國立雲林科技大學
100 學年度碩士班暨碩士在職專班招生考試試題

系所：機械系
科目：工程數學(1)

1. (30%)

By definition, the function $u(t-a)$ is 0 for $t < a$, has a jump of size 1 at $t = a$, and is 1 for $t > a$.

Please find the Laplace transform for the function shown below

$f(t) = \sin(2t)u(t-1)$

2. (20%)

Given an equation as below

$y'' + 3y' + 2y = 2f(t)$,

with $y(0)=1.5$, and a force function f(t) given in figure 1,

please find y(t) **in the range $0 \leq t \leq 1$. (Explicit form is required)**

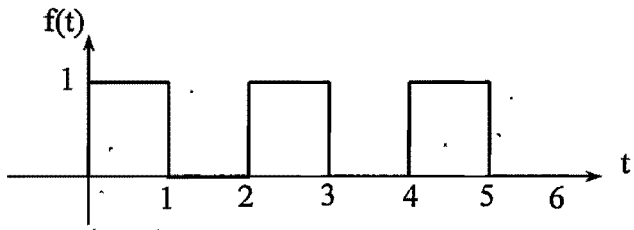

Figure 1.

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3. Let $A=\begin{bmatrix} 5 & 0 & 0 \\ 1 & 0 & 3 \\ 0 & 0 & -2 \end{bmatrix}$

Find (1) the eigenvalues, (2) the corresponding eigenvectors of the matrix A, and (3) the matrix P, matrix P^{-1} and the diagonal matrix D such that $P^{-1}AP=D$. (25%)

4. Let $\vec{f}=f_1\,\vec{i}+f_2\,\vec{j}+f_3\,\vec{k}$ be a vector field where $f_1=f_1(x, y, z)$, $f_2=f_2(x, y, z)$, and $f_3=f_3(x, y, z)$, and $\phi=\phi(x,y,z)$ be a scalar field. Prove that (1) div (curl $\vec{f}$) = 0 (10%) and (2) $\nabla\cdot(\phi\vec{f})=\vec{f}\cdot\nabla\phi+\phi\nabla\cdot\vec{f}$ (15%)。

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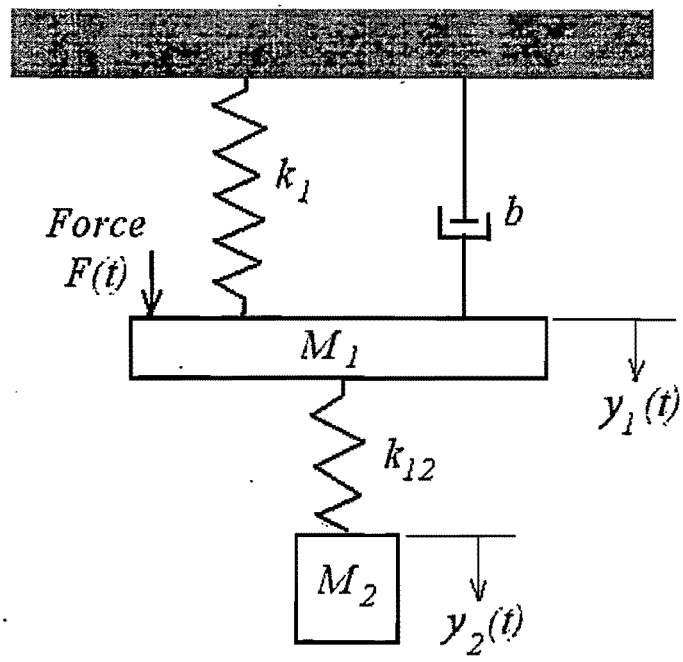
系所：機械系
科目：自動控制(1)

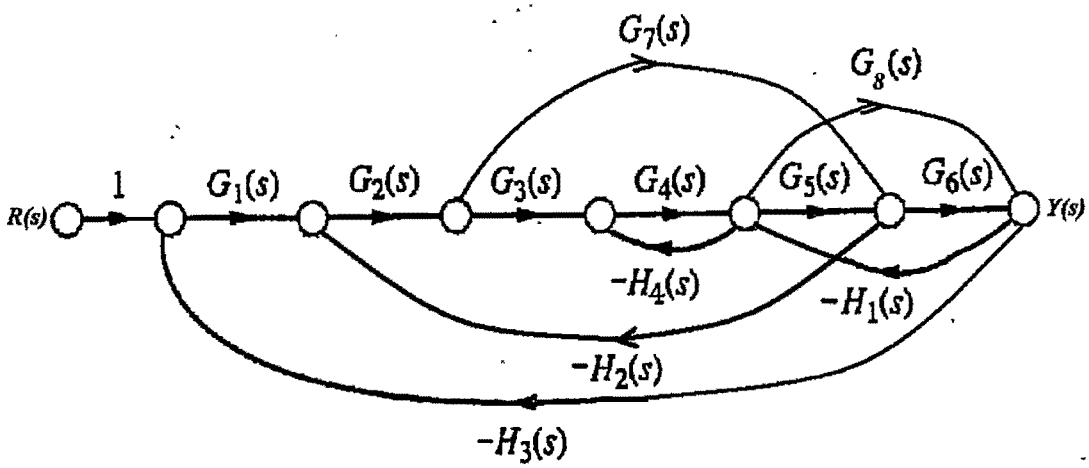
1. For the mechanical system shown below.

(a) Obtain the differential equations describing the system. (10%)

(b) Using Cramer's rule to solve the transfer function $G(s)=Y_1(s)/F(s)$. (15%)



2. For the signal-flow-graph shown below, find the transfer function $T(s)=Y(s)/R(s)$. (25%)



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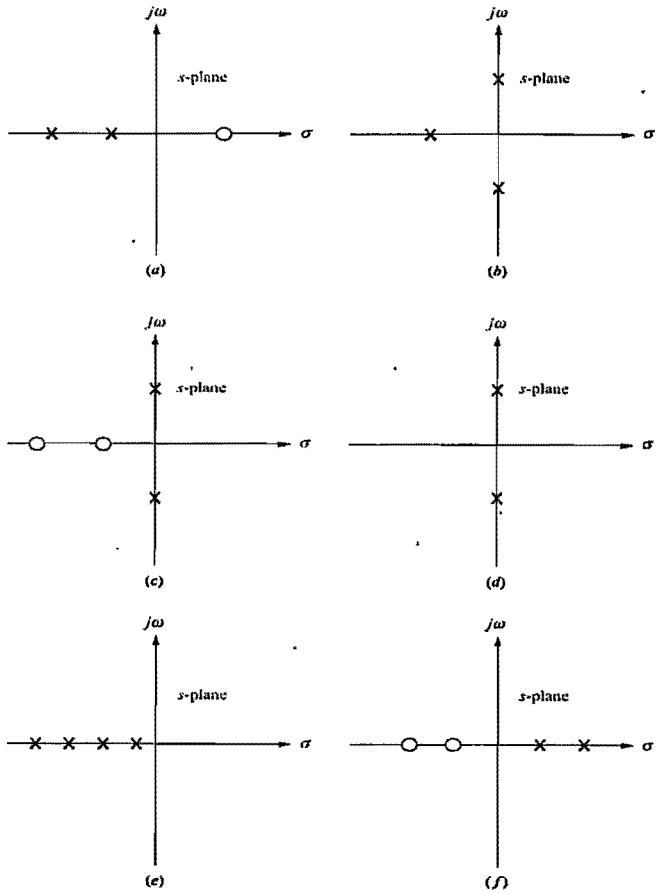
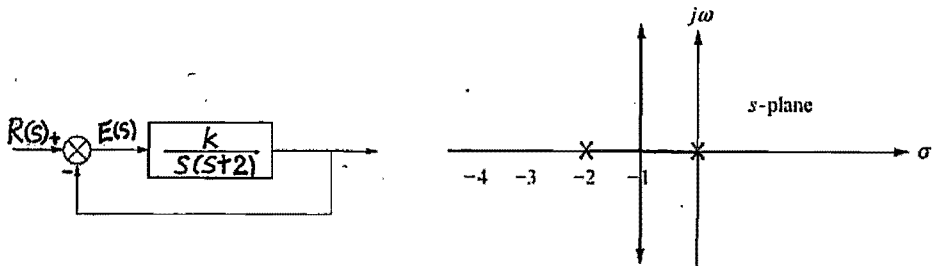
3. Sketch the general shape of the root locus for each of the plots shown below.(20%)

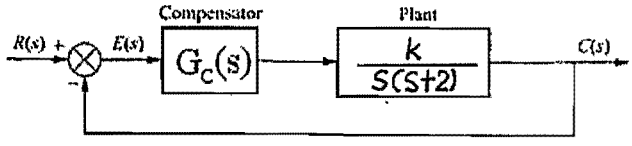


4. 系統及其根軌跡如下圖



a. 希望系統的 closed-loop poles $S=-1\pm j\sqrt{3}$ 求系統之 k=? e_{ss}=? (10%) $(R(s)=\frac{1}{s^2})$

b. 試設計補償器 $G_c(s)$，使補償後系統的穩態誤差 e_{ss} 降低 10 倍，並儘量維持系統的暫態反應。試求系統補償後的 closed-loop poles S=？系統補償後的 k=? (20%)



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100學年度碩士班暨碩士在職專班招生考試試題

系所：機械系
科目：機械製造

1. 從材料加工成形機理來分析，材料加工可分爲哪三類？請分別簡述此三類加工法及舉例各有哪些典型加工方法？ (15%)

2. 奈米科技是指在奈米尺度(1-100nm)上研究物質的特性和相互作用。當材料結構小到奈米尺寸時，請說明有哪些效應造成奈米材料具有與普通材料不同的特異性能。 (10%)

3.

(a) Define the modulus of elasticity (Young's modulus) for a metal. (5%)

(b) Define the yield strength for a metal or alloy as used in engineering design. (5%)

(c) How is the yield strength (0.2 percent offset) determined from the engineering stress-strain diagram? (5%)

(d) What is meant by toughness? How does it differ from strength? (10%)

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4. Please draw the setup of the electrochemical machining (ECM) process and describe the principle of operation. (10%)

5. Please draw the setup of the electro-discharge chemical machining (EDM) process and describe the principle of operation. (10%)

6. Please describe the definitions of surface roughness below and the principle of operation of optical interference microscope for the measurement of surface roughness. (20%)

(a) Arithmeric Mean Value (R_a)
(b) Root-Mean-Square Roughness (*RMS*)
(c) Maximum Roughness Height (R_t)

7. In IC fabrication, photolithography is a main step to define the dimension of transistors. Please describe the process of pattern transfer by photolithography. (10%)

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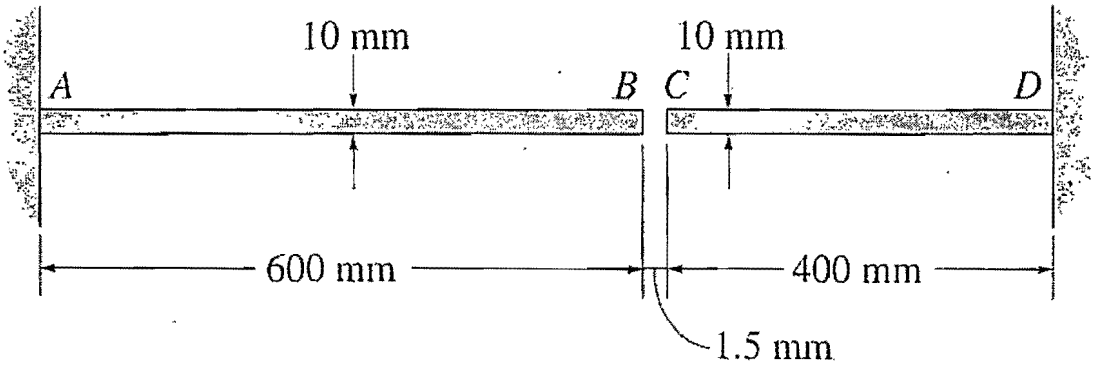
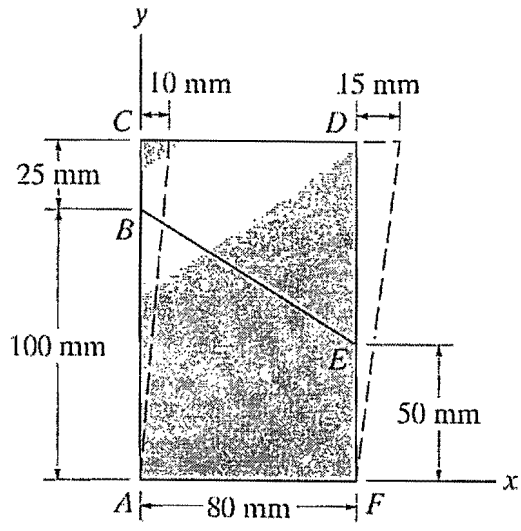
系所：機械系
科目：材料力學

1. A thermo gate consists of a 6061-T6-aluminum plate AB and an Am-1004-T61-magnesium plate CD, each having a width of 15 mm and fixed supported at their ends. (a) If the gap between them is 1.5 mm when the temperature is $T_1 = 25^0C$, determine the temperature required to just close the gap. (b) Also, what is the axial force in each plate if the temperature becomes $T_2 = 100^0C$? Assuming bending or buckling will not occur. The Young's modulus and coefficient of thermal expansion for both materials are as follows:
$E_{al} = 68.9GPa$, $\alpha_{al} = 24\text{x}10^{-6}/^0C$ for aluminum
$E_{mg} = 44.7GPa$, $\alpha_{mg} = 26\text{x}10^{-6}/^0C$ for magnesium [25%]



2. The material distorts into the dashed position shown. Determine (a) the average normal strains ε_x, ε_y and the shear strain γ_{xy} at A, and (b) the average normal strain along line AD. [25%]



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3. A cantilever beam AB carrying two concentrated loads P (Fig.3) has a rectangular cross section of width b and height h. (a) Determine the reaction for the beam. (b) Construct the shear-force and bending-moment diagrams for the beam. (c) Determine the maximum bending and transverse shear stress in the beam. (25%)

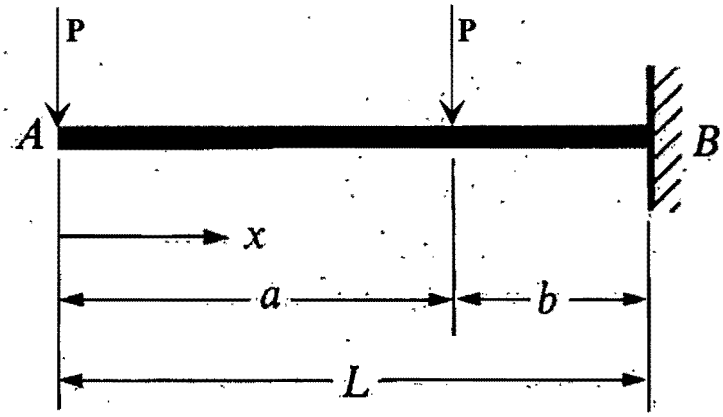

Fig.3

4. Due to the applied loading, the element at point A on the outer surface of solid cylinder in Fig.4 is subjected to the state of stress. (a) Make a sketch for the view of stress of element A and show the values of the stress. (b) Determine the principal stresses acting at element A. (c) Determine the maximum in-plane shear stress at element A. (25%)

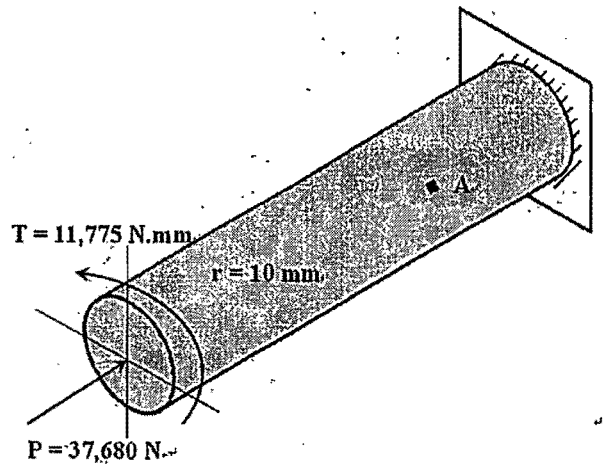

Fig.4

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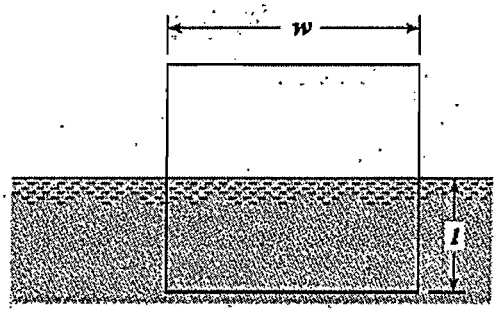
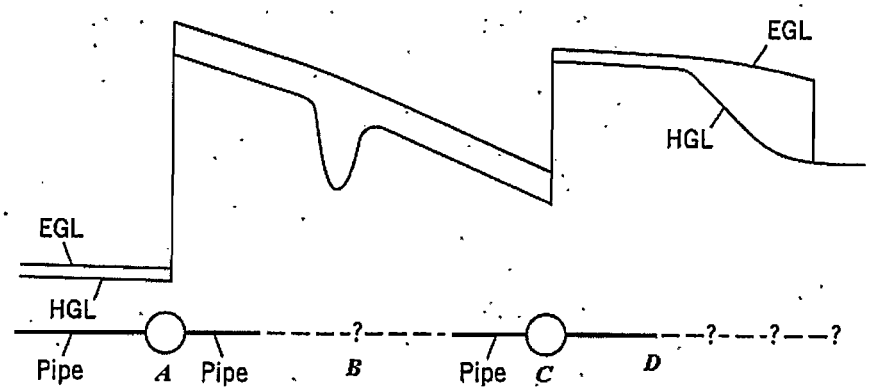
系所：機械系
科目：流體力學(1)

1. A floating cube with side w sinks l in the water as shown in the figure. A) What is the weight of the floating cube? (10%), (B) If the cube has a specific gravity of 0.8, then what will be the depth l ? (10%), (C) Will l be different if the cube is solid or hollow inside? In which case l is larger? Solid or hollow?(5%) (The specific weight of water is γ_w)



2. Referring to the figure, (A) What do you think are at A and C? (B) What do you think is at B? (C) Beyond D, complete the physical setup that could yield the EGL and HGL shown. (D) What other information is revealed by the EGL and HGL? Specify two. (25%) (EGL: Energy Grade Line; HGL: Hydraulic Grade Line)



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系所：機械系
科目：流體力學(1)

3. As shown in Fig. 3 at the entrance to a 3-ft-wide channel the velocity distribution is uniform with a velocity V. Further downstream the velocity profile is given by $u = 4y - 2y^2$, where u is in ft/s and y is in ft. Determine the value of V. (25%)

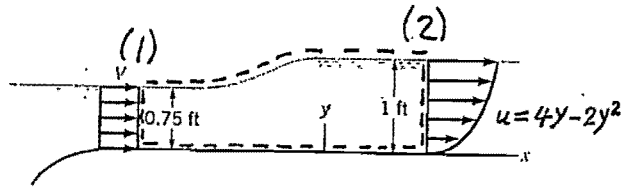

Figure 3

4. The velocity potential for a certain inviscid flow field is

$$\Phi = -(3x^2y - y^3)$$

Where Φ has the units of ft^2/s when x and y are in feet. Determine the pressure difference (in psi) between the points (1,2) and (4,4), where the coordinates are in feet, if the fluid is water and the elevation changes are negligible. (25%)