Faculty of Maritime Engineering and Marine Sciences

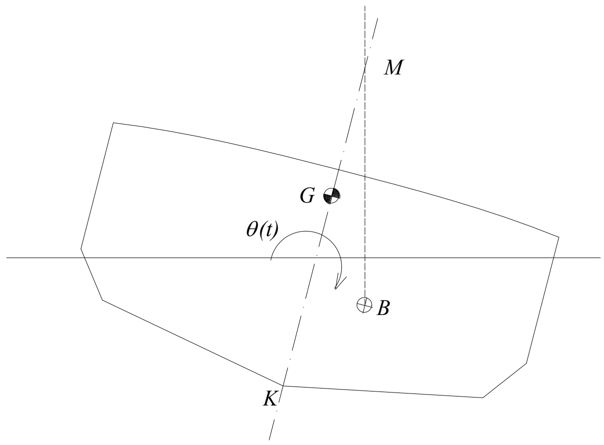
Mechanical Vibrations

First Evaluation – Oscillation 1 dof **November 25th, 2022**

Student: .... Student ID: ....

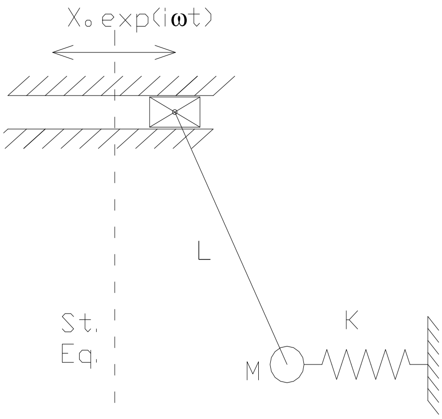
CLOSED BOOKS

1.- The mass of a ship model is 50 kg_m, and has a second moment of inertia of 6530 kg_m-cm^2 , with respect to a longitudinal axis passing through the mass center G; the model has KM_T=0.35 m, the mass center is located 0.15 m above keel, and the nondimensional damping ratio is 0.05. You are going to analyze the linearized uncoupled balance motion. If the model is released from an angle of 5 degrees, what is approximately the largest heel angle which will be reached after its release? (35).

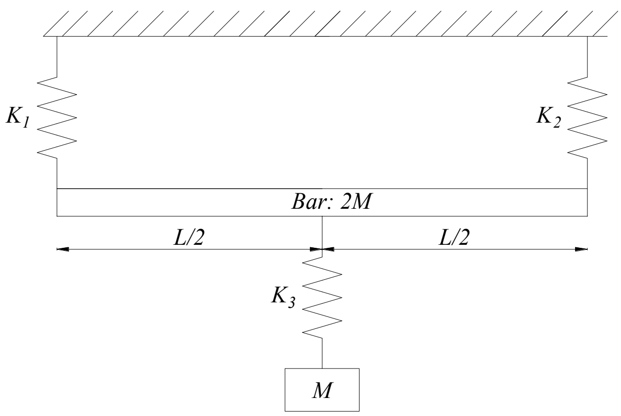


2.- Deduce the equation of motion of the pendulum with its support point undergoing an specified harmonic motion $X_0 e^{i\omega t}$ in the horizontal direction. A spring with stiffness $K=Mg/L$, is acting on its lower end, in the horizontal direction, as shown in the figure. Deduce the equation for general value of angle, and finally linearize.

What would be the amplitud of response for $\omega = \sqrt{g/L}$? (40)



3.- A system composed by a rigid bar with mass *2M* and length *L*, is suspended through two springs from its ends, with stiffnesses K_1 and K_2. At the center of the bar there is a block with mass *M* connected through a third spring, with stiffness K_3, as shown in the figure. Deduce motion equations for the system, as it oscillates in the plane of the figure, and express it in matrix notation as function of the parameters shown. (25)



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I certify that during this exam I have complied with the Code of Ethics of ESPOL.

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