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Unit-I- Part-3: Cycloid, Epicycloid and Hypocycloid

Theory Questions

1. What is a cycloid?

A: The curve generated by a point on the circumference of a circle rolling along a straight line without slipping is called as Cycloid. It can be described by an equation y = a (1-cosθ)

2. Define base line, rolling circle and generating point in a cycloid.

A: The fixed line on which the circle rolls is called the base line.
The circle which rolls along the straight line is called as rolling circle or generating circle.
The intersecting point of the circle and the line in the initial contact position is called generating point.

3. What is the length of the base line for one complete revolution of a circle in a cycloid? (ans: πD or 2πR; where R is the radius of the circle and D is the diameter)

4. Define epicycloid.

A. It is the curve generated by a point on the circumference of a circle rolling along another circle & outside it.

5. Define hypocycloid.

A. It is the curve generated by a point on the circumference of a circle rolling along another circle & inside it.

For both epicycloids and hypocycloid, the small circle will be the rolling or generating circle, the larger circle on which it rolls is called the directing circle or base circle and the point of intersection of these two circles is called as the generating point P.

Note: While drawing the epicycloid and the hypocycloid, first draw the rolling circle of diameter d. Then, to begin the larger circle (directing circle), mark P on the bottom most point of the circle for epicycloid and on topmost point for the hypocycloid. From P, mark PO as the radius of the directing circle and draw it.

6. When the rolling circle (generating circle) diameter is half of the base circle (or directing circle), the hypocycloid is a _______ (ans: straight line).

Problems

7. A circle of 50 mm diameter rolls along a straight line without slipping. Draw the locus of a point P on the circumference of the circle for one complete revolution. Name the curve. Draw a tangent and normal to the curve at a point on it 40 mm from the line. (cycloid- refer to construction of cycloid)

8. A circle of 50 mm diameter rolls on the circumference of another circle of 150 mm diameter & outside it. Trace the locus of a point on the circumference of the rolling circle for one complete revolution. Draw a tangent & normal to the curve at a point 85 mm from the centre of the directing circle. (epicycloids- refer construction of epicycloid)

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9. A circle of 50 mm diameter rolls on the circumference of another circle of 150 mm diameter & inside it. Trace the locus of a point on the circumference of the rolling circle for one complete revolution. Draw a tangent & normal to the curve at a point 85 mm from the centre of the directing circle. (hypocycloid- refer to construction of hypocycloid)

10. Draw the curve traced out by a point on the circumference of a circle of diameter 50 mm when it is rolling on another circle of 50 mm radius & inside it. Name the curve. (hypocycloid; it will be a straight line)

    Or

    Show by means of drawing that the hypocycloid is a straight line when the diameter of the directing circle is twice the diameter of the generating circle. Take the diameter of the generating circle as 50 mm. (refer solutions: Hypocycloid straight line)

11. A circle of 40 mm rolls on the inside of a circle of 200 mm diameter for one revolution. Draw the curve & name it. Draw tangent & normal at any point on it. (hypocycloid)

12. A circle of 50 mm diameter rolls on a horizontal line. Draw the curve traced out by a point P on the circumference for one half revolution of the circle. For the remaining half revolution, the circle rolls on a vertical line. The point P is vertically above the centre of the circle in the starting position. (Refer solution in Cycloid: half horizontal; half vertical)

13. A circle of 50 mm diameter rolls on a horizontal line. Draw the curve traced out by a point P on the circumference for one half revolution of the circle. For the remaining half revolution, the circle rolls on a line inclined at 60^0 to the horizontal line. The point P is vertically above the centre of the circle in the starting position. (Refer solutions in Cycloid: half horizontal; half inclined).

14. A bicycle has 660 mm diameter wheels. Draw the locus of a point P, on the circumference of a wheel for its complete revolution when it passes over a segmental arched culvert of radius 2000 mm. Take scale 1 : 10.

    (Ans: Curve is Epicycloid; d= 660; D=4000; $\theta = 360 * d/D$; use the given scale and construct the epicycloid using the general procedure)

    Assignment problems: 11 and 14 from above.
    For the rest, refer solutions.