College of Maritime Engineering and Sea Sciences

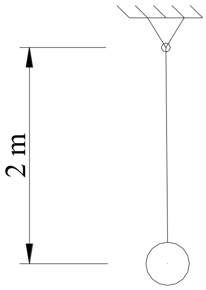
Ship Dynamics

First evaluation **Nov. 23, 2018**

Closed books

Student: ....

1.- Estimate the natural frequency of free oscillation in the plane, of a simple pendulum deeply submerged in water considered as an ideal fluid. On its lower end, the pendulum has an aluminum sphere of 20 cm in diameter. Aluminum density is 2.6 gr/cm^3. (20)



2.- Consider the following velocity potential which corresponds to a free flow with velocity U in the x-direction and a source singularity located at the origin of the reference system. Characteristic values for the problem are: ρ =1 gr/cm^3, U = 1 m/s, and m = 1 m^2/s.

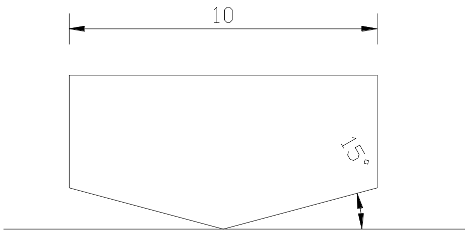
$$\phi = U\,x + \frac{m}{2\pi} log\left(x^2 + y^2\right)^{1/2}$$

i.- Determine the position where the stagnation (point of zero velocity) in the flow is produced. (10)

ii.- Estimate the pressure at the stagnation point. (15)

3.- Deduce the expression for the frequency which a ship encounter waves as it sails with velocity U, and the relative direction between ship and waves is defined by the angle β. (15)

4.- The **pure pitch motion** of a simplified barge is going to be analyzed when sails at 10 knots and receives waves from the bow of the ship. Main dimensions of the vessel are: L= 50 m, B: 10 m, D: 5.0 m, k_{yy}=12 m, Δ=1200 tons, and is floating in sea water. The transverse section is constant along the length of the ship, and has a 15º deadrise angle, as shown in the figure. For the excitation force consider waves of 0.75 m in amplitude and length equal to ship`s length; use the following expressions deduced in class:

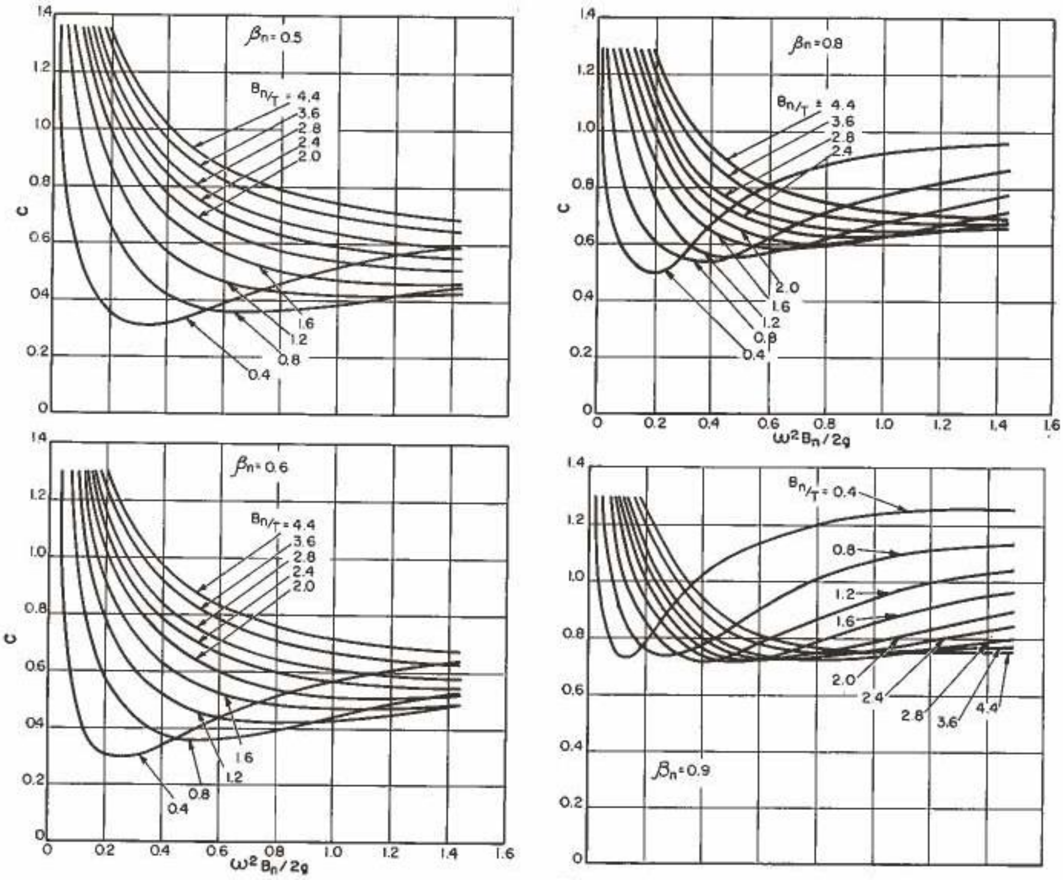


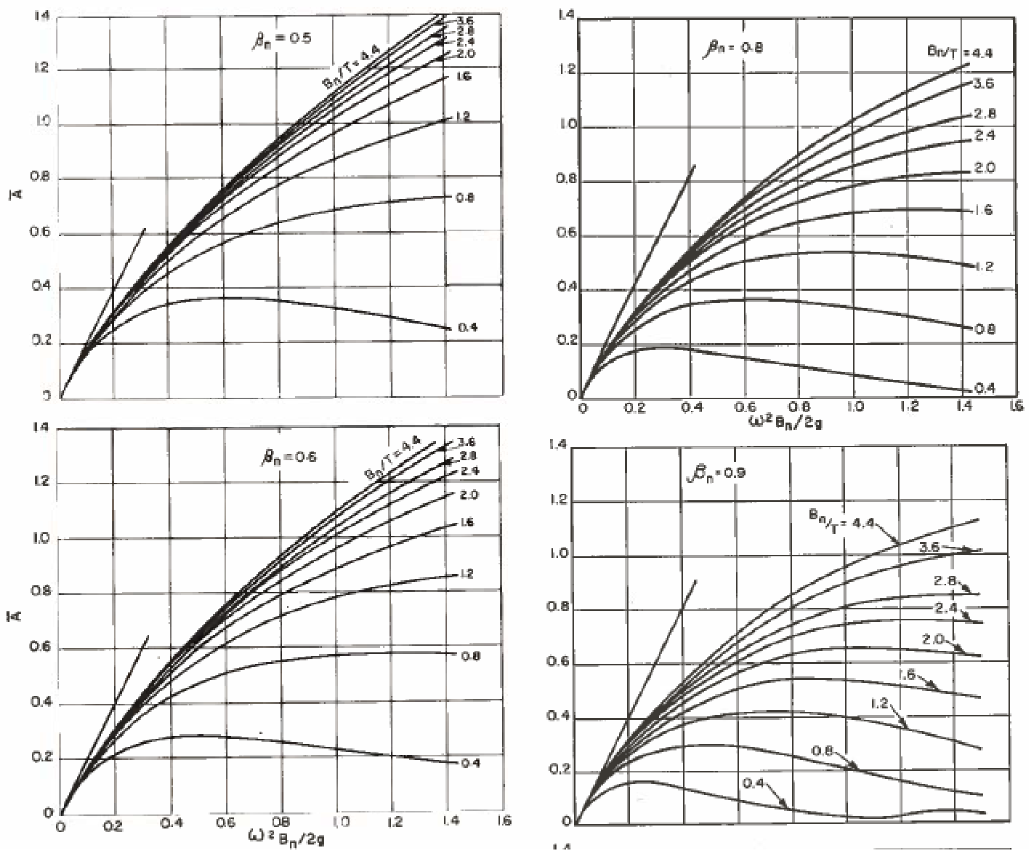
$$F_3(t) = \varsigma_o e^{i\omega t} \int_L dx e^{-kT^*(x)} e^{ikx} \left[\rho g B(x) - \omega^2 a_{33}(x) + i\omega b_{33}(x)\right]$$

$$F_5(t) = -\varsigma_o e^{i\omega t} \int_L dx e^{-kT^*(x)} e^{ikx} x \left[\rho g B(x) - \omega^2 a_{33}(x) + i\omega b_{33}(x)\right]$$

but include only the Froude-Krylov component.

To estimate sectional properties use: $a_{33} = C \frac{\rho \pi B_n{}^2}{8}$, $b_{33} = \frac{\rho g^2 \overline{A}^2}{\omega_e{}^3}$, and attached figures. (40)





Certifico que durante este examen he cumplido con el Código de Ética de nuestra universidad:

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