國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：工程數學(1)

1. Consider the second-order linear homogeneous ODE

$$y'' + 3y' = 0.$$

The solutions of ODE can be written in the form as $y(x) = e^{\lambda x}$ where λ are the roots of characteristic equation of ODE. Please find (a) the characteristic equation (5%), (b) the roots (λ_1, λ_2) of characteristic equation (5%), (c) the general solution as the form as $y(x) = c_1 e^{\lambda_1 x} + c_2 e^{\lambda_2 x}$ (5%) of ODE, and (d) the unique solution that satisfies the initial condition $y(0) = 3$, $y'(0) = 6$ (10%).

2. If f(t) is a function defined for all $t \geq 0$, its Laplace transform is a function of s, say F(s), and is shown as

$$F(s) = L[f(t)] = \int_0^{\infty} e^{-st} f(t)\, dt.$$

Please use Laplace transform formula as shown above to calculate (a) L[1000] (10%) and (b) $L[2e^{5t} + 7e^{-3t}]$ (15%).

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科目：工程數學(1)

Prob. 3 (20%)

Please find

(1) the tangent plane to the surface $z = x^2 + y^2$ at the point (2, −2, 8).

(2) the line normal to the surface $z = x^2 + y^2$ at the point (2, −2, 8).

Prob. 4 (10%)

Consider the system of equations as below:

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + a_{13}x_3 &= y_1 \\ a_{21}x_1 + a_{22}x_2 + a_{23}x_3 &= y_2 \\ a_{31}x_1 + a_{32}x_2 + a_{33}x_3 &= y_3 \end{aligned}$$ with coefficient matrix $A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$

Assume matrix A is an orthogonal matrix. Please show that the solution is

$$x_1 = a_{11}y_1 + a_{21}y_2 + a_{31}y_3$$
$$x_2 = a_{12}y_1 + a_{22}y_2 + a_{32}y_3$$
$$x_3 = a_{13}y_1 + a_{23}y_2 + a_{33}y_3$$

Prob. 5 (20%)

Please show that the eigenvectors associated with distinct eigenvalues are orthogonal for a real symmetric matrix A.

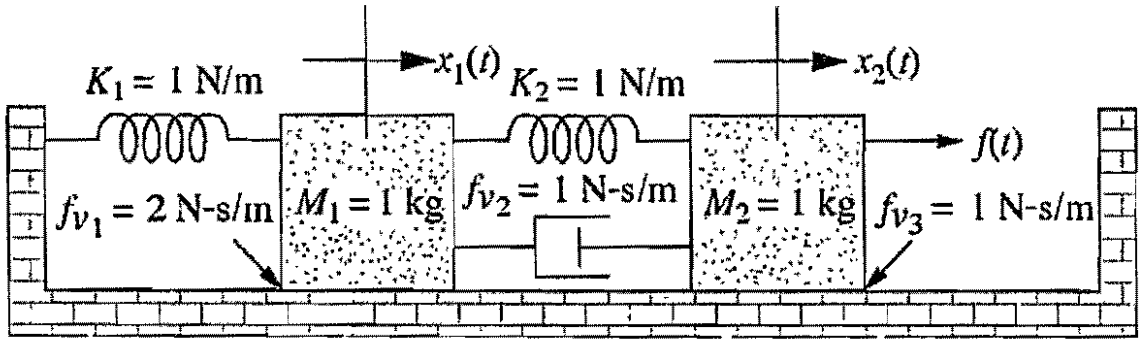
國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

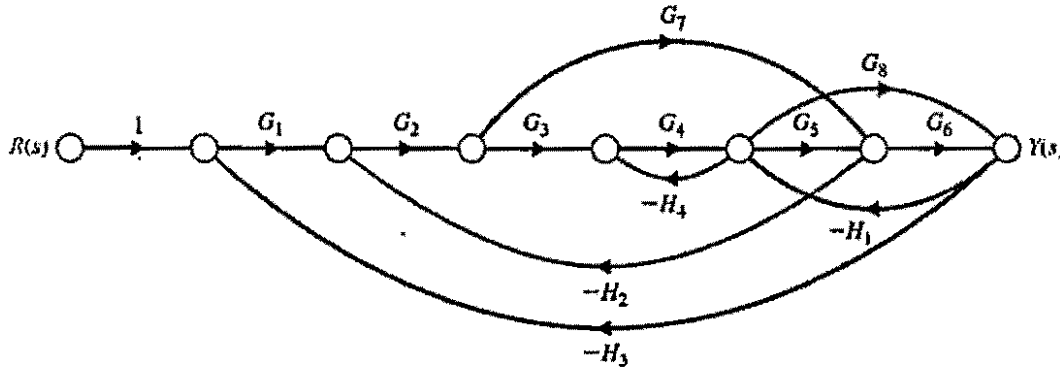
科目：自動控制(1)

1. Modeling of a Mechanical System：(25%)

For the system shown below, find the transfer function, $G(s)=X_1(s) / F(s)$.



2. Use Mason's rule to find the transfer function, $Y(s)/R(s)$, of the signal-flow graph shown below (25%)



國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：自動控制(1)

3. Consider the system shown in Fig. 3.

(A) Sketch the root locus of the system for $k > 0$. (10%)

(B) Determine the range of k for which all of the poles are on the negative *real* axis. (i.e., no imaginary part) (10%)

(C) Sketch the root locus of the system for $k < 0$. (5%)

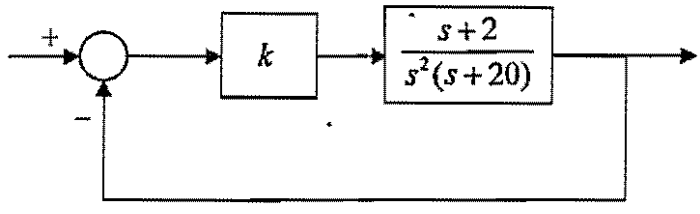


Fig. 3

4. Consider a system described by the following differential equation: (10%)

$$\frac{d^3y}{dt^3}+\frac{d^2y}{dt^2}-6\frac{dy}{dt}=\frac{du}{dt}+0.5u$$

where u is the input variable and y is the output variable. If $u=-k(y-1)$, determine the range of k for which the system is stable.

5. Consider the system described by the transfer function, $\frac{Y}{U}=\frac{s+2}{s(s-4)}$.

Suppose $U=-k\frac{s+1}{s+4}Y$.

(A) Determine the range of k for which the closed-loop system is stable. (7%)

(B) The closed-loop system oscillates if it is marginally stable. What is the *frequency* of oscillation? (8%)

國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：機械製造

1. 圖示說明一般金屬材料在拉伸試驗時，其工程應力(σ)-工程應變(ε)曲線及真實應力(σ_T)-真實應變(ε_T)曲線；並說明真實應力(σ_T)、真實應變(ε_T) 與工程應力(σ)、工程應變(ε)的關係。 (10%)

2. 說明彈性 滯彈性 塑性變形行為及其主要差異。 (10%)

3. 分別圖示說明潛變試驗之潛變曲線及疲勞試驗之S-N曲線。 (10%)

4. 分別以示意圖例舉具共晶反應(eutectic reaction)及共析反應(eutectoid reaction)之二元成分相圖。並說明共晶反應與共析反應之差異。 (10%)

5. 說明經冷加工之金屬材料於退火時產生回復、再結晶及晶粒成長各階段的驅動力、機制及材料組織與性質的變化。 (10%)

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系所：機械系

科目：機械製造

6. 請說明電化學加工(Electrochemical Machining, ECM)與脈衝式電化學加工(Pulsed Electrochemical Machining, PECM)的差異並說明 PECM 相較於 ECM 的優點 (15%)

7. 微電子製造技術中，微影與蝕刻爲重要之製程，可決定微電子的線寬大小。請解釋下列蝕刻製程中之名詞並舉一例來輔助說明:
   (1) Wet etching
   (2) Isotropic etching
   (3) Anisotropic etching
   (4) Physical-chemical etching (20%)

8. 請解釋 Welding, Brazing, 與 Soldering 三種接合方式並說明其不同處 (15%)

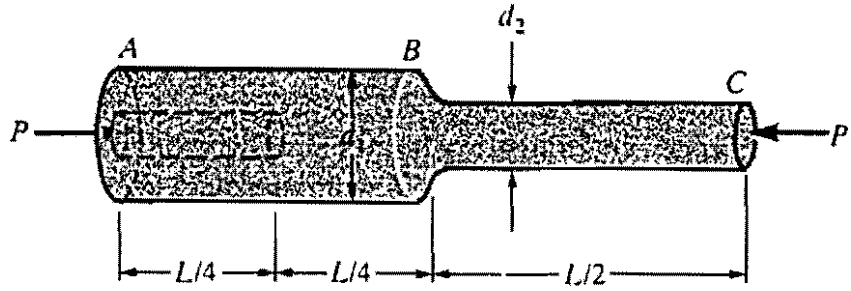
國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：材料力學

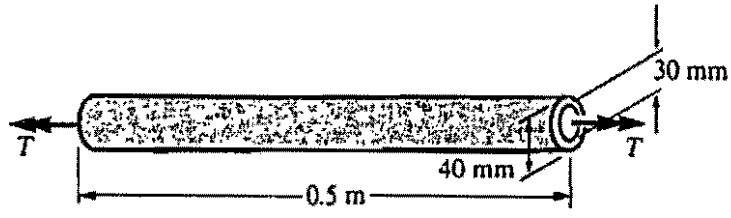
1. A plastic bar ABC of total length L = 1.2 m and Young's modulus E = 4.0 GPa is made of two parts AB and BC of equal length (see figure of Prob. 1). Part AB has diameter d_1 = 100 mm and part BC has diameter d_2 = 60 mm. A longitudinal hole is drilled through part AB for one-half of its length. The bar is compressed by force P = 110 kN acting at the ends. If the shortening of the bar is limited to δ = 8.0 mm, what is the maximum allowable hole diameter d?

(25%)



2. A hollow circular tube of metal is subjected to twisting by torque T applied at the ends (see figure of Prob. 2). The bar is 0.5 m long, and the inside and outside diameters are 30 mm and 40 mm, respectively. It is determined by measurement that the angle of rotation φ is 3.57° when the torque T is 600 N-m. Calculate the shear modulus G for the metal.

(25%)



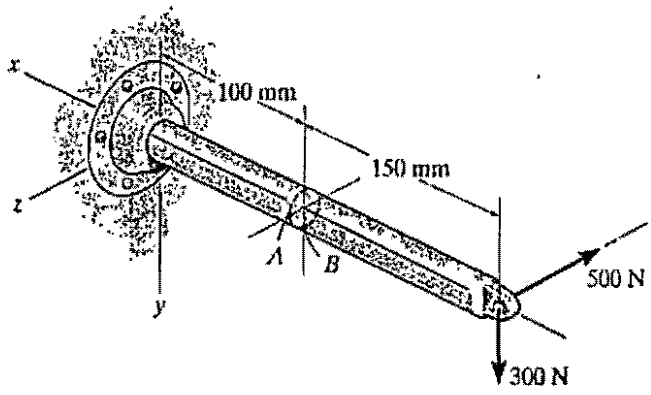
Prob. 2

國立雲林科技大學 103 學年度 碩士班招生考試試題

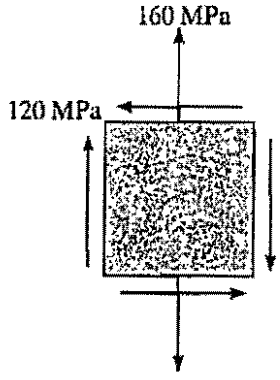
系所：機械系

科目：材料力學

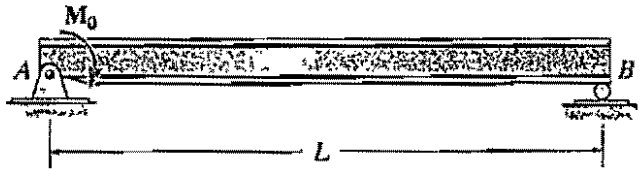
3. The bar has a diameter of 40 mm. If it is subjected to the two force components at its end as shown, determine the state of stress at point A. The distance from the centroid of a semi-circle to its boundary diameter is $4r/3\pi$. [20%]



4. The state of stress at a point is shown on the element. Determine (a) the principal stresses and (b) the maximum in-plane shear stress and average normal stress at the point. [15%]



5. Determine the maximum slope and maximum deflection of the simply supported beam which is subjected to the couple moment M_0. EI is constant. [15%]



國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：流體力學(1)

1. The fluid velocity along the x-axis shown in Figure 1 is changing from 12 m/sec at Point A to 36 m/sec at Point B. It is also known that the velocity is a linear function of distance along the streamline. Determine the accelerations at Points A, B, and C. 25%

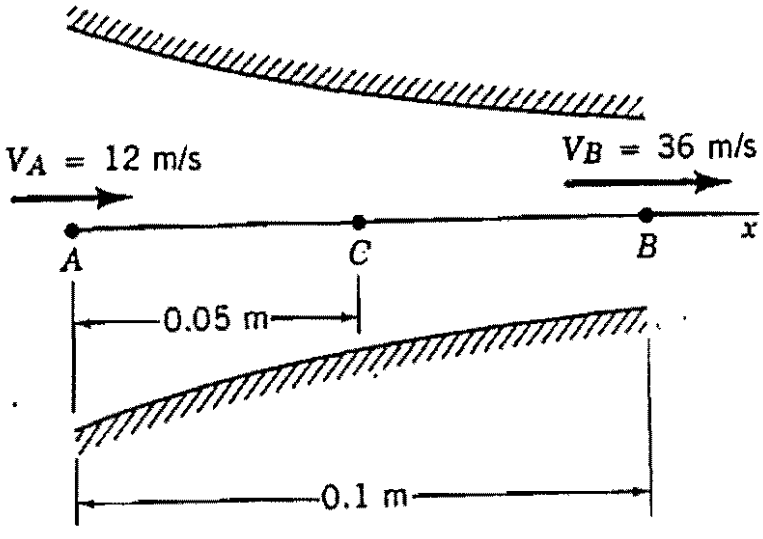


Figure 1

2. An inward flow radial turbine shown in Figure 2 involves a nozzle angle $\alpha_1 = 0^\circ$ and an inlet rotor tip speed U_1= 6m/sec. The ratio of rotor inlet to outlet diameters is 2.0. The absolute velocity leaving the rotor at section (2) is radial with a magnitude of 12m/sec. Determine the energy transfer per unit mass of fluid flowing through this turbine if the fluid is (a) air (b) water. 25%

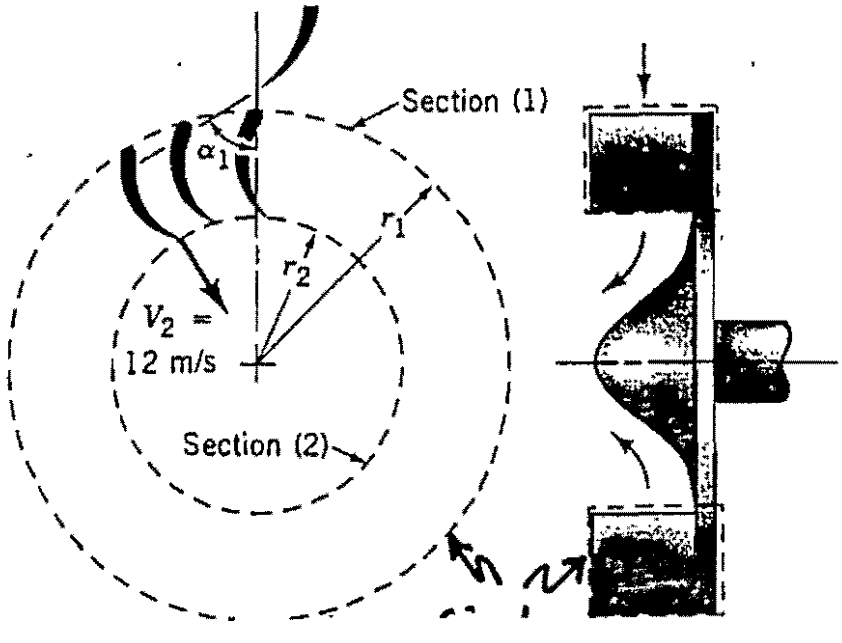


Figure 2

國立雲林科技大學 103 學年度 碩士班招生考試試題

系所：機械系

科目：流體力學(1)

3 (25%)A rectangular tank is filled with liquid of depth ***h*** and is opened to the atmosphere ,

a) Draw the gage pressure distribution on the side wall of the tank and the bottom of the tank.

b) Draw the absolute pressure distribution on the side wall of the tank.

c) If the tank is now closed at the top and pressurized with compressed air, how will the gage pressure distribution change?

d) If the metal tank is sealed and has no window, how can you keep track of the liquid level inside the tank? Please propose a method.

4 (25%)Water is pumped between two tanks as shown in the figure with energy line (EL) indicated. a) Is the fluid being pumped from A to B or B to A? Why? b) Which pipe has the larger diameter? A-P or B-P? Why? c) If we raise tank A to a sufficient height H (with pipe A-P tilted and extended) and replace the pump with a small hydraulic turbine, what will the new energy line look like?