

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL & MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

SUPPLEMENTARY EXAMINATIONS - OCTOBER 2009

Fluid Mechanics: TIE2202

Instructions

Time: 3 hours

Answer Five questions

QUESTION 1

A horizontal venturi tube, 280mm diameter at the entrance and 140mm diameter at the throat has a discharge coefficient of 0.97. a differential u-tube manometer using mercury as the manometric fluid is connected between pressure tapings at the entrance and at the throat. The venturi tube is used to measure the flow of water, which fills the leads to the U – tube and is in contact with the mercury. Calculate the flow rate when the difference in mercury levels is 50mm. The densities of mercury and water are 1000kg/m^3 and 13600kg/m^3 [20]

QUESTION 2

A flat plate is struck normally by a jet of 50mm in diameter with a velocity of 18m/s.

- a) Calculate the force on the plate when it is stationary,
- b) The force on the plate when it moves in the same direction as the jet with a velocity of 6m/s.
- (c) The work done per second and the efficiency in the case of (b) [20]

QUESTION 3

A pipe AB carries water and tapers uniformly from a diameter of 0.1m at A to 0.2m at B over a length of 2m. Pressure gauges are installed at A, B and also at C the midpoint of AB. if the centerline slopes upwards from A to B at an angle of 30° and the pressures recorded at A and B are 2.0 and 2.3 bars respectively, determine the flow through a pipe and the pressure recorded at C neglecting all losses [20]

QUESTION 4

A closed tank of fixed volume is used for continuous mixing of two liquids which enter at A and B and are discharged completely mixed at C. The diameter of inlet pipe at A is 150mm and the liquid flows in at the rate of $56\text{dm}^3/\text{s}$ and has a specific gravity of 0.93. At B the inlet pipe is 100mm diameter the flow rate is $30\text{dm}^3/\text{s}$ and the liquid has specific gravity of 0.87. If the diameter of the outlet pipe at C is 175mm, what would be the mass flow rate, velocity and specific gravity of the mixture discharge? [20]

QUESTION 5

- (a) Define the following terms, in relation to boundary layer theory [4]
1). Boundary layer thickness [4]
2). Displacement thickness [4]
- (b) Show that the displacement thickness $= \int_0^{\infty} (1-u/U) dy$ [8]
- (c) Explain the differences between a pump and a turbine [4]

QUESTION 6

Summarise the objectives of the chapters that have been covered in fluid mechanics [20]

QUESTION 7

Air at standard conditions flow over a flat plate. The free stream speed is 15m/s. find δ and τ at $x=1\text{m}$ from the leading edge for complete;
a) Laminar flow assumes parabolic velocity profile
b) Turbulent flow assumes a 1/7-power profile. [20]

End of Exam