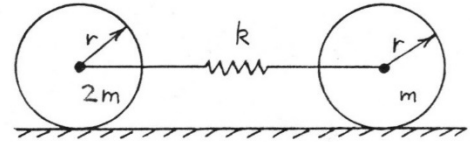


MECH 463 -- Tutorial 5

1. A vibrating system consists of two circular cylinders, both of radius r , rolling on a rough horizontal surface. One cylinder has mass $2m$ and the other has mass m . A spring of stiffness k joins the two cylinders. Choose a convenient coordinate system and derive the matrix equation of motion. Solve for natural frequencies and mode shapes. Sketch the mode shapes.



2. The diagram shows a highly idealized model of an airplane in flight. The fuselage is represented by a concentrated mass M and the wings by uniform beams of mass m , length ℓ , and centroidal polar moment of inertia $J = m\ell^2/12$. For simplicity, the flexibility of the wings is assumed to be concentrated in a central spring of angular stiffness s .

Guess the three mode shapes. Interpret the meanings of your guesses. Use your guessed mode shapes to simplify the analysis of the system. Find the three natural frequencies.

