AE4ASM003: Linear Modelling (incl. FEM)
Preparatory Test

This test consists of a total of three questions. In all questions, you are required to carry out basic mathematical manipulations using your prior knowledge from BSc courses. The questions are from three different backgrounds including discrete mathematical system solutions, statics, and dynamics. The last question requires you to carry out a derivation.

Question 1
In an effort to find solutions of discrete models, continuous mathematical models can be solved using the variational approach. In this approach, the potential Π of the system is calculated and its stationary value, $\delta\Pi = 0$, with respect to ech state variable is computed. This potential, also called *functional*, must be a C^{m-1} variational problem. In this context, is the given functional Π a C^0 variational problem?

$$\Pi = \frac{1}{2}\int_0^L EI\left(\frac{d^2w}{dx^2}\right)^2.dx - \frac{P}{2}\int_0^L \left(\frac{dw}{dx}\right)^2.dx + \frac{1}{2}kw_L^2$$

Question 2
In the following truss system shown in figure 1, find the force in the truss 4, given that $F_1 = 2F$ and $F_2 = F$.
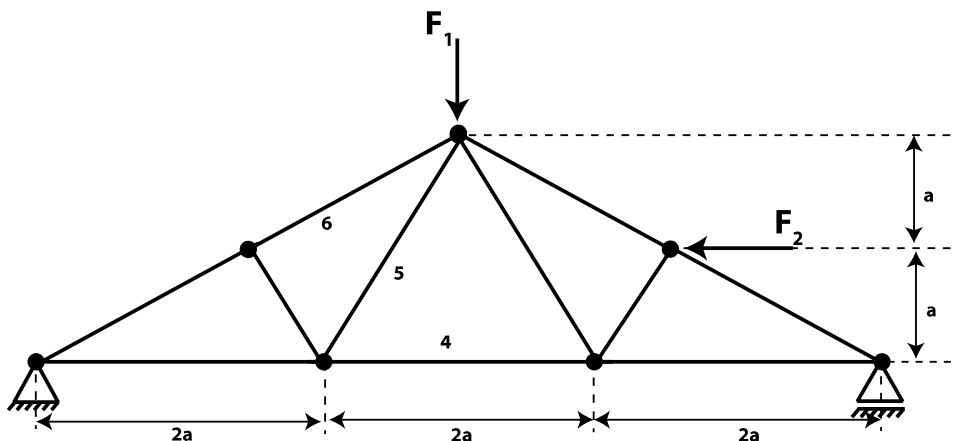

Figure 1: Truss system

Question 3
Derive equations of motion, both translational and rotational, of the system as shown in figure 2. Assume that the system is in vertical translation along x. As a translational perturbation, consider displacement x and acceleration x'', and a rotational disturbance as θ and θ'' Use Newton's second law for this derivation.
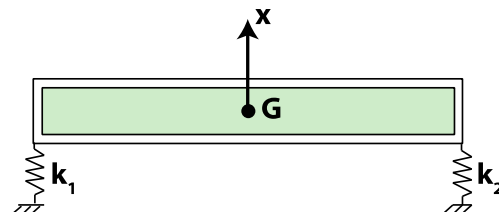

Figure 2: System under translation and rotation

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