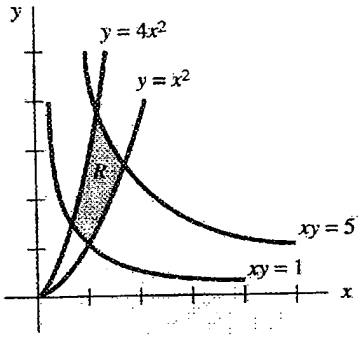
九十七學年度第二學期博士學位候選人資格考試　　工程數學

1. Find the general solution of the equation $y''+y=\sec x$ (15%)

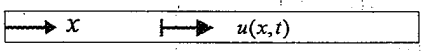
2. Solve the initial value problem $y''+3y'+2y=\delta(t-2),\ y(0)=0,\ y'(0)=0$. Where $\delta(t-2)$ is the Dirac delta function. [Hint: Laplace transform] (20%)

3. Evaluate $\int_0^{2\pi}\frac{d\theta}{(2+\cos\theta)^2}$. [Hint: residue theorem] (20%)

4. Evaluate $\iint_R xydA$ over the region R shown in figure. [Hint: change variables] (15%)



5. (a) Derive the equation for longitudinal oscillations of a slender uniform rod of constant cross section area: $\frac{\partial^2 u}{\partial x^2}-\frac{1}{v^2}\frac{\partial^2 u}{\partial t^2}=0$,



where $u(x,t)$ is the displacement of the cross section of the rod with abscissa x at time t.

(b) Explain the physical meaning of the parameter v.

(c) Formulate the initial and boundary conditions for the special case:

A rod of length l is clamped at the end $x=0$, and stretched by a force F applied to the other end; at the time $t=0$ the force is suddenly released.

(d) Solve $u(x,t)$ for the case (c).

[Assume that E = Young's modulus of the material, A = cross section area of the rod, ρ = density of the material] (30%)

97 學年度第二學期博士班資格考

土壤力學 (考試時間 100 分鐘, 總分 100 分, 60 分及格)

1. Describe "long-term stability problem" and "short-term stability problem" (10%); What are their relationships with "effective stress analysis" and "total stress analysis" ? (10%)

2. Derive the equation of Rankine's active earth pressures. (20%)

3. Describe the theoretical background of Terzaghi's bearing capacity equation. (10%) Describe "bearing capacity factors" and "correction factors" used in this equation ? (10%)

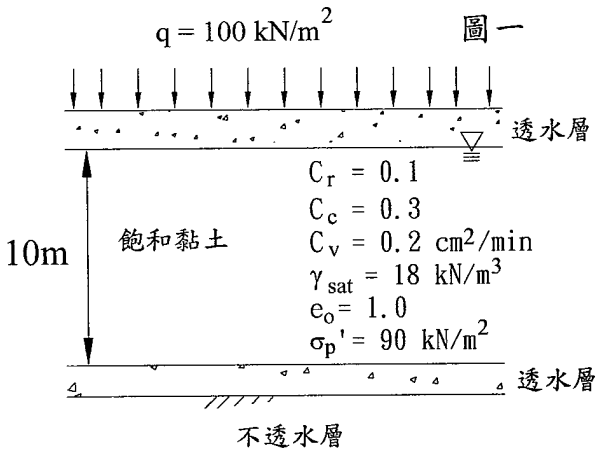
4. 如圖一所示之飽和黏土地盤(均佈載重及飽和黏土層皆為無限寬廣)：

   1. 圖中列舉之參數中何者為標準壓密試驗之結果(5%)；

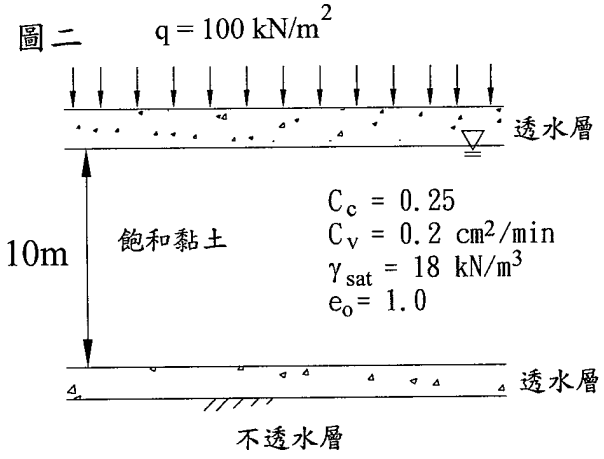
   2. 描述上題所列舉參數之中文、英文名稱及意義(5%)；

   3. 計算地盤之主要壓密沈陷量(10%)

圖一



圖二



5. 一正常壓密之飽和黏土地盤上方計畫以預壓密工法進行地盤改良(如圖二)，採用一均佈載重 q = 100 kPa，試求改良地盤達平均壓密度(U_{avg})為 50%狀態時之地表壓密沈陷量(5%)及所需時間，以'天'表示(5%)，並求黏土層中央處在 U_{avg} = 50%時之不排水剪力強度(c_u)增加量(10%)。

   假設：

   甲、改良前黏土層表面(深度為 0 m)處之 c_u = 20 kPa

   乙、$\frac{c_u}{p'}$ = 0.3 (p'：有效覆土應力)

   丙、T_v = 0.197 for U_{avg} = 50%

   丁、土層中之超額孔隙水壓均勻分佈

Wednesday, March 18, 2009

Ph.D. Qualification Examination (Spring 2009)

1. Please *compare* and *contrast* the following terms in each question. (50%)
   (a) elastic vs. anelastic and inelastic deformation,
   (b) elasticity vs. plasticity, viscoelasticity and viscoplasticity,
   (c) relaxation vs. recovery,
   (d) screw vs. edge dislocations
   (e) crystalline vs. amorphous solids
   (f) Nabarro-Herring vs. Coble creep
   (g) deformation vs. growth twins in crystalline materials
   (h) fatigue under stress vs. strain loading
   (i) fracture under the plane strain vs. plane stress assumptions
   (j) friction vs. internal friction

2. Please *discuss* the following questions and *define* the symbols in the equations. (30%)
   (a) The meaning of the Hall-Petch relationship ($\sigma_y = \sigma_i + k_y d^{-1/2}$), and sketch of its derivation.
   (b) The meaning of the creep constitutive relationship $\dot{\varepsilon} = A\frac{Gb}{kT}\left(\frac{\sigma}{G}\right)^n D$, and sketch of its derivation.
   (c) The meaning of $\dot{E} = \pi f J'' \sigma^2$ for calculating the energy dissipated in a given loading cycle, and sketch of its derivation.
   (d) The meaning of the plastic zone radius $r = \frac{K^2}{2\pi\sigma_y^2}$, and sketch of its derivation.
   (e) The meaning of $Q^{-1} = \tan\delta$ for calculating loss tangent from the quality factor, and sketch of its derivation.
   (f) The meaning of $E_c = \frac{E_f E_m}{V_f E_m + V_m E_f}$ for estimating the Young's modulus of a fiber-reinforced composite and sketch of its derivation.

3. Given the three-dimensional stress state of a stress element, as below, please answer the following questions. (20%)

$$\sigma = \begin{bmatrix} 3 & 8 & -1 \\ 8 & 6 & 2 \\ -1 & 2 & 13 \end{bmatrix}$$

(a) Find the maximum normal stress state of the stress element
(b) Find the maximum shear stress state of the stress element
(c) Find the normal stress under the maximum normal stress fracture criterion
(d) Find the shear tress under the maximum shear stress yield criterion
(e) Find the shear tress under the octahedral (von Mises) shear stress yield criterion

本題組與最短路徑問題(Shortest path problem)有關。

1. (30 分) 請寫出最短路徑問題的定義。

2. (30 分) 若網路中所有節線(arc)的長度均不為負值，則可以使用 Dijkstra's algorithm 求解該網路上的最短路徑問題。試寫出此演算法的步驟。

3. (40 分) 假設各節線長度為非負值。此外各節線亦有非負旅行時間。節線的長度與旅行時間無特定關係。路徑的旅行時間定義為組成該路徑的所有節線之旅行時間之線性加總。給定一常數 T。今欲求旅行時間不大於 T 之最短路徑。此問題稱為 restricted shortest path problem (RSPP)。請建議一個 RSPP 的求解演算法。

Finite element analysis

1. 請討論應該具備的有限元素法知識(請分項說明)。

2. 請說明平面應力、平面應變、軸對稱平面元素之用途及在設計程式時有何不同之處。

3. 請說明你博士論文會用到有限元素法的地方。

以上三題無一定之答案，請盡量回答之。

4. Use the 1 by 1 and 2 by 2 Gauss rule to approximate I ($I = \int\int \frac{1+y+x^2}{y} dxdy$) over the rectangular region shown in Fig.1. (50/3)

Order n	Sampling point	Weight factor
1	0	2
2	$\pm 1/\sqrt{3}$	1

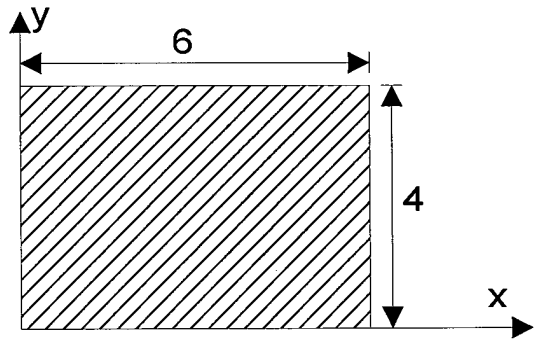


Fig.1

Dynamics of Structures 972

1. (a) What is the definition of response spectrum? Please describe briefly the procedures to determine the deformation response spectrum. (10%)
   (b) What are the differences between pseudo-velocity and relative-velocity response spectra? (5%)
   (c) What are the differences between pseudo-acceleration and acceleration response spectra? (5%)
   (d) What is the earthquake design spectrum? (10%)

2. A 2-story shear building shown in Fig. 2a is subjected to a design spectrum shown in Fig. 2b. Assume 2% damping ratio for all modes, and zero initial conditions. (Given $m=2\,kg$, $EI/h^3=8\,N/m$ and $h=3\,m$)
   Please determine
   (a) Mass matrix $\mathbf{M}$ and Stiffness matrix $\mathbf{K}$. (10%)
   (b) Natural Frequencies ω and corresponding mode shapes Φ. (10%)
   (c) Modal maximum floor forces, base shear, and overturning moment for each individual mode. (25%)
   (d) The maximum floor forces, base shear, and overturning moment by using square-root-of-sum-of-squares (SRSS) rule. (25%)

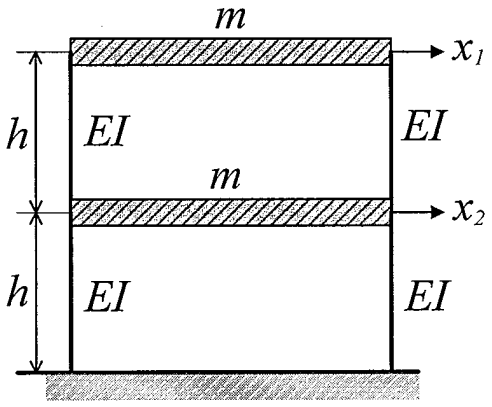


Fig. 2a

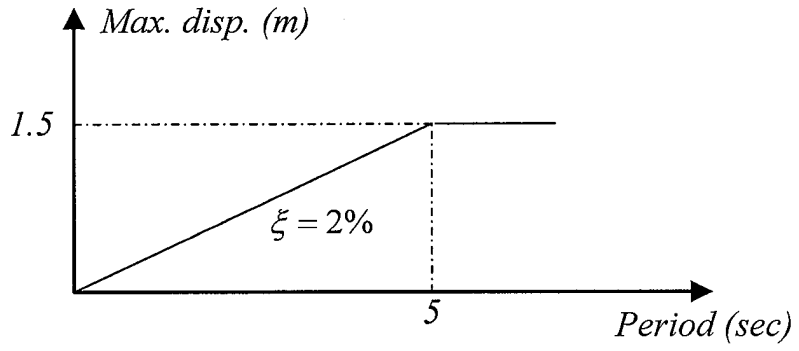


Fig. 2b

Qualifying examination (Elasticity)

(1) The constitutive law for linear, isotropic, thermoelastic material is

$$\varepsilon_{ij} = \frac{1+\nu}{E}\tau_{ij} - \frac{\nu}{E}\tau_{kk}\delta_{ij} + \alpha\,\Delta T\delta_{ij}$$

(a) Inert this law to express τ_{ij} in terms of ε_{ij} and ΔT. (10%)

(b) Derive the Navier equation for this material which is in the form

$$(\lambda+\mu)u_{j,ji} + \mu u_{i,jj} + A = 0$$

where A is purely related to ΔT in the absence of body forces. (10%)

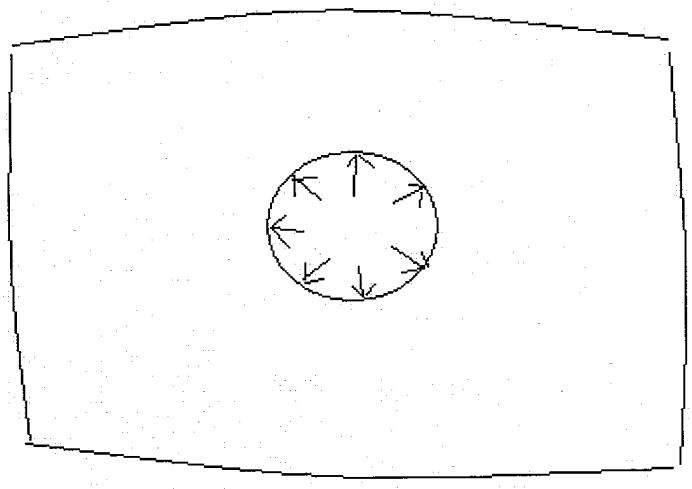
(2) Are the principal axes of strain coincident with those of stress for

(a) an anisotropic material satisfying generalized Hooke's law? (10%)

(b) a material with one plane of elastic symmetry? (10%)

(c) an orthotropic material? (10%)

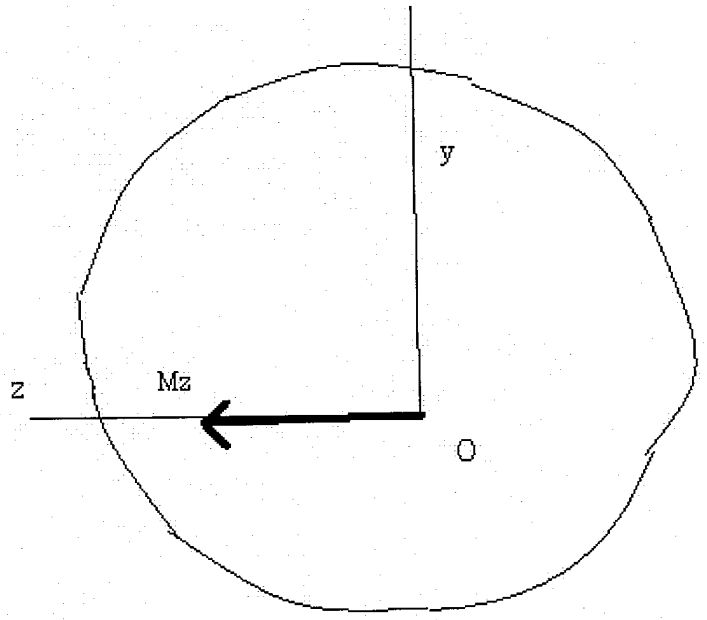
(3) Determine the stress fields for the 2-D infinite medium with a circular hole in it, as shown in the Figure where a uniform pressure P is acting on the circular hole. (25%)



(4) Consider a linear elastic beam of arbitrary cross section, subjected to pure bending M_z about the z-axis(Fig). Show that the flexure formula

$$\tau_{xx} = -\frac{M_z y}{I_{zz}}$$

is exact if O is at the centroid and yz are principal axes.(25%)



九十七學年度第二學期博士學位候選人資格考試

考試科目：工程地質

一. 解釋名詞（22%）

（1）何謂 RQD、lugeon 試驗?（6%）

（2）何謂走向、傾角、傾向?(6%)

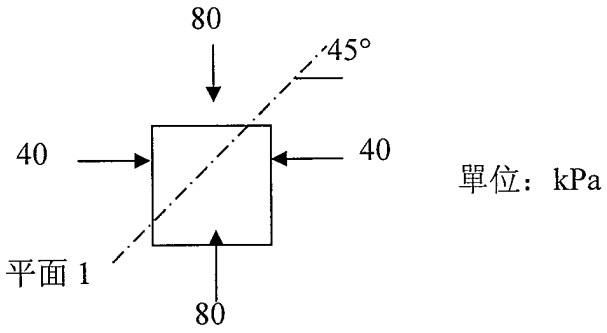
（3）何謂交角不整合?非整合?假整合?(6%)

（4）何謂節理?何謂斷層?(4%)

二. 試畫出正斷層、逆斷層、左移斷層的三維圖形，並分別在其上標出所代表的現地主應力分布?（18%）

三. 試述 RMR 岩體分類法與 Q 法(20%)

四. 試繪出下圖應力狀態下莫耳圓之極點位置與寫出平面 1 的應力狀態（10%）



五. 試敘述三種常用岩盤現地應力量測法(15%)

六. 試述繪出地層位態、逆斷層、左移斷層、背斜與向斜分別在地質圖上所代表的符號(15%)。

Engineering Management Information System, Qualification (2009)

1 What are the differences between Structured Query Language and Query By Example? (15%)

2 What is the 3-tier network? Illustrate it. (15%)

3 What is Virtual Private Network (VPN)? What applications can we build with VPN to benefit the construction industry? (15%).

4 Describe what update anomalies, addition anomalies, and deletion anomalies are. Give an example for each of them? (15%)

5 Please identify and explain the rule violations and formating errors within the DFD shown in Figure 1. (15%)

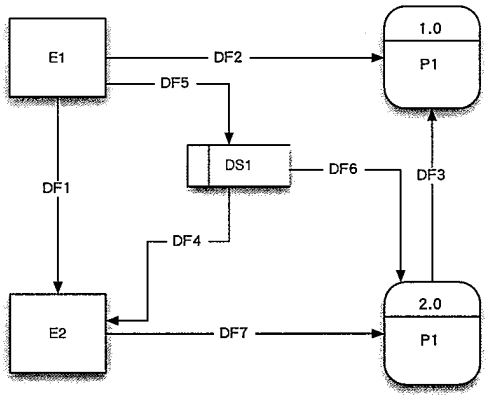


Figure 1

6 Transform the E-R diagram of Figure 2 into a set of 3NF relations. (25%)

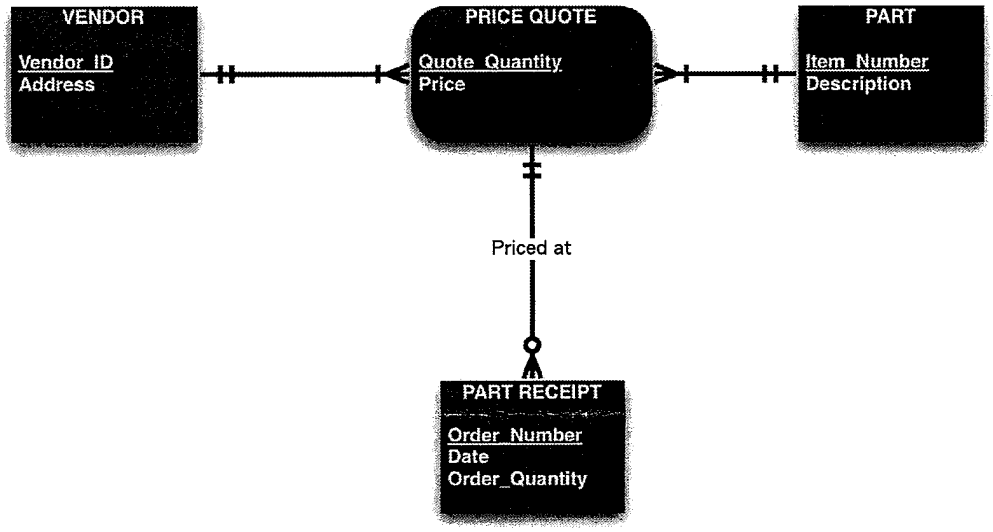


Figure 2