一、填空題 (不抄題，共十格，每格3%)

1. A standard steel specimen of 1/2 inch diameter is elongated 0.0087 inch in an 8-inch gage length when it is subjected to a tensile force of 6250 lb. If the specimen is in the elastic range, then the elastic modulus of the steel will be ___(1)___.

2. The axial strain for an aluminum rod due to an axial force is 10^{-3} m/m. If the rod is 400 mm long and 12 mm in diameter, then the axial spring constant for the bar is ___(2)___ kN/mm. (Assume elastic behavior and let E = 75 GPa)

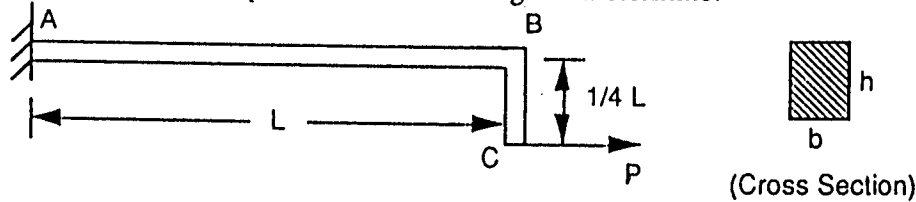3. Consider the problem shown in Fig. 1. Determine:

Fig. 1

(a) The bending energy stored in portion AB is ___(3)___.

(b) The strain energy due to the axial force in portion AB is __(4)__.

(c) If the condition ___(5)___ is satisfied, then the displacement at point B which is resulted from the axial force can be neglected.

4. A piece of 50 x 250 x 10 mm steel plate is subjected to uniformly distributed stresses along its edges (Fig. 2). The change in thickness will be ___(6)___ μm.
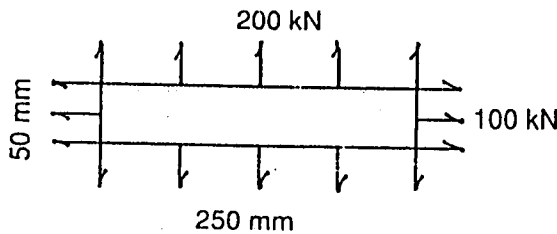

Fig. 2

5. In most problems where strain gauges are often used to determine the principal stresses at some point. It is known that this is a plane stress problem. Why? ___(7)___.

6. Is the stress matrix always symmetric? __(8) answer yes or no__. Why? ___(9)___.

7. Give the definition of shear strain γ_{xy} ___(10)___.

二、 Consider a uniformly loaded beam with both ends built-in (Fig. 3). Use the Castigliano Theorem to determine the bending moment at central point A. (10%)
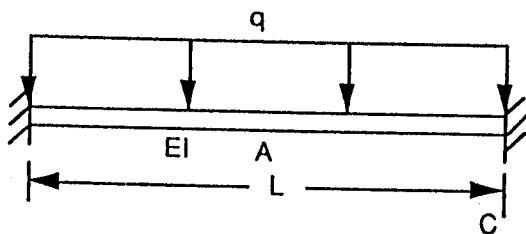

Fig. 3

三. Please answer the following questions in detail: (16%, 4 point for each problem)

(1) State the differences between 'strength', 'stress' and 'pressure'.

(2) State at least four basic assumptions for classical beam theory.

(3) It is common to use $\tau = Tr/J$ for the stress analysis of a bar subjected to a torsional load. Here T is the applied torque, r the radius of the sample and J the polar moment of area of the cross section of the bar. State at least four basic assumptions for this equation to be valid.

(4) Classical beam theory is not consistent in its assumption about shear stress or shear strain. Please state this inconsistency in detail. How can we get rid of this inconsistency?

四. Please use singularity function to find the deflection at point C for the cantilever beam ABC. Please also find reaction forces (moments) at points A and B. (E: Young's modulus, I: area moment of inertia of the beam) (14%)
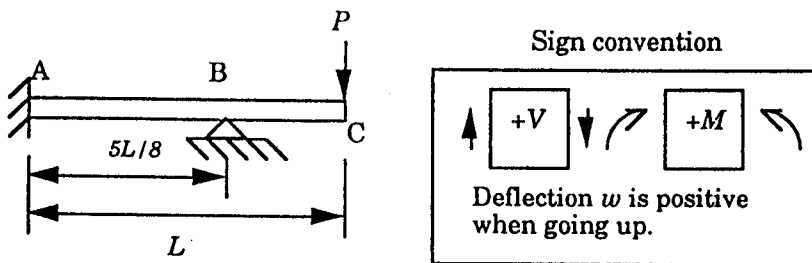
五. The uniform bar is subjected to a distributed compressive axial loading: $p_x = -p_0 \left(\dfrac{x}{L} \right)^2$. Determine the elongation of the bar. Here, E is the elastic modulus, A the cross section and L the length of this bar. (10%)
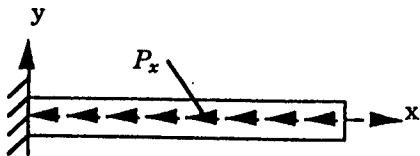
六. 簡述下列諸問題 (每題 4 分共 20 分)

1. 什麼是熱力學第一定律 (the first law of thermodynamics)？什麼是功 (work)？又什麼是熱 (heat)？

2. 為什麼在冰水杯子的外表會有水珠的形成？

3. 什麼是絕對壓力 (absolute pressure)？什麼是錶壓力 (gage pressure)？說明在平地或高山上煮開水會有何不同？

4. 什麼是理想氣体之關係式 (ideal-gas relationship) 試在 P-V (壓力-体積) 圖上 繪出等溫過程 (isothermal process) 有等壓過程 (isobaric process) 之表示線.

5. 在熱力學中所謂的開放式系統 (open system) 有密閉式系統 (closed system) 有何分別？