Test No.2

Name	Neptun code

Problem 1

The outer diameter of a radial pump's impeller is 220 mm. The speed of revolution is 1450 1/min, and the blade angle (β_2) is 22°. The meridian component of the absolute velocity ($c_{2,m}$) is 2.2 m/s. At the inlet, rotation-free flow can be assumed!

Question	Answer	Unit
Find the circumferential velocity at the outlet (u_2)!		$\frac{\text{m}}{\text{s}}$
Find the relative velocity at the outlet (w_2)!		$\frac{\text{m}}{\text{s}}$
Find the projection of the absolute velocity to the circumferential velocity ($c_{2,u}$)		$\frac{\text{m}}{\text{s}}$
Calculate the specific work! (Y)		$\frac{\text{J}}{\text{kg}}$
Find the absolute velocity (c_2)		$\frac{\text{m}}{\text{s}}$

Solution

$$u_2 = D_2 \pi n = 0.22 \cdot \pi \frac{1450}{60} = 16.7 \ \frac{\text{m}}{\text{s}}$$

$$w_2 = \frac{c_{2,m}}{\sin(\beta_2)} = \frac{2.2}{\sin(22°)} = 5.873 \ \frac{\text{m}}{\text{s}}$$

$$c_{2,u} = u_2 - \frac{c_{2,m}}{\tan(\beta_2)} = 16.7 - \frac{2.2}{\tan(22°)} = 11.2576 \ \frac{\text{m}}{\text{s}}$$

$$Y = c_{2,u} u_2 = 11.2576 \cdot 16.7 = 188 \ \frac{\text{J}}{\text{kg}}$$

$$c_2 = \sqrt{u_2^2 + w_2^2} = \sqrt{16.7^2 + 5.873^2} = 17.705 \ \frac{\text{m}}{\text{s}}$$

Problem 2

An axial pumps circumferential velocity is $u = 22\ \frac{\mathrm{m}}{\mathrm{s}}$, and the axial component of the absolute velocity is $c_{ax} = 4.5\ \frac{\mathrm{m}}{\mathrm{s}}$. Rotation-free flow can be assumed at the inlet.

Question	Answer	Unit
Find the blade angle at the inlet! (β_1)		$^\circ$
Find the relative velocity at the inlet! (w_1)		$\frac{\mathrm{m}}{\mathrm{s}}$

$$\beta_1 = \tan^{-1}\left(\frac{c_{ax}}{u}\right) = \tan^{-1}\left(\frac{4.5}{22}\right) = 11.56^\circ$$

$$w_1 = \sqrt{u_2^2 + c_{ax}^2} = \sqrt{22^2 + 4.5^2} = 22.46\ \frac{\mathrm{m}}{\mathrm{s}}$$