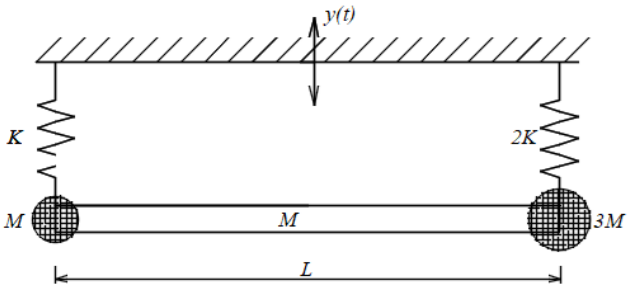
Faculty of Maritime Engineering and Marine Sciences

Mechanical Vibrations

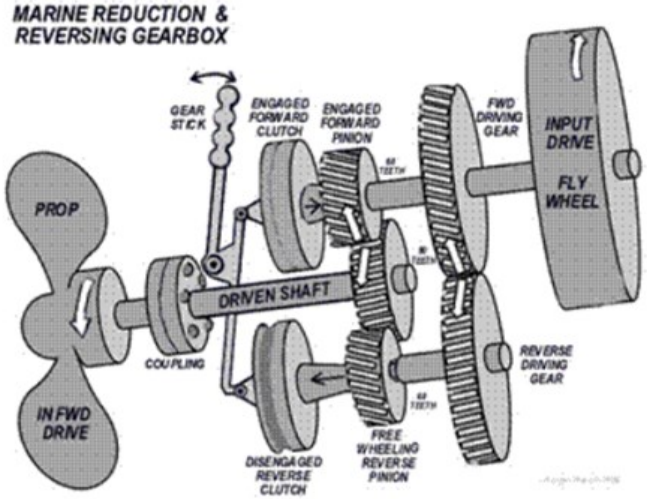
Exam 2 – V-dof, hydrodyn. properties, beam vibrations Jan. 26th, 2024

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

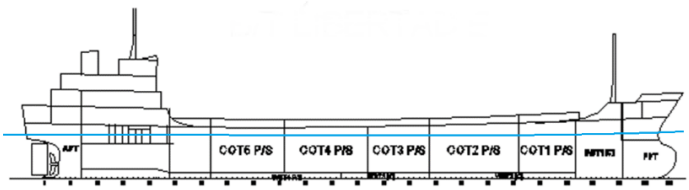
1. A rigid bar of mass M is suspended with two springs installed on its ends. There are also two concentrated masses attached on the ends of the bar. If the support moves vertically with a harmonic motion $y(t)$, deduce the equations of motion of the bar, and express them in matrix form. Any parameter in the equations must be expressed with the values included in the figure. (40)



2.- Consider the following marine reduction gear, which may operate in both rotational directions. To later develop a Holzer torsional vibration analysis, prepare models for the system in forward and reverse drive operations. Clearly name the elements included in each diagram. (25)



3. The hull of a tanker ship is vibrating in resonance at the second mode of vibration when partially loaded with Δ: 10700 tons. Main dimensions of the ship are: L: 135 m, B: 21 m and D: 10 m. The excitation is believed to come from the propeller at blade rate when it operates at N_{Prop}: 60 rpm (propeller characteristics are Z: 3, P/D: 1.05, A_e/A_o: 0.75). According to the structural plan, midship sectional inertia of this steel ship is 263300 m^2-cm^2. In a simplified model, the hull of the ship may be considered as a prismatic beam. Estimate the added mass/length on the vibrating ship hull, and express it as a percentage of the dry mass/length of the ship. Attached is a table with different beam supports that may be helpful. (35)



Beam Configuration	$(\beta_1 l)^2$ *Fundamental*	$(\beta_2 l)^2$ *Second Mode*	$(\beta_3 l)^2$ *Third Mode*
Simply supported	9.87	39.5	88.9
Cantilever	3.52	22.0	61.7
Free-free	22.4	61.7	121.0
Clamped-clamped	22.4	61.7	121.0
Clamped-hinged	15.4	50.0	104.0
Hinged-free	0	15.4	50.0

jrml/2024

I certify that during this exam I have complied with the Code of ethics of our university.

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