國立雲林科技大學 系所：機械系
九十一學年度研究所碩士班入學考試試題 科目：工程數學

1. a) Solve $\frac{d^2y}{dt^2}+\omega^2 y=\cos(\gamma t)$, in which ω and γ are constants, $\gamma\neq\omega$ and $y(0)=y'(0)=0$. (10%)

   b) Evaluate $\lim_{\gamma\to\omega} y(t)$, where $y(t)$ is defined in (a). (5%)

2. Suppose that $y_1(x)$ is a solution of $y''+p(x)y'+q(x)y=0$. Let

$$y_2(x)=y_1(x)\int\frac{e^{-\int p(x)dx}}{y_1^2(x)}dx.$$

   a) Is $y_2(x)$ also a solution of $y''+p(x)y'+q(x)y=0$? Why or why not? (5%)

   b) Are $y_1(x)$ and $y_2(x)$ linearly dependent on any interval on which $y_1(x)$ is not zero? Why or why not? (*Hint: Check the Wronskian, $W(y_1,y_2)$.*) (10%)

3. Define $f(x)=\begin{cases}0, & -\pi\le x<0\\ \pi-x, & 0\le x\le\pi.\end{cases}$ Let $g(x)=k_0+k_1\sin(x)+k_2\sin(2x)$, in which k_0, k_1 and k_2 are constants. Find the values of k_0, k_1 and k_2 so that $\int_{-\pi}^{\pi}(f(x)-g(x))^2dx$ is minimized. (10%)

4. Solve $\frac{d^2y}{dt^2}+16y=f(t)$, $y(0)=0$, $y'(0)=1$, where

$$f(t)=\begin{cases}\cos(4t), & 0\le t<\pi\\ 0, & t\ge\pi.\end{cases}$$

(10%)

Prob. 5 (10%)

Evaluate the given determinant.

$$\begin{vmatrix} 2 & 0 & 1 & 0 \\ 0 & 1 & 1 & -1 \\ 0 & 1 & -1 & 0 \\ 1 & 2 & 3 & 6 \end{vmatrix}$$

Prob. 6 (15%)

Find the inverse of

$$A = \begin{bmatrix} 1 & 1 & 0 \\ -2 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

Prob. 7 (25%)

Let the electric potential (i.e. the voltage) be given by $V(x,y,z) = 3x^2y - xz$. If a positive charge is placed at $P = (1,1,-1)$, in what direction will the charge begin to move?

(Note: It is known, from electric field theory, that such a charge will begin to move in the direction of maximum rate of voltage drop.)

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本試題計 4 題，每題 25 分，共 100 分

1. At the instant shown in Fig. 1 the length r of the boom is increasing at the constant speed $\dot{R}_s$ and the boom is uprising at the constant angular velocity ω, derive
   (a) the velocity of point B. (10%)
   (b) the acceleration of point B. (15%)

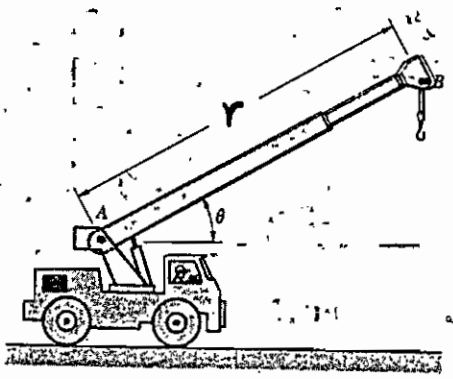

Fig. 1

2. The period of vibration of the system shown in Fig. 2 is observed to be 0.6 second. After cylinder B has been removed, the period is observed to be 0.5 second. Determine
   (a) the mass of cylinder A. (12%)
   (b) the constant of the spring. (13%)

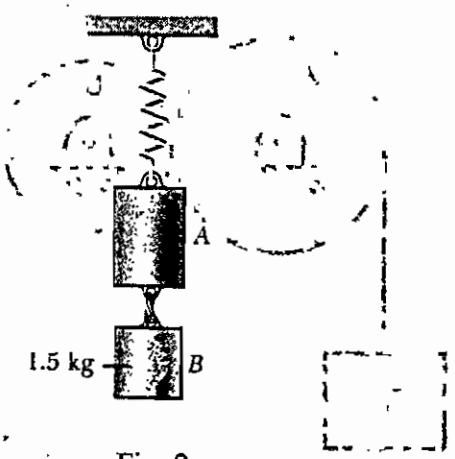

Fig. 2

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3. A ball of negligible diameter hits the solid wall and rebounds toward point A, as shown in Fig. 3, where $0 < \alpha < \frac{\pi}{2}$. Neglect gravity.

(A) What should α be if the collision is *perfectly elastic*? (12%)

(B) What should α be if the coefficient of restitution is 0.8? (13%)

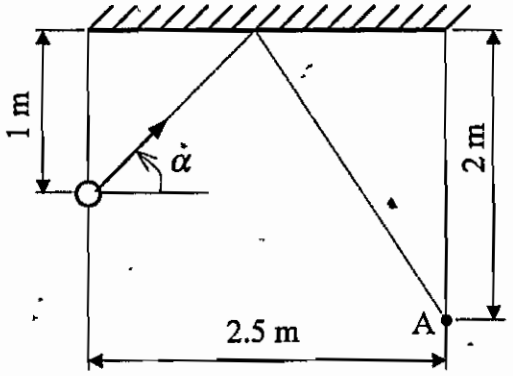

Fig. 3

4. Refer to Fig. 4. A weight W of mass 10kg is supported by Cylinder A with an inextensible cord. Cylinder B is driven by Cylinder A without slipping. Cylinder A has a diameter of 30cm, and its moment of inertia (about the center) is 32kg-m^2. The diameter of Cylinder B is 20cm.

(A) If the mass of Cylinder B is negligible, find the acceleration of W. (12%)

(B) If Cylinder B has a mass of 100kg, and its radius of gyration k = 0.5m, find the acceleration of W. (Hint: moment of inertia = mass × k^2.) (13%)

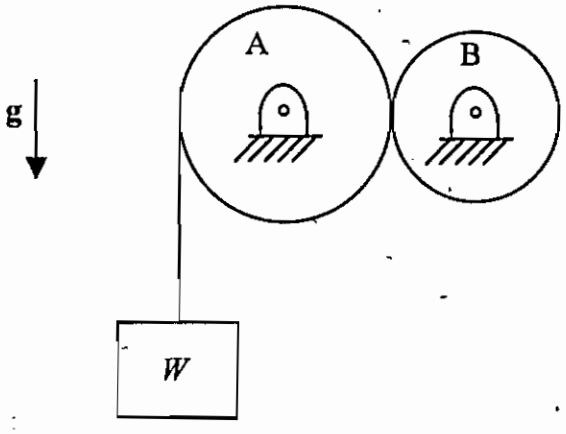

Fig. 4

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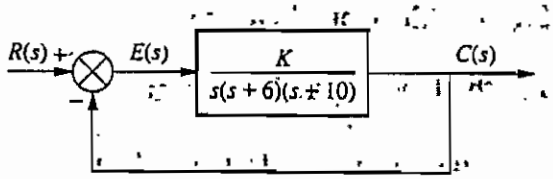
試回答下列與補償器設計之相關問題

1. 何種補償器能改善系統之 Steady-State Error? (3%)
2. 何種補償器能改善系統之 Transient Response? (3%)
3. Lag-Lead Compensator 能改善系統之何種特性? (4%)
4. 使用 cascade compensation, 試利用 Root Locus 設計一補償器使系統(如圖)獲得下述性能:
   (1) 系統具 Ramp input, 試繪未補償系統之 Root Locus: (5%)
   (2) 系統具 20% overshoot. 試標出系統在 Root Locus 上之位置. (5%)
   (3) 補償後系統之 Settling time 降爲未補償前的一半, 試標出系統在 Root Locus 上之位置., 並寫出所設計的補償器. (15%)
   (4) 補償後系統之 Steady-State Error 降爲未補償前的十分之一, 且維持(3)之成果, 試寫出所設計的補償器. (15%)



註: 相關公式

$$\zeta = \frac{-\ln(\%OS/100)}{\sqrt{\pi^2 + \ln^2(\%OS/100)}}$$

$$T_s = \frac{4}{\zeta\omega_n}$$

5. For the motor, load and torque-speed curve shown in Fig. A,

T_1 = torque developed by the motor

ω_1 = angular velocity of the motor shaft

e_a = applied armature voltage, volts

R_a = armature-winding resistance

J_1 = moment of inertia of the motor

J_2 = moment of inertia of the load

D_1 = viscous-friction coefficient of the motor

D_2 = viscous-friction coefficient of the load

N_1 = number of teeth of the input drive gear

N_2 = number of teeth of the output driven gear

θ_L = angular displacement of the load shaft, radians.

a) Find the transfer function, $G(s)=\theta_L(s)/E_a(s)$. (10%)

b) Find the state equations and output equation for the phase-variable representation of the transfer function $G(s)$, i.e. convert the transfer function representation to state space, where a set of state variables is selected such that each subsequent state variable is the derivative of the previous state variable. Let's choose the state variables $x_1=\theta_L$ and $x_2=d\theta_L/dt$. (5%)

c) Design a state-feedback controller $e_a=-k_1x_1-k_2x_2$ such that the closed-loop poles are $-10\pm j0$, i.e. design the phase-variable feedback gains, k_1 and k_2, to yield the desired closed-loop poles. (5%)

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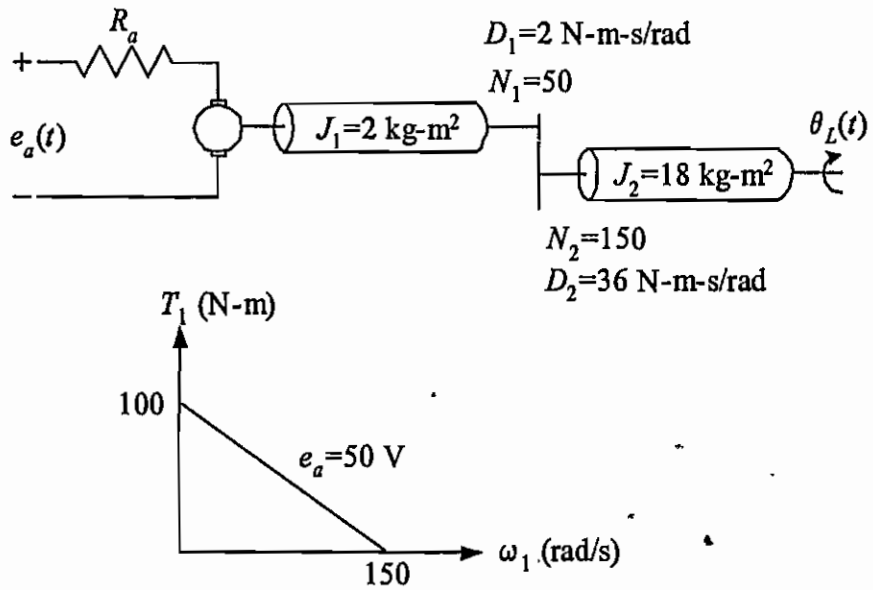

Figure A

6. Derive the transfer function of a compensator, whose realization using an operational amplifier is shown in Fig. B. (10%)

Draw the Bode plot for the compensator. (10%)

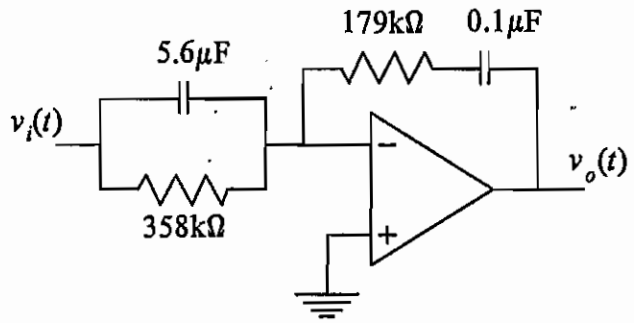

Figure B

7. Explain why

a) systems with greater gain and phase margins can withstand greater changes in system parameters before becoming unstable. (5%)

b) for a minimum-phase system, both the phase and gain margins must be positive for the system to be stable. Negative margins indicate instability for minimum-phase systems. (Suggestion: *Use Nyquist criterion*) (5%)

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1. (1) 假設你用普通車床車削一鋁合金圓棒，結果在試車加工第一個工件後，經由游標卡尺量測後，發現該圓棒的外徑比你所要的尺寸多了0.01mm，試說明可能造成此一誤差的原因。Hint: 請由多方面思考去探討此問題，而不僅是從刀具方面。 [10 %]

   (2) 試說明精密鑄造與傳統砂模鑄造之製程，並由多方面（例如工件品質等等）去比較這兩種鑄造法之差異。[10 %]

2. 說明以下各種加工法之中文名稱與目的，並詳述出其製程特性：
   [a] upset forging; [b] fine blanking; [c] abrasive jet machining;
   [d] deep drawing; [e] seam welding. [30 %]

國立雲林科技大學
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系所：機械系
科目：機械製造

3. (A)汽車製造工廠使用機器人點焊鈑金組件，請問點焊所產生的熱量(H, 單位 joules) 和那些參數有關，用公式表示？又那些製程條件影響焊點(nugget)的強度？如何測試焊點的強度？ [9%]

(B)雲技公司擬用雷射焊接(spot size ~ 0.5mm) 取代目前的 SMAW 焊接，製造厚度 6 mm 的鋼構架焊接件，以提升公司的知名度，請比較兩種焊接的優點和缺點？ [8%]

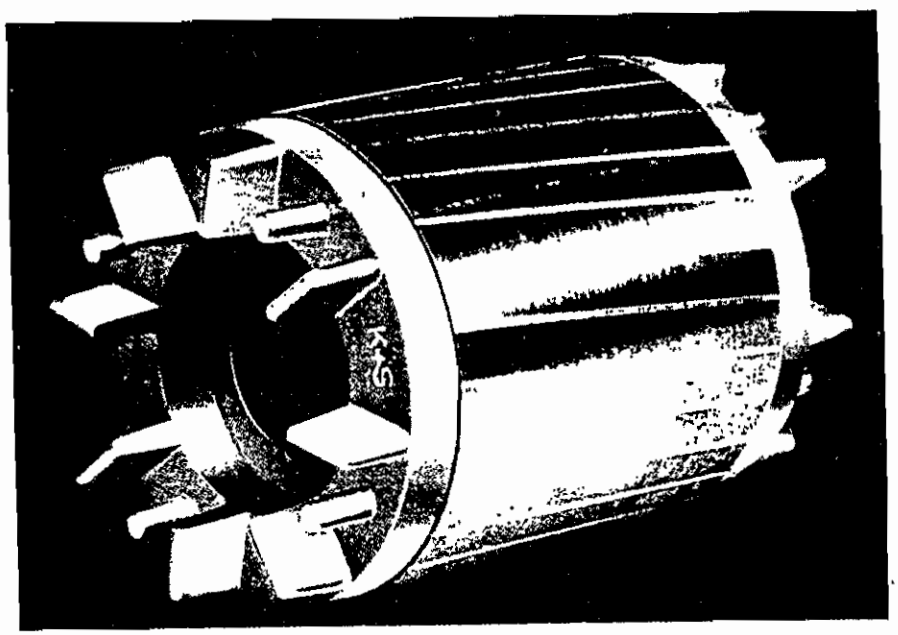
(C) 潛弧焊製造的鋼構，其熱影響區對鋼構的機械性質有重要的影響，繪圖說明熱影響區的位置、成因及其微觀組織與焊道和基材的差異。[8%]

4. 感應馬達是應用其轉子與靜子的電磁交互作用而產生扭力轉動，寬度 900mm 厚度 0.5mm 的電磁鋼片是製造轉子與靜子的原材料，將電磁鋼片沖切成轉子與靜子單片後，再把一定厚度的單片疊積壓鑄鋁組成如圖一的轉子，回答下列問題：

(A) 甲公司擬向國內大鋼廠購買電磁鋼片，加工製造馬達的轉子與靜子，請你擔任轉子生產部門的主管，請規劃生產線的詳細製造流程及所需的設備。[12%]

(B) 電磁鋼片的塗膜分成有機塗膜與無機塗膜兩大類，從加工潤滑的觀點，比較其差異性。[6%]

(C)電磁鋼片有那些重要的磁特性？[7%]



圖一

國立雲林科技大學
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系所：機械系
科目：熱力學

1.Consider a 5 kW (the heat removal rate from the cooled space to the outdoor) refrigeration system that operates on an ideal vapor-compression refrigeration cycle with refrigerant-134a as the working fluid. The refrigerant enters the compressor as saturated vapor at 140 kPa and is compressed to 800 kPa. Show the cycle on a T-s diagram with respect to saturation lines, and determine (a) the quality of the refrigerant at the end of the throttling process, (b) the coefficient of performance, (c) the power input to the compressor, and (d) the refrigerant mass flow rate in the cycle.(25%)

2.The radiator of a house heating system has a volume of 0.02 m^3 and is filled with superheated vapor at 300kPa and 250°C. At this moment both the inlet and exit valves to the radiator are closed. Determine the amount of heat that will be transferred to the house when the steam pressure drops to 100 kPa. (25%)

3.Steam at 800 kPa, 400 C, is throttled slowly to 100 kPa. Neglecting potential and kinetic energies calculate the average Joule Thomson coefficient for this process. (25%)

4.Derive an equation for the specific work produced when an ideal gas undergoes a reversible polytropic process ($n \neq 1$) in a single inlet-outlet, steady-flow system. The final result should be in terms of the inlet and outlet pressures and the inlet temperature.(25%)

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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

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1. In Fig.1 the three bars are of the same material and have equal cross sections and lengths. Find the force in each bar. [25%]

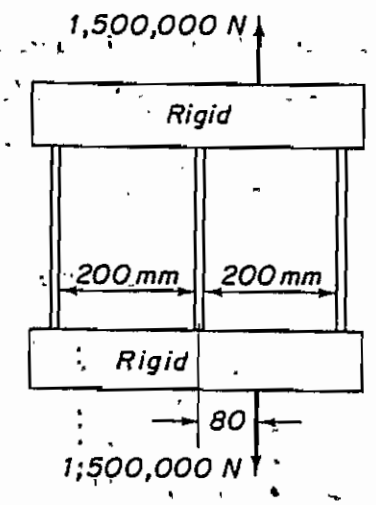

Fig. 1

2. The shaft in Fig.2 does not rotate. Loads are steady. Assume simple supports. Diameter is 50mm. Length is 180mm. Elements are located similarly to those of the figure. Load at center is 9,000N. Torques at ends are equal to 1,000,000Nmm each. Also, a=90mm, b=45mm, L=180mm; P=9,000N, T=1,000,000Nmm. [25%]

(a) Make a sketch for the element at A on the bottom surface of the shaft and show the values of the stresses. [13%]

(b) Do the same for the element at the elevation of the shaft axis. (Point B) [12%]

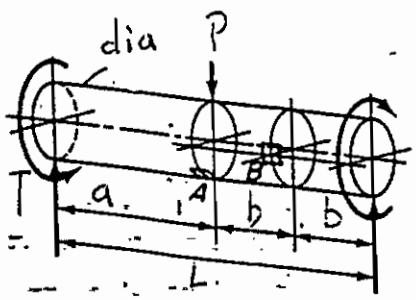

Fig. 2

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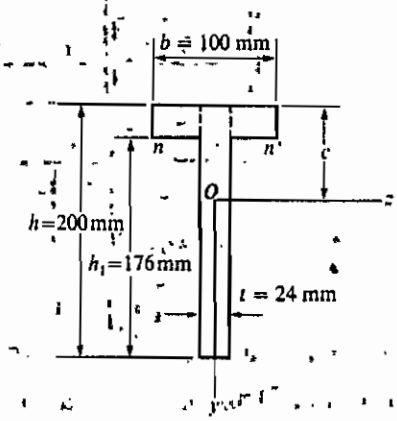
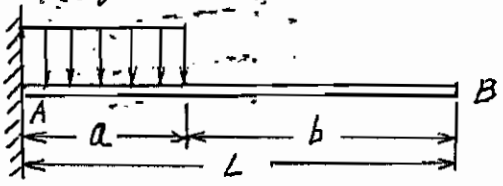
3. (25%) Calculate the maximum shear stress τ_{max} in the web of a beam having the T-shaped cross section shown in the figure if b = 100 mm, t = 24 mm, h = 200 mm, h_1 = 176 mm, and the vertical shear force V = 90 kN.



4. (25%) A cantilever beam AB with length L = 11 m is subjected to a uniform load of intensity q = 10 kN/m acting over part of the length, say a = 5 m. Please determine EI value of the beam that will produce a deflection δ_b = 0.01 m at the free end B. E is the Young's modulus and I is the moment of inertia of the beam.



國立雲林科技大學
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系所：機械系
科目：熱力學

TABLE A–6

Superheated water

H_2O

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
	P = 0.01 MPa (45.81°C)*				P = 0.05 MPa (81.33°C)				P = 0.10 MPa (99.63°C)			
Sat.†	14.674	2437.9	2584.7	8.1502	3.240	2483.9	2645.9	7.5939	1.6940	2506.1	2675.5	7.3594
50	14.869	2443.9	2592.6	8.1749								
100	17.196	2515.5	2687.5	8.4479	3.418	2511.6	2682.5	7.6947	1.6958	2506.7	2676.2	7.3614
150	19.512	2587.9	2783.0	8.6882	3.889	2585.6	2780.1	7.9401	1.9364	2582.8	2776.4	7.6134
200	21.825	2661.3	2879.5	8.9038	4.356	2659.9	2877.7	8.1580	2.172	2658.1	2875.3	7.8343
250	24.136	2736.0	2977.3	9.1002	4.820	2735.0	2976.0	8.3556	2.406	2733.7	2974.3	8.0333
300	26.445	2812.1	3076.5	9.2813	5.284	2811.3	3075.5	8.5373	2.639	2810.4	3074.3	8.2158
400	31.063	2968.9	3279.6	9.6077	6.209	2968.5	3278.9	8.8642	3.103	2967.9	3278.2	8.5435
500	35.679	3132.3	3489.1	9.8978	7.134	3132.0	3488.7	9.1546	3.565	3131.6	3488.1	8.8342
600	40.295	3302.5	3705.4	10.1608	8.057	3302.2	3705.1	9.4178	4.028	3301.9	3704.4	9.0976
700	44.911	3479.6	3928.7	10.4028	8.981	3479.4	3928.5	9.6599	4.490	3479.2	3928.2	9.3398
800	49.526	3663.8	4159.0	10.6281	9.904	3663.6	4158.9	9.8852	4.952	3663.5	4158.6	9.5652
900	54.141	3855.0	4396.4	10.8396	10.828	3854.9	4396.3	10.0967	5.414	3854.8	4396.1	9.7767
1000	58.757	4053.0	4640.6	11.0393	11.751	4052.9	4640.5	10.2964	5.875	4052.8	4640.3	9.9764
1100	63.372	4257.5	4891.2	11.2287	12.674	4257.4	4891.1	10.4859	6.337	4257.3	4891.0	10.1659
1200	67.987	4467.9	5147.8	11.4091	13.597	4467.8	5147.7	10.6662	6.799	4467.7	5147.6	10.3463
1300	72.602	4683.7	5409.7	11.5811	14.521	4683.6	5409.6	10.8382	7.260	4683.5	5409.5	10.5183
	P = 0.20 MPa (120.23°C)				P = 0.30 MPa (133.55°C)				P = 0.40 MPa (143.63°C)			
Sat.	0.8857	2529.5	2706.7	7.1272	0.6058	2543.6	2725.3	6.9919	0.4625	2553.6	2738.6	6.8959
150	0.9596	2576.9	2768.8	7.2795	0.6339	2570.8	2761.0	7.0778	0.4708	2564.5	2752.8	6.9299
200	1.0803	2654.4	2870.5	7.5066	0.7163	2650.7	2865.6	7.3115	0.5342	2646.8	2860.5	7.1706
250	1.1988	2731.2	2971.0	7.7086	0.7964	2728.7	2967.6	7.5166	0.5951	2726.1	2964.2	7.3789
300	1.3162	2808.6	3071.8	7.8926	0.8753	2806.7	3069.3	7.7022	0.6548	2804.8	3066.8	7.5662
400	1.5493	2966.7	3276.6	8.2218	1.0315	2965.6	3275.0	8.0330	0.7726	2964.4	3273.4	7.8985
500	1.7814	3130.8	3487.1	8.5133	1.1867	3130.0	3486.0	8.3251	0.8893	3129.2	3484.9	8.1913
600	2.013	3301.4	3704.0	8.7770	1.3414	3300.8	3703.2	8.5892	1.0055	3300.2	3702.4	8.4558
700	2.244	3478.8	3927.6	9.0194	1.4957	3478.4	3927.1	8.8319	1.1215	3477.9	3926.5	8.6987
800	2.475	3663.1	4158.2	9.2449	1.6499	3662.9	4157.8	9.0576	1.2372	3662.4	4157.3	8.9244
900	2.705	3854.5	4395.8	9.4566	1.8041	3854.2	4395.4	9.2692	1.3529	3853.9	4395.1	9.1362
1000	2.937	4052.5	4640.0	9.6563	1.9581	4052.3	4639.7	9.4690	1.4685	4052.0	4639.4	9.3360
1100	3.168	4257.0	4890.7	9.8458	2.1121	4256.8	4890.4	9.6585	1.5840	4256.5	4890.2	9.5256
1200	3.399	4467.5	5147.5	10.0262	2.2661	4467.2	5147.1	9.8389	1.6996	4467.0	5146.8	9.7060
1300	3.630	4683.2	5409.3	10.1982	2.4201	4683.0	5409.0	10.0110	1.8151	4682.8	5408.8	9.8780
	P = 0.50 MPa (151.86°C)				P = 0.60 MPa (158.85°C)				P = 0.80 MPa (170.43°C)			
Sat.	0.3749	2561.2	2748.7	6.8213	0.3157	2567.4	2756.8	6.7600	0.2404	2576.8	2769.1	6.6628
200	0.4249	2642.9	2855.4	7.0592	0.3520	2638.9	2850.1	6.9665	0.2608	2630.6	2839.3	6.8158
250	0.4744	2723.5	2960.7	7.2709	0.3938	2720.9	2957.2	7.1816	0.2931	2715.5	2950.0	7.0384
300	0.5226	2802.9	3064.2	7.4599	0.4344	2801.0	3061.6	7.3724	0.3241	2797.2	3056.5	7.2328
350	0.5701	2882.6	3167.7	7.6329	0.4742	2881.2	3165.7	7.5464	0.3544	2878.2	3161.7	7.4089
400	0.6173	2963.2	3271.9	7.7938	0.5137	2962.1	3270.3	7.7079	0.3843	2959.7	3267.1	7.5716
500	0.7109	3128.4	3483.9	8.0873	0.5920	3127.6	3482.8	8.0021	0.4433	3126.0	3480.6	7.8673
600	0.8041	3299.6	3701.7	7.3522	0.6697	3299.1	3700.9	8.2674	0.5018	3297.9	3699.4	8.1333
700	0.8969	3477.5	3925.9	8.5952	0.7472	3477.0	3925.3	8.5107	0.5601	3476.2	3924.2	8.3770
800	0.9896	3662.1	4156.9	8.8211	0.8245	3661.8	4156.5	8.7367	0.6181	3661.1	4155.6	8.6033
900	1.0822	3853.6	4394.7	9.0329	0.9017	3853.4	4394.4	8.9486	0.6761	3852.8	4393.7	8.8153
1000	1.1747	4051.8	4639.1	9.2328	0.9788	4051.5	4638.8	9.1485	0.7340	4051.0	4638.2	9.0153
1100	1.2672	4256.3	4889.9	9.4224	1.0559	4256.1	4889.6	9.3381	0.7919	4255.6	4889.1	9.2050
1200	1.3596	4466.8	5146.6	9.6029	1.1330	4466.5	5146.3	9.5185	0.8497	4466.1	5145.9	9.3855
1300	1.4521	4682.5	5408.6	9.7749	1.2101	4682.3	5408.3	9.6906	0.9076	4681.8	5407.9	9.5575

*The temperature in parentheses is the saturation temperature at the specified pressure.

†Properties of saturated vapor at the specified pressure.

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系所：機械系
科目：熱力學

H_2O

TABLE A–5

Saturated water—Pressure table

Press., P kPa	Sat. temp., T_{sat} °C	Specific volume, m³/kg: Sat. liquid, v_f	Specific volume, m³/kg: Sat. vapor, v_g	Internal energy, kJ/kg: Sat. liquid, u_f	Internal energy, kJ/kg: Evap., u_{fg}	Internal energy, kJ/kg: Sat. vapor, u_g	Enthalpy, kJ/kg: Sat. liquid, h_f	Enthalpy, kJ/kg: Evap., h_{fg}	Enthalpy, kJ/kg: Sat. vapor, h_g	Entropy, kJ/kg · K: Sat. liquid, s_f	Entropy, kJ/kg · K: Evap., s_{fg}	Entropy, kJ/kg · K: Sat. vapor, s_g
0.6113	0.01	0.001000	206.14	0.00	2375.3	2375.3	0.01	2501.3	2501.4	0.0000	9.1562	9.1562
1.0	6.98	0.001000	129.21	29.30	2355.7	2385.0	29.30	2484.9	2514.2	0.1059	8.8697	8.9756
1.5	13.03	0.001001	87.98	54.71	2338.6	2393.3	54.71	2470.6	2525.3	0.1957	8.6322	8.8279
2.0	17.50	0.001001	67.00	73.48	2326.0	2399.5	73.48	2460.0	2533.5	0.2607	8.4629	8.7237
2.5	21.08	0.001002	54.25	88.48	2315.9	2404.4	88.49	2451.6	2540.0	0.3120	8.3311	8.6432
3.0	24.08	0.001003	45.67	101.04	2307.5	2408.5	101.05	2444.5	2545.5	0.3545	8.2231	8.5776
4.0	28.96	0.001004	34.80	121.45	2293.7	2415.2	121.46	2432.9	2554.4	0.4226	8.0520	8.4746
5.0	32.88	0.001005	28.19	137.81	2282.7	2420.5	137.82	2423.7	2561.5	0.4764	7.9187	8.3951
7.5	40.29	0.001008	19.24	168.78	2261.7	2430.5	168.79	2406.0	2574.8	0.5764	7.6750	8.2515
10	45.81	0.001010	14.67	191.82	2246.1	2437.9	191.83	2392.8	2584.7	0.6493	7.5009	8.1502
15	53.97	0.001014	10.02	225.92	2222.8	2448.7	225.94	2373.1	2599.1	0.7549	7.2536	8.0085
20	60.06	0.001017	7.649	251.38	2205.4	2456.7	251.40	2358.3	2609.7	0.8320	7.0766	7.9085
25	64.97	0.001020	6.204	271.90	2191.2	2463.1	271.93	2346.3	2618.2	0.8931	6.9383	7.8314
30	69.10	0.001022	5.229	289.20	2179.2	2468.4	289.23	2336.1	2625.3	0.9439	6.8247	7.7686
40	75.87	0.001027	3.993	317.53	2159.5	2477.0	317.58	2319.2	2636.8	1.0259	6.6441	7.6700
50	81.33	0.001030	3.240	340.44	2143.4	2483.9	340.49	2305.4	2645.9	1.0910	6.5029	7.5939
75	91.78	0.001037	2.217	384.31	2112.4	2496.7	384.39	2278.6	2663.0	1.2130	6.2434	7.4564
Press., MPa												
0.100	99.63	0.001043	1.6940	417.36	2088.7	2506.1	417.46	2258.0	2675.5	1.3026	6.0568	7.3594
0.125	105.99	0.001048	1.3749	444.19	2069.3	2513.5	444.32	2241.0	2685.4	1.3740	5.9104	7.2844
0.150	111.37	0.001053	1.1593	466.94	2052.7	2519.7	467.11	2226.5	2693.6	1.4336	5.7897	7.2233
0.175	116.06	0.001057	1.0036	486.80	2038.1	2524.9	486.99	2213.6	2700.6	1.4849	5.6868	7.1717
0.200	120.23	0.001061	0.8857	504.49	2025.0	2529.5	504.70	2201.9	2706.7	1.5301	5.5970	7.1271
0.225	124.00	0.001064	0.7933	520.47	2013.1	2533.6	520.72	2191.3	2712.1	1.5706	5.5173	7.0878
0.250	127.44	0.001067	0.7187	535.10	2002.1	2537.2	535.37	2181.5	2716.9	1.6072	5.4455	7.0527
0.275	130.60	0.001070	0.6573	548.59	1991.9	2540.5	548.89	2172.4	2721.3	1.6408	5.3801	7.0209
0.300	133.55	0.001073	0.6058	561.15	1982.4	2543.6	561.47	2163.8	2725.3	1.6718	5.3201	6.9919
0.325	136.30	0.001076	0.5620	572.90	1973.5	2546.4	573.25	2155.8	2729.0	1.7006	5.2646	6.9652
0.350	138.88	0.001079	0.5243	583.95	1965.0	2548.9	584.33	2148.1	2732.4	1.7275	5.2130	6.9405
0.375	141.32	0.001081	0.4914	594.40	1956.9	2551.3	594.81	2140.8	2735.6	1.7528	5.1647	6.9175
0.40	143.63	0.001084	0.4625	604.31	1949.3	2553.6	604.74	2133.8	2738.6	1.7766	5.1193	6.8959
0.45	147.93	0.001088	0.4140	622.77	1934.9	2557.6	623.25	2120.7	2743.9	1.8207	5.0359	6.8565
0.50	151.86	0.001093	0.3749	639.68	1921.6	2561.2	640.23	2108.5	2748.7	1.8607	4.9606	6.8213
0.55	155.48	0.001097	0.3427	655.32	1909.2	2564.5	665.93	2097.0	2753.0	1.8973	4.8920	6.7893
0.60	158.85	0.001101	0.3157	669.90	1897.5	2567.4	670.56	2086.3	2756.8	1.9312	4.8288	6.7600
0.65	162.01	0.001104	0.2927	683.56	1886.5	2570.1	684.28	2076.0	2760.3	1.9627	4.7703	6.7331
0.70	164.97	0.001108	0.2729	696.44	1876.1	2572.5	697.22	2066.3	2763.5	1.9922	4.7158	6.7080
0.75	167.78	0.001112	0.2556	708.64	1866.1	2574.7	709.47	2057.0	2766.4	2.0200	4.6647	6.6847
0.80	170.43	0.001115	0.2404	720.22	1856.6	2576.8	721.11	2048.0	2769.1	2.0462	4.6166	6.6628
0.85	172.96	0.001118	0.2270	731.27	1847.4	2578.7	732.22	2039.4	2771.6	2.0710	4.5711	6.6421
0.90	175.38	0.001121	0.2150	741.83	1838.6	2580.5	742.83	2031.1	2773.9	2.0946	4.5280	6.6226
0.95	177.69	0.001124	0.2042	751.95	1830.2	2582.1	753.02	2023.1	2776.1	2.1172	4.4869	6.6041
1.00	179.91	0.001127	0.19444	761.68	1822.0	2583.6	762.81	2015.3	2778.1	2.1387	4.4478	6.5865
1.10	184.09	0.001133	0.17753	780.09	1806.3	2586.4	781.34	2000.4	2871.7	2.1792	4.3744	6.5536
1.20	187.99	0.001139	0.16333	797.29	1791.5	2588.8	798.65	1986.2	2784.8	2.2166	4.3067	6.5233
1.30	191.64	0.001144	0.15125	813.44	1777.5	2591.0	814.93	1972.7	2787.6	2.2515	4.2438	6.4953

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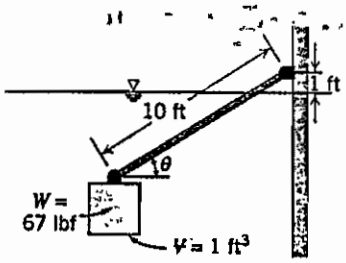
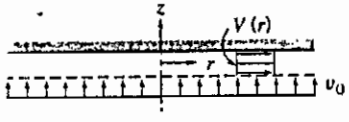
1. One cube foot of material weighting 67 lbf is allowed to sink in water as shown. A circular wooden rod 10 ft long and 3 in^2 cross section is attached to the weight and also to the wall. If the rod weights 3 lbf, what will be the angle, θ, for equilibrium? **25%**



2. Air flow into the narrow gap, of height h, between closely spaced parallel disks through a porous surface as shown. Use a control volume, with outer surface located at position r, to show that the uniform velocity in the r direction is $V = \upsilon_0 r / 2h$. Find an expression for the velocity component in the z direction ($\upsilon_0 << V$). Evaluate the components of acceleration for a fluid particle in the gap. **25%**



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系所：機械系
科目：流體力學

3. (25%) a) What is the physical interpretation of Prandtl number (Pr)? (5%) b) How does it influence the relative growth of the velocity and thermal boundary layer? Explain the difference between liquid metal (Pr<<1) and oil (Pr>>1) according to your answer. (10%) c) As fluid flow over a flat plate, the condition of the velocity boundary layer will go through a transition and change from laminar to turbulent flow. How does this affect the local friction and heat transfer coefficients? (10%)

4. (25%) a) Water is pumped through a vertical 10-cm new steel pipe to an elevated tank on the roof of a building. The pressure on the discharge side of the pump is 1.6 MPa. What pressure can be expected at a point in the pipe 80m above the pump when the flow is 0.02 m^3/s ? (Assumes friction factor f=0.0185) (20%) b) What will happen to the pressure at the same point, if a fully opened control valve is added right after the pump? (5%)

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系所：機械系
科目：應用微積分

1.試利用導函數 f',f"的性質確定 f(x)圖形之上昇、下降、極值及反曲點,再利用解析幾何的描圖原則,討論其截距、對稱範圍及漸近線,繪出

$$f(x)=\frac{2}{x^2+1}$$

之圖形。(20%)

2.試設計一圓柱形無蓋的杯子, 使其容積爲定值 V, 而製作材料最經濟。(15%)

3.已知 f(x)爲三次多項式, 且 f(0)=－1, f'(1)=11, f"(1)=12, f'"(2)=6, 試求 f(x)與 f(1)。(15%)

4. (25%)
Find the area of the region bounded by
The graphs of $f(x) = x^2$ and $g(x) = 1 - x^2$

5. (25%)
Please find the integration as below

$$\int e^{-x}\sin(2x)dx$$

國立雲林科技大學　　系所：機械系
九十一學年度研究所碩士班入學考試試題　　科目：專業實務

(一) 機械領域專業實務簡答題: (30%)

(1) 工業上常用之 AC 三相馬達，如何改變其轉向？如何改變其轉速？

(2) 齒輪齒形(例如:正齒形)的加工有哪些常用的方法？請詳述並比較之.

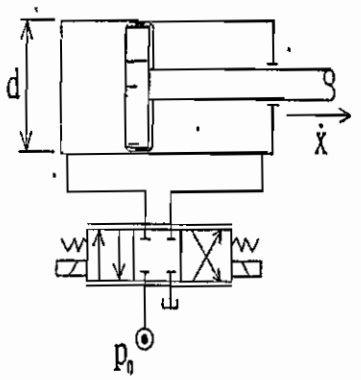
(3) 一般家庭抽水用的離心式水泵與液壓系統中之液壓泵在結構及特性上有差異嗎？請詳細說明之.

(4) 請詳述 PC-based 控制系統與 PLC-based 控制系統在結構，性能，成本等各方面的比較與分析.

(5) 在一般工廠中均具有電動工具(例如:電動板手, electric wrench)及氣動工具(例如:氣動板手, air wrench)，請比較這二者在性能，操作，成本及維護上有何差異？若您是負責的工程師，您會採用哪一系統，為什麼？

(二) 計算題: (20%)

右圖所示為一液壓壓床示意圖，若內徑 d=350 mm, 出力為 150 噸，液壓缸移動速度為 5 mm/s, 試求:



(1) 系統供應壓力 P_0 之值(bar)

(2) 系統供應流量之值(liter/min)

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(三) 假如您欲開發一新產品，何種因素將決定此產品能否開發成功？ 就提昇此種產品的市場競爭力而論，亦請詳細描述這些因素所扮演的角色以及如何能達成提昇的目標？ (25%)

(四) 請詳細描述下列各名詞：設計流程、製造流程、與同步工程，以及它們之間的關係。 (25%)