1. After 921 Chi-Chi Earthquake, which caused disasters in the central area of Taiwan, the seismic zone has been revised from 3 zones to 2 zones. The influence will cover both the new buildings that are to be constructed and existing buildings that will not match the safety standards of the new code. What are your opinions about these changes in terms of the structural safety, economy and functioning? For the harbor structures, what will be the major impact? 25%

2. For the Finite Element Method generally there are 2 approaches to partition the equation of motion. Would you please describe these 2 methods including a sample derivation? 25%

Fluid Mechanics   (50%)

1. The homogeneous timber AB has a cross section 0.15 m by 0.35 m. Determine the specific weight of the timber and the tension in the rope.   (15%)
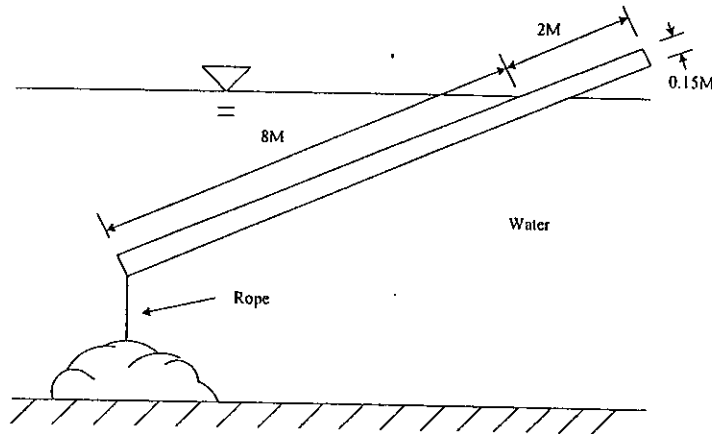
2. The velocity potential for a certain inviscid flow field is   (15%)
$$\phi = -(3x^2y - y)$$
Determine (1) the velocity in (1, 2), and (4, 4);
(2) the pressure difference, if the fluid is water and the elevation changes are negligible. (Unit in metric system)

3. What is the Reynolds Transport Theorem? Why is this also called the 'Control Volume Approach'?   How to apply it in   (20%)
(1) conservation of mass;
(2) conservation of momentum;
(3) conservation of energy.

94 工程數學【海洋環境及工程學系博士班】（甲組）
時間：100 分鐘

1、【Ordinary Differential Equations】20%

(a) Find the general solution of $(1+2e^{x/y})\,dx+2e^{x/y}(1-x/y)\,dy=0$

(b) Find a second solution of the following 2nd order linear differential equation using the given y_1:

$$(1-x^2)y''-2xy'+2y=0, \quad y_1=x$$

2、【Ordinary Differential Equations】20%

(a). Differential equations arise in many engineering applications. Please NAME the possible engineering application for each of the following differential equations:

(1). $my''+ky=0$

(2). $EIy''=f(x)$

(b). Find a general solution for the following second-order differential equation:

$$y''+\omega_o^2 y=\cos\omega t,\; y(0)=y_o, y'(0)=v_o,\; \text{and}\;\; \omega^2\neq\omega_o^2$$

3、【Fourier analysis】20%

Find the Fourier series for a periodic square wave given by the function

$$f(x)=\begin{cases}0, if -2<x<-1\\ k, if -1<x<1; p=2L=4, L=2\\ 0, if\, 1<x<2\end{cases}$$

4、【Method of least squares】20%

A straight line $y=a+bx$ is to be fitted through a set of n points (x_1, y_1), …, (x_n, y_n).
Find the mathematical expression for the constant coefficients a and b.

5、【Quadratic equations】10%

Consider the quadratic equation $ax^2+bx+c=0,\; a\neq 0$.

(a) Find the quadratic formula for x.

(b) Use the *discriminant* (辨別式) of the quadratic equation, state when the equation will have two real and distinct roots, two real and equal roots, or two distinct imaginary numbers.

6、【Integration by substitution】10%

Find the indefinite integral of $\int(x^2\sqrt{x^3+4})dx$.

1. Please explain "the First law of thermodynamics" and use an example to illustrate it. (5%)

2. Please explain "the Second law of thermodynamics" and use an example to illustrate it. (5%)

3. Determine pE for wastewater that contains 5.0×10^{-7} M Cd^{2+}. Does this wastewater favor oxidation or reduction? (10%)
   Given: $Cd^{2+} + 2e^- = Cd$ $\qquad$ $pE^0 = -6.81$

4. Please explain how to prepare a buffer solution with a specific pH value. (10%)

5. Does the alkalinity of a natural solution (isolated from its surrounding) increase, decrease or stay constant upon addition of small quantities of the following (with explanation): (10%)
   (i) $CaCO_3$ (ii) HCl (iii) Na_2SO_4 (iv) CO_2 (v) $NaHCO_3$

6. Explain what is the 'Environmental Hormone' or the 'Endocrine disrupting chemical' and what is its effect on ecosystem? (5%)

7. What are the major components of the 'Dirty dozen' or the 'Key Persistent Organic Pollutants' and why are these compounds of environmental concern? (5%)

8. 請寫出水中含固相 $CaCO_3$ 平衡時水中各離子之電荷平衡式。 (5%)

9. 進行加氯消毒處理時，影響消毒效果的因素有哪些？ (5%)

10. 請說明並簡述影響金屬離子與土壤吸附之因子。如果是如多氯聯苯等之有機物與土壤吸附之因子又是如何？ (10%)

11. 試述腐植質在環境中之重要性。(5%)

12. 請說明 AA (原子吸收光譜儀) 與 GCMS (氣相層析質譜儀) 與 HPLC (高效液相層析儀) 之分析原理與應用對象 (10%)

13. 某有機污染物在水環境中裂解(degradation)動力學屬一級反應(first order reaction)，在一次意外洩漏到一水環境中 50 天後，發現該污染物濃度剩下原來 60%，請列式子以估計需要多少天該污染物濃度會剩下 20%。(5%)

14. 何謂吸附等溫線？如何設計實驗以得到吸附等溫線？ (10%)

一、試述農業污染對環境可能造成的影響，並提出可能的改善方案。(15%)

二、試述生態工法的內涵與規劃設計的原則並分析其與傳統工法之優缺點，舉二例說明。(35%)

三、試述台灣地區發生過的海洋污染事件及其應有的對策。(25%)

四、何謂生物多樣性？為何地球需要維持生物的多樣性？(25%)

1. (50%) According to annual precipitation (rainfall) data kept for the past 75 years, the average precipitation in city A is 41.76 inches per year and the observed sample standard deviation is 5.74 inches per year. Answer the following questions. (You don't have to find the real answer, but write down the required equations and the computational processes)

   (1)   Please state how to find the mean of the distribution of yearly precipitation in city A with 99% confidence interval. (20%)

   (2)   Please state how to determine the required sample size in order to determine the mean of the distribution of yearly precipitation in City A to within 1.2 inches at the 99% confidence level. (20%)

   (3)   During the same 75-year period, the average precipitation in city B was 34.37 inches per year and observed sample standard deviation was 4.98 inches per year. Please state how to construct a 95% confidence interval for the difference between the mean yearly precipitation in city A and B. (10%)

2. (50%) The accurate prediction of the timing of earthquakes is an important task in the interests of public safety. In this question, you are asked to explore a regression model approach to this problem. (You don't have to find the real answer, but write down the required equations and the computational processes)

The first column of the following table shows the month and year of all earthquakes measuring 3.5 or larger on the Richter scale on a small island in the Pacific Ocean between December, 1990 and November, 1997. The dates in first column of the table are converted to a "month number" in the second column of the table starting with December, 1990 being month number 0. Thus, for example, October, 1991 is month number 10, since this month is 10 months after December, 1990.

We might postulate that the time to the next earthquake might be a function of the number of months after the most recent earthquake, as well as the number of months after the second-most-recent earthquake. These numbers are shown in the third and fourth columns of the table.

   (1)   Please state how to construction a regression model to predict the time when earthquakes occur based on the data in the table. (25%)

   (2)   Please state how to evaluate the validity of the regression model. (25%)

Month of Earthquake	Month Number	Number of months after the most recent earthquake	Number of months after the second-most-recent earthquake
December, 1990	0	---	---
October, 1991	10	10	---
February, 1992	14	4	14
November, 1992	23	9	13
April, 1993	28	5	14
⋮	⋮	⋮	⋮
March, 1997	75	2	11
November, 1997	83	8	10

1. (50%) The solid waste landfill that serves a city is nearing its full capacity. The administration is starting to explore alternatives to avoid disruption in garbage collection service. Options that have been proposed include (a) expanding the existing landfill, (b) buying land and building a new city-owned landfill, (c) contracting with a company that will take waste out of the city, and (d) building an incineration facility and at the same time, expanding the existing recycling program. How would you formulate an optimization model to help the decision maker to evaluate these alternatives?

2. (30%) Please state in detail how would you apply the quantitative method(s) for you master thesis research, and what's the major contribution of your study?

3. (20%) Coastal zone, which is part of marine environment, is influenced by numerous inter-related factors including socio-economic, administrative and hydrological systems. Is it possible to use some management approaches to deal with the coastal zone management problem? If your answer is yes, please give two potential examples.

一、 台灣為世界上重要的漁業大國。台灣的漁業面臨哪些問題？從漁業資源、漁港和漁民三方面，未來在保育和管理上，你有何看法和建議？（50%）

二、 海洋污染的主要來源有哪些？我國對於海洋污染的主要機制為何？針對油污染問題，現行措施和改進之道為何？對於陸源性污染，有何較佳改善方式？（50%）

1. 請說明 GIS 系統建置之程序、內容及其應注意事項。 （25%）

2. 請說明影響 GIS 資料品質的因素有哪些？何謂詮釋資料 (Metadata)？何謂資料字典(Data Dictionary)？ （25%）

3. 請說明 GIS 之應用型態有哪些類型？並舉一個應用例子詳加說明。 （25%）

4. 請說明何謂 Voronoi 圖形(或 Thiessen's Polygon)？其重要之 功能為何？ （25%）

1. 請說明在多音束測深時何謂 Patch Test？並說明其如何進行。
(25%)

2. 請說明你可用那些方法來確定水深測量之精度可達到 IHO 之規範。　(25%)

3. 請說明水深測量之作業程序(包含內外業)，並加繪其流程圖。
(25%)

4. 請說明在進行水深測量內外業時應填具那些資料(表格或說明文件)，以便後處理計算或成果查核時之用。　(25%)

1、解釋名詞：(5%x7=35%)

（1）Gulf Stream Rings（2）Biological amplification（3）Continental shelf（4）Mid-ocean ridge（5）Sv (Sverdrup)（6）Lagoon（7）Primary production

2、油污染發生後，對海洋生物的影響為何？有何方法清除油污染、利弊各為何？。(15%)

3、何謂板塊理論（Plate Tectonics）？請列舉板塊運動的證據？（20%）

4、下圖為 12/28/2004 西太平洋及東亞的等壓力線圖，請繪圖求出（1）台灣東北部海域的風向，（2）以及其引發的風漂流流向。（30%）