

國立高雄大學 103 學年度研究所碩士班招生考試試題

科目：輸送現象與單元操作
考試時間：100 分鐘

系所：化學工程及材料工程學系
(甲組)
本科原始成績：100 分

是否使用計算機：是

- (40 pts) Please answer the following questions:
 - Please derive the **boundary thickness** and **drag force** of a fluid flows on a **flat plate**. (10 pts)
 - Please compare the **Reynolds analogy, Prandtl and von Karman analogies, and Chilton-Colburn analogy** and their limit and applications. (9 pts)
 - Please derive the **view factors** from the exchange of energy between black bodies and show the **relations** between each other. (8 pts)
 - What are **equilibrium-stage operations, equilibrium and operating lines** and how does **ideal stage** produce? (6 pts)
 - Please explain what **Fenske equation, invariant zone and azotropes** in distillation are, and then compare the considerations of **minimum or optimum reflux ratios**. (7 pts)
- (15 pts) (a) Please find the fluid **velocity profile, flow rate** and **force** acting in a tube by **shell balance** when Ostwald-de Waele model is employed $\tau_{yx} = -\mu(dv_x/dy)^{n-1}dv_x/dy$. (b) Calculate the viscosity of the fluid in the 0.1 in diameter and 2 ft long tube with 75 psi pressure drop and flow rate 0.006 ft³/min.
- (10 pts) There is a famous vender in Tainan Flowers Night Market focused on the oyster roast. The size of oyster is about larger than a 50 NTD coin (ca. 3 cm in diameter) with thickness of 2 cm of meat and 0.7 cm shell. The thermal conductivity and density of oyster shell are in average around 1.2 W/m °C and 1825 kg/m³, respectively. The thermal conductivity and specific heat of oyster meats varied from 0.577 to 0.677 W/m K and increased from 3.79 to 4.05 kJ/kg °C as the temperature increased from 0 to 50 °C. The specific heat of water is 4.186 kJ/kg °C. The temperature of Longan charcoal for **cooking oysters** may maintain at 130°C. When you are *ready to serve the oysters*? Please list your assumptions.
- (15 pts) The air pollution in Taiwan is more serious than before, a **wetted-wall column** is designed for the reduction of this problem. (a) Please find the **concentration profile** from the **Navier-Stoke equation** in a falling film and also **list your assumptions**. (b) How do you design the column to reduce half amount of the initial concentration is 400 µg/m³, the diffusivity can be assumed 2×10^{-13} m²/s.
- (10 pts) Please find the **velocity profile** of a fluid between **two vertical plates** with **different temperatures**.

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6. (10 pts) One valuable biomarker can be extracted from a cancer cell culture medium by an organic solvent containing surface modified magnetic nanoparticles. The **distribution coefficient** is 25. (a) Please find the volume ratio to achieve 75 % recovery in a **single ideal stage**. How many ideal stages are required (b) to give 99% of recovery or (c) if in a **counter flow cascade** with the same recovery in (b)? (d) Please explain how to estimate **the height of this extraction tower** and how to measure the **required mass transfer properties**.