ME 254: Compliant Mechanisms		
Assigned: Jan. 22, 2026	Homework 2 (40 points)	Due: Jan. 29, 2026

If you use AI-agents, include your prompts just like you would cite any references that you use.

Question 1 (20 points)

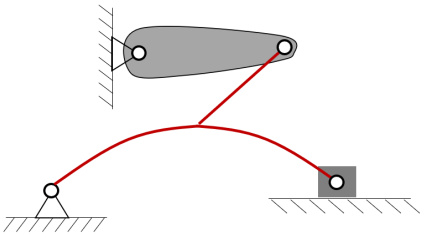
Use the extended Grübler's formula and compute the number of degrees of freedom (DoFs) for the following. Clearly mention the values of all symbols in the formula.

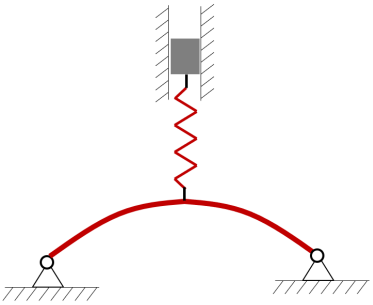
$$DoF = 3(n_{seg} - 1) - \sum_{j=1}^{2}(3-j)\,n_{Kj} - \sum_{j=1}^{2}(3-j)\,n_{Ej} - 3n_{fix} + \sum_{j=1}^{3} j\,n_{scj}$$ for planar

and

$$DoF = 6(n_{seg} - 1) - \sum_{j=1}^{5}(6-j)\,n_{Kj} - \sum_{j=1}^{5}(6-j)\,n_{Ej} - 6n_{fix} + \sum_{j=1}^{6} j\,n_{scj}$$ for spatial cases.

The segments in a compliant mechanism can be rigid, compliant, or virtual rigid. The last type is needed to interpret DoFs as independent actuations when it is not obvious to do it without introducing virtual rigid segments (VRSs).

a)  (Red-colored ones are compliant segments.)

b)  (Red-colored ones are compliant segments.)

c)  CM 23 in the Compliant Mechanisms collection of M2D2@IISc. See https://mecheng.iisc.ac.in/m2d2/CMcollection/23.html.

d)  (from an Instagram post)

e) 

Source: https://blog.adafruit.com/2019/06/20/2-dof-fully-compliant-space-pointing-mechanism-3dthursday-3dprinting/

You can read about this device in a paper that I will email separately.

Question 2 (20 points)

Look around you and choose a device that has a compliant mechanism in it. Note that we define a compliant mechanism as one that transfers, transforms, or transducts motion, force, or energy by utilizing elastic deformation of its constituent members. It is a broad definition and the key is the elastic deformation. A compliant mechanism consists of rigid segments, elastic segments, kinematic pairs, and elastic pairs.

For the device you have chosen, do the following.

a. Draw a kinematic sketch.
b. Identify all the counts in the extended Grübler's formula to compute the degrees of freedom (DoFs).
c. Calculate DoF.
d. Interpret DoF as independent actuations you can give. Note than for compliant mechanisms, you can apply 1 to as many as DoF and still get the deterministic motion of the entire mechanism.

What you need to submit:

1. A paper copy of your answers clearly written down with all details.
2. Graphs and pictures of your results with proper annotation (paper copy).