1. 解釋名詞
   (1) 痛痛病　　(3%)
   (2) Suspended solids, Total nitrogen, and Biochemical oxygen demand　(3%)
   (3) 零廢棄 (Zero Waste)　(5%)
   (4) 土壤污染監測基準　(5%)
   (5) 污染控制場址　(5%)

2. 試依據現行「資源回收再利用法」說明物質之使用原則。　(10%)

3. 試針對高溫熔融法處理垃圾焚化飛灰，利用 SWOT（優勢、劣勢、機會及威脅）分析國內之技術現況。　(10%)

4. 何謂噪音（Noise）？ 請簡述噪音防治之策略。　(6%)

5. 何謂室內空氣污染（Indoor Air Pollution）？ 試列舉五種不同類型之室內空氣污染源。　(6%)

6. 右列三種懸浮微粒（$PM_{2.5}$, PM_{10}, TSP）中，何者列入現行「空氣品質標準」？何者對人體健康較為有害？又何者對能見度之影響較為顯著？　(10%)

7. 在一大氣壓及室溫條件下，200 ppm 之二氧化硫（SO_2）相當於多少 $\mu g/m^3$？(5%)　25°C

8. 試針對（1）氣狀污染物及（2）粒狀污染物，分別列舉三種空氣污染控制設備，並簡述其原理。　(8%)

9. 一工廠廢水條件為水量 200CMD, BOD 為 500mg/L; 假設每人每天 BOD 負荷量為 20g，計算工廠排水之 BOD 人口當量為何?　(3%)

10. Determine the amount (in kg/day) of primary sludge solids generated in a domestic treatment plant for a people number of 20,000, with an efficiency of (TSS) removal of 60 %.　Assume per capita flow = 225L/day and TSS = 300mg/L.　(3%)

11. 簡述初級, 二級與三級廢水處理之目標污染物?　(3%)

12. 污泥脫水處理之方法?　(3%)

13. 鹼度, 通常指哪些成分?　(3%)

14. 舉出三種屬於影響自來水適飲性之物質。　(3%)

15. 試解釋 錯接, 直接供水與間接供水。　(3%)

16. 配水系統之配水池功用? 常用之二種管網分析方法為何?　(3%)

1. Please find a complete solution of the linear differential system: (15 points)

$$\frac{dx}{dt} + 2x + \frac{dy}{dt} + 6y = 2e^t$$

$$2\frac{dx}{dt} + 3x + 3\frac{dy}{dt} + 8y = -1$$

2. Please use Fourier series to express the following functions:

   (1) $f(x) = |x|$ when $-\pi < x < \pi$, $f(x + 2\pi) = f(x)$ (10 points)

   (2) $f(x) = \begin{cases} 1 & when\ -2 < x < 0 \\ -1 & when\ 0 < x < 2 \end{cases}$, $f(x + 4) = f(x)$ (10 points)

3. Solve the following differential equations: (20%)

   (1) $y'' - 2y' + y = \dfrac{2e^x}{x}$

   (2) $y'' - 3y' + 2y = 4x$, $y(0) = 1$, $y'(0) = -1$

4. Transform the quadratic form to principal axes. (15%)

   $Q = 17x_1^{\ 2} - 30x_1x_2 + 17x_2^{\ 2}$

5.

   (1) 已知 $A = \begin{pmatrix} \sin t & \cos t \\ -\cos t & \sin t \end{pmatrix}$ ，試計算 $(dA/dt)^2$ (7%)

   (2) 試求 $B = \begin{pmatrix} 1 & 2 \\ 4 & 8 \end{pmatrix}$ 之 eigenvalues   (8%)

   (3) 試求 $(d^2y/dx^2) + 4\,(dy/dx) + 4 = 0$ 之一般解   (7%)

   (4) 試求 $(d^2y/dx^2) + k^2x = 0$ 之一般解   (8%)
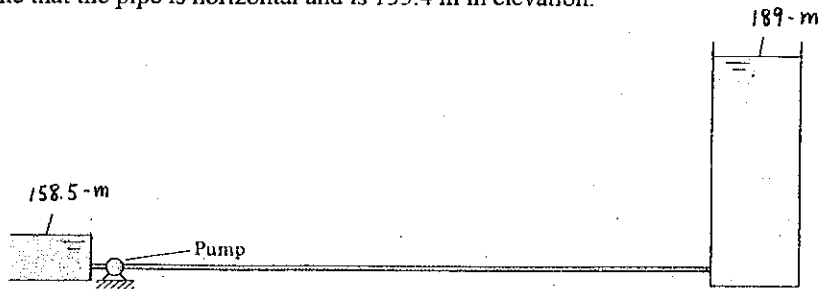
1. A pump draws water from a reservoir, water surface elevation = 158.5 m, and forces the water through a 1,524-m-long, 30.5-cm-diameter pipe. This pipe then discharges the water into a reservoir, with water-surface elevation = 189 m. If the flow rate is 0.222 m^3/s and if the head loss in the pipe is given by $0.01(L/D)(V^2/2g)$, please
   (1) determine the head supplied by the pump h_p,　　　　(8 points)
   (2) determine the power supplied to the flow, and　　　　(6 points)
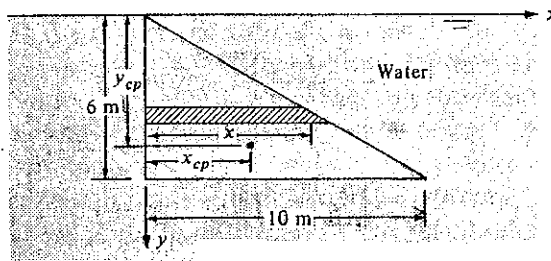   (3) draw the hydraulic and energy grade lines for the system.　　(6 points)
   Assume that the pipe is horizontal and is 155.4 m in elevation.

2. Water flows in a 6-m-wide rectangular channel at a depth of 3 m and has a discharge of 30 m^3/s. Please
   (1) compute the Froude number,　　　　(4 points)
   (2) classify the flow,　　　　(3 points)
   (3) determine the alternate depth, and　　　　(4 points)
   (4) compute critical depth for this discharge.　　　　(4 points)

3. (1) Determine the magnitude of the hydrostatic force acting on one side of this submerged vertical plate, and　　　　(5 points)
   (2) determine the location of the center of pressure.　　　　(10 points)

4. Consider a steady, incompressible, two-dimensional viscous flow between two stationary parallel plates with distance h apart. If the velocity field (u, v) in (x, y) coordinates is given by

$$u = A y^2 + B y + C, \text{ and } v = 0 \quad (A, B, \text{ and } C \text{ are constants})$$

Find the average velocity U and the volume flow rate Q per unit depth across the plate. Note that x and y are parallel and normal to the plate, respectively. (15 points)

5. The speed of sound, a, of a gas varies with pressure P and density ρ. Find the proper functional form of $a = f(P, \rho)$ by dimensional reasoning. (15 points)

6. (a) Describe briefly the essence of " Boundary Layer Theory". (8 points)

(b) Describe the "Kutta-Joukowski Life Theorem". (7 points)

(c) Which one of the following dimensionless numbers is often used to measure the compressibility of a flow field? ① Reynolds number, ② Mach number, ③ Froude number, ④ Weber number. (5 points)

一、試利用一化學反應方程式描述含碳酸鉛污泥與家戶垃圾共同掩埋之可能後果並加以討論之。　（10%）

二、試述廢棄物不相容可能產生之各種現象與/或化學反應。　（15%）

三、試說明污染場址之電動力法整治（Electrokinetic Remediation）其主要反應機制。　（10%）

四、假設某工程師擬利用零價鐵現地整治受到硝酸鹽污染之地下水，

(1) 試述其主要反應機制。　（5%）

(2) 試針對硝酸鹽可能之降解產物分別寫出其化學反應方程式。　（10%）

五、計算 pH=8 時之溶解度？（已知：$Fe(OH)_2$ 之 K_{SP}=7.9 ×10^{-15}，氫氧化物控制）　（5%）

六、已知反應 $Fe^{+3} + e^- \Leftrightarrow Fe^{+2}$，電子活性 $PE = 13.2 + \log\left(\dfrac{[Fe^{+3}]}{[Fe^{+2}]}\right)$，若某水樣 PE =13.9，試求：

(1) $\dfrac{[Fe^{+3}]}{[Fe^{+2}]}$ 比值為何？　（5%）

(2) 此水樣（$Fe^{+3} + e^- \Leftrightarrow Fe^{+2}$）好氧或厭氧狀況為何？　（5%）

七、簡述哪些方法可用於淨水場自來水之消毒？　（5%）

八、已知 HOCl 之 Ka = 2.7 ×10^{-8}，求某水樣於 pH = 7.0 之 HOCl 酸所佔比例為 pH =8 之大約倍數？　（5%）

九、已知 $CaCO_{3(s)} \Leftrightarrow Ca^{+2}_{(aq)} + CO_3^{-2}_{(aq)}$　K_{sp}=10^{-7}..............................(1)

$CO_3^{-2}_{(aq)} + H_2O \Leftrightarrow HCO_3^-_{(aq)} + OH^-_{(aq)}$　K_b=10^{-2}.....................(2)

試求：

(1) 若(1)式為主要反應，則$[Ca^{+2}] = ?M$　（5%）

(2) 若 $CaCO_{3(s)} + H_2O \Leftrightarrow Ca^{+2}_{(aq)} + HCO_3^-_{(aq)} + OH^-_{(aq)}$，平衡常數 K=? $[Ca^{+2}] = ?$　（5%）

(3) 比較說明上述二種情形　（5%）

十、已知水中生化反應為：$CH_2O + O_2 \rightarrow CO_2 + H_2O$，試求：

(1) 10 mg 的糖（分子式為 CH_2O）溶解於 1 公升水中，求 $BOD = ?mg/L$　（5%）

(2) 你認為此 BOD 值(mg/L)大於或小於 20℃時飽和溶氧量(mg/L)　（5%）