國立中央大學98學年度碩士班考試入學試題卷

所別：機械工程學系碩士班 丙組(熱流)　科目：流體力學及熱傳學　

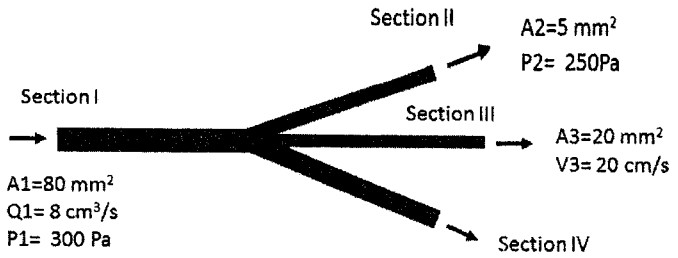
＊請在試卷答案卷（卡）內作答

● 流體力學 (50 分)

1. Please brief describe (less than 50 words) (a) Newtonian fluids and (b) Lagrangian method. (4 分)

2. Please derive capillary pressure, P_c, in a ***w x h rectangular*** tube (4 分)

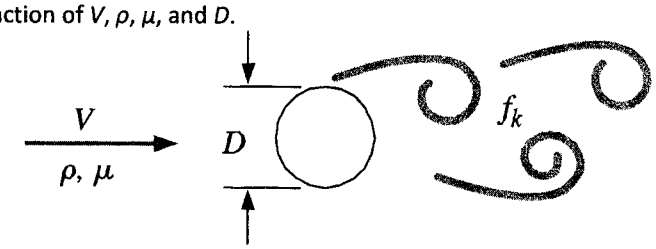
3. In a test, water was pumped through a horizontal artificial blood vessel (as shown in the figure) with a rate of 8 cm^3/s. Please determine (a) the water speed in section II, (b) the pressure in section III and (c) flowrate in section IV. Assume the artificial blood vessel is rigid and viscous effects can be neglect. Specific weight of water is 9.8 kN/m^3 (9 分)



4. In an incompressible flow, the radial and circumferential component of the velocity are: $v_r = \frac{A}{r} - B\cos\theta$ and $v_\theta = B\sin\theta$ where A and B are positive real constants. Please answer the following questions:
   (a) Does this flow satisfy continuity? (3 分)
   (b) Find the corresponding streamline function (5 分)

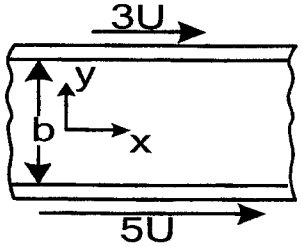
Dimensional Analysis (10 分)

5. As shown in the figure below, a uniform stream with fluid density ρ and fluid viscosity μ having a free-stream velocity V flows over a circular cylinder of a diameter D forming a periodic Kármán vortex street. Please use the method of repeating variables to generate a dimensionless relationship for the Kármán vortex shedding frequency f_k as a function of V, ρ, μ, and D.



Viscous Flow (15 分)

6. As shown in the figure below, there is an incompressible, viscous fluid inside the two horizontal plates, where both upper and lower plates are moving toward the x-direction at constant but different velocities, 3U and 5U, respectively. Assuming that the flow is laminar, the pressure gradient in the x direction is zero, and the only body force is due to the fluid weight. Please find the velocity distribution $u(y)$ between these two plates.



參考用

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所別：機械工程學系碩士班 丙組(熱流)　科目：流體力學及熱傳學　共 2 頁 第 2 頁
＊請在試卷答案卷（卡）內作答

● 熱傳學 (50 分)

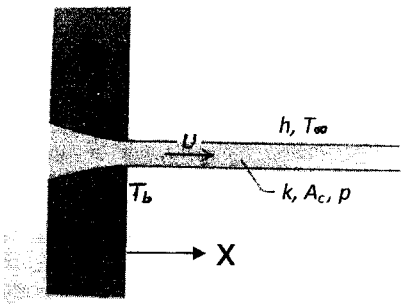
1. Please plot the axial variation of tube wall temperature (T_s) and fluid mean temperature (T_m) for flow in a circular tube at (a) constant wall temperature and (b) constant heat flux conditions. (10 分)

2. Please make a brief description of Reynolds analogy? (5 分) (no more than 50 words)

3. What are the values of a, b, c, d, and e of the following relation for liquid flow over a flat plate? (10 分) (δ: boundary layer thickness, c_{fx}: local friction coefficient, h_x: local heat transfer coefficient, Nu_x: local Nusselt number)

Laminar	Turbulent
$\delta \sim x^{1/2}$	$\delta \sim x^{a}$
$c_{fx} \sim x^{-1/2}$	$c_{fx} \sim x^{b}$
$h_x \sim x^{c}$	$h_x \sim x^{d}$
$Nu_x \sim x^{e}$	$Nu_x \sim x^{4/5}$

4. A hot plastic fiber is extruded through an opening, where the cross-sectional area is A_c and temperature is T_b. The fiber material travels longitudinally with the velocity U, and is cooled gradually by the ambient fluid at temperature of T_∞ .
(a) From energy conservation, derive the governing equation for the temperature. (10 分)
(b) The fiber temperature will be equal to the ambient temperature as $x \to \infty$, find the temperature distribution T(x). (5 分)



5. The intensity of the solar irradiation that strikes the earth is 1360 W/m^2. The earth's surface absorptivity for solar radiation is 0.7. At the same time, the earth loses heat by radiation to the universe of temperature 4 K. With the protection of atmosphere, the earth's emissivity is 0.95. The Boltzman-Stefan constant is 5.67 x 10^{-8} W/(m^{2}K^4). Calculate the earth's average temperature. (10 分)

參考用

注音：背面有試題