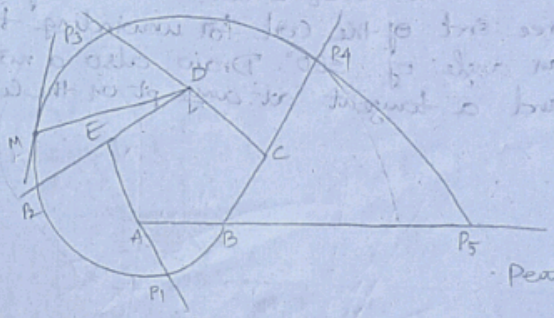
$P_2 \longrightarrow$ D as Centre & DP_1 as radius

$P_3 \longrightarrow$ C as Centre & CP_2 as radius

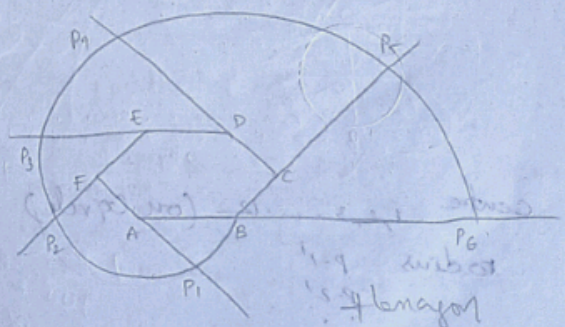
$P_4 \longrightarrow$ B as Centre & BP_3 as radius



Square



Pentagon



Hexagon

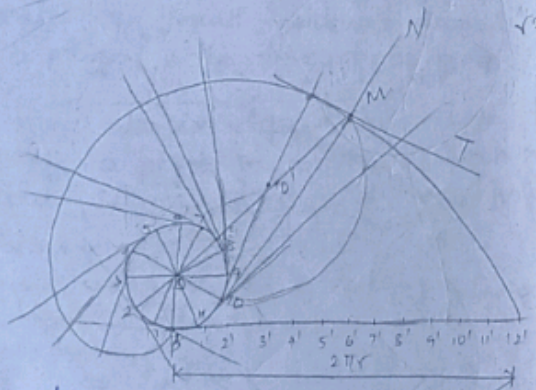
Involute of a Circle:

Problem:

1) Draw an Involute of a ckle of 40 mm diameter. Also, Draw a normal and a tangent to it at a pt 100 mm from the Centre of the ckle.

(or)

A Coil is unwound from a drum of 30 mm diameter draw the locus of the free end of the coil for unwinding through an angle of 360°. Draw also a normal and a tangent at any pt on the curve.



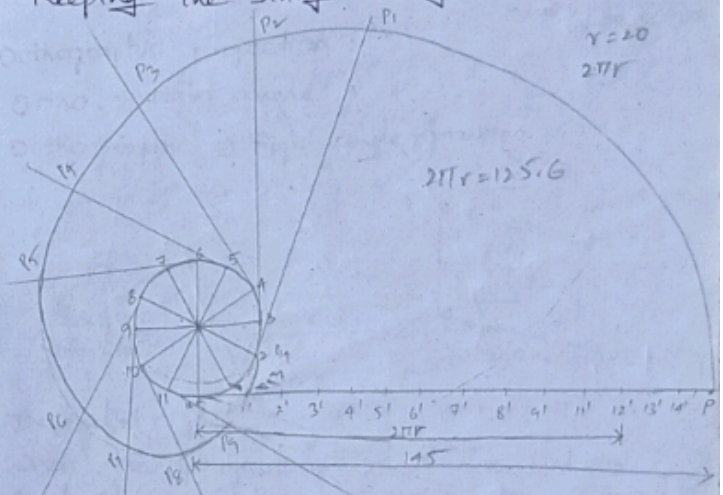
r=15
2×3.14×15

centre 1, 2, 3 . . . . 12 (on Circle)

radius P-1'
P-2'
⋮
P-12'

take any pt M
join M to O
take mid pt of MO
as radius draw a semicircle
join M with pt on ckle

2) An Inelastic String 145 mm long, has its one End attached to the circumference of a ckle at this of 40 mm diameter Draw the Curve traced out by the other End of the string, when it is Completely wound around the disc, Keeping the string always ~~straight~~ tight



3) Trace the paths of the Ends of the St-line AP, 100 mm long, when it rolls, without Slipping, on a Semi ckle having its diameter AB 75 mm long. Assume the line AP to be tangent to the Semi ckle in the stooting position

Sp-6.30
Pg-135