PROGRAMMING ASSIGNMENT
MS2105 KINEMATICS AND DYNAMICS
Semester 1, 2024/2025

Figure 1 shows a windshield wiper mechanism. The lengths of the crank (link 2) and coupler (link 3) are L^2 and L^3, respectively. The crank of the mechanism is assumed to rotate with a constant angular velocity ω^2. The initial orientation of the crank is assumed to be θ_o^2. Please conduct the kinematics analysis of the windshield wiper mechanism below. You must write down all the matrix needed in the kinematics analysis in A4 papers and write the program in the MATLAB.

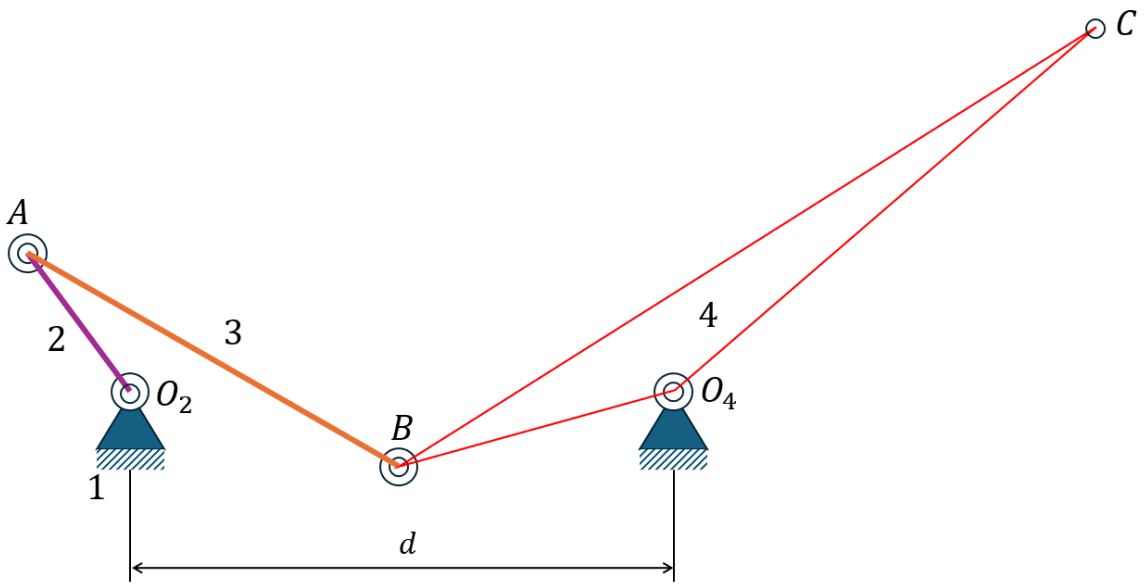

Figure 1 Windshield wiper mechanism

The **input** of the program are the geometry or dimension of the mechanism and the angular velocity of link 2, as below:

$$L^2 = 50 + \text{XYZ}\ [mm] \qquad O_4C = 3.5L^2$$
$$L^3 = 2.9L^2 \qquad BC = 4L^2$$
$$O_4B = 1.2L^2 \qquad d = 3L^2$$

$$\omega^2 = \begin{cases} 6\ \dfrac{rad}{s} & \text{if XYZ is odd number} \\ 7\ \dfrac{rad}{s} & \text{if XYZ is even number} \end{cases}$$

$$\theta_o^2 = \frac{\pi}{3}\ rad$$

where:
L^2: length of link 2
L^3 length of link 3
O_4B: distance between O_4 and B
O_4C: distance between O_4 and C
BC: distance between B and C
d: distance between O_2 and O_4
ω^2 angular velocity of link 2
θ_o^2 : initial angle of link 2
XYZ: last three digits of your NIM, i.e. 13123XYZ

The expected **output** are the plot of:

1. Trajectory of joint A ($r^2_{A,x} - r^2_{A,y}$)
2. Trajectory of joint B ($r^3_{B,x} - r^3_{B,y}$)
3. Trajectory of point C ($r^4_{C,x} - r^4_{C,y}$)
4. Angular velocity of link 3 vs. time, ($\omega^3 - t$)
5. Angular velocity of link 4 vs. time, ($\omega^4 - t$)
6. Angular acceleration of link 3 vs. time, ($\alpha^3 - t$)
7. Angular acceleration of link 4 vs. time, ($\alpha^4 - t$)

You may use the simulation time from 0 s to 2 s, t = 0 – 2 [s]

Submission and due date:

You should submit following documents or files:

1. All the matrices required in the kinematics analysis (e.g. constraint matrix, Jacobian matrix, etc.) in pdf file
2. Please explain in the PDF file: What are the requirements, according to *Grashof's criterion*, for the mechanism to function as a *crank-rocker* mechanism based on the lengths of bars L^2, L^3, O_4B, and the distance d?
3. The syntax of your program (with extension .m)
4. All the expected plots in .jpg or .png file.

Please submit all the documents or files in .rar or .zip extension to e-learning page *or* MSTeam channel of your class before **Saturday, 21 Desember 2024.**

Note: please learn MATLAB by yourself.