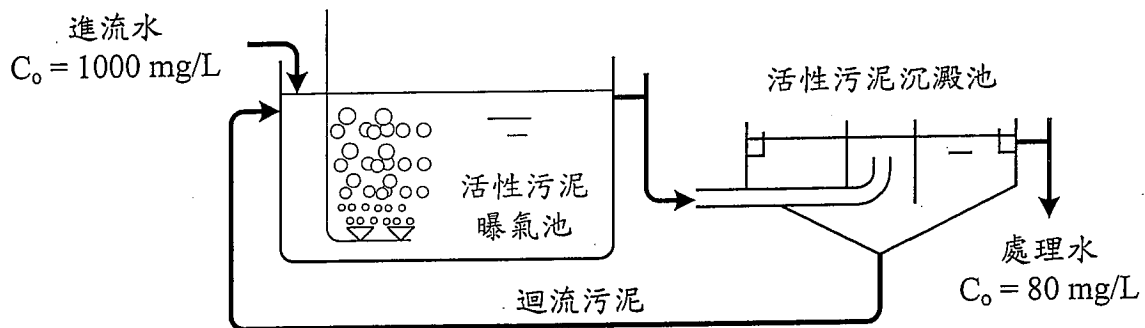國立中山大學99學年度碩士班招生考試試題

科目：工程數學【環工所碩士班】

1. 一廢水中之溶解性有機物濃度以 C (mg/L)表示，該有機物之生物分解速率式可以

$$-dC/dt=kC$$

表示，其中 t＝時間(hour)、k＝分解速率常數(1/hour)。在圖示連續式流動完全攪拌活性污泥曝氣池中，設 k＝0.10 1/hour，欲將廢水中有機物濃度 C_0＝1,000 mg/L 分解至 C＝80 mg/L，試計算廢水在活性污泥曝氣池所需水力停留時間。(15%)

2. 一廢氣中甲苯濃度以 C (mg/Nm^3)表示，其中 Nm^3 表示在標準狀態(0°C、1 atm)下，氣體之立方公尺。在 350°C，廢氣中甲苯經一管狀式觸媒燃燒器 (catalyst incinerator)之分解速率式可以

$$-dC/dt=kC$$

表示，其中 t＝時間(hour)、k＝分解速率常數(1/s)。如在 350°C，廢氣在一管狀觸媒燃燒器內之停留時間(反應時間)為 0.5 秒時，甲苯之分解率為 95%。試估算在同一溫度，廢氣反應時間為 1.0 秒時，甲苯之分解率。(15%)

3. (1)求 $(d^2y/dx^2)+4(dy/dx)+3=0$ 之一般解。(10%)

   (2)求 $(d^2y/dx^2)+k^2x=0$ 之一般解。(10%)

4. Find the characteristic polynomial and the eigenvalues for the following matrix.

$$A = \begin{bmatrix} 2 & -1 \\ 1 & 2 \end{bmatrix} \quad (20\%)$$

5. 若(x, y)之 4 組實驗數據為：$(1, 1), (4, 2), (8, 4), (11, 5)$，求其最小平方線性迴歸式(least-square linear fit)。(15%)

6. Let z be a complex number. Find the integration of

$$\frac{z^2 + 1}{z^2 - 1}$$

in the counterclockwise sense around a circle of radius 1 with center at $z = 1$.

[Hint: Use Cauchy's integral formula.] (15%).

國立中山大學99學年度碩士班招生考試試題

科目：環境工程概論【環工所碩士班】

1. 試評述"八八水災"（亦稱"莫拉克風災"）和全球環境變遷之關聯性。又其對本土環境及生態系統之可能影響為何？ (15%)

2. 何謂二次氣膠（secondary aerosols）？請說明其生成原因及粒徑範圍。又其對空氣品質之影響為何？ (20%)

3. 試繪圖說明典型污水處理廠的處理流程，並比較快混池和慢混池操作功能之異同性。 (15%)

4. Try to give each an example for adsorption in liquid-solid phase and in gas-solid phase using two adsorbents, respectively. Do these two adsorbents have something in common? (20%)

5. In November 2009, it was reported that thousands of ducks in Kaohsiung County were contaminated with dioxins originated from steel slag dumped by steel mills. As an environmental engineer, try to explain the true reason behind this pollution event. (10%)

6. In general, materials in municipal solid waste contain plastics, paper and paperboard, rubber and leather, metals, wood, glass, textiles, food scraps, yard trimmings, and miscellaneous inorganic wastes. If you are in charge of the operation of a municipal incinerator, try to describe what efforts could be made to "conserve energy and reduce the carbon footprint"（節能減碳）. (20%)

國立中山大學99學年度碩士班招生考試試題

科目：流體力學【環工所碩士班甲組】

1. As illustrated in figure 1, a gravity separator is used to separate immiscible liquids A and B. Please express h_3 in terms of h_1, h_2, ρ_A (density of liquid A) and ρ_B (density of liquid B). With $h_1 = 0.40$ m, $h_2 = 0.60$ m, $\rho_A = 1600$ kg/m^3 and $\rho_B = 1000$ kg/m^3, find the value of h_3. **(25%)**
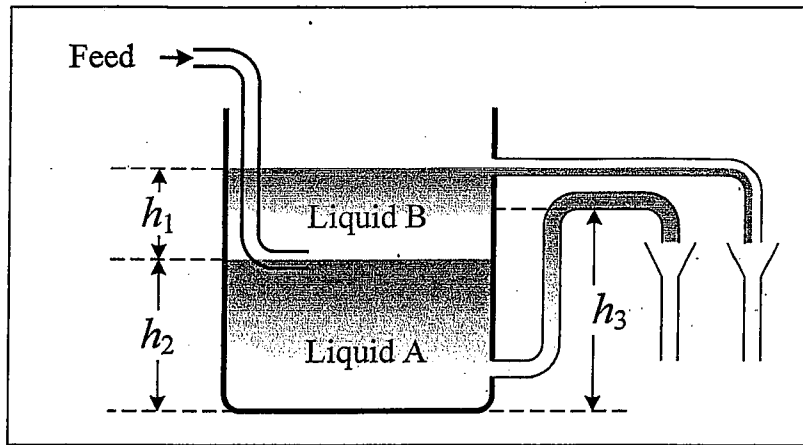

Fig. 1: Continuous atmospheric gravity separator for immiscible liquids

2. For flow past immersed objectives, the drag coefficient C_D is defined as the ratio of the total drag force per unit area to $\rho U^2/2$.

$$C_D = (F_D/A_p)/(\rho U^2/2)$$

where F_D is the total drag force in N, A_p in m^2 is the area obtained by projecting the body on a plane perpendicular to the line of flow, C_D is dimensionless, U is the free-stream velocity in m/s, and ρ is the fluid density in kg/m^3. Find C_D for a sphere of diameter $D = 0.0030$ m in water with $U = 0.00030$ m/s and $\rho = 1000$ kg/m^3 if F_D can be estimated by

$$F_D = 3\pi\mu DU$$

where μ is the viscosity of water (0.001 kg/m.s). **(25%)**

3. Water flows in a 6-m-wide rectangular channel at a depth of 3 m. The water flow rate (Q) is 30 m^3/s. Please answer the following questions: **(25%)**

   (1) What is the Froude number?

   (2) Please classify the flow.

   (3) What is the specific energy?

   (4) Please determine the alternate depth.

   (5) Please compute the critical depth for this discharge.

4. Water flows at a rate of 0.05 m³/s in a 20-cm iron pipe (temperature = 20℃, kinematic viscosity $\nu = 1 \times 10^{-6}$ m²/s, resistance coefficient $f = 0.019$, pipe diameter = 20 cm, Q = 0.05 m³/s) **(25%)**

   (1) What is the flow velocity?

   (2) What is the Reynolds number?

   (3) What is the head loss per kilometer of pipe length?

國立中山大學99學年度碩士班招生考試試題

科目：環境化學【環工所碩士班乙組】

1. What is the critical coagulation concentration (CCC)? Try to discuss the relationships between CCC and (1) the type of ions; and (2) the valence of ions, respectively. (20%)

2. Try to point out four types of oxidants that are widely used in groundwater remediation and discuss respectively why they are chosen. (20%)

3. In general, electrolysis of water in the neighborhood of electrodes would take place in every electrochemical reaction system. When a Cr(VI) species is migrated to the anode compartment in an electrochemical reactor, try to use chemical reaction equation(s) to describe what would happen. (10%)

4. List the equilibrium equation in the reaction of chlorine in water disinfection. (10%)

5. The processes of a conventional water treatment plant for drinking water? (10%)

6. The processes of a municipal solid waste incinerator? (10%)

7. Describe two processes to treat volatile organic compounds (VOCs) dissolved in wastewater, for example the wastewater are outlet from chemicals or petroleum plants. (10%)

8. What are three important gases that contribute to the greenhouse effect on global warming? (6%) and write the damage results caused by climate change of global warming? (4%)