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

1. (40 pts) Please answer the following questions:

(a) What are approximate solutions of a **potential flow**, a **creeping flow** and **flow in boundary layer**? (8 pts)

(b) Please find the dimensionless numbers in **Heat Transfer** by **Buckingham method** under forced and natural convection. (8 pts)

(c) What are **film theory**, **boundary-layer theory** or **penetration theory**, and **two resistance theory**? (6 pts)

(d) Describe the phenomenon "**flooding**" when a (a) packed column and (b) plate column is operated. (6 pts)

(e) Please indicate the driving forces involved in the following unit operation process (a) distillation (b) liquid extraction (c) gas absorption (d) drying (e) screening (f) filtration. (6 pts)

(f) Please explain three common types of **adsorption isotherms** and their applications. (6 pts)

2. (15 pts) Please find the velocity profile, flow rate and force acting on an **annulus** (with inner radius R_i and outer radius R_o) by **shell balance** when Bingham fluid (e.g. $\tau_{rz} = -\mu_0(dv_z/dr) \pm \tau_0$) is employed and also list the assumptions.

3. (15 pts) When hot water (c.a. 40^oC) flows at a rate of 10 cm/s along a flat plate (3 cm width) made by species A at 0^oC, please discuss the momentum, heat and mass transport phenomena occurred and possible equations can be employed. The solubilities of species A in water is 0.01 molar at this temperature range. The thermal conductivity is 0.6 W/m·K and diffusion coefficient of species A in water is 600 $\mu m^2/s$. Please estimate the heat, mass fluxes and force acting on the surface at distance 8 cm after contact and list your assumptions.

4. (10 pts) The radiation cooling, which means a body directly exposed to a clear night sky will be cooled below ambient temperature by radiation to outer space, is always happened in Chiayi in winter. Please state what **assumptions** may be made and then **estimate the maximum air temperature** for which freezing is possible. The total emissitivity of water is 0.95 at 0^oC, and the heat transfer coefficient [Btu/hr·ft^2·^oR] is $0.2 \cdot (T_{air}-T_{water})^{1/4}$. The conversion factor of Stefan–Boltzmann constant is 33.08-fold in SI units higher than that in US customary.

5. (10 pts) Please derive the expression of **the effectiveness** ($\mathscr{E}$) of a **counterflow heat exchanger** in terms of NTU and C_{min} and C_{max}.

國立高雄大學一百學年度研究所碩士班招生考試試題

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6. (10 pts) For distillation, please answer the following questions:

(a) The usage of **volatility** in a vapor-liquid system.

(b) The **material balance** of **flash distillation.**

(c) The physical meaning of **q line.**

(d) How to use **McCabe-Thiele method** to find the **theoretical trays?**

(e) How to find the **minimum reflux ratio?**