KDOM Project

PART A : Q3

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Given information :

The translating radial roller follower of a cam is to **rise 40 mm** with cycloidal motion in 180° of cam rotation and return with cycloidal motion in the remaining 180° . If the **roller radius is 10 mm** and the **prime circle radius is 50 mm**,

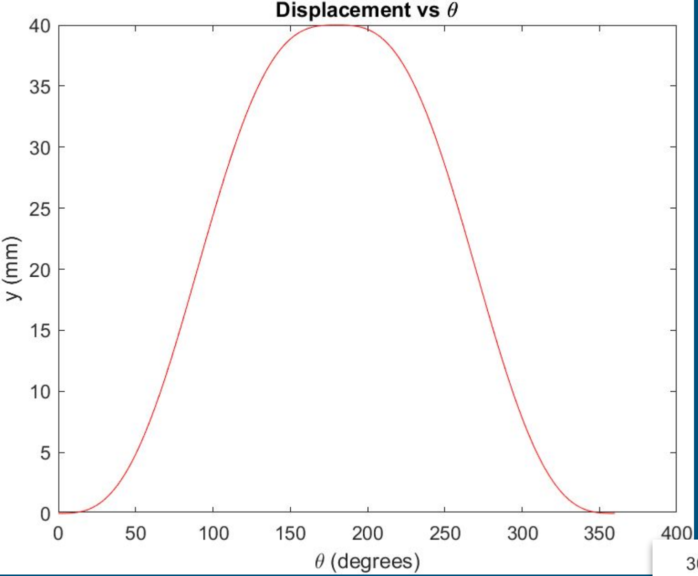
Formula for lift :

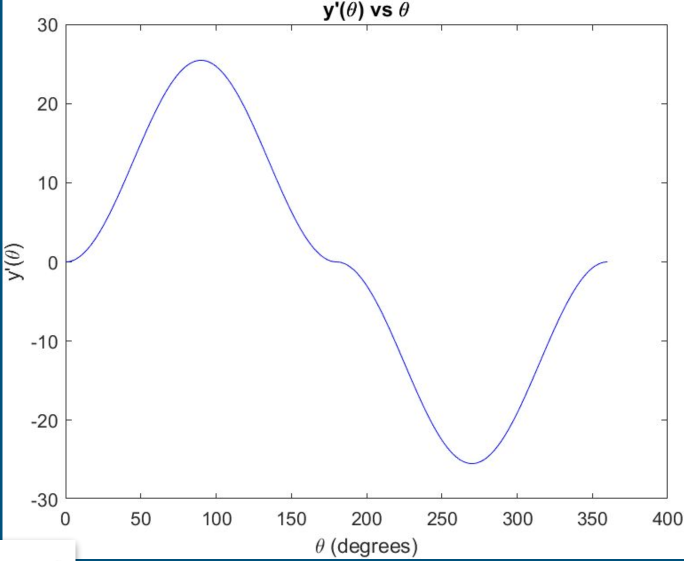
Since the motion is cycloidal, we have the lift as a function of theta given below:

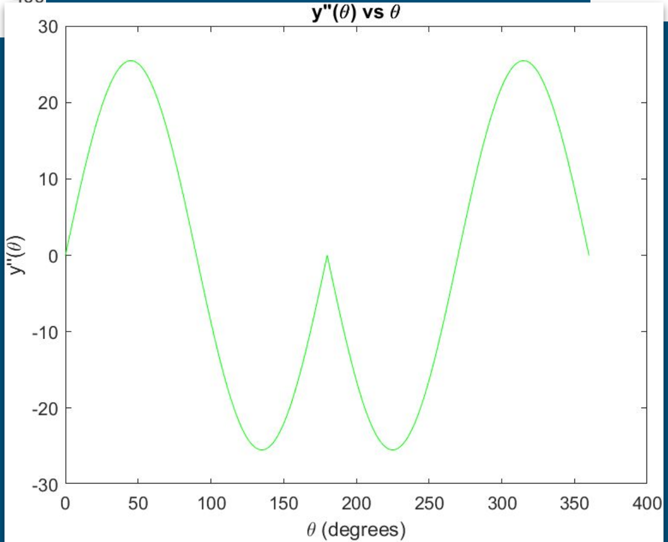
$$y(\theta) = \begin{cases} L(\frac{\theta}{\theta_i} - \frac{sin(2\pi\frac{\theta}{\theta_i})}{2\pi} & \text{for} \quad 0^\circ \leq \theta \leq 180^\circ \\ L(1 - \frac{\theta-\beta}{\theta_r} + (\frac{sin(2\pi\frac{\theta-\beta}{\theta_r})}{2\pi}) & \text{for} \quad 180^\circ < \theta \leq 360^\circ \end{cases}$$

where,

$$\beta = 180^\circ, L = 40mm, \theta_r = 180^\circ$$


Displacement vs θ
y (mm)
θ (degrees)


y'(θ) vs θ
y'(θ)
θ (degrees)


y''(θ) vs θ
y''(θ)
θ (degrees)

STEP1

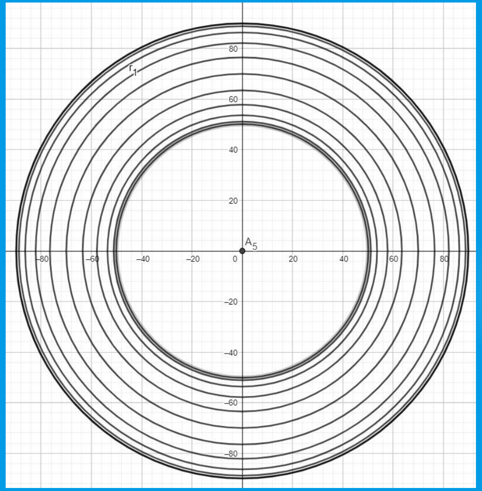
Using the expression for lift as mentioned earlier, we plot circles with centre at origin and radii of base circle + value of lift expression at intervals of 15°, starting from 15° (15° to 180 ° i.e.).

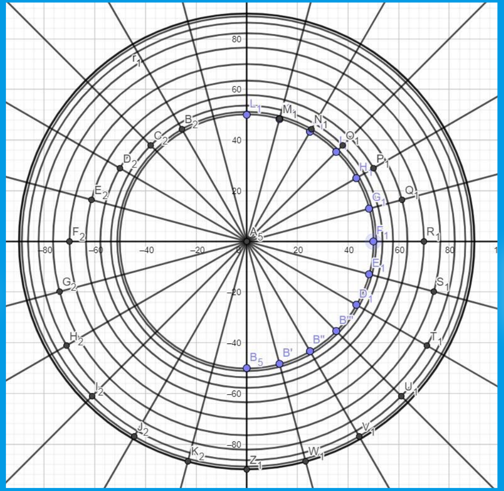
STEP2

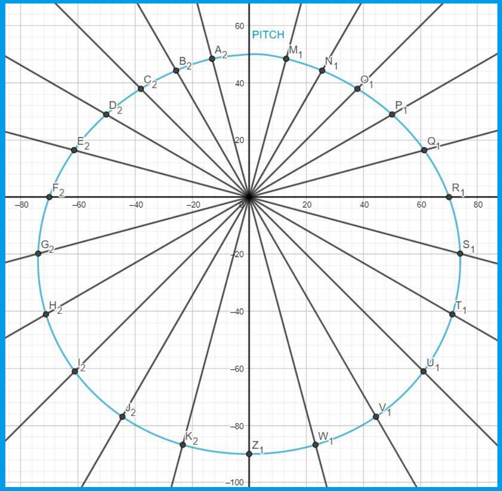
Next, we take points 15° apart (from 0 °) and draw lines through them from origin, which intersect the corresponding circle with the value of lift expression at that angle (e.g. for 15°, we intersect the circle of radius 50 + f(15°)) and we mark these points.

STEP3

We then use the spline function to draw a curve through all the points marked in the previous step, which forms the pitch curve (we are doing this first for convenience).







STEP4

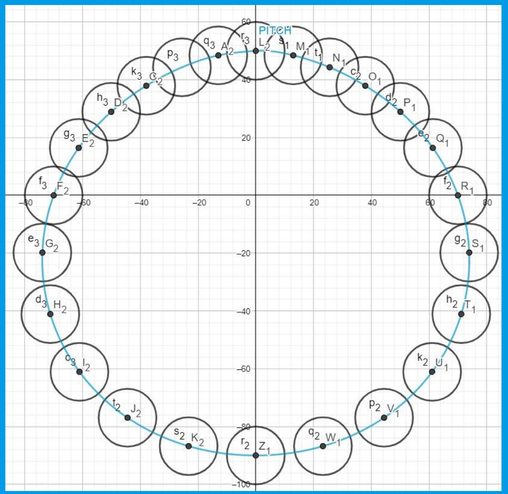
After this, we draw circles of roller radius (5 mm) with centres at the points marked in step 2.

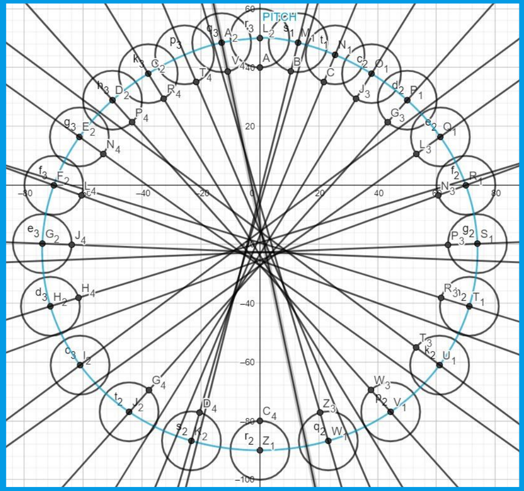
STEP5

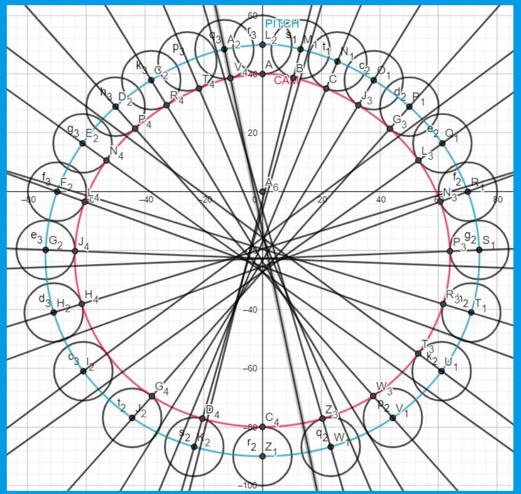
We then draw normals to the pitch curve through the centre of each circle (using tangents drawn to pitch curve at those points), and the points where these intersect the respective circle are marked (inner side).

STEP6

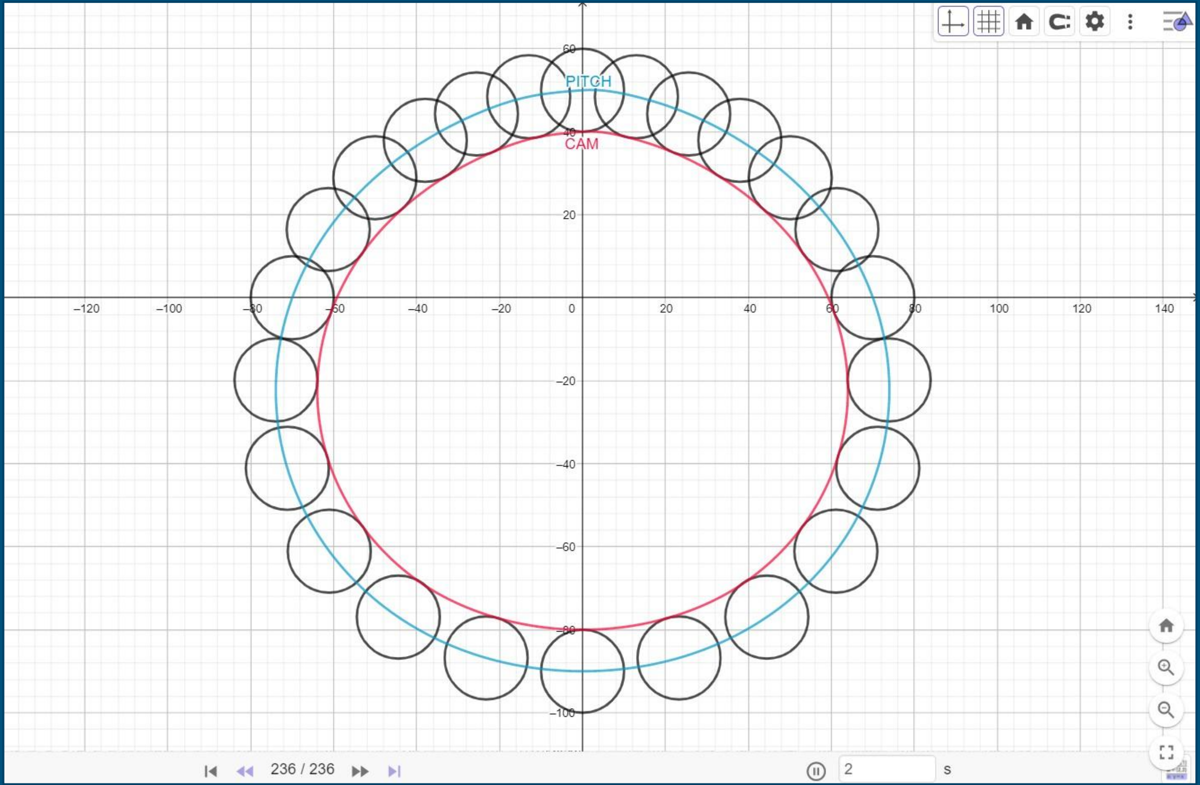
We then use the spline function again to plot an *approximate* cam profile for the given specifications, thus completing the construction.







Final profile:



Geogebra file -https://www.geogebra.org/classic/jtztxsvh

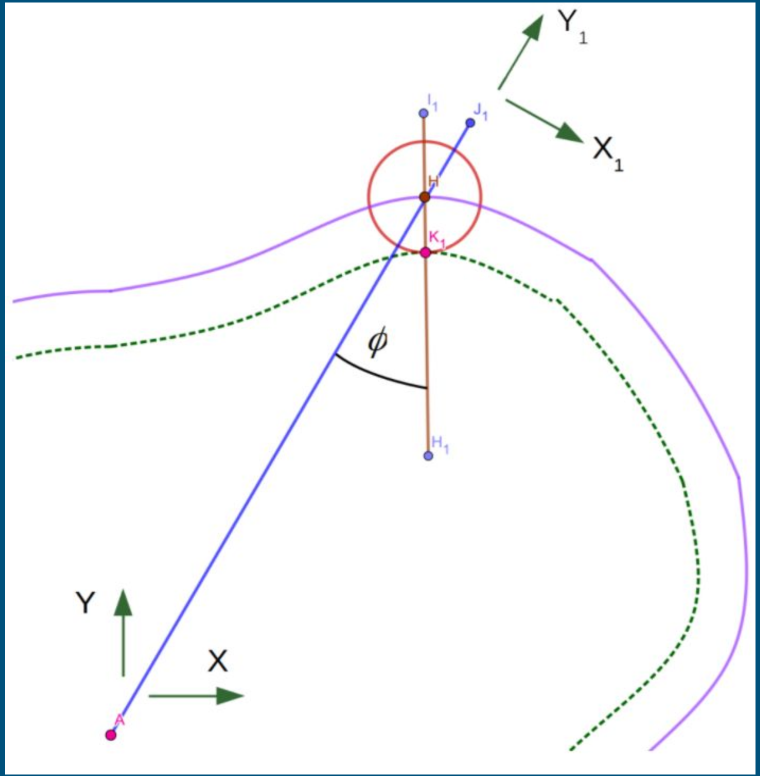
Analytical approach:

- Analytically ,we can synthesise the cam profile by formulating parametric equations Xc and Yc in terms of theta
- First, we can find the coordinates of Pitch curve by simply taking component of lift in the X and Y axes

$$X_p = (R_p + y(\theta))sin(\theta)$$

$$Y_p = (R_p + y(\theta))cos(\theta)$$

- A is the origin, we require the coordinates of the vector $A\vec{K}_1$
- We have coordinates of H in the rotating coordinates as $(0, R_p + y(\theta))$
-
- So we need to add $A\vec{H}$ and $H\vec{K}_1$
- is given by $(R_r sin(\phi), -R_r cos(\phi))$
-
- $A\vec{K}_1$ is given by $A\vec{H} + H\vec{K}_1$
- $(R_r sin(\phi), R_p + y(\theta) - R_r cos(\phi))$



- Now we transform to XY coordinate system:

$$X_c = (R_r sin(\phi))cos(\theta) + (R_p + y(\theta) - R_r cos(\phi))sin(\theta)$$

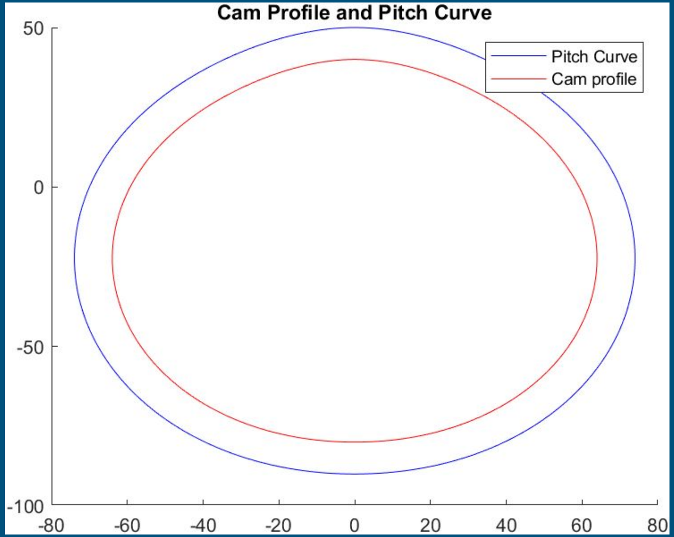
$$Y_c = -(R_r sin(\phi))sin(\theta) + (R_p + y(\theta) - R_r cos(\phi))cos(\theta)$$

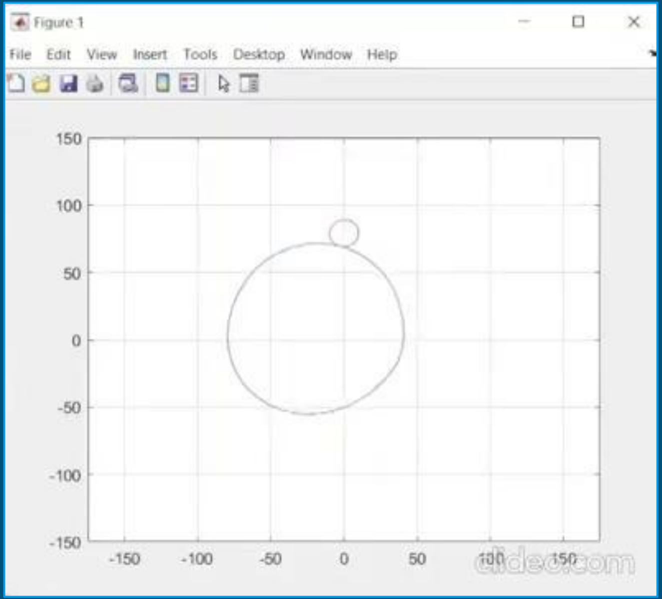
- For return, the sign of phi is negative, so the coordinates are given by:

$$X_c = (-R_r sin(\phi))cos(\theta) + (R_p + y(\theta) - R_r cos(\phi))sin(\theta)$$

$$Y_c = (R_r sin(\phi))sin(\theta) + (R_p + y(\theta) - R_r cos(\phi))cos(\theta)$$

- On running the matlab code, we get the pitch curve and the cam profile as follows:





Click on the pic for the video

Matlab code link:
https://drive.google.com/file/d/1cWymPQFacDsClpy82YExh0nMChGyjlhb/view?usp=sharing