

國立中山大學九十一學年度博士班招生考試試題

科目：工程數學【海工系甲組】

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1. [Ordinary Differential Equation - ODE] (20% : 10% each)

(a) Using solution by undetermined coefficients, solve the ordinary ODE that satisfies the initial conditions :

$$y'' + 4y' + y = 2 \cos x + 3 \sin x, \quad y(0) = 1, y'(0) = 0.$$

(b) Using solution by variation of parameters, find the general solution for the ordinary ODE :

$$y'' - 2y' + y = x^{1/2} e^x.$$

2. [Residue Integration Method] (20% : 10% each)

(a) Evaluate the following integral $\oint_C \frac{e^{-z^2}}{\sin 4z} dz$ by residual integration.

(b) Evaluate the following integral $\int_0^{\infty} \frac{1+x^2}{1+x^4} dx$ by residual integration.

3. [Partial Differential Equations - PDE] (20% : 10% each)

(a) Three kinds of specific equations can be derived from a general expression for linear PDE : $Au_{xx} + 2Bu_{xy} + Cu_{yy} = F(x, y, u, u_x, u_y)$. Indicate (1) the name, (2) the relationship among the constants A, B and C , and (3) the typical mathematical equation (i.e., Laplace, heat and wave equations, etc.), for each kind of the three equations.

(b) Show the function $u = \frac{2xy}{(x^2 + y^2)^2}$ satisfies a Laplace equation.

4. [Wave Equation - Laplace Equation] (40%)

Mathematical expression for the velocity potential ϕ of wave propagation in a constant water depth h can be derived from Laplace equation. By using the method of separation of variables, show all relevant steps for the solution of velocity potential ϕ for one-dimensional wave propagation. Start the procedure from a given surface elevation $\eta(x, t) = a \cos(kx - \sigma t)$

that satisfies the governing Laplace equation:

$$\phi_{xx} + \phi_{zz} = 0, \quad -h \leq z \leq \eta(x, t), \quad -\infty < x < \infty$$

and a set of four boundary conditions:

$$-\phi_z = 0, \quad \text{at bottom } z = -h$$

$$-\phi_z = \eta_t, \quad \text{at free surface } z = \eta(x, t)$$

$$-\phi_t + g\eta = 0, \quad \text{at free surface } z = \eta(x, t), \text{ and the periodicity condition}$$

$$\phi(x, t) = \phi(x + L, t + T) = \phi(x + L, t) = \phi(x, t + T)$$

In the equations above, Cartesian coordinates are used in which x is the direction of wave propagation, z is positive upward from the still water level; a is the wave amplitude, t is the time, h is the water depth, L is the local wave length, T is the wave period in second, k is the wave number ($2\pi/L$), and σ is the angular wave frequency ($2\pi/T$).

國立中山大學九十一學年度博士班招生考試試題

科目：應用力學【海工系甲組】

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1. Please explain the following terms:
(a) streamline (b) pathline (c) rate of strain (d) rate of deformation (e) Buckingham Pi-theorem (f) circulation (g) boundary layer (h) wake (i) vorticity (j) no-slip condition. (30%)
2. Based on differential view, please derive (a) continuity equation (b) Navier-Stokes equation. (20%)
3. Please describe the difference between Rayleigh-Ritz method and Galerkin method. (15%)
4. Please describe the major discipline that a structural engineer should take. (10%)
5. After the disastrous 921 Chi-Chi earthquake, a new code has divided Taiwan from three into two seismic zones, please find the difference for this code update and the influences to the structural design. (25%)

國立中山大學九十一學年度博士班招生考試試題

科目：環境科學【海工系乙組】

共 0 / 頁 第 0 / 頁

一、請說明海港浚渫工程所產生的污泥海拋後在海洋中傳輸的過程機制與宿命變化，並分析其對海洋環境及生態的影響。(25%)

二、請分別討論(1)環境荷爾蒙(2)POPs (persistent organic pollutant)的定義及其對於環境生態的影響，並請盡量多舉例說明哪一些化合物屬之。(25%)

三、何謂環境(environment)? 何謂資源 (resources)? 何謂污染 (pollution)? 何謂永續? (sustainability)? (25%)

四、台塑公司六輕麥寮廠區，位於濁水溪口南岸填海造地而成。但每到冬天之時，因東北季風關係，廠區內風沙的問題十分嚴重。而該公司雖曾試圖以傳統之防風林及護堤等方式，來解決此一問題，但似乎效果不彰。試問如改採以「生態工法」的方式，是否可以替台塑解決此一問題? 而此生態工法為何? 為什麼可以用來解決廠區內風沙之問題? 而此生態工法又對該廠兼具有那些附帶的功能? (25%)

國立中山大學九十一學年度博士班招生考試試題

科目：環境化學【海工系乙組】

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1. 解釋名詞 (50%)

- (a) Electrical (or diffuse) double layer in a colloid system
- (b) Solubilization (for a solution with surfactant)
- (c) Buffer intensity
- (d) Proton condition
- (e) Chlorine Demand
- (f) Total alkalinity
- (g) TCLP
- (h) Chromatographic separation
- (i) Activity coefficient
- (j) K_{ow}

2. A man-made wastewater contains 400 mg/l of CH_3COOH . What is the COD value for this sample if the organic matter can be completely oxidized. If BOD_5 is 80% of the COD value, what is the maximum dilution ratio will you suggest for a 5-day BOD test. (12%)

3. Please draw a titration curve (pH as the y-axis and 'ml of NaOH added' as the x-axis) for titration of 1 liter of 0.1N CH_3COOH (assume $\text{pK}_a = 4.7$) with 0.1N of NaOH. (Note: please give a qualitative diagram at least.) (10%)

4. Discuss the limitations of using equilibrium chemistry (K_{sp}) to predict the solubility of a compound involved in precipitation and dissolution reactions. (8%)

5. A commercial solid detergent contains only 10-30% surfactant. What are the other ingredients in detergent? What are the major functions of these ingredients? Please discuss possible environmental problems attributed to these ingredients. (10%)

6. Please discuss (a) the mechanisms of greenhouse gasses to cause the global warming. (b) the mechanisms of ozone layer destruction. (10%)

國立中山大學九十一學年度博士班招生考試試題

科目：地理資訊系統【海工系丙組】

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國立中山大學海洋環境及工程研究所博士班 地理資訊系統考題

2002/06/07

1. 試說明 TIN(Triangulated Irregular Network)之面資料可以處理成那些型式?又 TIN 可進行之空間分析功能? (20 分)
2. 影響地理資料品質(data quality)之因素有那些? 何謂 metadata(中介資料或血統資料)? 並說明 metadata 與地理資料品質之關係為何? (20 分)
3. 試比較向量(vector)、網格(raster)及不規則三角網(TIN)資料表示法(data representation)之異同? (20 分)
4. 試說明 CAD data model, coverage data model 及 geodatabase data model 之特性? (20 分)
5. 試說明地圖(map)與地理資訊系統(Geographic Information Systems)之差異? (20 分)

國立中山大學九十一學年度博士班招生考試試題

科目：海洋與海岸管理【海工系丙組】

共01頁第0/頁

1. 什麼是「海洋保護區(Marine Protected Areas, MPAs)」？請就你所知，要述其劃定時應考慮的要素或原則。未來如何管理維護，我國現行法制有否可以採用的規定，還是應建立專法？(25%)
2. 最近海域觀光遊憩十分盛行，地方政府或各地漁港紛紛推出「藍色公路」的構想，你對此一議題的看法如何，請就規劃和管理角度予以說明。(25%)
3. 台塑公司六輕麥寮廠區，位於濁水溪口南岸填海造地而成。但每到冬天之時，因東北季風關係，廠區內風沙的問題十分嚴重。而該公司雖曾試圖以傳統之防風林及護堤等方式，來解決此一問題，但似乎效果不彰。以海岸管理及開發之角度來看此一問題，是否可採用一些「生態工法」及「生態開發」的方式來替台塑解決此一問題？試詳述之。(25%)
4. 海岸防災的工作，一向是我國在海岸管理上重要的一環。試建議我國在海岸防災上應有的策略。(25%)

國立中山大學九十一學年度博士班招生考試試題

科目：管理數學【海工系丙組】

共 1 頁 第 1 頁

1. (20%) What are the differences between Deterministic and Stochastic models? Given one specific example to show your viewpoints.

2. (40%) Given a linear programming (LP) model as following:

$$\text{Maximize } Z=2x_1+x_2$$

$$2x_1 - x_2 \geq 2$$

$$x_1 - x_2 \leq 2$$

$$x_1 + x_2 \leq 4$$

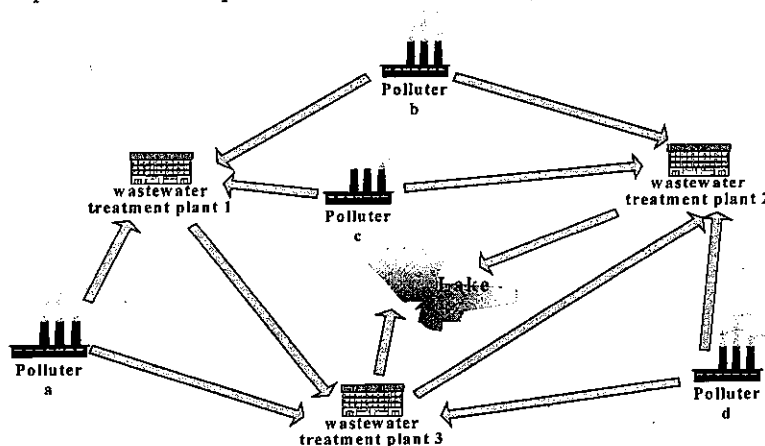
$$x_1, x_2 \geq 0$$

(a) Solve the LP by graphic method, and show the feasible region and corner point **feasible** solutions (CPF).

(b) Can the normal simplex algorithm deal with such problem? Explain your answer.

(c) Use two phases simplex to find the **initial BF** (basic feasible solution). Does this initial BF belong to one of the CPF in problem (2a)'s graph?

3. (30%) There are four polluters (marked as a, b, c, d) and three wastewater treatment plants (marked as 1, 2, 3) in a watershed as shown in the following graph. Only plants 2 and 3 are allowed to discharge the treated wastewater into the lake without over the limit **MAX** (污染物質質量). Given W_i is the amount of wastewater from each polluter, and K_i is the treatment cost per unit of wastewater in each plant. Also C is the initial concentration of the wastewater flowing into each treatment plant, and E_i is the efficiency (pollutant removal rate) of each plant. The unit cost of transporting wastewater from place i to place j is P_{ij} . Formulate a mathematical programming model to minimize the overall cost (including wastewater treatment cost and transportation cost). (Hint: you may assume Q_{ij} the flow from i to j and T_i the total input to a treatment plant as the decision variables)



4. (10%) Briefly describe the major contributions of your master thesis or research!

國立中山大學九十一學年度博士班招生考試試題

科目：統計學【海工系丙組】

共 2 頁 第 1 頁

1. Let A and B be events such that $P(A) = \frac{1}{4}$, $P(B|A) = \frac{1}{2}$, and $P(A|B) = \frac{1}{4}$. Define random variables X and Y by:

$X = 1$ if A occurs, $Y = 1$ if B occurs,
 0 if A does not occur, 0 if B does not occur.

Determine which of the following statements are true.

- ① X and Y are independent ② $P[X^2 + Y^2 = 1] = \frac{1}{4}$
 ③ $P[XY = X^2Y^2] = 1$ ④ X and Y are identically distributed. ⑤ X is uniformly distributed on the interval $[0, 1]$. Choose one from the below.

- (1) ①, ③
 (2) all of the five statements are true
 (3) ①, ③, ④
 (4) ①, ②, ④
 (5) ①, ②, ③
 (6) ②, ③, ④

(10%)

2. Assume independent random variables X is $N(10, 4)$ and Y is $N(5, 3)$. Find the following probabilities:

- (1) $P(X > 14 | X > 12)$
 (2) $P(9 < X < 11 | 8 < X < 14, Y > 6)$
 (3) $P(X < 10, Y < 3 | X > 7, 2 < Y < 5)$
 (4) $P(0 < X^2 + Y^2 - 2XY - 2X + 2Y < 3)$

(15%)

3. 抽樣調查台中市 100 戶，結果有 25 戶空屋：
 是否有證據說台中市空屋率超過 20%，為什麼？

($\alpha = 0.05$) ($Z_{0.05} = 1.645$)

(10%)

4. Consider the following hypothesis test.

$H_0: \mu \geq 10$ $H_1: \mu < 10$

The sample size is 120, and the population standard deviation is 5. Use $\alpha = 0.05$. If the actual population mean is 9 the probability of a Type II error is 0.2912. Suppose that the researcher would like to reduce the probability of a Type II error to 0.10 when the actual population mean is 9. What sample size is recommended?

($Z_{0.05} = 1.645$; $Z_{0.1} = 1.2816$)

(15%)

國立中山大學九十一學年度博士班招生考試試題

科目：統計學【海工系丙組】

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5. (1) Briefly describe how the experiment should be arranged if this is to be a completely randomized design.
 (2) Fill in the blanks in the following ANOVA table.

Source of Variation	Degree of Freedom	Sum'of Squares	Mean Square	F
Treatment	①	②	86	⑤
Error	9	③	④	
Total	11	307		

(15%)

6. Suppose you are asked to estimate the following model:

$$y_t = \beta_1 + \beta_2 x_{2t} + \beta_3 x_{3t} + e_t$$

where $t = 1, \dots, 50$. And you get the following results:

parameter	coefficient	std.err.	t-stat	p-value
β_1	-9.790	0.8173	-11.978	0.000
β_2	0.518	0.0479	11.559	0.000
β_3	1.248	0.0987	12.636	0.000
R-square	0.8444			
adjusted R-square	A sample mean of y_t		-0.2630	
	standard deviation of y_t		0.2390	
standard error of regression	B			
F-statistic	127.4938			
	sum of squared residuals		C	

- (1) What are A, B, and C?
 (2) The F-statistic given in the table is provided to test "if the model is significant". What are the degrees of freedom for the F-statistic? What is the underlying null hypothesis for this test.

(15%)

7. (1) The presence of high simple correlations among hand side variables is a sufficient but not a necessary condition for the existence of multicollinearity Explain why. (Be sure to define multicollinearity in your answer.)
 (2) This following estimated equation is claimed to show classic sign of multicollinearity. What are they? Explain.

$$Y_i = 24.7 + 0.94X_i + 0.042Z_i$$

$$(0.82) \quad (0.08)$$

$$R^2 = 0.96, N = 20$$

(20%)

$$(t_{0.05} = 1.74, t_{0.025} = 2.11)$$

國立中山大學九十一學年度博士班招生考試試題

科目：海洋學【海工系丙組】

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每題十分，請依序作答：

1. 試述海洋學的研究範疇，並描述海洋學和海洋環境及海洋工程間的關係。
2. 海岸地區 (Coast Zone) 的定義為何？並請描述台灣海岸地形的種類及其變遷(自然與人為開發)的情形。
3. 試述世界主要洋流之分布狀況，並探討其成因與為何其特性能保持平衡的狀態。
4. 描述聖嬰現象成因及其與南方震盪的關係，並描述其對全球產生之影響。
5. 在不同的地點及狀況下，請問你要使用何種設備來測量潮汐、波浪、海流及海水的特性，並描述台灣附近海流之特性及其對台灣的影響。？並請以圖表解釋其隨時間或水深的變化與相互間的關係。
6. 何謂科氏力？並探討它對洋流及對河口地區海流的影響。
7. 試述台灣沿海氣候及海流之變化，及其對台灣的影響？
8. 台灣沿海海域的魚產豐富，試述其可能成因，並探討人類活動對海域生態的影響。
9. 最近「珊瑚白化」的情形時有所聞，請探討其原因、影響及防治與復育的方法。
10. 請說明氣候、陸源性污染物、營養鹽與海域生態之間的關係。