Problem 1. For the statically indeterminate system loaded as shown in Figure p1, determine the vertical deflection of point C, the torsion in the shaft AB, and the maximum moment in the beam CD. (Note: the deflection at the end of a cantilever beam is given by $v_{max} = PL^3/3EI$.) (*15* Points)

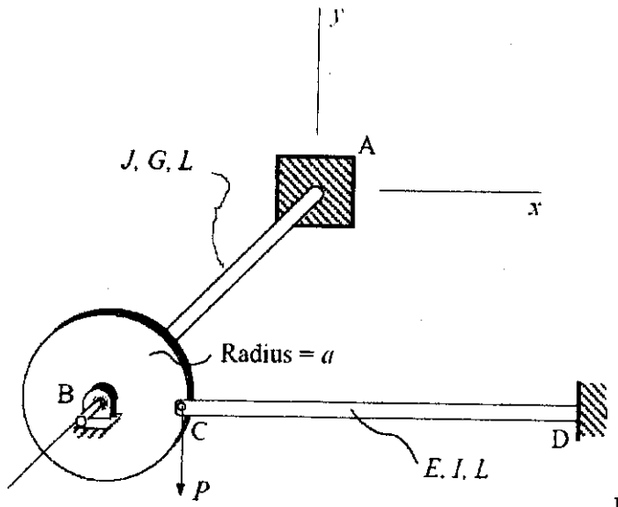

Figure p1

Problem 2. Failure Criteria and Safety Factor (20 Pts)

(a) What is the von Mises failure criterion? What is the Mohr failure criterion? (8 Points)

(b) A solid shaft of circular cross-section, 140 mm in diameter, is loaded simultaneously by bending moment 8 kN.m and torque 12 kN.m. The material is isotropic and is known to yield at a stress of 200 Mpa in uniaxial tension. What is the safety factor according to (a) the maximum shear stress failure criterion, and (b) the von Mises failure criterion? (12 Points)

(背面仍有題目,請繼續作答)

Problem 3. Please provide detail answer for the following questions or concepts (Total 25 Points)

a. The four-point bending test is a popular test scheme for evaluating mechanical behavior of materials. Please sketch its schematic scheme and provide the associate typical bending moment diagram for the specimen during the test. (8 Pts)

b. Please define the volumetric strain, ε_V and use any methods to show that $\varepsilon_V = 3\varepsilon_L$. Where ε_L is the engineering strain. (6 Pts)

c. Why the Poisson's ratio for materials cannot exceed 0.5? (5 Pts)

d. A wide cantilever beam shown in Figure p2, a concentration line load is applied at the edge. Please sketch a schematic deformation plot along A-A' and explain it. (6 Pts)

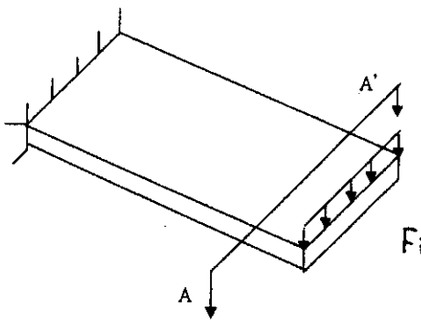

Figure p2

Problem 4. Strain Energy and Energy Methods (40 Points)

(a) Find the strain energy stored in a solid circular cylindrical bar of diameter ***d*** and length ***L***, subjected to equal and opposite end torques ***T***. The material has modulus of rigidity ***G***. (10 Points)

(b) For the structure shown in Figure p3, you are asked to use the Rayleigh-Ritz method with a one degree of freedom approximation to estimate the displacement under the load.

(I): Please develop your trial function. (10 Points)

(II): Please find the strain energy of the structure. (10 Points)

(III): Without performing any detail calculation, please tell us the rest procedures to find the final solution. (10 Points)

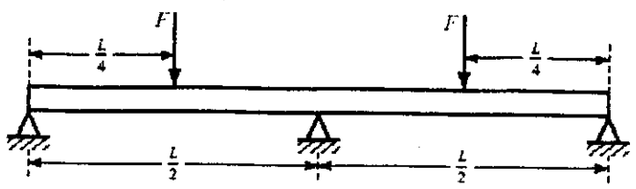

Figure p3