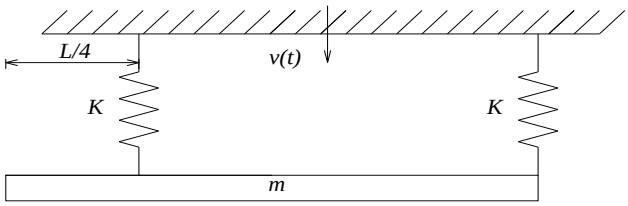
Faculty of Maritime Engineering and Marine Sciences

Ship Vibrations

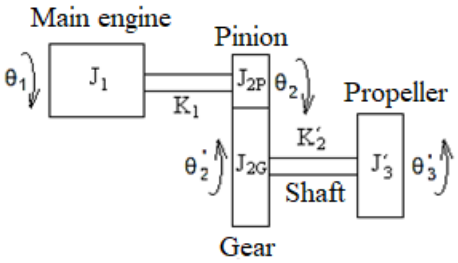
Second Evaluation January 30th, 2020

Student: .....

1.- Deduce the equations of motion of a rigid bar in the plane, with uniformly distributed mass *m*, length *L*, and suspended through two springs from the ceiling, as shown in the figure. The support has a harmonic pure vertical motion $v(t) = V\,exp(i\omega t - \beta)$. (25)



2.- Consider the simplified model of a ship propulsion system, which includes an engine, a reduction gear, shaft, and propeller. Due to the high stiffness of the crankshaft, the model of the engine is a single disk. Diameter of the pinion is 15cm, and its mass polar moment of inertia is 0.25kg m^2, and, reduction gear ratio of 2.5:1, as shown in the figure:



In the following table it has been calculated the forced response, considering the reduction gear, for a frequency 20rad/sec. If the amplitude of the exciting torque generated by the propeller is 24500N-m, calculate the amplitude of the contact force between pinion and gear teeth for that frequency. (30)

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ω:	20	1/s										
j	J_j	C_j	θ_j ***Real***	θ_j ***Imag***	$(-J\omega^2+i\omega C)\,\theta_j$ ***R***	$(-J\omega^2+i\omega C)\,\theta_j$ ***I***	**Σ *Real***	**Σ *Imag***	***K***	***G***	**Σ*/(K+i ω G) R***	**Σ*/(K+i ω G) I***
	kg m s^2	**kg m s**			**kg-m**	**kg-m**	**kg-m**	**kg-m**	**kg -m**			
1	2.00	0	-0.0102	-0.0293	8.13	23.42	8.1	23.4	159345	0	5.10E-05	1.47E-04
2	0.07	0	-0.0102	-0.0294	0.30	0.85	8.4	24.3	4249	0	1.98E-03	5.71E-03
3	20.32	1270.3	-0.0122	-0.0351	991.58	-24.27	1000.0	0.0				

3.- Explain in Spanish, in no more than 4 lines:

a.- What is entrained water? (10)

b.- What is the origin of the vibratory forces generated by a ship propeller? (10)

4.- Free vibration of a prismatic beam of length *L* with left end clamped and the other as SS is to be analyzed. One of principal values has been estimated as $(\beta_i L)$ = 7.06858. Plot the corresponding mode shape, and explain what is its mode number. (25)

Jrml/2019-20

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

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