

國立臺灣科技大學102學年度碩士班招生試題

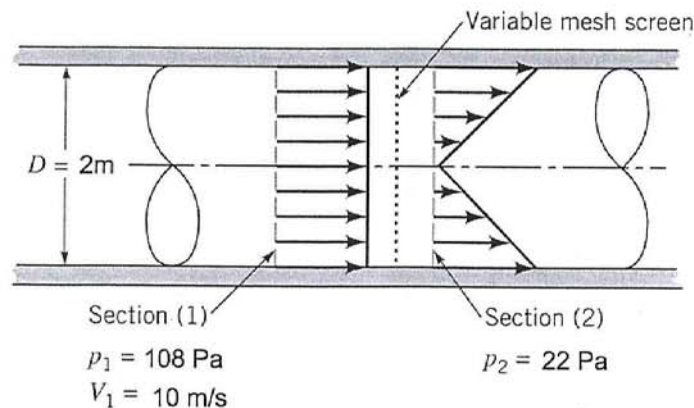
系所組別：機械工程系碩士班丙組

科目：熱力與流力

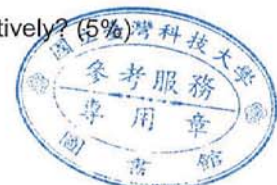
(總分為100分)

本試卷共有十題

1. Bernoulli's equation is a very important equation to describe a fluid flow. It includes three terms in the equation. Please write down those three terms and explain them. (5%)
2. Moody diagram is a tool to determine the friction factor f in a pipe flow. Please tell us how to use Moody diagram to find f step by step. (5%)
3. There are three kinds of lines to describe a flow pattern in flow kinematics. Could you tell us the definitions of those three lines? (5%)
4. Dimensional analysis is a useful tool to find dimensional parameters in a fluid flow problem. The Buckingham pi theorem play a vital role in dimensional analysis. Please show us the way to determine pi terms in a flow problem step by step. (5%)
5. A variable mesh screen produces a linear and axisymmetric velocity profile as indicated in the figure shown below in the air flow through a 2-m-diameter circular cross-sectional duct. The static pressures upstream and downstream of the screen are 108 Pa and 22 Pa and are uniformly distributed over the flow cross-sectional-area. Neglecting the friction force exerted by the duct wall on the flowing air, calculating the screen drag force. (Density of air: 1.23 kg/m^3) (15 %)



6. Drag reduction has been receiving more and more attention in vehicle design due to the fuel shortage. There are a number of ways to reach this purpose. Also, one can perform drag reduction according to the shape of a solid object in fluid flow. Presumably, there are two kinds of shapes, i.e. a streamlined object and a bluff object.
 - (a) What is the main difference between them in terms of drag? One of the well known examples is the drag reduction of a golf ball. There are many cavities on the golf ball surface. The design is highly associated with drag reduction. (5%)
 - (b) Could you explain why this design can reduce drag for a golf ball effectively? (5%)
 - (c) Could you illustrate three advanced methods for drag reduction? (5%)



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7. Is an isothermal process the same as an adiabatic process? Please explain. (5%)
8. Is an isentropic process necessary a reversible adiabatic process? Please explain. (5%)
9. A spherical egg with 6 cm in diameter was initially at a temperature of 10°C and then dropped into boiling water at 100°C . Assume the density of the egg is 1000 kg/m^3 , and C_p is $5\text{ kJ/kg}\cdot\text{K}$. Please calculate :
- (a) the amount of heat is transferred to the egg by the time the egg temperature rises to 70°C . (10%)
- (b) the entropy generation associated with this heat transfer. (10%)
10. A 40 L hot-water tank whose heaters are rated at 1.5 kW is initially full with hot water at 70°C . Jack takes a shower by mixing a constant flow of hot water from the tank with cold water at 20°C at a rate of 0.06 kg/s . After a shower period of 10 min, the water temperature in the tank is measured to drop to 60°C . The heater remained on during the shower and hot water leave from the tank is replaced by cold water at the same flow rate. Assume a steady flow process for the mixing chamber, heat transfer, kinetic and potential energy changes are negligible, and water properties : $C_p = 4.18\text{ kJ/kg}\cdot\text{K}$, $\rho = 1000\text{ kg/m}^3$. Determine

- (a) the mass flow rate of hot water leave from the tank during the shower. (10%)
- (b) the average temperature of mixed water used for the shower. (10%)

