SNS COLLEGE OF TECHNOLOGY

COIMBATORE-35

DEPARTMENT OF MECHATRONICS ENGINEERING

23MCT205 MECHANICS OF MACHINES

UNIT – II

KINEMATICS OF CAMS

Construction of Cam Profile for a Radial Cam

Problem 1. *A cam is to be designed for a knife edge follower with the following data:*

1. *Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.*

2. *Dwell for the next 30°.*

3. *During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.*

4. *Dwell during the remaining 180°.*

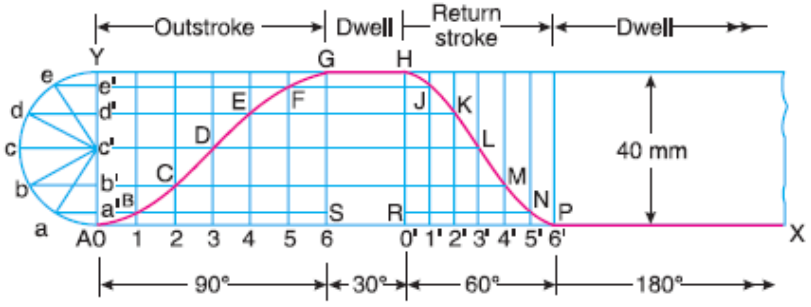
Draw the profile of the cam when

(a) *the line of stroke of the follower passes through the axis of the cam shaft, and*

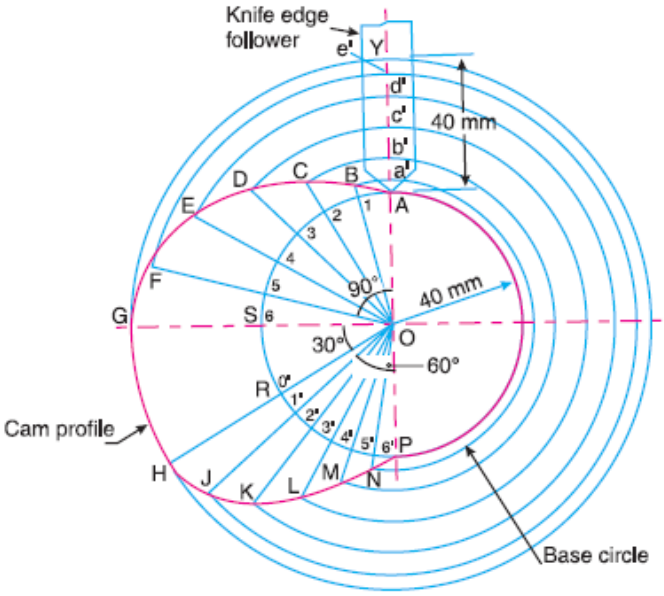
(b) *the line of stroke is offset 20 mm from the axis of the cam shaft.*

The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

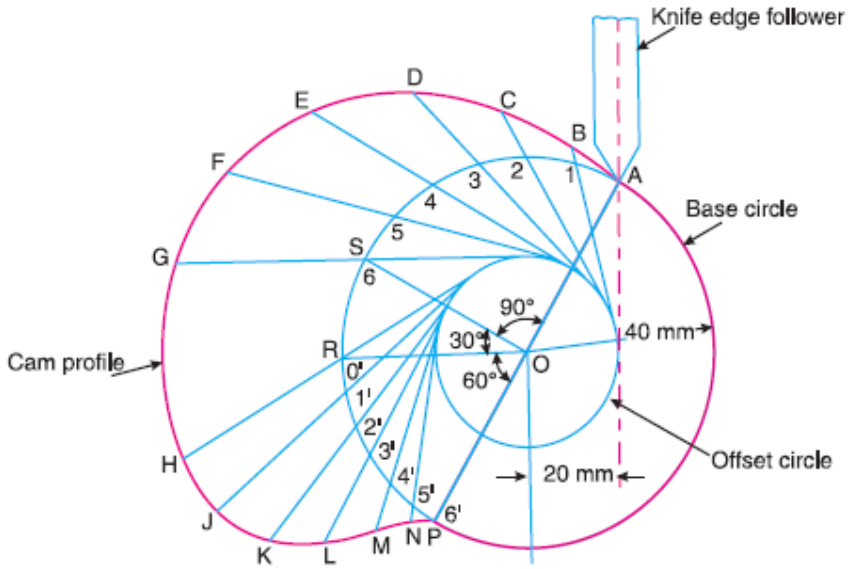
Solution. Given: S = 40 mm = 0.04 m; $\theta_O = 90° = \pi/2$ rad = 1.571 rad ; $\theta_R = 60° = \pi/3$ rad = 1.047 rad ; N = 240 r.p.m.



(a) Profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft



(b) Profile of the cam when the line of stroke of the follower is offset 20 mm from the axis of the cam shaft



Maximum velocity of the follower during its ascent and descent

We know that angular velocity of the cam,

$$\omega = \frac{2\pi N}{} = \frac{2\pi \times 240}{} = 25.14 \text{ rad/s}$$

$$v_O = \frac{\pi \omega S}{2\theta_O} = \frac{\pi \times 25.14 \times 0.04}{2 \times 1.571} = 1 \text{ m/s Ans.}$$

and maximum velocity of the follower during its descent,

$$v_R = \frac{\pi \omega S}{2\theta_R} = \frac{\pi \times 25.14 \times 0.04}{2 \times 1.047} = 1.51 \text{ m/s Ans.}$$

Maximum acceleration of the follower during its ascent and descent

We know that the maximum acceleration of the follower during its ascent,

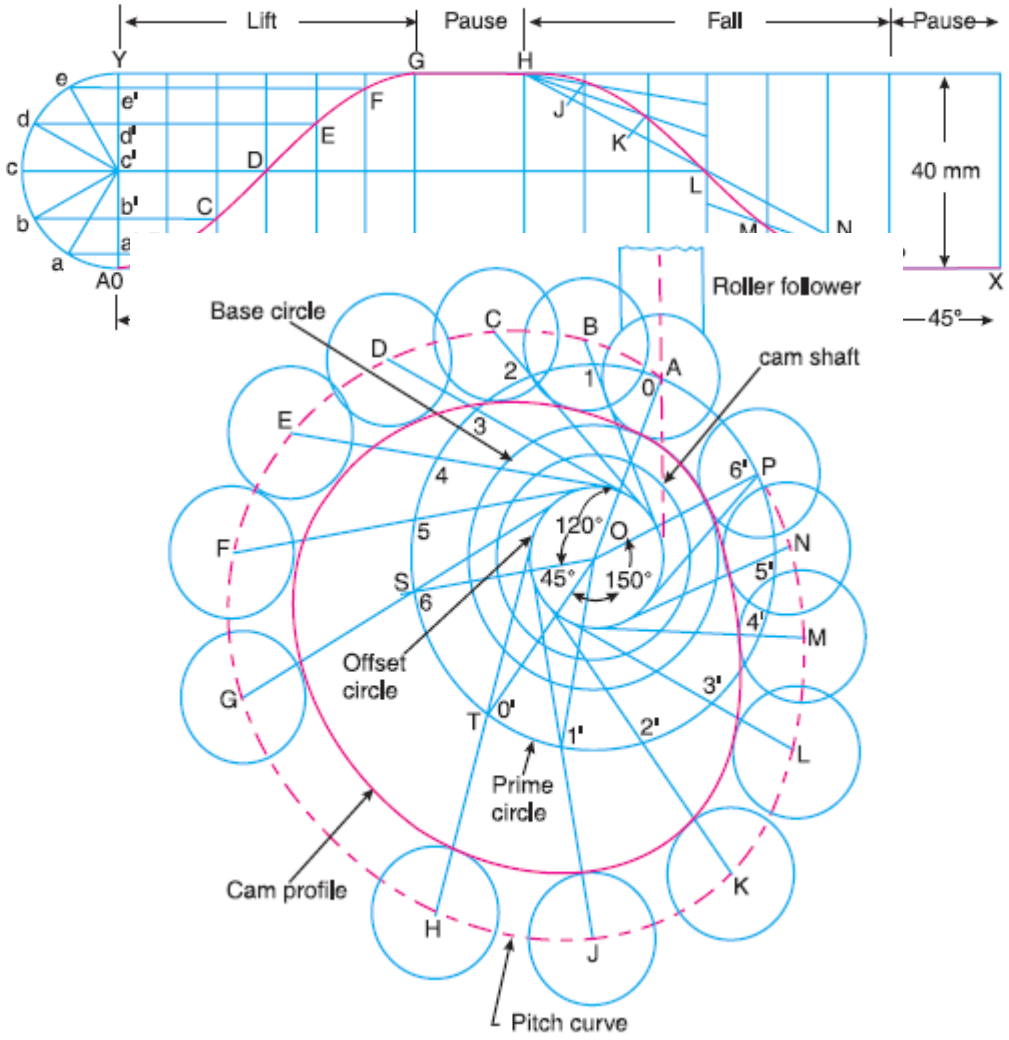
$$a_O = \frac{\pi^2 \omega^2 .S}{2(\theta_O)^2} = \frac{\pi^2 (25.14)^2 0.04}{2(1.571)^2} = 50.6 \text{ m/s}^2 \textbf{ Ans.}$$

and maximum acceleration of the follower during its descent,

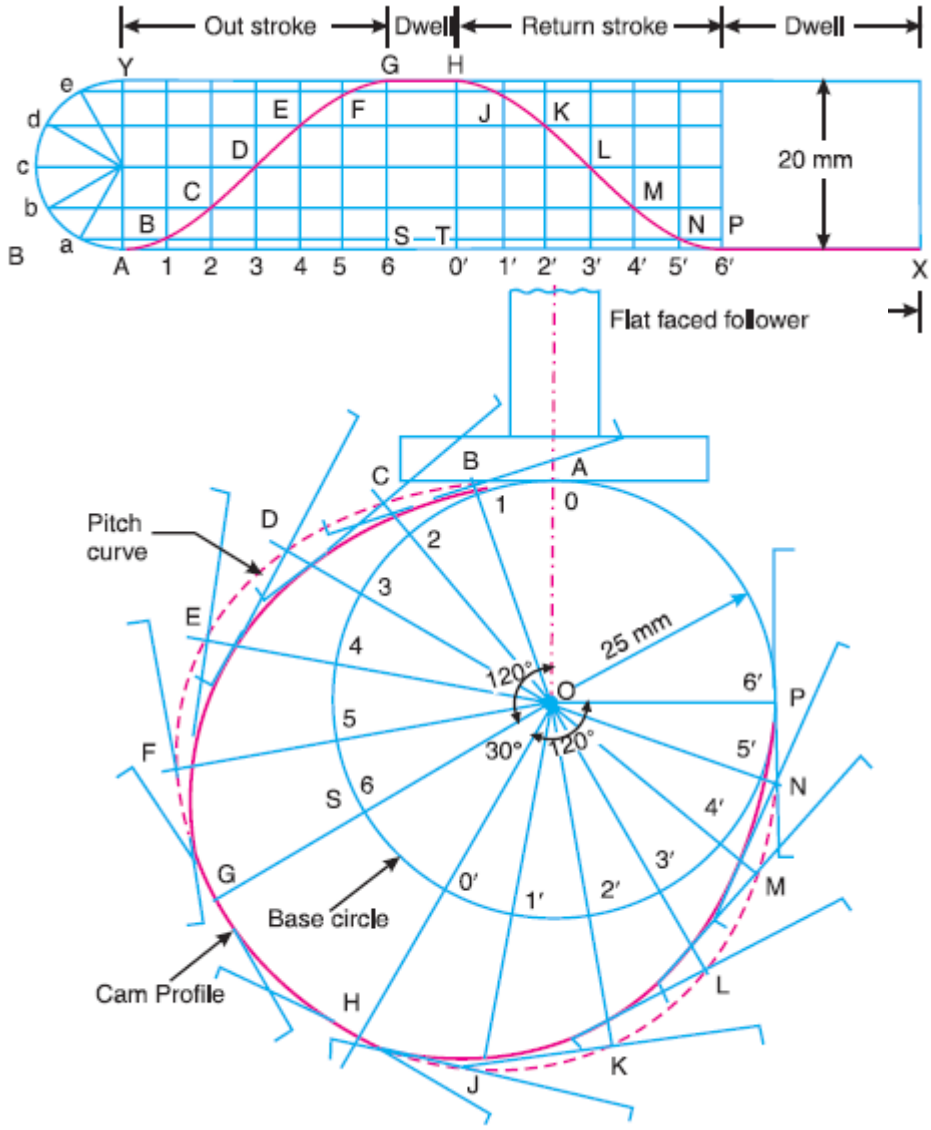
$$a_R = \frac{\pi^2 \omega^2 .S}{2(\theta_R)^2} = \frac{\pi^2 (25.14)^2 0.04}{2(1.047)^2} = 113.8 \text{ m/s}^2 \textbf{ Ans.}$$

Problem.2. *Construct the profile of a cam to suit the following specifications: Cam shaft diameter = 40 mm; Least radius of cam = 25 mm; Diameter of roller = 25 mm; Angle of lift = 120°; Angle of fall = 150°; Lift of the follower = 40 mm; Number of pauses are two of equal interval between motions.*

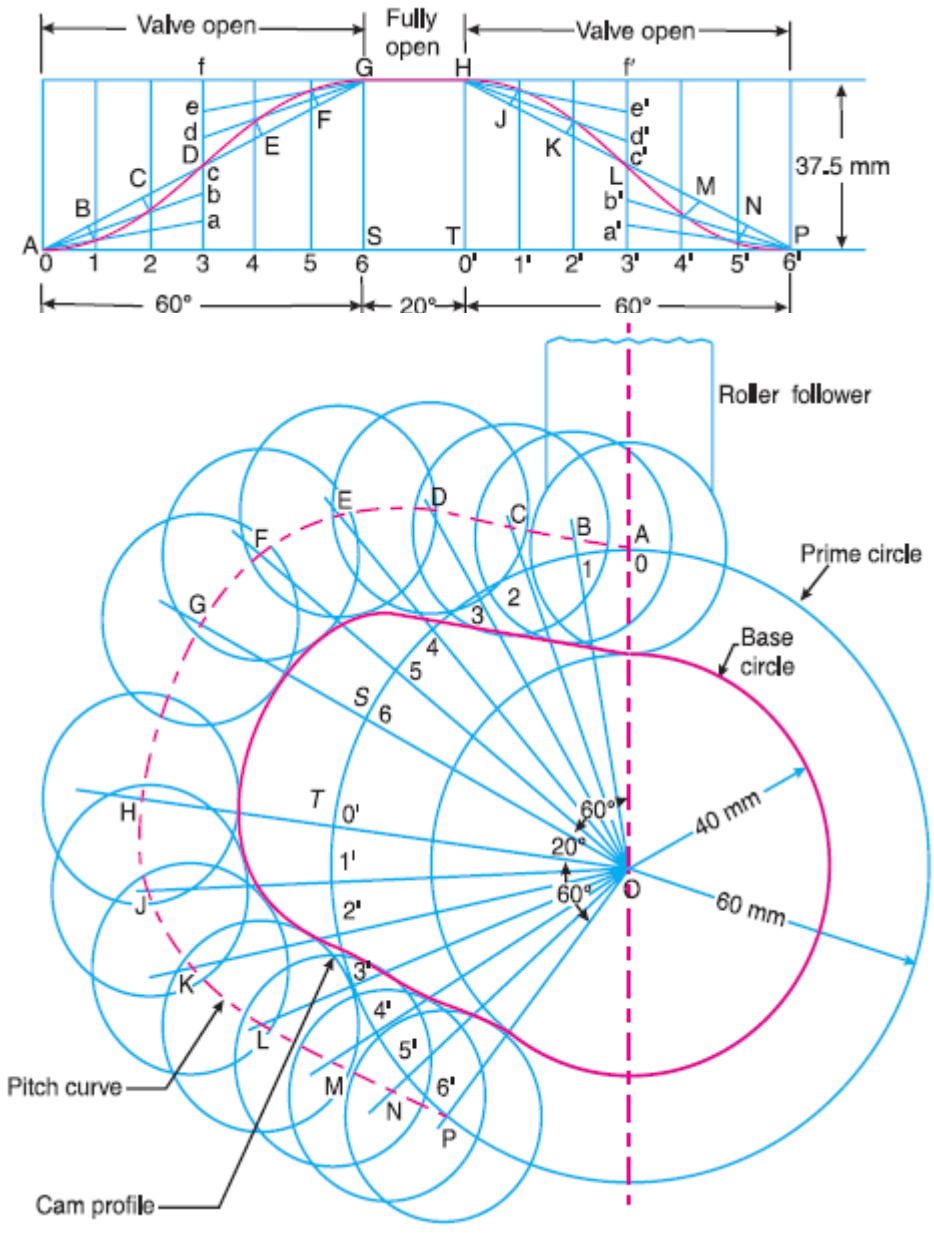
During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set 12.5 mm from the centre of the cam.



Problem 3. *A cam drives a flat reciprocating follower in the following manner: During first 120° rotation of the cam, follower moves outwards through a distance of 20 mm with simple harmonic motion. The follower dwells during next 30° of cam rotation. During next 120° of cam rotation, the follower moves inwards with simple harmonic motion. The follower dwells for the next 90° of cam rotation. The minimum radius of the cam is 25 mm. Draw the profile of the cam.*



Problem 4. *Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for20° of cam rotation.*
The lift of the valve is 37.5 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam.



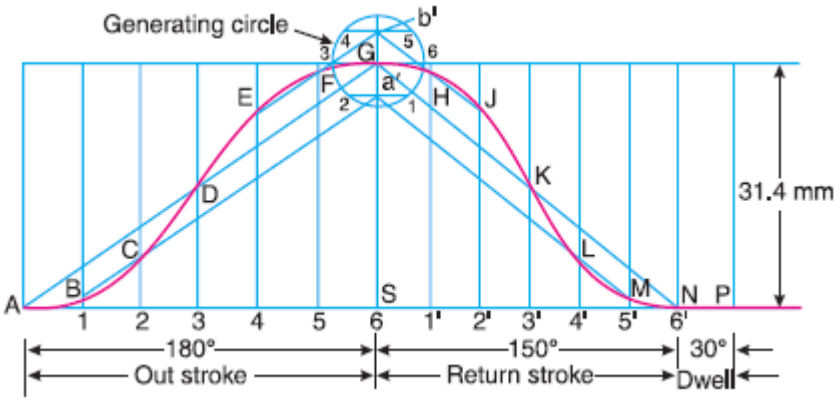
Problem 5. *Draw the profile of the cam when the roller follower moves with cycloidal motion during out stroke and return stroke, as given below:*

1. *Out stroke with maximum displacement of 31.4 mm during 180° of cam rotation,*

2. *Return stroke for the next 150° of cam rotation,*

3. *Dwell for the remaining 30° of cam rotation.*

The minimum radius of the cam is 15 mm and the roller diameter of the follower is 10 mm. The axis of the roller follower is offset by 10 mm towards right from the axis of cam shaft.



$$r = \frac{\text{Stroke}}{2\pi} = \frac{31.4}{2\pi} = 5 \text{ mm}$$