國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：工程數學

1. Consider the following initial value problem (IVP)

$$\frac{d^2x}{dt^2}+2\frac{dx}{dt}+x=0,\ x(0)=1,\ x'(0)=c$$

where c is a parameter. Find the range of c within which all solutions of the given IVP are non-negative, that is, determine all possible values of c which yield $x(t)\geq 0$ for $t\geq 0$. (10%)

2. Solve $f(t)=t-\int_0^t f(\tau)\exp(t-\tau)d\tau$ for $f(t)$, where $t\geq 0$ and $\exp(\cdot)$ denotes the exponential function. (10%)

(***Hint:*** *Use the Laplace transform and the convolution theorem.*)

3. Is the set $\{1, x, 3x^2-1\}$ orthogonal on the interval $[-1,1]$? Why or why not? (10%)

4. Find the Fourier series of the following periodic function. (10%)

$$f(t)=\begin{cases}1, & 0\leq t<\pi\\ 0, & -\pi\leq t<0\end{cases};\ f(t+2\pi)=f(t)$$

5. Solve $\frac{d^2x}{dt^2}+2x=f(t)u(t),\ x(0)=0,\ x'(0)=0$, where $u(\cdot)$ denotes the unit step function, and $f(t)$ is defined in Problem 4. (10%)

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6. Find the the flux $\int_S \vec{F}\cdot\hat{n}dA$, of $\vec{F}=x\vec{i}+y\vec{j}-z\vec{k}$ across the part of the plane $x+2y+z=8$ lying in the first octant (卦限). (25%)

7. Solve the following partial differential equation (25%)

$$\frac{\partial u}{\partial t}=k\frac{\partial^2 u}{\partial x^2} \quad \text{for } 0\le x\le L,\ t>0$$

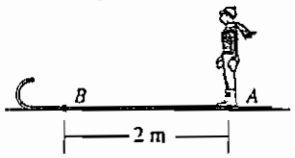
$$u(0,t)=T_1,\ u(L,t)=T_2 \quad \text{for } t>0$$

$$u(x,0)=f(x) \quad \text{for } 0\le x\le L$$

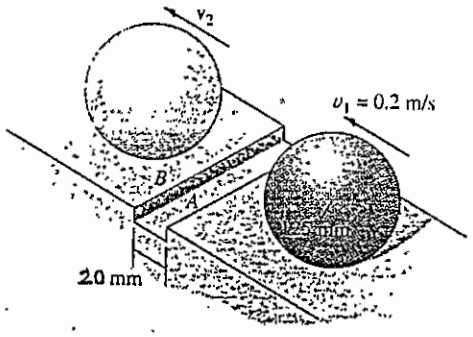
國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：動力學

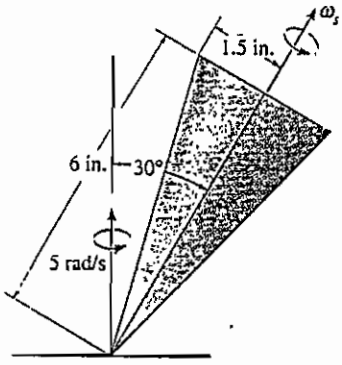
1. A boy having a mass of 50 kg stands on the back of a 15-kg toboggan which is originally at rest. If he walks to the front B and stops, determine the distance the toboggan moves. Neglect friction between the bottom of the toboggan and the ground (ice). (15%)



2. A ball having a mass of 10 kg and initial speed of $v_1 = 0.2$ m/s rolls over a 20-mm-long depression. Assuming that the ball rolls off the edges of contact, first A, then B, determine its final velocity v_2 when it reaches the other side. (20%)



3. The top has a mass of 4 lb and can be considered as a solid cone. If it is observed to precess about the vertical axis at a constant rate of 5 rad/s, determine its spin. (15%)



國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：動力學

4. A rocket is fired vertically from a launching pad at B. Its flight is tracked by radar from point A as shown in Fig. 4.
   (a) Determine the velocity of the rocket in terms of b, θ, and ω. (12%)
   (b) Determine the acceleration of the rocket in terms of b, θ, ω, and α. (13%)

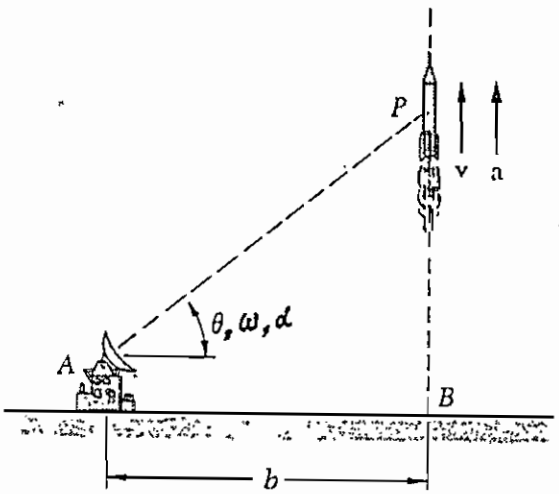


Fig. 4

5. Rod AB slides with its ends in contact with the floor and the inclined plane as shown in Fig. 5.
   (a) derive an expression for the angular velocity of the rod in terms of v_B, θ, l, and β. (12%)
   (b) derive an expression for the angular acceleration of the rod in terms of v_B, θ, l, and β, knowing that the acceleration of point B is zero. (13%)

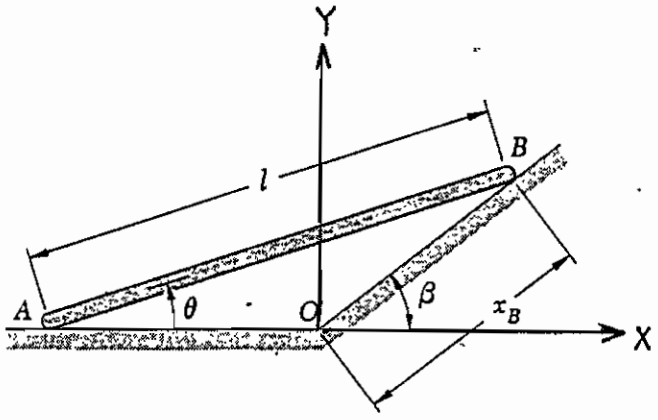


Fig. 5

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：機械製造

1. (1) 試說明麻花鑽頭(twist drill)各個部位的中英文名稱與功能，並介紹幾種解決鑽頭磨損問題的方法。 [12 %]

   (2) 說明陶瓷模製造法的製程與其加工特性。[8 %]

2. 試繪出一台普通常見的「腳踏車」之零件爆炸圖，並簡單說明每一個零件的材料及其加工方法。[30 %]

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：機械製造

3.解釋下列各種材料的強化機制。
(A)晶粒細化強化 (5%)
(B)固溶體強化 (5%)
(C)加工硬化 (5%)
(D)析出硬化 (5%)

4.圖一是用鋁合金製作的二片式可口可樂的罐子
(A) 詳細說明其製造流程？(15%)
(B) 鋁合金的平面異方性(planar anisotropy)對製程的影響如何？(5%)

圖一

5.壓鑄(die casting)常用來製造槍件、筆記型電腦外殼等另件
(A) 說明壓鑄的設備及流程？(7%)
(B) 適用於那些材料？(3%)

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：熱力學

1. Refrigerant 134a is cooled within a piston-cylinder device from an initial superheated state of 6 bars and 60°C with the specific volume v = 0.04134 m^3/kg and internal energy u = 273.54 kJ/kg to a final state of a saturated liquid at the same pressure. Determine (a) the work, (b) the heat transfer in the process in kJ/kg. (25%)

2. Subcooled Refrigerant 134a at 800 kPa and 25°C is throttled to a temperature of -20°C. Determine the pressure and the internal energy of the refrigerant at the final state. (25%)

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九十二學年度碩士班入學招生考試試題

系所：機械系
科目：熱力學

TABLE A–12

Saturated refrigerant-134a—Pressure table

		Specific volume, m³/kg		*Internal energy,* kJ/kg		*Enthalpy,* kJ/kg			*Entropy,* kJ/kg · K	
Press., P MPa	Temp., T_{sat} °C	Sat. liquid, v_f	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
0.06	−37.07	0.0007097	0.3100	3.41	206.12	3.46	221.27	224.72	0.0147	0.9520
0.08	−31.21	0.0007184	0.2366	10.41	209.46	10.47	217.92	228.39	0.0440	0.9447
0.10	−26.43	0.0007258	0.1917	16.22	212.18	16.29	215.06	231.35	0.0678	0.9395
0.12	−22.36	0.0007323	0.1614	21.23	214.50	21.32	212.54	233.86	0.0879	0.9354
0.14	−18.80	0.0007381	0.1395	25.66	216.52	25.77	210.27	236.04	0.1055	0.9322
0.16	−15.62	0.0007435	0.1229	29.66	218.32	29.78	208.18	237.97	0.1211	0.9295
0.18	−12.73	0.0007485	0.1098	33.31	219.94	33.45	206.26	239.71	0.1352	0.9273
0.20	−10.09	0.0007532	0.0993	36.69	221.43	36.84	204.46	241.30	0.1481	0.9253
0.24	−5.37	0.0007618	0.0834	42.77	224.07	42.95	201.14	244.09	0.1710	0.9222
0.28	−1.23	0.0007697	0.0719	48.18	226.38	48.39	198.13	246.52	0.1911	0.9197
0.32	2.48	0.0007770	0.0632	53.06	228.43	53.31	195.35	248.66	0.2089	0.9177
0.36	5.84	0.0007839	0.0564	57.54	230.28	57.82	192.76	250.58	0.2251	0.9160
0.4	8.93	0.0007904	0.0509	61.69	231.97	62.00	190.32	252.32	0.2399	0.9145
0.5	15.74	0.0008056	0.0409	70.93	235.64	71.33	184.74	256.07	0.2723	0.9117
0.6	21.58	0.0008196	0.0341	78.99	238.74	79.48	179.71	259.19	0.2999	0.9097
0.7	26.72	0.0008328	0.0292	86.19	241.42	86.78	175.07	261.85	0.3242	0.9080
0.8	31.33	0.0008454	0.0255	92.75	243.78	93.42	170.73	264.15	0.3459	0.9066
0.9	35.53	0.0008576	0.0226	98.79	245.88	99.56	166.62	266.18	0.3656	0.9054
1.0	39.39	0.0008695	0.0202	104.42	247.77	105.29	162.68	267.97	0.3838	0.9043
1.2	46.32	0.0008928	0.0166	114.69	251.03	115.76	155.23	270.99	0.4164	0.9023
1.4	52.43	0.0009159	0.0140	123.98	253.74	125.26	148.14	273.40	0.4453	0.9003
1.6	57.92	0.0009392	0.0121	132.52	256.00	134.02	141.31	275.33	0.4714	0.8982
1.8	62.91	0.0009631	0.0105	140.49	257.88	142.22	134.60	276.83	0.4954	0.8959
2.0	67.49	0.0009878	0.0093	148.02	259.41	149.99	127.95	277.94	0.5178	0.8934
2.5	77.59	0.0010562	0.0069	165.48	261.84	168.12	111.06	279.17	0.5687	0.8854
3.0	86.22	0.0011416	0.0053	181.88	262.16	185.30	92.71	278.01	0.6156	0.8735

R-134a

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：熱力學

3. (25%) Starting with the entropy function s= f(T,v) and internal energy function u = f(T,v) to derive the following general expression for the entropy change.

$$ds = c_v \frac{dT}{T} + \left(\frac{\partial P}{\partial T}\right)_v dv$$

4. (25%) A steam of 2 mol/s of air goes from 1000 K and 10 bar to 500 K and 5 bar while doing 5 kW work. Surroundings are 300 K and 1 bar. What is the lost work for this process (Cp=29.1 J/mol K and R= 8.314 J/mole K)?

Prob. 1 (25%)

Consider a standard unity feedback system shown in figure 1.

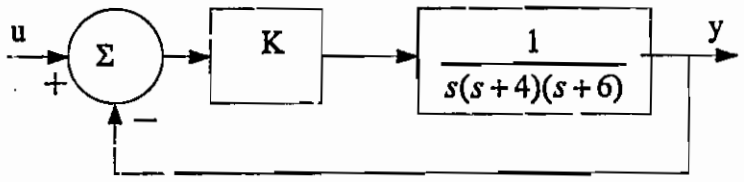

figure 1

Construct the Root-Locus plot for the given system.

In the plot, please show the angles of the asymptotes, the point at which the asymptotes intersect the real axis, and determine the breakaway points if they exist. The points, at which Root-Locus plot crosses the imaginary axis, must be determined with corresponding value of K.

Prob. 2 (25%)

Consider a standard unity feedback system shown in figure 2.

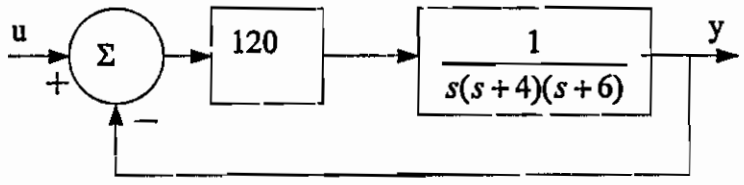

Figure 2

Please determine the stability of the given system by using Nyquist stability criterion, and the gain margin (in dB) with its corresponding frequency.

3. Consider the system described by

$$\ddot{y}-2\dot{y}+\alpha\cos(y+\pi/2)=u,\quad u=-k(\dot{y}+2y)$$

where y is the output and u is the input variable; α is a constant.

(A) If $\alpha=0$, find the range of k for which the system is stable. (10%)

(B) If $\alpha=8$, determine the range of k for which the system is asymptotically stable (漸進穩定) at the origin (i.e. at $(y,\dot{y})=(0,0)$). (15%)

4. Consider the system shown in Fig. 3. Given a unit step input, determine the steady state errors for

(A) $C(s)=10s+5$ (8%)

(B) $C(s)=10s+5+\frac{2}{s}$ (8%)

(C) $C(s)=10s+5+\frac{72}{s}$ (9%)

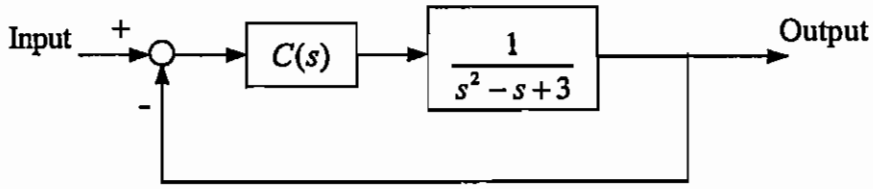

Fig. 3

1. The round bar shown in Fig. 1 is mounted as a cantilever beam. The material has E = 206,900 Mpa and σ_{yp} = 410 Mpa.

(a) What point in the bar would you expect to be critical for stress ? (5%)

(b) At critical point, draw the Mohr circle for this element and determine the value of the maximum normal stress and the maximum shear stress. (20%)

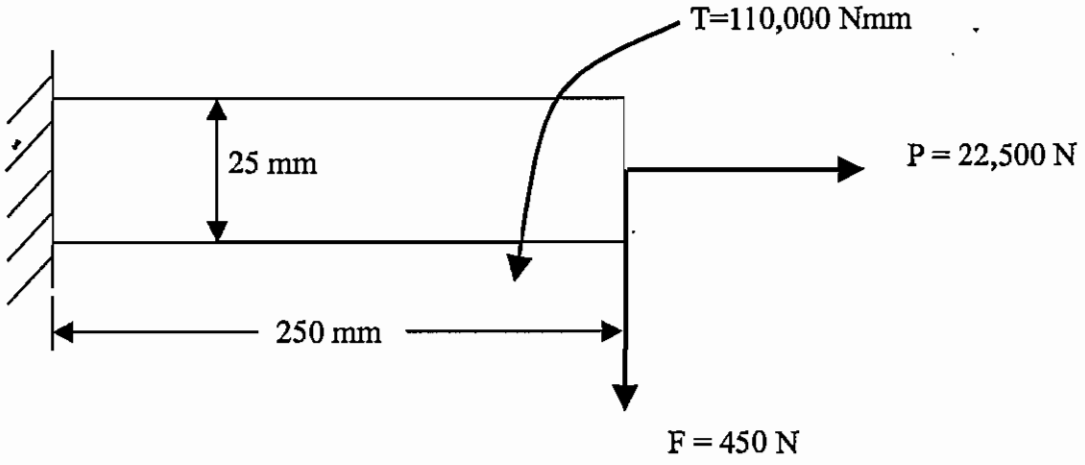

Fig. 1

2. In Fig. 2 the outer bars are symmetrically placed with respect to the center bar. The top member is rigid and located symmetrically on the supports. Find the load carried by each of the supports. Modulus for the bars is 138,000 MPa. (25%)

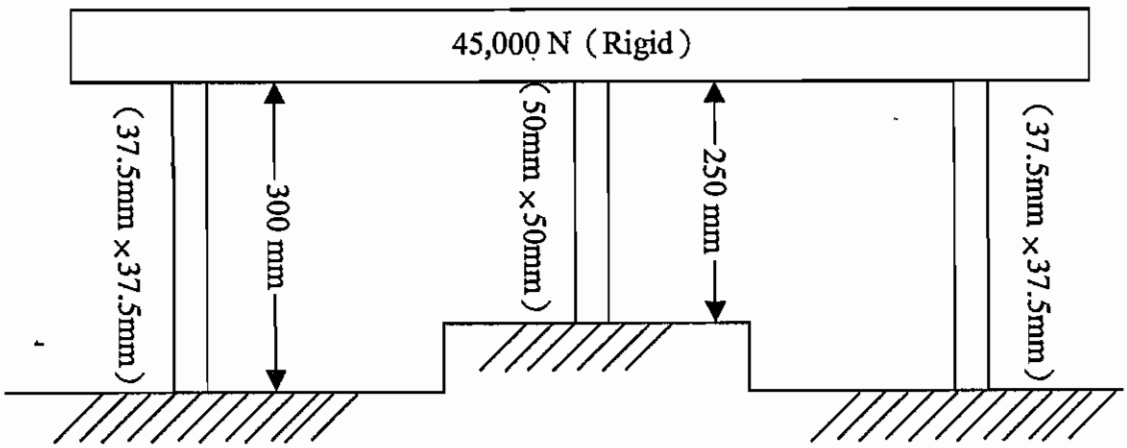

Fig. 2

國立雲林科技大學
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系所：機械系
科目：材料力學

3. A thin-walled elastic frustum of a cone has the dimensions shown in the figure. (a) Determine the torsional stiffness of this member, i.e., the magnitude of torque per unit angle of twist. The shearing modulus for the material is G. [15%] (b) What is the torsional flexibility of this member? [10%]

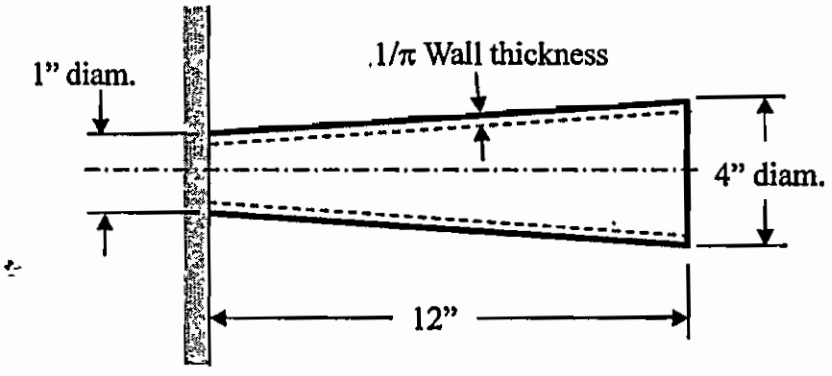


Fig. 3 (Figure of Problem 3)

4. Determine the equations of the elastic curves for the beam shown in the figure due to the applied loading for the given boundary conditions. W is the total loading results from the distributed pressure. The length of the beam is L. The Young's modulus and momentum of inertia are E and I respectively. [25%]

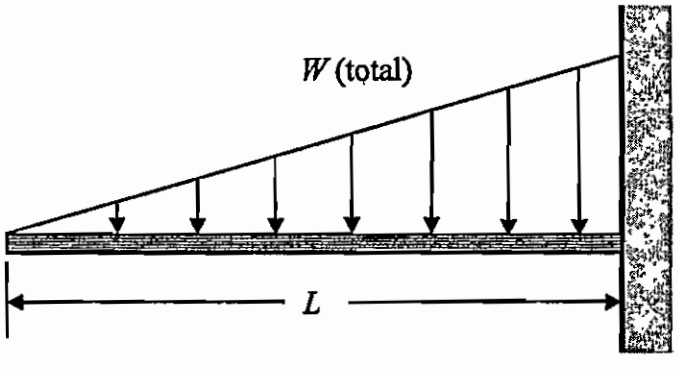
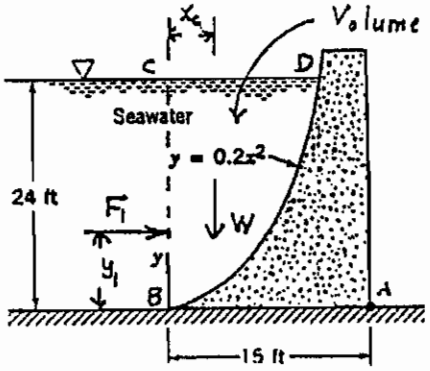


Fig. 4 (Figure of Problem 4)

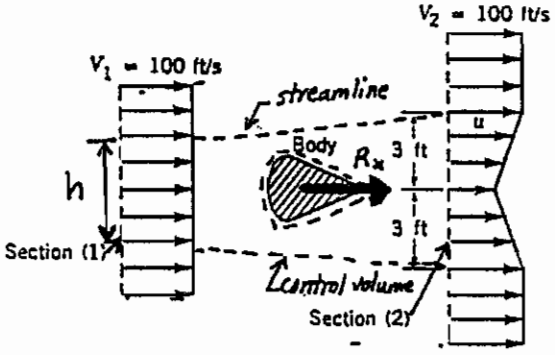
1. The concrete (specific weight = 150 lb/ft^3) seawall has a curved surface and restrains seawater at a depth of 24 ft. The trace of the surface is a parabola as illustrated. Determine the moment of the fluid force (per unit dept) with respect to an axis through the toe (Point A). **25%**



2. The results of a wind tunnel test to determine the drag force on a body are summarized below. The upstream [section (1)] velocity is uniform at 100ft/sec. The static pressures are given by $P_1 = P_2 = 14.7$ psia. The downstream velocity distribution which is symmetrical about the centerline is given by

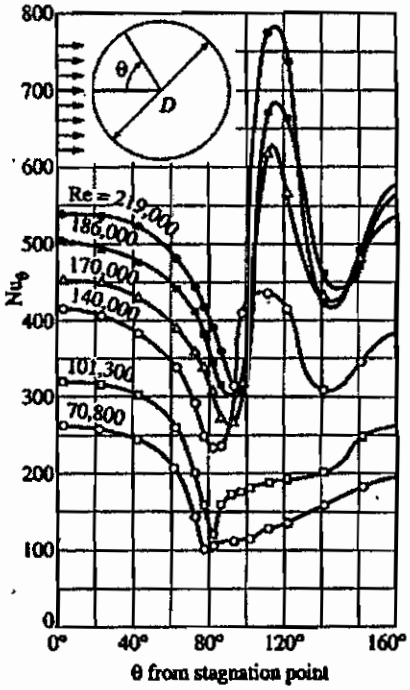
$$u = 100 - 30\,[\,1 - |y|/3] \qquad |y| \leq 3$$
$$u = 100 \qquad |y| > 3$$

where u is the velocity in ft/sec and y is the distance on either side of the centerline in feet. Assume that the body shape does not change in the direction normal to the paper. Calculate the drag force (reaction force in the x-direction) exerted on the air by the body per unit length normal to the plane of the sketch. **25%**



3. Design a viscometer for liquids that utilizes a small tank with a horizontal tube connected to it. State a) all the necessary requirements for the system (10%), and b) the procedure for determination of the viscosity of a given fluid. (15%)

4. In the figure to the right, the variation of the local heat transfer coefficient along the circumference of a circular cylinder in cross flow of air is shown. Please answers the following questions,



a) Why the curves corresponding to the lower Reynolds number have lower local heat transfer coefficient (Nu_θ) ? (5%)

b) For the two curves at the bottom, why the Nu_θ decreases first to a minimum at $\theta \approx 80°$, and then starts increasing ? (10%)

c) For the rest of the curves, they differ from the first two curves in that they have two minima for Nu_θ. What causes the sharp increase following these two minima? (10%)

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：應用微積分

1. Find each limit. [20%]

(a) $\lim_{x\to 0}\left(x\ln x^{1000}\right)$ (b) $\lim_{x\to 0}(\cos x)^{\csc x}$

2. Find $\frac{d^2y}{dx^2}$ if $x^3-4y^2+3=0$. [10%]

3. Find $\frac{dy}{dx}$ if $y=\cos^2\left(\frac{x^2+2}{x^2-2}\right)$. [10%]

4. Find the maximum value and minimum value of $f(x)=\frac{x}{1+x^2}$ and $x\in[-1,4]$. [10%]

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：應用微積分

45、 Evaluate $\int_0^1 \frac{x+1}{(x^2+2x+6)^2}\,dx$. (12%)

46. The region bounded by the line $y = (r/h)x$, the x-axis, and $x = h$ is revolved about the x-axis, thereby generating a cone (assume that $r > 0, h > 0$). Find its volume by the disk method and by the shell method. (13%)

47、 Find the volume of the solid generated by revolving the region bounded by the parabolas $y = x^2$ and $y^2 = 8x$ about the x-axis. (12%)

48、 Find the centroid of the region bounded by the curves $y = x^3$ and $y = \sqrt{x}$. (13%)

國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：專業實務

1. 請重點說明你在工作單位的工作內容. 並以你最得意的案例說明你實際解決的問題。你有已設定的碩士研讀目標嗎?如有請詳細說明。 10%
2. 圖2.1及圖2.2爲處於平衡狀態之兩系統,試以力的平衡觀點說明其平衡現象。 10%
3. 平行板電容爲電器元件中之儲能元件，試以式子說明其儲存能量之大小。 10%
4. 陀螺剛甩出接觸地面旋轉時，其旋轉軸最初可能並不垂直於地面，但陀螺隨即會轉正使轉軸垂直於地面；當轉速漸慢，旋轉軸會偏向地面，最後傾倒；試說明此一現象支原理。 10%
5. 請說明你所了解的，能全自動操作之機電系統。說明其系統組成、系統詳細的工作流程等。 10%

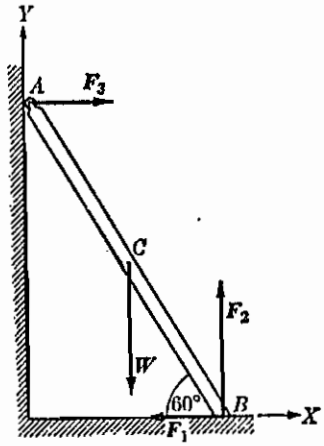


Fig. 2.1

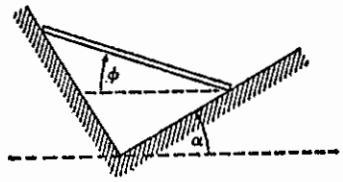


Fig. 2.2

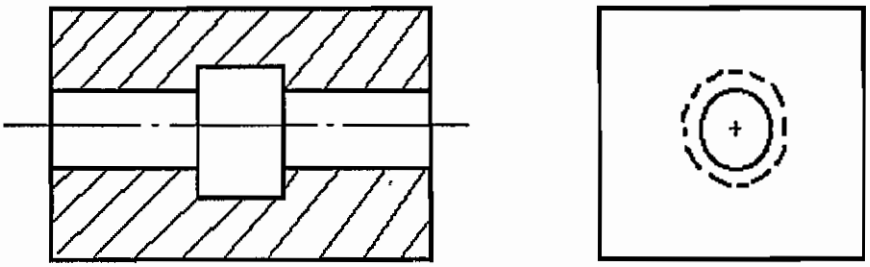
國立雲林科技大學
九十二學年度碩士班入學招生考試試題

系所：機械系
科目：專業實務

6. 機械領域專業實務簡答題: (50%)

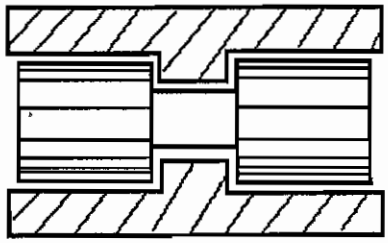
(1) 現今機械工業都已融入電腦的應用，請簡述何為 CAE, CAD 及 CAM？ 並請比較其間的異同及關聯性。 (10%)

(2) 請問圖一所示工件之加工程序為何？ (10%)



圖一

(3) 圖二所示為一液壓閥類元件示意圖，請問如何加工並完成組裝？請簡述其程序。 (10%)



圖二

(4) 請問圖學中的第一角法與第三角法有何不同？又 CNS 標準是採用何種角法？ (10%)

(5) 請申論：機械工業是否為夕陽工業？請舉例說明。 (10%)