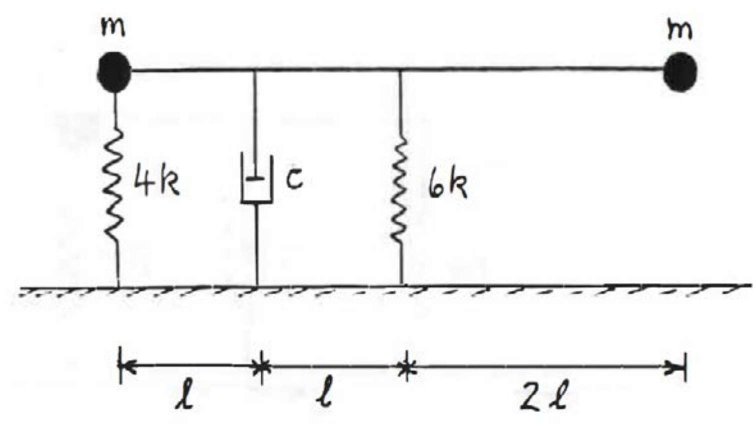
MECH 463 -- Tutorial 8

1. The diagram shows an idealized damped vibrating system. The rod supporting the two masses may be assumed to be rigid and have negligible mass. Find the natural frequencies and damping factors of the system.



   Hint: Use the trial solution $\underline{x} = \underline{X}\, e^{\lambda t}$. Two of the roots of your characteristic equation are $\lambda^2 = -k/m$. You may therefore use the factor $(\lambda^2 + k/m)$ to reduce your characteristic equation to manageable form.

   Interpret the meaning and significance of the solutions $\lambda^2 = -k/m$.

   Ans. $\omega_n = \sqrt{(6k/m)}$. $\zeta = 5c/(16\sqrt{(6km)})$. $\omega_d = \omega_n \sqrt{(1-\zeta^2)}$

2. Two solid cylinders of mass m rest on a rough horizontal surface. The cylinders, which both have radius r, are connected together by a spring of stiffness k and a damper of rate c. A horizontal force $f(t) = F \cos \omega_f t$ is applied at the centre of cylinder 1. Derive an expression for the vibrational displacement at that point. Note: The polar moment of inertia of a cylinder $J = \frac{1}{2}mr^2$.