國立交通大學 100 學年度第 2 學期

博士班資格考筆試考試試題

土木工程學系 水利組　　科目：水資源規劃　　選考學生數：1　　考試時間：60 min

1. Applied the steepest descent method to minimize the function

   $f(\boldsymbol{x}) = 4x_1^2 + x_2^2 - 2x_1x_2$

   Use $(x_1, x_2) = (0.25, 1)$ as the starting solution point. (25%)

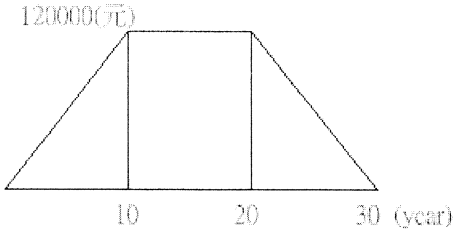
2. For the optimization problem of a single multiple-purpose reservoir, list at least four possible constraints to the problem in equation form. (25%)

3. 若有 A、B 三個水資源工程開發案例，假設各工程之壽命皆為 30 年，其中 A 工程之期初投資成本為 100 萬，B 工程之期初投資成本為 70 萬，各工程方案之收益如下圖所示，A 工程在第一年末的收益為 12,000 元，之後以定額的方式增加，至第十年末的收益為 120,000 元，接著利潤維持在 120,000 元至第二十年末，第二十一年起以定額方式減少，至第三十年結束時的收益為 0 元。B 工程在第一年末的收益為 20,000 元，之後以定額的方式增加，至第五年末的收益為 100,000 元，接著利潤維持在 100,000 元至第十年末，第十一年起以定額方式減少，至第三十年結束時的收益為 0 元。試求上述 A、B 方案何者益本比為最佳。(25%)

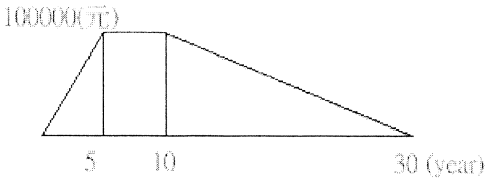
註：

$$\left[\begin{array}{l}\left(\frac{P}{F}, i\%, n\right) \Rightarrow \mathrm{F} = \mathrm{P} \times \frac{1}{(1+\mathrm{i})^n} \\ \left(\frac{P}{A}, i\%, n\right) \Rightarrow \mathrm{P} = \mathrm{A} \times \frac{(1+\mathrm{i})^n - 1}{i(1+i)^n} \\ \left(\frac{P}{G}, i\%, n\right) \Rightarrow \mathrm{G} = \mathrm{P} \times \frac{(1+\mathrm{i})^{n+1} - (1+ni+i)}{i^2(1+\mathrm{i})^n}\end{array}\right]$$

A 工程



B 工程



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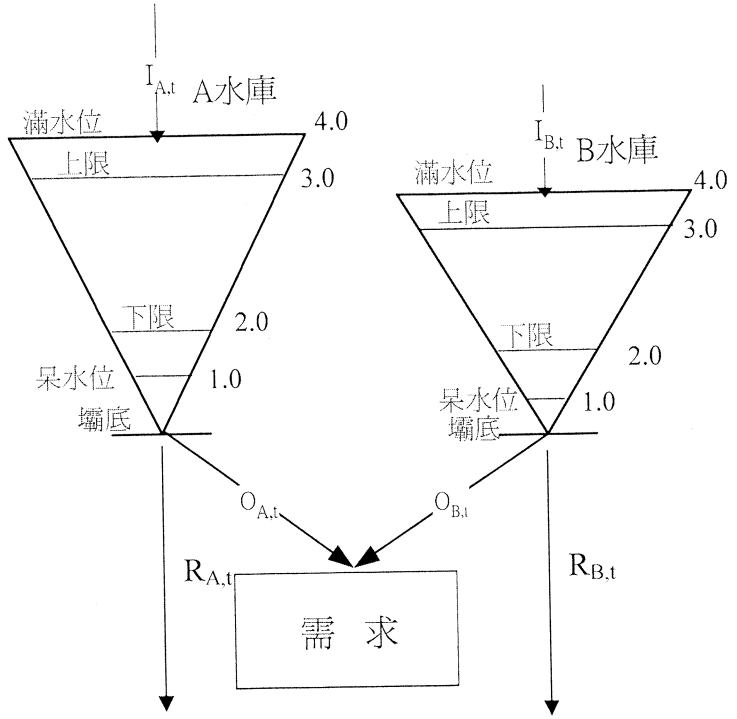
博士班資格考筆試考試試題

土木工程學系 水利組　　科目：水資源規劃　　選考學生數：1　　考試時間：60 min

4. 下圖為 A、B 兩水庫並聯操作供給一需求點，試以對等水庫與指標平衡原則，計算水庫各時刻之需求供給量與河川放水量。 (25 分)



基本資料：

	水庫 A	水庫 B	標的需水量
初始水位	2400	4000	
水庫分層			
滿水位	51000	31000	
上限	50000	30000	
下限	5000	6000	
呆水位	600	600	
入流量			
t=1	2700	2400	5000
t=2	7000	6000	5000
t=3	8800	7500	5000

放水原則：

1. 對等水庫水位在上限以上：防洪操作（落於該分層之蓄水量需洩放）。
2. 對等水庫水位在上限以下、下限以上：全額供水。
3. 對等水庫水位在下限以下、呆水位以上：打折供水，以標的需水量之 85% 供應。
1. 對等水庫水位在呆水位以下：不放水。

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博士班資格考筆試考試試題

土木工程學系 水利組　科目：工程數學　選考學生數：2　考試時間: 60 min

1. A forced oscillation is governed by $y''(t)+9y(t)=f(t)$ where the force f(t) with a period of 2π is given by

$$f(t)=\begin{cases} k, & 0\le t<\pi \\ -k, & \pi\le t<2\pi \end{cases}$$

(1) Find the corresponding Fourier series. (15%)

(2) Find the homogeneous solution and show the natural frequency. (10%)

(3) Find the particular solution. (15%)

2. For the given vector fields $\mathbf{v}_1=\begin{bmatrix} ye^x & e^x & 2z \end{bmatrix}$ and $\mathbf{v}_2=\begin{bmatrix} e^x & ye^x & e^z \end{bmatrix}$, Which vector field can be represented as the gradient of a potential ? (8%) (Hint: Check if $\operatorname{curl}\mathbf{v}=0$?) Find f for the vector field in (a)? (7%)

3. $\dfrac{d^2y}{dt^2}+y=3\cos 2t$, $y(0)=0$, $\dfrac{dy(0)}{dt}=0$. Please solve by Laplace transform. (25%)

4. solve ode: $x\dfrac{dy}{dx}+y=-2x^2y^2$, $x>0$. (25%)

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博士班資格考筆試考試試題

土木工程學系 水利組　科目：流體力學　選考學生數：2　考試時間：60 min

1. Using the differential element shown in Fig. 1, derive the relationship for pressure drop of steady, viscous flow through a horizontal circular tube. Also derive the equation for the velocity profile and show that it is parabolic in form. (25%)

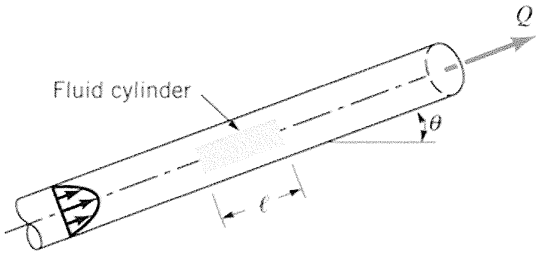

Fig. 1

2. Two immiscible, incompressible, viscous fluids having the same densities but different viscosities are contained between two infinite, horizontal, parallel plates (Fig. 2). The bottom plate is fixed and the upper plate moves with a constant velocity U. Determine the velocity at the interface. Express your answer in terms of U, μ_1, and μ_2. The motion of the fluid is caused entirely by the movement of the upper plate; that is, there is no pressure gradient in the x direction. The fluid velocity and shearing stress are continuous across the interface between the two fluids. Assume laminar flow. (25%)

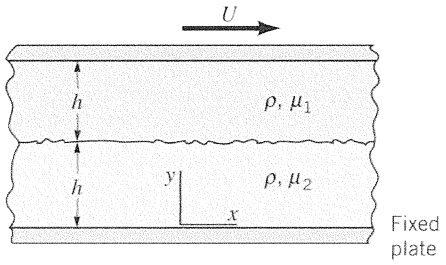

Fig. 2

3. The velocity components in an ideal, two-dimensional velocity field are given by the equations

$$u = 3(x^2 - y^2)$$

$$v = -6xy$$

where u and v are the x- and y-directional velocity components, respectively. Determine the equation for the pressure gradient in the y direction at any point in the field. (25%)

4. Use the momentum integral and the velocity profile

$$\frac{u}{U} = a + b\frac{y}{\delta}$$

to evaluate the boundary-layer thickness δ. (25%)

Note that the momentum integral is:

$$\frac{d}{dx}\int_0^{\delta} u(U-u)dy = \frac{\tau}{\rho}$$

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博士班資格考筆試考試試題

土木工程學系 水利組　科目：渠道水力學　選考學生數：1　考試時間：60 min

1. (50%)
   A sluice gage is placed in a channel of rectangular section. The initial upstream and downstream depths are 10 ft and 2 ft respectively, and the discharge is 46.2 cfs/ft. The gate is suddenly opened far enough to make the depth immediately downstream equal to 2.5 ft. The discharge for the new gate opening is 54.8 cfs/ft. The velocity of the surge formed due to sudden increase in the gate opening is 31.4 ft/sec. Plot the water surface profile at t=100sec after increasing the gate opening. (To plot the negative wave profile, determine the location of the end points only)

2. (25%) Water flows with a velocity of 1.5 m/s and at a depth of 2.5 m in a rectangular channel. Determine (a) the maximum size of rise in the channel bottom without affecting flow condition upstream of the rise in the bottom, and (b) the depth over the rise when the height of the rise is one-half of the height in (a).

3. (25%) Two long, rectangular channels of different widths are connected by a relatively short channel contraction. Sketch the flow profile for the following flow conditions: q_1 = 1.0 cms/m; y_{n1} = 0.8 m; q_2 = 1.5 cms/m; and y_{n2} = 0.5 m, where q = discharge per unit width, and y_n = normal depth. The subscripts 1 and 2 denote the conditions in the upstream and downstream reaches, respectively. Neglect the energy loss in the transition.

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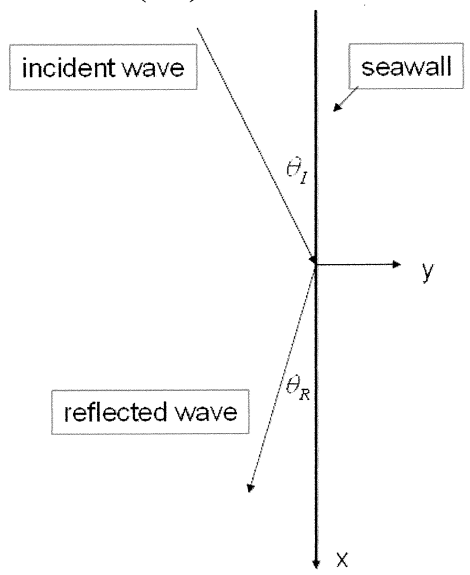
博士班資格考筆試考試試題

土木工程學系 水利組　科目：波浪理論　選考學生數：1　考試時間：60 min

1. Describe the refraction process over bathymetry with straight and parallel bottom contours. Specifically, discuss why the refraction coefficient decreases with decreasing depth. (25%)
2. Consider a wave with incoming angle, θ_I. The wave is reflected completely by a seawall of infinite length on y = 0. The angle of reflection, θ_R, with respect to the wall is equal to the angle of incidence, θ_I.
   (a) What is the velocity potential, Φ_I, for the incident wave? (5%)
   (b) What is the appropriate boundary condition at the seawall? (5%)
   (c) Develop expression for the combine (incident + reflected): (5%)
   (c-1) Water surface displacement, $\eta_I + \eta_R$, and
   (c-2) Velocity potential, $\Phi_I + \Phi_R$
   (d) What is the ratio of maximum wave height at the seawall to incoming wave height? How does this ratio depend on the incoming wave direction, θ_I. (5%)
   (e) What is the net energy flux in the x direction per unit length in a direction perpendicular to the x direction? (5%)



3. What is the wave celerity and wave group velocity of the linear small-amplitude wave theory? (15%) For the limits at both deep water and shallow water, give physical interpretation to the relationship between wave celerity and wave group velocity. (10%)
4. Derive wave reflection and transmission coefficients for a long wave propagating over a step of which both water depths are h1 and h2. (25%)

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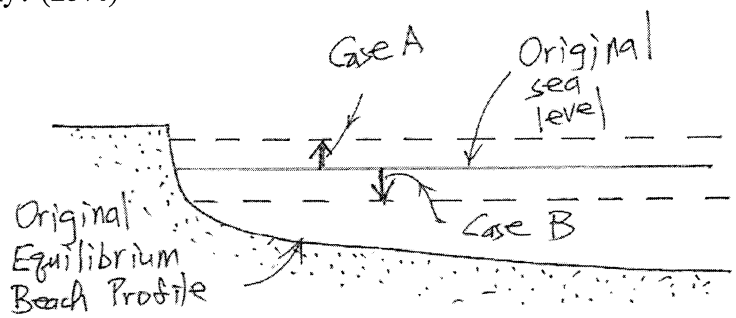
博士班資格考筆試考試試題

土木工程學系 水利組　科目：海岸過程　選考學生數：1　考試時間：60 min

1. Explain the effect of groins and offshore breakwaters on alongshore and on-offshore sediment transport along and offshore. How to decrease downstream beach erosion after the construction of groins? (25%)

2. What is the equilibrium beach? Give some examples of applying the concept of equilibrium beach to coastal engineering.(25%)

3. Consider a beach profile that is initially in equilibrium. In Case A, there is a sea level increase and in Case B, there is a sea level decrease. In which case would you expect a barrier island system to tend to form? Why? (25%)



4. A pair of spits is developing east and west from a headland which faces south. A causeway (solid fill of land) is later constructed to an offshore island. Discuss, using sketch where helpful, the effects that you would expect this to have on future spit development. (you need to consider different incident wave directions) (25%)