# Chapter 5 HW Hints (due Friday, 10/30; ADAMS due Monday, 11/2)

**Problem 5.2.** *NOTE:* DO NOT offset the follower stem for this problem! Assume that the follower axis (stem) intersects the axis of the cam (my examples have all had zero follower axis offset).

Since this cam rotates CCW you must modify my analysis (and MATLAB function) accordingly.

Both the rise (full-rise) and return (full-return) motions are SHM (Simple Harmonic Motion); the plots for these motions are in text Figures 5.14 and 5.17, respectively. The corresponding equations $y$, $y'$, $y''$, *etc.* are 5.18(a–d) and 5.21(a–d), respectively. I advise you to keep all angles in `RAD` (although `DEG` is useful for visualizing the motion plots).

**(a)** Find the displacement functions $y(\theta)$ for the full motion and plot the displacement diagram using MATLAB. Use units of `DEG` for the plot.

**(b)** Assuming the follower has a circular cross-section, how large must this follower radius be to accommodate the contact point?

**(c)** Find and plot the profile that will accomplish this motion. Use 1° steps for cam angle $\theta$.

**Problem 5.7:** This problem is similar to text Example 5.2. The motion is composed of:

1. Initial dwell
2. Full-rise lift
3. Half-return to a uniform velocity
4. Uniform velocity return segment
5. Half-return back to rest (ending at $\theta = 360°$)

Since it's said to be a "high-speed" cam you must keep the $2^{nd}$ kinematic coefficient $y''$ continuous between motion segments. Also, if you have a choice of motion types, select those that yield lower peak values of acceleration (text Figures 5.14–5.23 are scaled the same so you can compare their peak values). Of particular interest are the motions used for segments 2 + 3; the two possibilites—as I see it—are to use either (a) a cycloidal full-rise followed by a cycloidal half-return, or (b) an $8^{th}$-order polynomial full-rise followed by a harmonic half-return. You will need to find the lift $L$ and the cam duration $\beta$ for each segment. Then match the first and second derivatives all through the motion.

You will end up with five equations (one of them nonlinear) in five unknowns. They're a little tricky to solve but with some thinking you can do it. Two of my results are:

$$\beta_2 = 1.084 \text{ rad } (62.1084°)$$
$$L_3 = 0.0814 \text{ in}$$

**(a)** Plot the position $y$ (in), velocity $\dot{y}$ (in/s), and acceleration $\ddot{y}$ (ft/s$^2$) *vs* cam angle $\theta$ (`DEG`) for the complete motion.

**(b)** Assuming the follower has a circular cross-section, how large must the follower radius be to accommodate the contact point?

**(c)** Find and plot the cam profile. To avoid any cusps on the cam profile, the radius of curvature $\rho > 0$. Apply text equation (5.33) and find the minimum base circle $(R_o)_{min}$. Round $(R_o)_{min}$ up to the nearest inch, and use that value for $R_o$.

Use 1° increments for $\theta$. Since this cam rotates CW you can use my results without modification.

**(d)** Using the numerical data from parts (b) and (c), construct an ADAMS model of the cam and follower. A section on this will be added to the "ADAMS Guide." Verify that the follower displacement, velocity, and acceleration agree with the desired behavior.

This problem is a *LOT* of work, especially if you do the ADAMS model, but it is highly instructive. I hope you can make progress.

**Problem 5.9:** You are given a cam angular speed of 400 rpm; the dwell time should be simple to find. The maximum and minimum velocity and acceleration will be given by the displacement functions you selected in Problem 5.7. *Note:* It is these maximum and minimum velocities and accelerations that dictate your choice of motions (a) or (b) as I discussed in Problem 5.7 above.