國立台灣海洋大學九十一學年度研究所博士班招生考試試題

系所名稱：河工系博士班（結構組）　　＊答案以橫式由左至右書寫於答案卷上！

科目名稱：結構力學綜論　　＊可使用計算機

一、 A spring-mass system subjected to a load-time function as shown in Figure 1. Determine the displacement as a function of time for (15%)

(1) $0 \le t \le \frac{1}{2} t_d$, (2) $\frac{1}{2} t_d \le t \le t_d$, and (3) $t_d \le t$

二、 (1) Determine the member forces in each member of the unbraced frame shown in Figure 2. The length of all members is 25 feet. (Bending is *about the weak axis*, the applied loads are factored load, the self-weight of the members is neglected, E=29000 Ksi, Fy=36 Ksi) (15%)

	A (in^2)	Ix (in^4)	Iy (in^4)	b_f(in)	D (in)	Zx (in^4)	Zy (in^4)
Column W18X40	11.8	612	19.1	6.015	17.9	78.4	9.95
Beam W16X26	7.68	301	9.59	5.5	15.69	44.2	5.48

b_f: the width of the flange.　D: the depth of the cross section

(2). If the flexural rigidity of the beam is infinite, determine the adequacy of the column, based on $\frac{P}{P_a} + \frac{M}{M_P} \le 1$; (the stability behavior of the column must be considered) (20%)

Note: No design formula is provided.

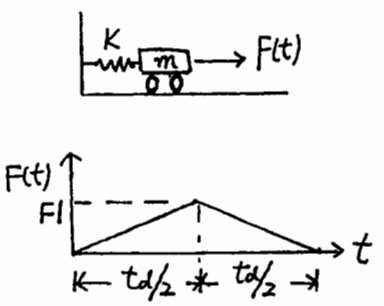


Fig 1

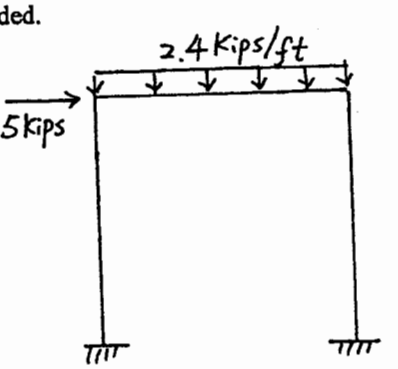
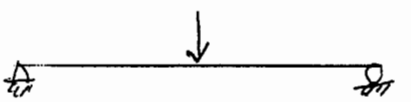


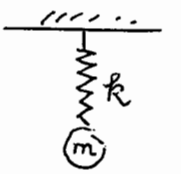
Fig 2.

三、



A simply-supported beam with a length L subjected to a concentrated load at the center, please find the moment diagram. (5%) If the loading is moving from the left side to the right side of the beam, please determine the response of moment at the center point, i.e., determine the influence line. (5%) Please classify the similarity and difference between the two results mathematically and physically. (10%)

四、



A single degree of freedom with a mass m and a spring k, the system is in static equilibrium due to the weight of mg. Please find the natural frequency (5%) and the static deformation. (5%) If half of the mass falls off the system , please describe the motion mathematically and physically. (10%) Does natural frequency change ? (5%) Will the mass vibrate upward or downward at the instant when half of the mass separates ? (5%)

國立台灣海洋大學九十二學年度研究所博士班招生考試試題

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科目名稱：結構力學綜論　　＊可使用計算機

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1. 何謂張量 (tensor)？其階數 (rank) 如何決定? 試以結構力學的物理量為例說明之。(10%)

2. 試解釋下列結構力學名詞:(20%)
   (1) 莫耳圓 (Mohr circle)
   (2) 主軸應力 (principal stress)
   (3) 偏差應力 (deviatoric stress)
   (4) 應力不變量 (stress invariants)
   (5) 諧合方程式 (compatibiliy equation)

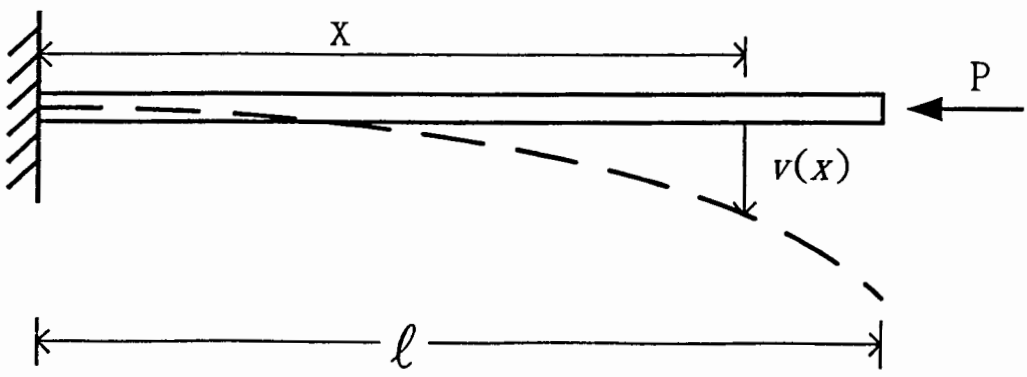
3. 何謂雙自由度結構動力系統? 阻尼模式有幾種? 作實驗如何定阻尼參數? (20 %)

4. 如圖所示，一懸臂樑，彎矩剛度 EI

   (a) 列出應變能 U 及位能 V。 (15 分)

   (b) 藉由變分法求控制方程式及自由端的自然邊界條件。 (15 分)

   (c) 令 $v(x) = a \cdot (1 - \cos\frac{\pi x}{\ell})$，請用 Rayleigh-Ritz method 求臨界挫屈值。 (20 分)



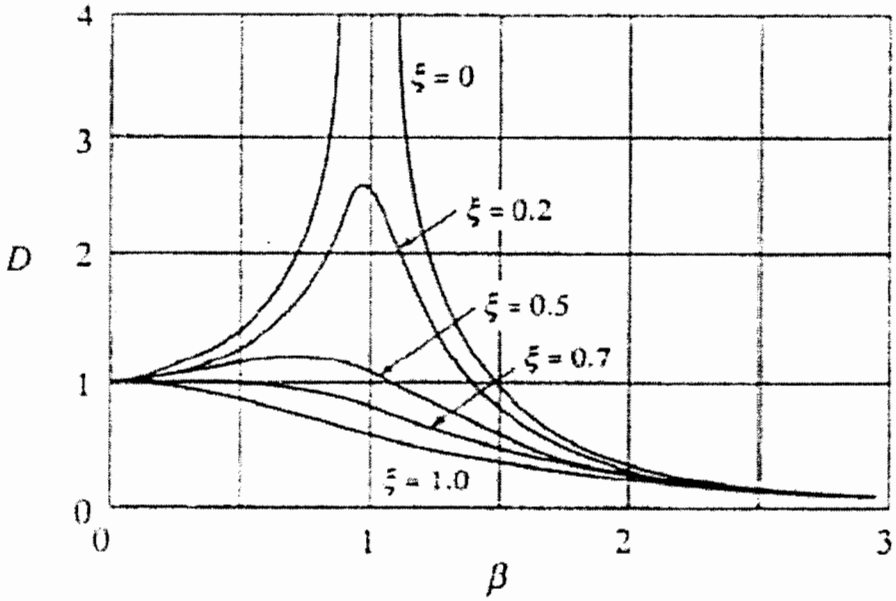
國立臺灣海洋大學九十三學年度研究所博士班招生考試試題

系所名稱：河工系博士班(結構組)　　＊答案以橫式由左至右書寫於答案卷上！

科目名稱：結構力學綜論　　＊可使用計算機

1. (a) 請問下圖所要說明之意義為何？(3%)

   (b) 請列舉下圖之特性四點？(各3%，共12%)

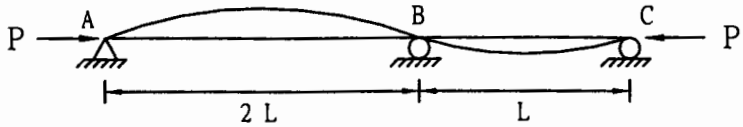


2. (a) 何謂古典阻尼(Classical Damping)？(4%)

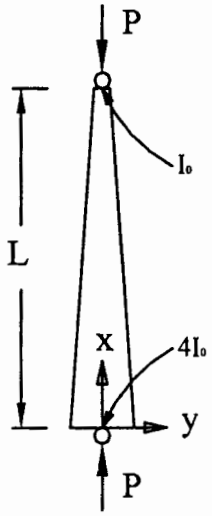
   (b) 何謂擴展雷利阻尼(Extended Rayleigh Damping)？(4%)

   (c) 若假設其阻尼形態為Rayleigh阻尼時，已知某一結構系統的第一自然頻率ω_1=5rad/sec、第二自然頻率ω_2=10rad/sec、第三自然頻率ω_3=15rad/sec、第一振態阻尼比ξ_1=0.01及第二振態阻尼比ξ_2=0.02，試問此結構系統的第三個振態阻尼比ξ_3為何？(10%)

3. 寫出下圖臨界載重的控制方程式。(17%)



4. 使用能量法，求下圖的臨界載重。(17%)



5. 如圖 1.*a* 所示簡支樑，二端承受彎矩 Me=10，其斷面彎矩與曲率的關係如圖 1.b 所示。請求 *a* 點的位移 Δ_a 18 分

6. 如圖 2 所示軸力桿件，已知軸向剛度 $EA(x)=EA_0\left[1-\frac{1}{2}(\frac{x}{L})\right]$

桿件應變能 $U=\frac{1}{2}\int_0^L EA(x)\left[\frac{du}{dx}\right]^2 dx$　　位能 $V=-P\cdot\Delta_a$

桿件勢能 $\Pi=U+V$　　令 軸向位移 $u(x)=\frac{x}{L}\Delta_a$

請利用 Rayleigh-Ritz method（最小勢能原理）求Δ_a 15 分

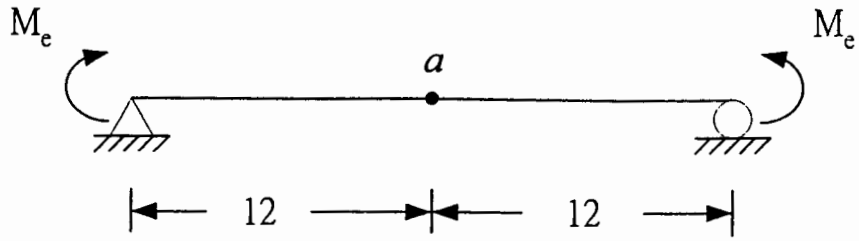


圖 1.*a*

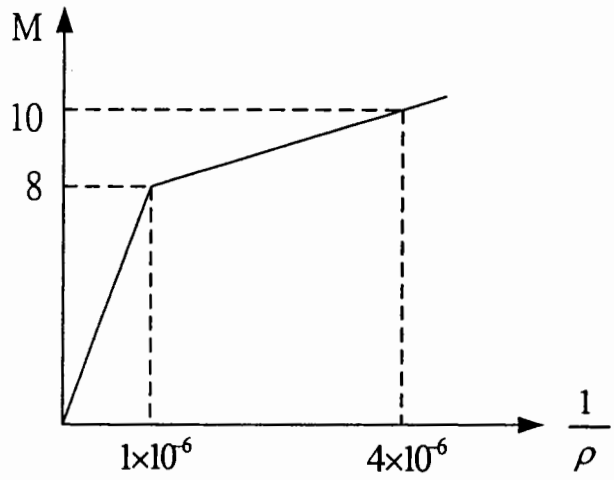


圖 1.b

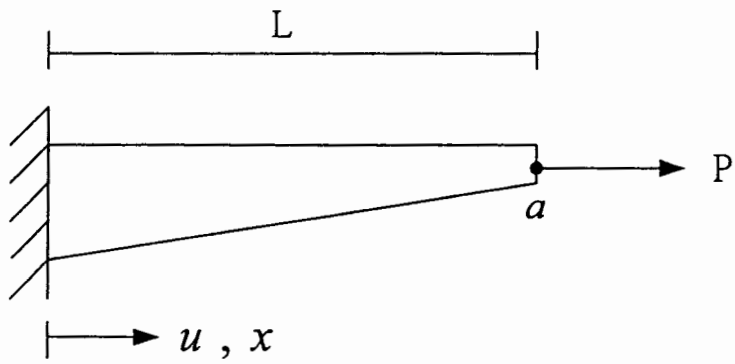


圖 2

1. 如圖 1.*a* 所示簡支樑，端點 *a* 承受彎矩 M=12，其斷面彎矩與曲率的關係如圖 1.b 所示。請求 *a* 點的轉角　20%

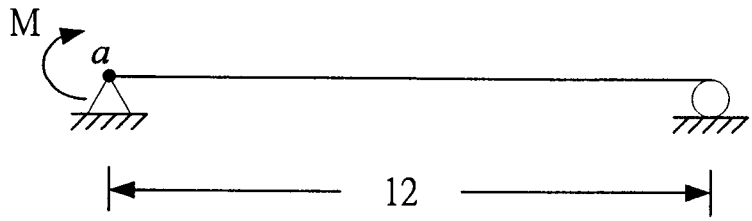


圖 1.*a*

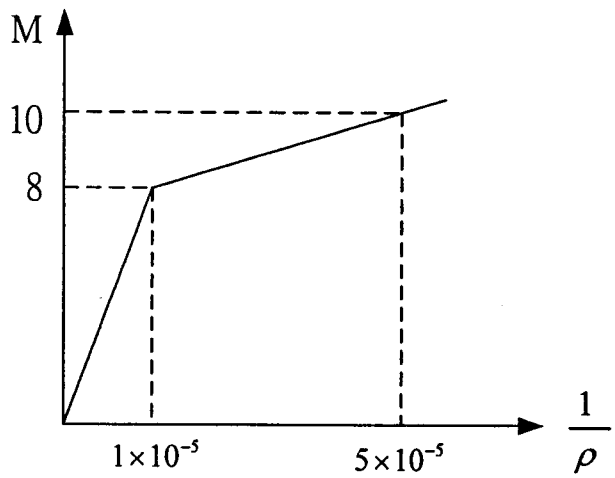


圖 1.b

2. A column with one end clamped and the other end supported by a roller is subjected to an axial compressive force P. (20%)
   (1) Set up the differential equation that governs the buckling behavior of this column.
   (2) Solve the eigenvalue problem to determine the buckling load and the associated buckling mode.
   (3) Derive the elastic and the geometric stiffness matrices for this column.

3. 請解釋下列名詞, 並列出數學表示式(20 %)

(a). displacement

(b). strain

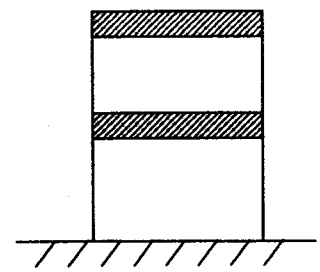
(c). stress

(d). constitutive law

(e). traction

4. A 2-DOF structure system with mass [M]、stiffness [K] as shown in below: (20%)

$$[M]=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}\ \text{kip-sec}^2/\text{in} \qquad [K]=\begin{bmatrix}1204 & -217\\ -217 & 1204\end{bmatrix}\ \text{kip/in}$$



(1). Calculate the modal frequency and period.

(2). Plot the modal mode shape.

5. 試求出下圖由剛體板及彈簧組合系統的自然頻率。剛體板的長度爲 a，寬度爲 b，剛體板的單位面積質量爲 γ，兩彈簧勁度均爲 k，板的左下角點爲鉸支承，有一 p(t)的外力作用在右下角點的位置，此振動系統的描述亦以右下角點爲基準，定義其位移座標爲 Z(t)。(20%)