國立雲林科技大學
八十七學年度研究所碩士班入學考試試題

所別：機械所
科目：工程數學

1. To solve the system

$$x' - x - y = 3t$$

$$x' + y' - 5x - 2y = 5 \qquad (20\%)$$

2. Find the Fourier transform of

$$f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases} \qquad (10\%)$$

3. Evaluate $\int_{1+i}^{2+4i} z^2 dz$ along the parabola $x = t$, $y = t^2$, where $1 \le t \le 2$, and $i = \sqrt{-1}$. (20%)

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科目：工程數學

4. Given the equation $y'' + ay' + by = 0$.....(eq:1)
If $\lambda^2 + a\lambda + b = 0$ has double root λ_1, and one of the nontrivial solution of eq.1 is $e^{\lambda_1 x}$, show how to obtain the other nontrivial solution $xe^{\lambda_1 x}$. (18%)

5. Given two vectors **A** and **B** in R^3 as below

$$\mathbf{A} = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$$

(1) Please find a surface in R^3, which contains vectors **A** and **B**. (10%)

(2) Point $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ is reflected by the surface obtained in (1), find the linear transformation from $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ to $\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$ (10%)

(3) Find the eigenvalues of above linear transformation. (6%)

(4) Find the corresponding eigenvectors for each eigenvalue. (6%)

(Note : Part (3) and Part(4) in Prob **5.** may be directly obtained from your geometrical sense.)

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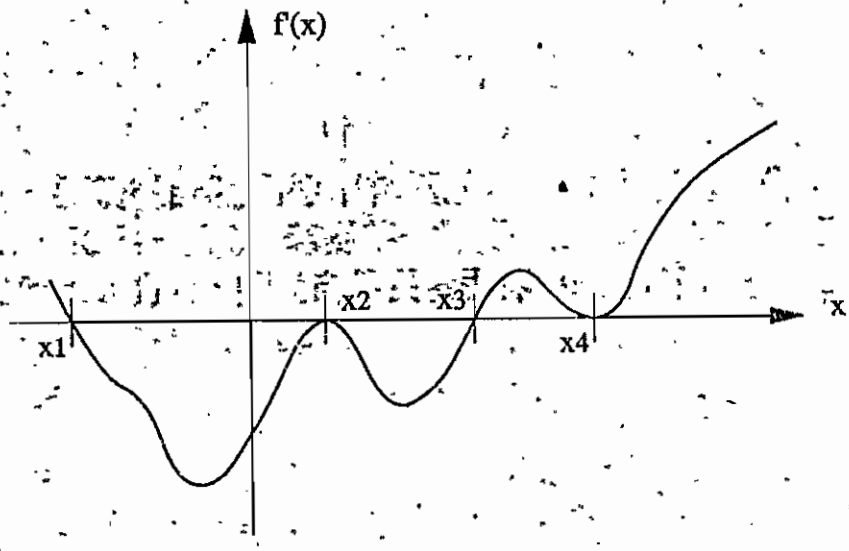
所別：機械所
科目：應用微積分

1. Given the graph of the derivative of f(x) as shown below, please show all local maximum and minimum points of f(x) and explain why they are or are not. (20%)



2. Please find the following integrals.

(1) $\int e^{ax}\sin(bx)\,dx$, where a and b are constants. (15%)

(2) $\int \sin^5(x)\cos(x)\,dx$ (15%)

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所別：機械所
科目：應用微積分

3.試求周長爲 2a 之矩形的最大面積。（25%）

4.根據虎克定律，一彈簧從自然長度引伸或壓縮 x 單位長度時，會產生應力， F(x)=Kx ， K 爲一常數。若對某一彈簧而言，將其自然長度引伸 50mm 需 18Newton 的力，問從自然長度引伸 100mm 下作多少功？（25%）

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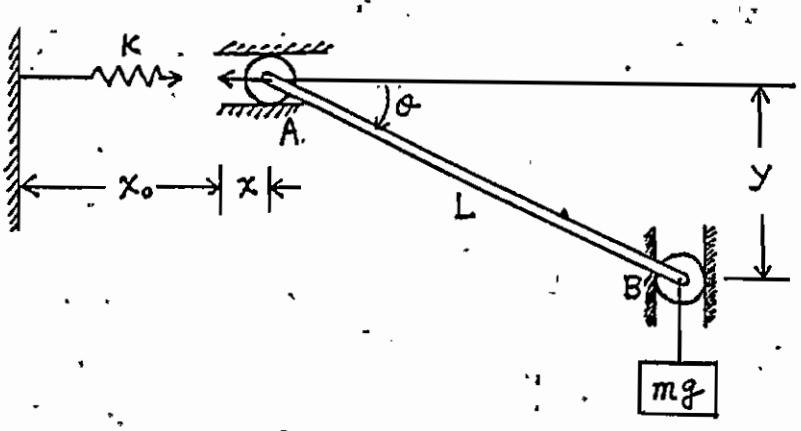
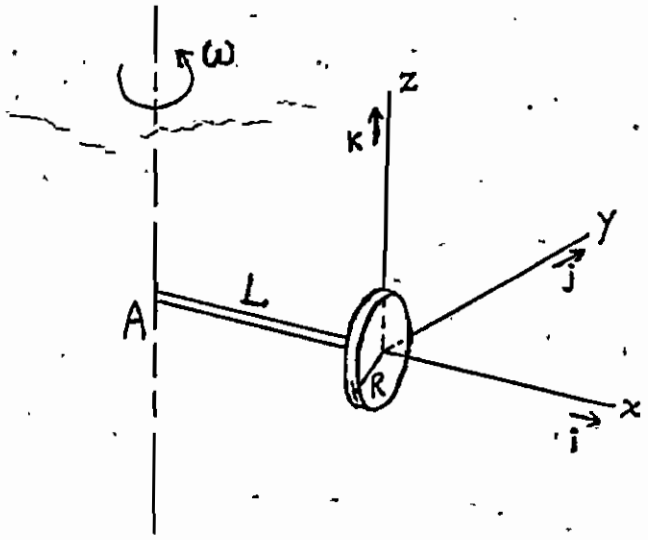
所別：機械所
科目：動力學

1. The following system consists of a mass m suspended through a massless link of length L and a spring of stiffness k, as shown. When the spring is unstretched, the link is in the horizontal position. Use the principle of virtual work to calculate the angle θ corresponding to the equilibrium position of the system. [25%]



2. Calculate the angular momentum of the wheel about A as shown in the figure. The massless shaft of length L is rotating about the vertical axis with angular velocity ω. It always remains in the horizontal plane normal to the wheel. Assuming that the wheel is rolling without slipping. [25%]



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所別：機械所
科目：動力學

3. The slender bars *AB* and *BC* of the linkage in Figure 3 have mass m, $2m$, and length L respectively. The collar *C* has mass *M*. A torsional spring at *A* exerts a clockwise couple $k\theta$ on bar *AB*. The system is released from rest in the position $\theta = 0$ and allowed to fall. Neglecting friction, determine the angular velocity $\omega = d\theta / dt$ of bar *AB* as a function of θ. Use energy method only! 〔25 %〕

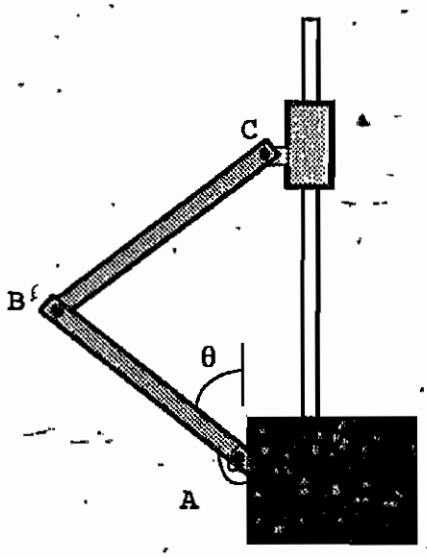

Figure 3

4. See Figure 4, arm *AB* is rotating with an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s^2, both in the clockwise direction. Determine
(a) the angular acceleration of arm *BC*. [15%]
(b) the velocity at which it slides relative to the sleeve at *C*. [10%]

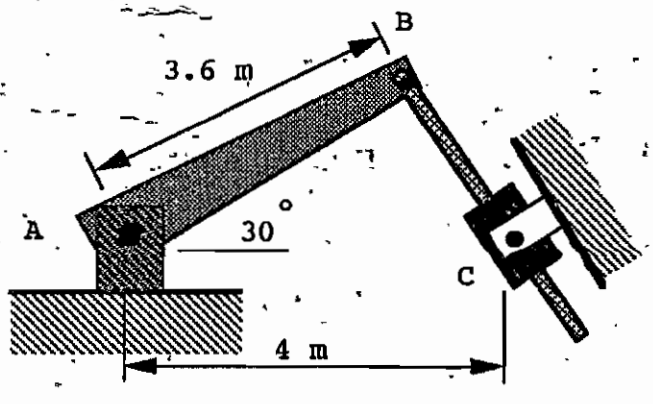

Figure 4

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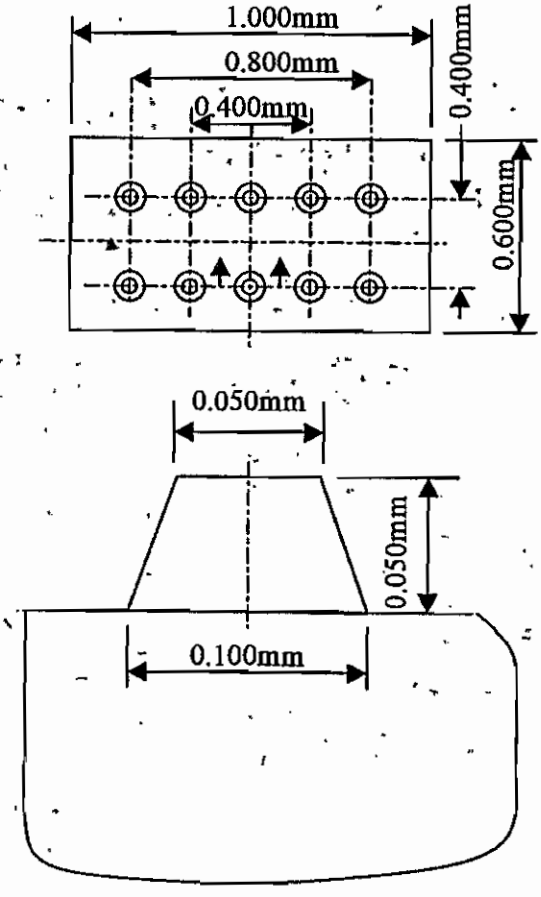
所別：機械所
科目：機械製造

1. 請問下圖之不銹鋼工件可能之加工製造方法有哪些？(10%)並請比較其優缺點及是否適合量產(15%)。(1μm≒0.001mm)



2. 目前資訊電子週邊產品常要求輕薄短小，如行動電話外殼可以所謂塑膠薄肉射出成型 (plastic thin wall injection molding) 製造，請問其與傳統方式在模具設計、製造與成型條件上有何差別？(25%)

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所別：機械所
科目：機械製造

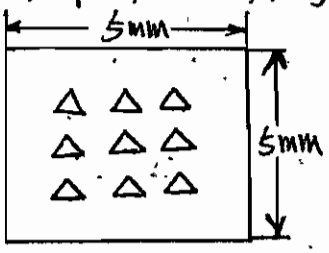
3. (a)鋼片或鋁片在成形後,常發生突耳(earing)現象，說明其原因及對策。(7%)
(b)試說明熱機處理 (thermomechanical treatment) 的原理及其應用實例。(7%)
(c)說明材料的各種強化機制(mechanism)。(6%)

4. (a)試述 electroformimg 的原理，並舉例說明其應用。 (5%)
(b)試述 ultrasonic welding 的原理，製程參數的影響及其優點與缺點。 (5%)
(c)試述 chemical machining 的原理，製程參數的影響及其優點與缺點。 (5%)

5. (a)試述用金屬粉末射出成形生產鐵鎳合金小齒輪的流程及其可能發生的缺陷與對策。 (8%)
(b)試述用脫臘鑄造生產不銹鋼高爾夫球頭的流程及其可能發生的缺陷與對策。 (7%)

國立雲林科技大學　　所別：機械所
八十七學年度研究所碩士班入學考試試題　　科目：專業實務

1. 試繪圖說明加工如圖所示之工件，試舉3種方法說明之，並分別論述在加工精度、加工效率、加工成本等方面的優缺點。(10%)



厚度50um，材質SUS304
其中△孔的外接圓直徑為50um。

2. 試繪圖說明適用於半導体IC等微小精密元件的熔接技術有那兩種，試分別論述其優缺點，並從熱傳的觀點來論述其對於熔點差異極大的不同材料在接合時的優點。(10%)

3. 試論述微放電加工的電源為何使用RC回路，試推導其充電和放電回路的數學式，並設計一電源回路來改善RC回路的缺點。(10%)

4. 試繪圖說明快速無模成形技術(Rapid Prototyping)的原理，列舉3種不同的材料來說明其成形的方法，並說明如何配合CAD/CAM來提升其成形精度。(10%)

5. 試繪圖說明超音波加工原理，並從材料破壞的觀點來說明那些材料適合使用此方法來進行加工，那些材料不適合。(10%)

國立雲林科技大學
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所別：機械所
科目：專業實務

6. 電腦(computer)在機械工程上的應用，機械工程人員需具備那些電腦知識。(10%)

7. 能源的形態有那些種類，並說明其如何產生能量。(10%)

8. 電動機和發電機有何差異。(10%)

9. 請舉例說明在機械上摩擦力的應用。(10%)

10. 如何使用上限只有五十公斤的磅秤去測量一輛摩托車。(10%)

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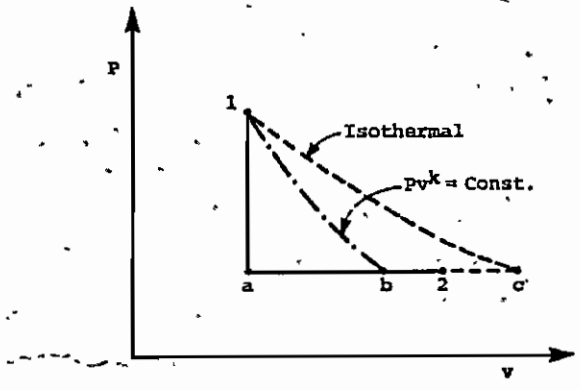
所別：機械所
科目：熱力學

1.(25%)Consider a gas mixture whose apparent molecular weight is 33, initially at 3 bars and 300 K, and occupying a volume of 0.1 m^3. The gas undergoes an expansion to 0.2 m^3 during which the pressure-volume relation is $pV^{1.3} = C$. Assume the ideal gas model with $c_v = 0.6 + (2.5 \times 10^{-4})T$, where T is in K and c_v has units of kJ/kgK. Neglecting kinetic and potential energy effects. Determine

(a)the mass of gas, in kg. (6%)
(b)the final pressure, in bars. (6%)
(c)the final temperature, in K. (6%)
(d)the work and heat transfer, each in kJ. (7%)

2.(25%)Derive $\Delta S = R \ln P_1/P_2 + c_p \ln T_2/T_1$ for the entropy change of an ideal gas undergoing any reversible or irreversible process, by using the definition for the change in entropy $ds = \delta q/T$ along any reversible path connecting the same end states. Assume constant specific heats.



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所別：機械所
科目：熱力學

3. (25%) A Carnot vapor refrigeration cycle uses Refrigerant 134a as the working fluid. The refrigerant enters the condenser as saturated vapor at 28°C and leaves as saturated liquid. The evaporator operates at a temperature of -10°C. States your assumptions clearly, then
   a) Draw the T-s diagram, and determine, in kJ per kg of refrigerant flow,
   b) the work input to the compressor,
   c) the work developed by the turbine,
   d) the heat transfer to the refrigerant passing through the evaporator, and
   e) the coefficient of performance (COP) of the cycle.(5% each question)

4. (25%) a) How does useful work differ from actual work? For what kind of systems are these two identical?(7%)
   b) What does the area enclosed by the cycle represent on a P-v diagram? How about on a T-s diagram?(6%)
   c) Consider a simple ideal Rankine cycle with fixed turbine inlet condition. What is the effect of lowering the condenser pressure on turbine work output and heat rejected ?(6%)
   d) How does a diesel engine differ from a gasoline engine?(6%)

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科目：熱力學

Properties of Saturated Refrigerant 134a (Liquid–Vapor): Temperature Table

Temp. °C	Press. bars	Specific Volume m³/kg		Internal Energy kJ/kg		Enthalpy kJ/kg			Entropy kJ/kg · K		Temp. °C
		Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g	
−40	0.5164	0.7055	0.3569	−0.04	204.45	0.00	222.88	222.88	0.0000	0.9560	−40
−36	0.6332	0.7113	0.2947	4.68	206.73	4.73	220.67	225.40	0.0201	0.9506	−36
−32	0.7704	0.7172	0.2451	9.47	209.01	9.52	218.37	227.90	0.0401	0.9456	−32
−28	0.9305	0.7233	0.2052	14.31	211.29	14.37	216.01	230.38	0.0600	0.9411	−28
−26	1.0199	0.7265	0.1882	16.75	212.43	16.82	214.80	231.62	0.0699	0.9390	−26
−24	1.1160	0.7296	0.1728	19.21	213.57	19.29	213.57	232.85	0.0798	0.9370	−24
−22	1.2192	0.7328	0.1590	21.68	214.70	21.77	212.32	234.08	0.0897	0.9351	−22
−20	1.3299	0.7361	0.1464	24.17	215.84	24.26	211.05	235.31	0.0996	0.9332	−20
−18	1.4483	0.7395	0.1350	26.67	216.97	26.77	209.76	236.53	0.1094	0.9315	−18
−16	1.5748	0.7428	0.1247	29.18	218.10	29.30	208.45	237.74	0.1192	0.9298	−16
−12	1.8540	0.7498	0.1068	34.25	220.36	34.39	205.77	240.15	0.1388	0.9267	−12
−8	2.1704	0.7569	0.0919	39.38	222.60	39.54	203.00	242.54	0.1583	0.9239	−8
−4	2.5274	0.7644	0.0794	44.56	224.84	44.75	200.15	244.90	0.1777	0.9213	−4
0	2.9282	0.7721	0.0689	49.79	227.06	50.02	197.21	247.23	0.1970	0.9190	0
4	3.3765	0.7801	0.0600	55.08	229.27	55.35	194.19	249.53	0.2162	0.9169	4
8	3.8756	0.7884	0.0525	60.43	231.46	60.73	191.07	251.80	0.2354	0.9150	8
12	4.4294	0.7971	0.0460	65.83	233.63	66.18	187.85	254.03	0.2545	0.9132	12
16	5.0416	0.8062	0.0405	71.29	235.78	71.69	184.52	256.22	0.2735	0.9116	16
20	5.7160	0.8157	0.0358	76.80	237.91	77.26	181.09	258.36	0.2924	0.9102	20
24	6.4566	0.8257	0.0317	82.37	240.01	82.90	177.55	260.45	0.3113	0.9089	24
26	6.8530	0.8309	0.0298	85.18	241.05	85.75	175.73	261.48	0.3208	0.9082	26
28	7.2675	0.8362	0.0281	88.00	242.08	88.61	173.89	262.50	0.3302	0.9076	28
30	7.7006	0.8417	0.0265	90.84	243.10	91.49	172.00	263.50	0.3396	0.9070	30
32	8.1528	0.8473	0.0250	93.70	244.12	94.39	170.09	264.48	0.3490	0.9064	32
34	8.6247	0.8530	0.0236	96.58	245.12	97.31	168.14	265.45	0.3584	0.9058	34
36	9.1168	0.8590	0.0223	99.47	246.11	100.25	166.15	266.40	0.3678	0.9053	36
38	9.6298	0.8651	0.0210	102.38	247.09	103.21	164.12	267.33	0.3772	0.9047	38
40	10.164	0.8714	0.0199	105.30	248.06	106.19	162.05	268.24	0.3866	0.9041	40
42	10.720	0.8780	0.0188	108.25	249.02	109.19	159.94	269.14	0.3960	0.9035	42
44	11.299	0.8847	0.0177	111.22	249.96	112.22	157.79	270.01	0.4054	0.9030	44
48	12.526	0.8989	0.0159	117.22	251.79	118.35	153.33	271.68	0.4243	0.9017	48
52	13.851	0.9142	0.0142	123.31	253.55	124.58	148.66	273.24	0.4432	0.9004	52
56	15.278	0.9308	0.0127	129.51	255.23	130.93	143.75	274.68	0.4622	0.8990	56
60	16.813	0.9488	0.0114	135.82	256.81	137.42	138.57	275.99	0.4814	0.8973	60
70	21.162	1.0027	0.0086	152.22	260.15	154.34	124.08	278.43	0.5302	0.8918	70
80	26.324	1.0766	0.0064	169.88	262.14	172.71	106.41	279.12	0.5814	0.8827	80
90	32.435	1.1949	0.0046	189.82	261.34	193.69	82.63	276.32	0.6380	0.8655	90
100	39.742	1.5443	0.0027	218.60	248.49	224.74	34.40	259.13	0.7196	0.8117	100

國立雲林科技大學
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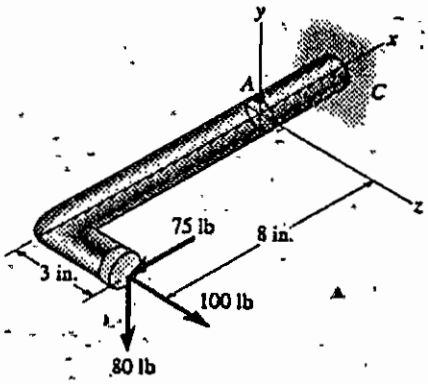
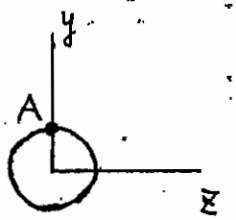
所別：機械所
科目：材料力學

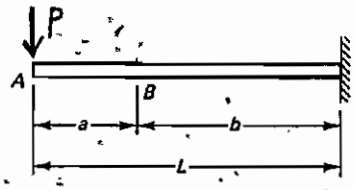
1. The 1-in.-diameter rod is subjected to the loads shown.
   (a) Determine the state of stress at point A, and show the results on a differential element located at this point. (20%)
   (b) If the failure stress at A is 10 ksi and the maximum stress criterion is used, determine the safety factor at point A. (5%)





2. (a) Show that the deflection at A for the cantilever beam due to force P at A is

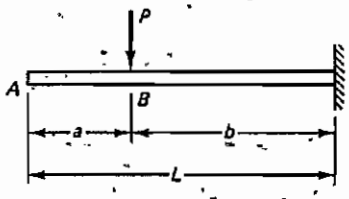
$$\upsilon_{AA} = \frac{PL^3}{3EI}$$



(8%)

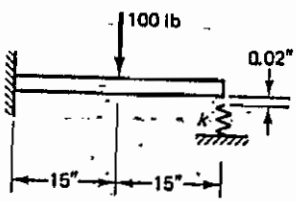
(b) Show that the deflection at A for the cantilever beam due to force P at B is

$$\upsilon_{AB} = \frac{Pb^2(3L-b)}{6EI}$$



(8%)

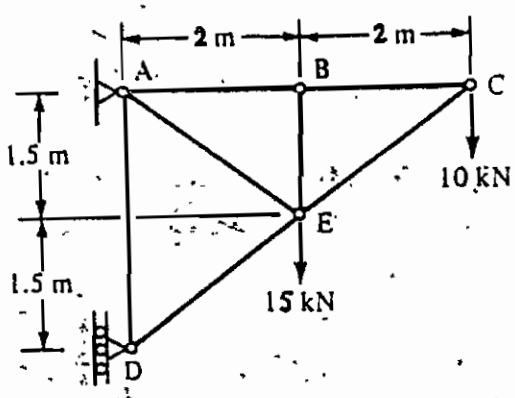
(c) A 30-in cantilever beam of constant flexural rigidity, $EI = 10^7$ lb-in^2, initially has a gap of 0.02 in between its end and the spring. The spring constant $k = 10$ lb/in. If a force of 100 lb is applied to the beam, how much of this force will be carried by the spring? (9%)

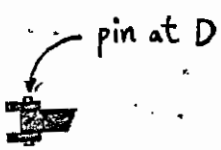


國立雲林科技大學
八十七學年度研究所碩士班入學考試試題

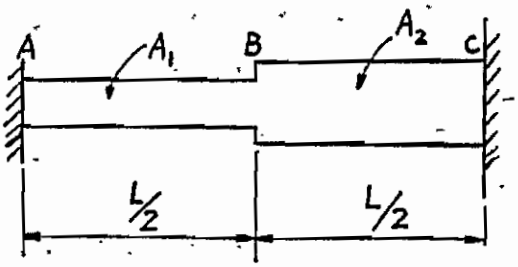
所別：機械所
科目：材料力學

3. The truss consists of seven pin-connected 50-mm-diameter rods. Young's modulus $E = 200$ GPa and Poisson's ratio $\nu = 0.3$ for the rods. In the rod AB, calculate: (a) the normal stress and shear stress on the cross section; (b) the total elongation; (c) the change in its diameter. If the pin at D is subjected to double shear, determine (d) the shear stress in the pin. [25%]



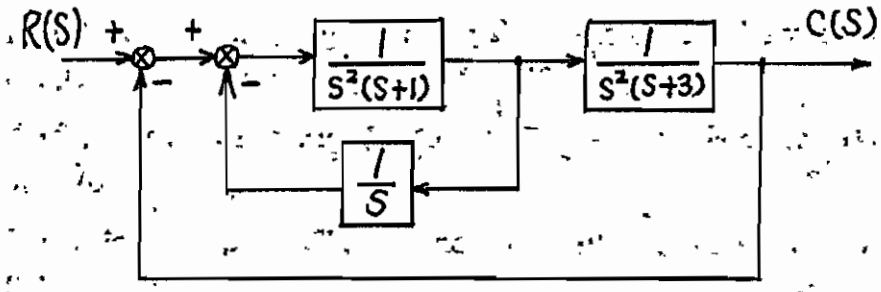


4. A nonprismatic bar ABC of total length L is held between rigid supports. The cross-sectional areas for the left half and the right half of the bar are A_1 and A_2 respectively. Young's modulus is E and the coefficient of thermal expansion is α for the whole bar. Assuming that the bar is subjected to a uniform temperature drop (ΔT), derive the expressions for (a) the axial stress in the bar; (b) the strain in the bar; (c) displacement of point B and its direction (toward the left or the right). [25%]



國立雲林科技大學 所別：機械所
八十七學年度研究所碩士班入學考試試題 科目：自動控制

1. Given the system shown below, find the following:



(a) The closed-loop transfer function (5%)

(b) The system type (5%)

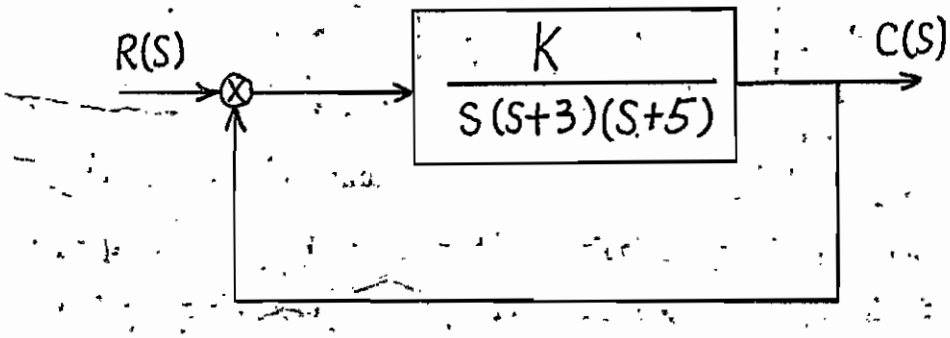
(c) The steady-state error for an input of 5tu(t) (where u(t) is a unit step function) (5%)

(d) Is the closed-loop system stable? Discuss the validity of your answer to part (c). (10%)

2. For the following unity feedback system, find the range of gain, K, for stability by using;

(a) Routh-Hurwitz Criterion (10%)

(b) Nyquist Criterion. (15%)



國立雲林科技大學　　所別：機械所
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3. Consider the system shown in Fig. 3a.

(A) If $f(e)$ is as shown in Fig. 3b, and $r(t) = 1$, determine the steady-state error between y and r (i.e., steady-state value of e). (6%)

(B) If $f(e)$ is as shown in Fig. 3b, and $r(t) = 2 - 2e^{-5t}$, determine the steady-state value of e. (6%)

(C) If $f(e)$ is as shown in Fig. 3c, and $r(t) = 10$, determine the steady-state value of e. (13%)

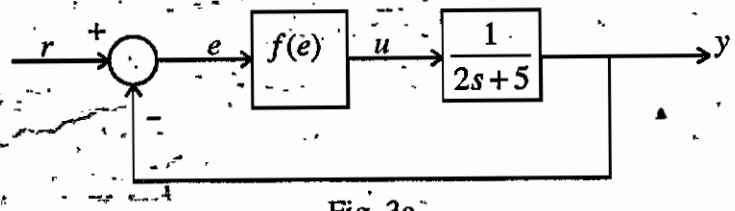


Fig. 3a

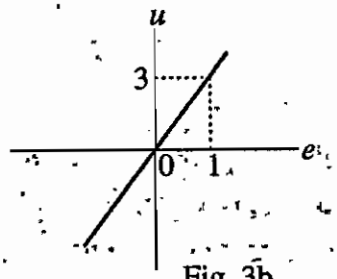


Fig. 3b

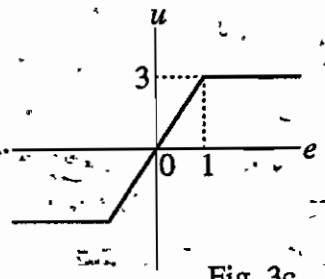


Fig. 3c

4. Consider the system described by

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -20 & 3 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u + \begin{bmatrix} 0 \\ 1 \end{bmatrix} d$$

$$y = [2 \;\; 1]\mathbf{x} + n$$

where d and n are constants.

(A) Let $u = -ky$. Find all values of k for which the system is stable. (8%)

(B) If $d = 1$, $n = 0$, and $u = -ky$, find all values of k for which the steady-state value of $|y|$ is smaller than 0.1. (6%)

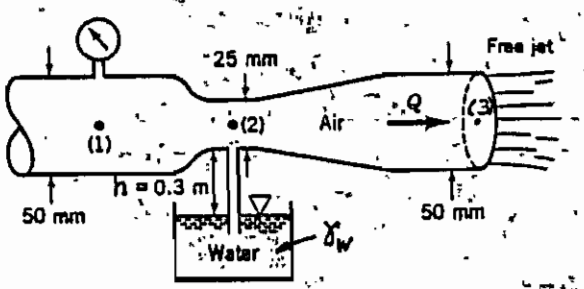
(C) If $d = 1$, $n = 0.3$, and $u = -ky$, find all values of k for which the steady-state value of $|y|$ is smaller than 0.1. (6%)

(D) Is the system observable? (5%)

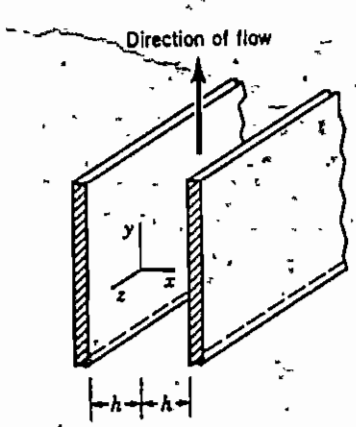
國立雲林科技大學
八十七學年度研究所碩士班入學考試試題

所別：機械所
科目：流體力學

1. Air flows through the device shown in the following figure. If the flowrate is large enough, the pressure within the constriction will be low enough to draw the water up into the tube. Determine the flowrate, Q, and the pressure needed at section (1) to draw the water into section (2). Neglect compressibility and viscous effects. **(25%)**



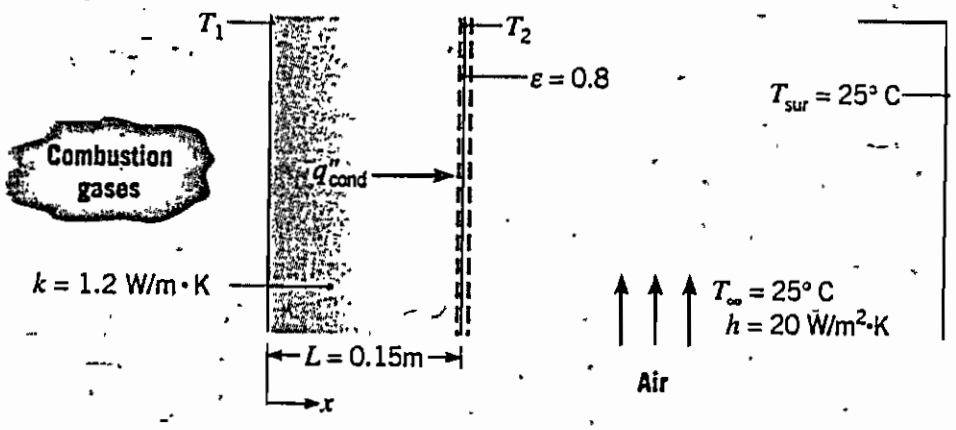
2. A viscous, incompressible fluid flows between the two infinite, vertical, parallel plates of the following figure. Determine, by use of the Navier-Stokes equations, an expression for thhe pressure gradient in the direction of flow. Express your answer in terms of the mean velocity. Assume that the low is laminar, steady, and uniform. **(25%)**



國立雲林科技大學
八十七學年度研究所碩士班入學考試試題

所別：機械所
科目：流體力學

3. The hot combustion gases of a furnance are seperated from the ambient air and its surrounding, which are at 25°C, by a brick wall 0.15 m thick. The brick has a thermal conductivity of 1.2 W/Km and a surface emissivity of $\varepsilon = 0.8$. Under steady-state conditions the inside surface temperature of the furnace is maintained at 352°C. Air flows over the outside surface of the furnace is characterized with a free convection coefficient of $h = 20$ W/Km^2. What is the brick surface temperature at the furnace outside ? (the Stefan-Boltzman constant $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K^4) (25%)



4. Air at 25°C (air density = 1.085 kg/m^3) flows over a 1-cm diameter sphere with velocity of 25 m/s, while the surface of the sphere is maintained at 75 °C. The drag coefficient is $C_D = 0.4$ and the heat transfer coefficient is h=200 W/Km^2. (a) What is the drag force on the sphere? (b) what is the heat transfer rate from sphere to air? (25%)