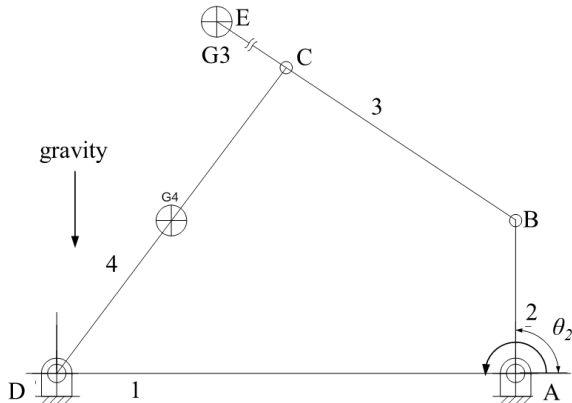


# Machine Dynamics - Assignment 1

Write a computer program (Matlab, Fortran, Mathematica, etc) to complete the analysis.

A 4-bar mechanism is given below. The gravity is parallel to the motion plane and pointing down. ( $G_2$ ,  $G_3$ , and  $G_4$  are the CGs of link 2, 3, and 4, respectively;  $I_2$ ,  $I_3$ , and  $I_4$  are the mass moment of inertia of each link about its CG)



AB = 100 mm	$G_2$ = point A
BC = 180 mm	$G_3$ = point E
CD = 250 mm	$G_4$ = middle of CD
AD = 300 mm AD is horizontal	
BE = 360 mm	
$m_2 = 1$ kg	$I_2 = 0.02$ kg·m <sup>2</sup>
$m_3 = 2$ kg	$I_3 = 0.06$ kg·m <sup>2</sup>
$m_4 = 0.2$ kg	$I_4 = 0.005$ kg·m <sup>2</sup>

Part I Statics: Complete the following tasks.

1. Kinematics: Write a program to calculate the angular displacement of each link.
2. Statics: Calculate the reaction forces at all joints and the required torque on Link 2 to achieve static balance when  $\theta_2$  is equal to 90 degree. List all the data in a table. (Accurate to 4 significant figures 有效位數取 4 位)

Part II Kinetostatics: Link 2 is the input link and rotating at 120 rpm CCW. The driving (input) torque is unknown. Complete the following tasks.

1. Use Simscape – Multibody to build this 4-bar mechanism. You need to use it to verify the results in Part II.
2. Kinematics: Continue from Part I-1, write a program to calculate the angular velocity and acceleration of each link.
3. Kinetostatics: Calculate the reaction force at all joints and the required torque on Link 2 when  $\theta_2$  varies from 0 to 360 degree (interval  $\leq 1$  degree). Take the angle of Link 2 ( $\theta_2$ ) as the horizontal axis to draw plots for these variables.
4. Continued from 3, draw (a) the plots of the x and y components of the shaking force with  $\theta_2$  as the horizontal axis, and (b) the polar plots of the shaking force and shaking moment.
  - a. What is the maximum input torque? When does it happen? Use degree as the unit and be accurate to 2 decimal places (精確至小數點下 2 位).
  - b. What are the maximum shaking force and shaking moment? When do they happen? Use degree as the unit and be accurate to 3 decimal places.

Report Requirements: No limitation for the page amount and the format. No need to submit the program. The content must be complete and organized. Arrange the report in proper sequence with labeling of the chapters. *The content **in bold** needs to be submitted.*