Exam on MEC-E2001 - Ship Hydrodynamics

1. Models tests of surface vessels

   a) Why Froude scaling law is normally obeyed when conducting model tests of the surface vessels (3p)

   b) Is flow separation occurring easier in full- or model scale. Present your reasoning (3p)

2. Explain why the propulsive efficieny is normally higher for a single screw ship when compared to a twin-screw arrangement (3p)

3. Why ship model is being towed in a self-propulsion test (3p)

4. Evaluate the effective power P_E - (2p) and delivered power P_D (4p) of a ship using the ITTC-57, that is Froude's, extrapolation method

The data of the model of a single screw vessel are: L_{WL} = 7.0 [m], scale of the model $\lambda = 30$, measured model resistance in a still water R_{TM} = 108 [N], wet surface of the model S_M = 10.9 [m^2], model speed V_M = 1.8 [m/s]. The wake fraction and the thrust deduction factor obtained in the model tests are w = 0.28 and t = 0.18. The open water efficiency of the propeller is $\eta_0 = 0.65$ and the rotative efficiency $\eta_R = 1.02$. Kinematic viscosity and water density during the model tests were

$$\nu_M = 1.02\ 10^{-6}\ [m^2/s],\ \rho_M = 1000\ [kg/m^3].$$

Sea water density and kinematic viscosity are ρ_S = 1015 [kg/m^3], $\nu_S = 1.16\ 10^{-6}$ [m^2/s].

Disregard the air resistance, Additional resistance coefficient, that is resistance allowance

$$C_A = \Delta C_F = [105\ (AHR/L_W)^{1/3} - 0.64]\ 10^{-3}$$

is the so-called additional resistance coefficient represented by the coefficient taking into account the average hull roughness AHR. Assume that AHR = 150 [μm] that is $150*10^{-6}$ [m].

Hint:

$$1\ \text{knot} = 0.5144\ \text{m/s},\ \text{Re} = \frac{VL}{\nu},\ C_F = \frac{0.075}{(\log \text{Re} - 2)^2},\ \eta_D = \frac{P_E}{P_D}$$

5. Describe conducting and analysis of the Zig-Zag test (5p)

6. Propeller cavitation (5p)

What is propeller cavitation affected by? In particular, what makes cavitation change rapidly and causes unsteady loading yielding hull vibration?