MeEn 437 Homework #5

For problems 2 and 3, assume that lengths are given in cm, angles in degrees, and angular velocities in radians/s.

1. Perform a 4-point function synthesis for a four bar mechanism. The function to be approximated is

$$\Delta\theta_4 = (\Delta\theta_2)^2$$

where both angles are measured in degrees. The function should be approximately satisfied for $\Delta\theta_2$ from 0 to 10 degrees. For the prescribed variables, use:

$$\begin{aligned} \beta_2 &= 4^\circ, \quad \gamma_2 = 16^\circ \\ \beta_3 &= 8^\circ, \quad \gamma_3 = 64^\circ \\ \beta_4 &= 10^\circ, \quad \gamma_4 = 100^\circ \end{aligned}$$

Use nonlinear equation solution, and either choose appropriate free choices or have your nonlinear solution choose them for you. Turn in a plot of your mechanism, as well as a plot of $\Delta\theta_2$ vs. $\Delta\theta_4$, with the exact desired function also plotted. Also, turn in all of your link lengths for your mechanism.

2. For the four-link mechanism illustrated in Figure P6-1 (page 319 of your text), and for the dimensions and values given in row c of Table P6-1, perform a position analysis using any desired method, and then draw the mechanism to scale in the open configuration. Using your scale drawing, perform the following analysis for the open form of the mechanism.

   (a) Using vector triangles, find $\mathbf{V}_A$, $\mathbf{V}_B$, ω_3, ω_4, and $\mathbf{V}_P$. Note that, for the vectors, you must give both magnitude and direction.

   (b) Find all of the instant centers for the mechanism. Using instant centers, find $\mathbf{V}_A$, $\mathbf{V}_B$, ω_3, ω_4, and $\mathbf{V}_P$.

3. For the slider-crank mechanism illustrated in Figure P6-2 (page 320 of your text), and for the dimensions and values given in row c of Table P6-2, perform a position analysis using any desired method, and then draw the mechanism to scale in the open configuration only. Using your scale drawing, perform the following analysis for the open form of the mechanism.

   (a) Using vector triangles, find $\mathbf{V}_A$, $\mathbf{V}_B$, and ω_3. Note that, for the vectors, you must give both magnitude and direction.

   (b) Find all of the instant centers for the mechanism. Using instant centers, find $\mathbf{V}_A$, $\mathbf{V}_B$, and ω_3.

4. For the mechanism below, perform a displacement analysis and draw the mechanism to scale in the given position (this is the problem you solved in homework 3, and the solution is posted online). Using the scale drawing, perform the following analysis. (Note that ω_2 is given in units of rpm.)

   (a) Using vector triangles, solve for the unknown velocities $\mathbf{V}_A$, $\mathbf{V}_B$, and $\mathbf{V}_C$.

   (b) Find all of the instant centers for the mechanism. Using instant centers, find $\mathbf{V}_A$, $\mathbf{V}_B$, and $\mathbf{V}_C$.

$r_2 = 2$ cm.
$r_3 = 6$ cm.
$r_4 = 6$ cm.
$r_5 = 6$ cm.
$x = 7.5$ cm.
$y = 5$ cm.
$\theta_2 = 45^o$
$\omega_2 = 1000$ rpm