ME 581 – C02 **Name ________________________**

1) Program your constraints and Jacobian for the web cutter into a Newton-Raphson iterative algorithm to solve position kinematics for any desired crank angle. To check your work, when = ϕ_2=90 degrees, ϕ_3 = 65.3 degrees and ϕ_4 = -69.0 degrees.

2) Develop the velocity right-hand-side vector $\{\nu\}$ for your constraints, and program them to solve for the generalized coordinate velocities $\{\dot{q}\}$. To check your work, when ϕ_2 = 90 degrees, $\dot{\phi}_3$ = 0.88 rad/s CW and $\dot{\phi}_4$ = 0.72 rad/s CCW.

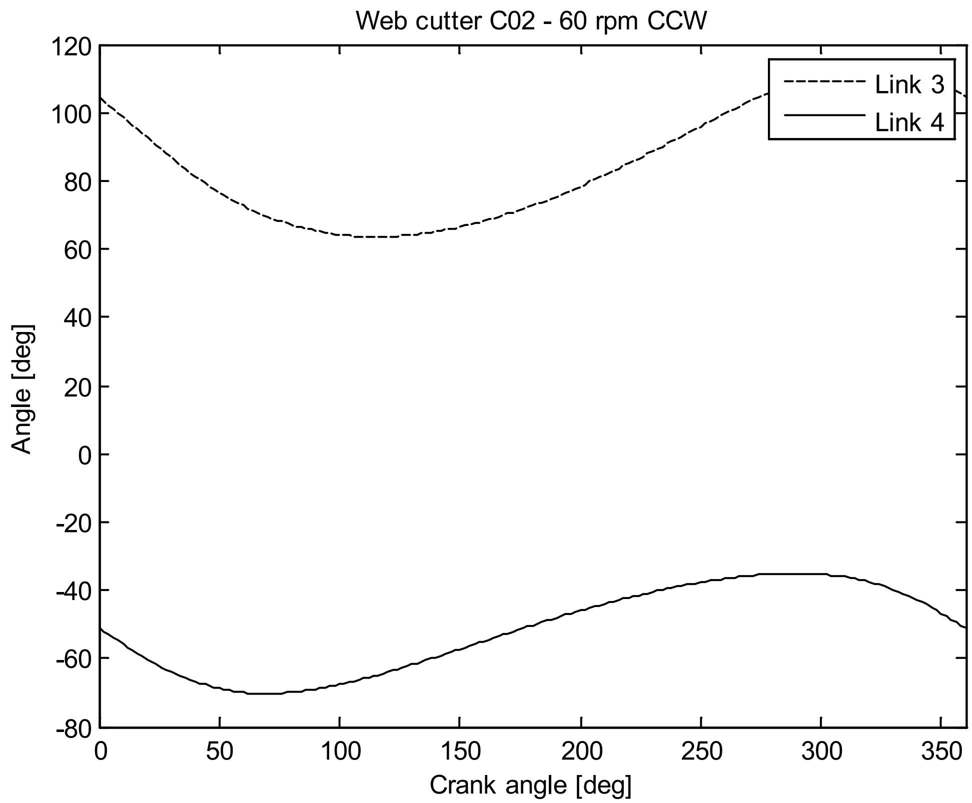
3) Develop the acceleration right-hand-side vector $\{\gamma\}$ for your constraints, and program them to solve for the generalized coordinate accelerations $\{\ddot{q}\}$. To check your work, when ϕ_2 = 90 degrees, $\ddot{\phi}_3$ = 14.2 rad/s/s CCW and $\ddot{\phi}_4$ = 10.1 rad/s/s CCW.

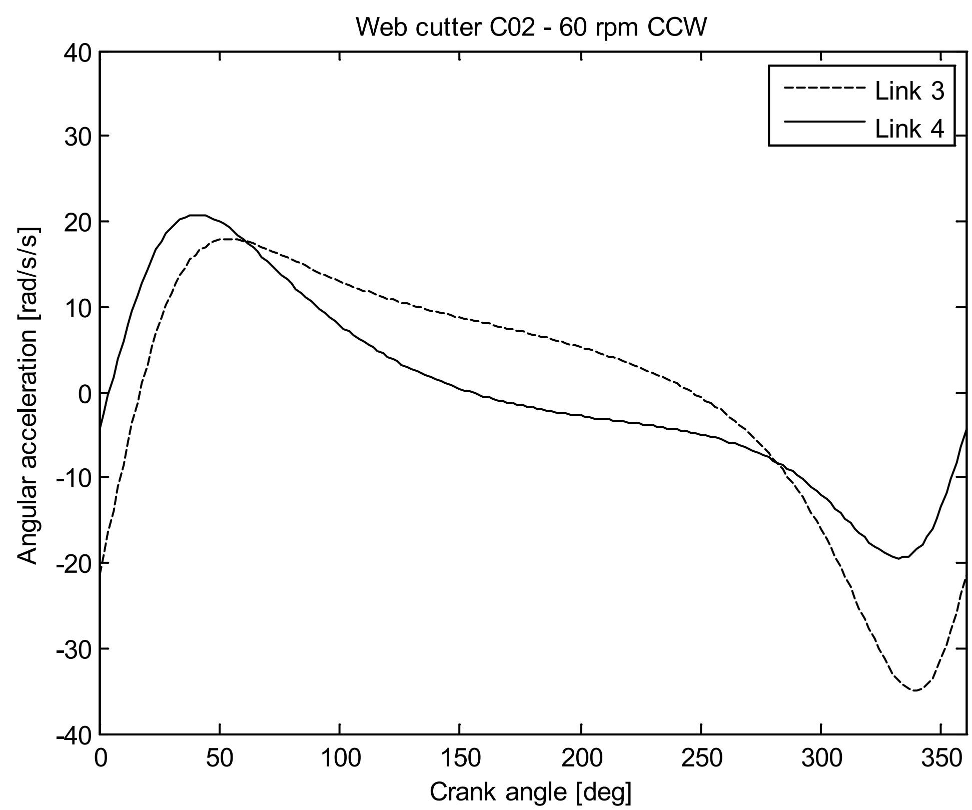
4) Place your position, velocity and acceleration algorithms within an outer loop to drive the crank through one complete revolution, and plot $\ddot{\phi}_4$ as a function of crank angle. Also plot the determinant of your Jacobian as a function of crank angle. Start the crank at ϕ_2 = 0 degrees in your plots.

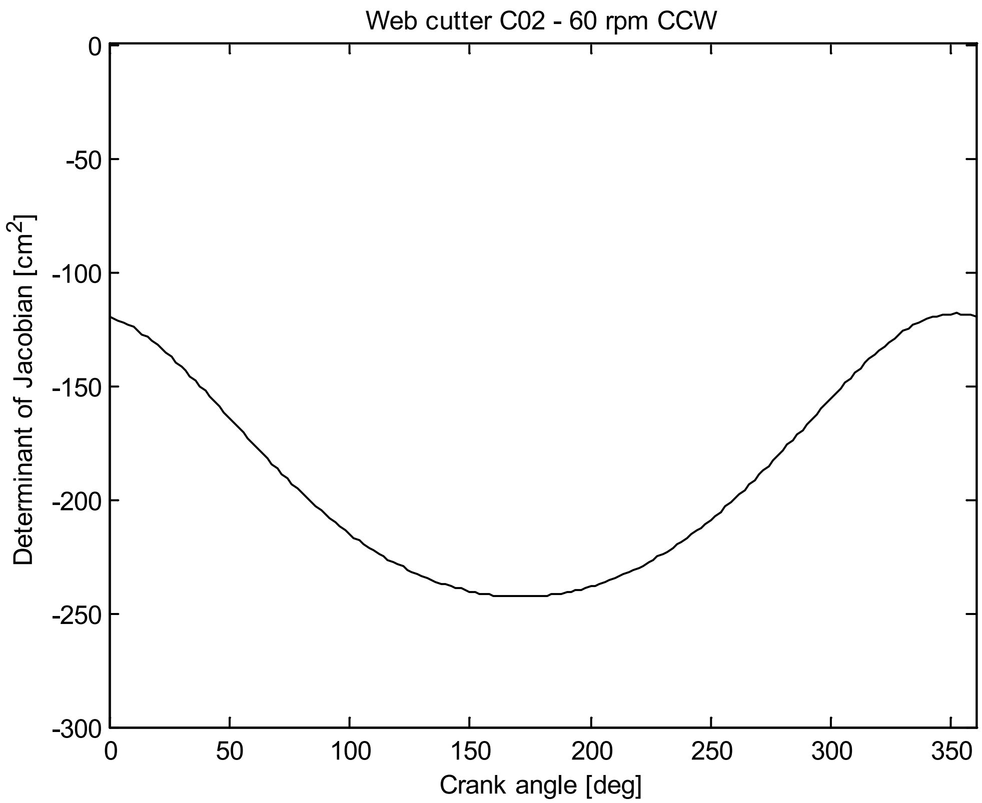
5) Determine the speed of the web.

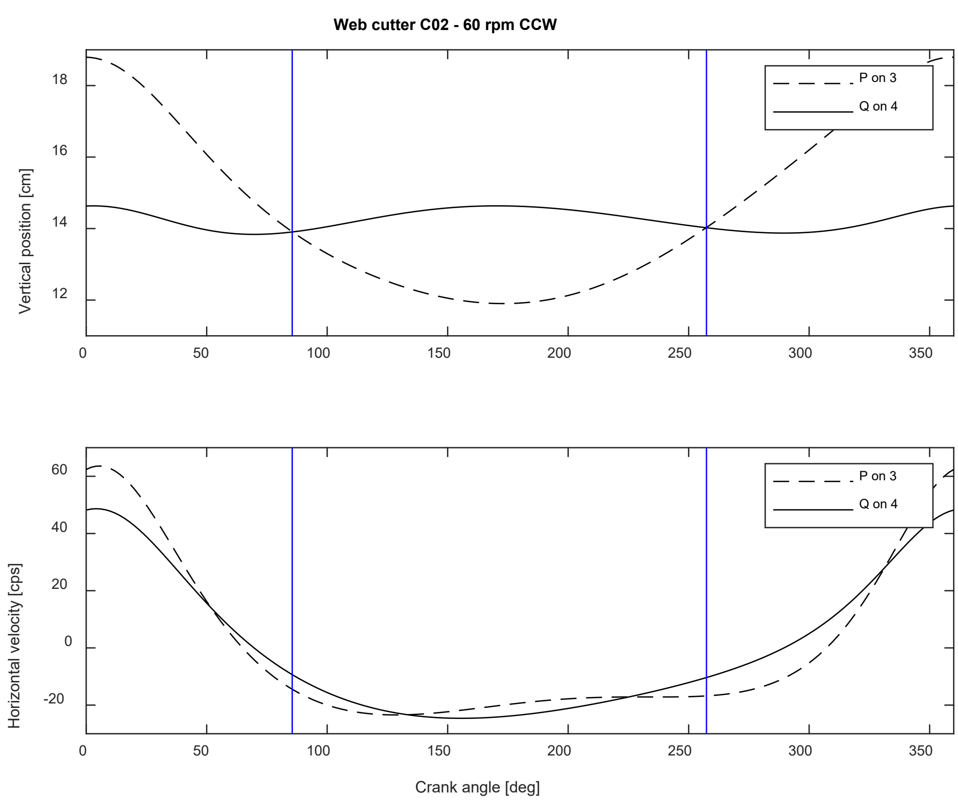
V_{WEB} ___________________________

EXTRA CREDIT
Modify your code to simulate an in-line slider crank with R = 4.00 cm and L = 14.23 cm operating at constant 60 rpm CCW crank speed. Validate your results by plotting piston acceleration as a function of crank angle compared to simple geometric equations.


Web cutter C02 - 60 rpm CCW
Link 3
Link 4
Angle [deg]
Crank angle [deg]
120
100
80
60
40
20
0
-20
-40
-60
-80
0
50
100
150
200
250
300
350


Web cutter C02 - 60 rpm CCW
Link 3
Link 4
Angular acceleration [rad/s/s]
Crank angle [deg]
40
30
20
10
0
-10
-20
-30
-40
0
50
100
150
200
250
300
350


Web cutter C02 - 60 rpm CCW
0
-50
-100
-150
-200
-250
-300
Determinant of Jacobian [cm^2]
0
50
100
150
200
250
300
350
Crank angle [deg]


Web cutter C02 - 60 rpm CCW
P on 3
Q on 4
18
16
14
12
Vertical position [cm]
0
50
100
150
200
250
300
350
P on 3
Q on 4
60
40
20
0
-20
Horizontal velocity [cps]
0
50
100
150
200
250
300
350
Crank angle [deg]

ME 581 – C02 **Name ________________________**