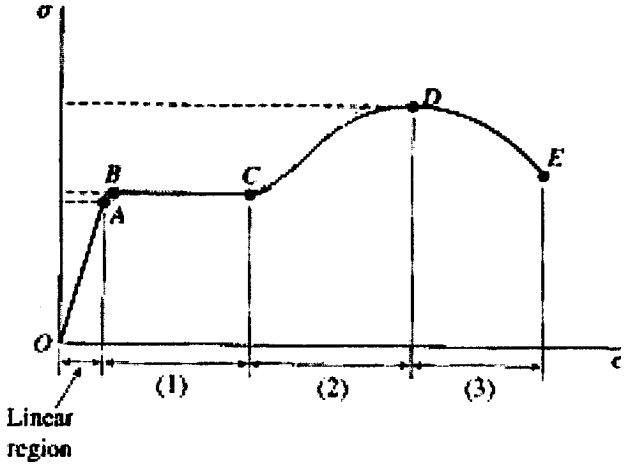
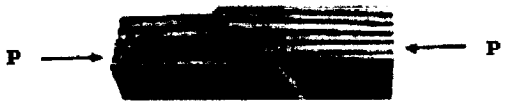
元智大學機械工程研究所 博士班資格考試
計算固力－材料力學

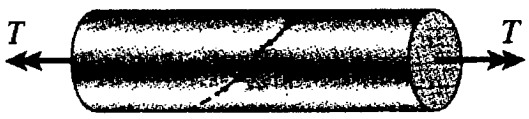
1. Explain the following terms:
   (a) For the following stress/strain diagram, explain why the stress goes up between C-D ? Please explain in details based on the crystalline structure change. (7%)
   (b) What are Engineering Strain and True Strain? What will happen on the above stress/strain diagram for these two definitions? (7%)
   (c) What are the assumptions for theory of the strength of materials? i.e what are the differences for those calculations with that of the real world cases? Please give example and list at least four terms. (6%)



2 Based on the theory of mechanics of materials, derive the equations indicating that the bar will break in the directions as designated when under the following two loading conditions. (20%)



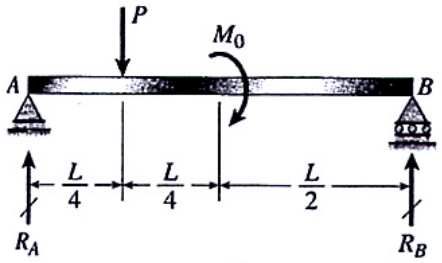
(a) Wood block under compression



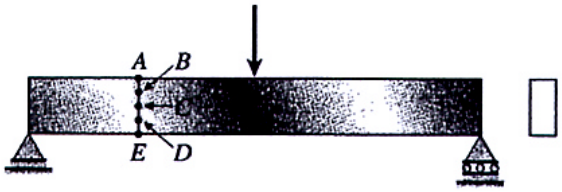
(b) Steel bar under torsion

3 A simple supported beam AB has length L and constant flexural rigidity EI of rectangular cross-section with height of h and width b, loaded by a concentrated load P and bending moment M_o acting at the positions as shown in the figure.
(a) Determine the shear force and bending moment diagrams of the beam. (10%)

(b) List the normal and shear stresses at the cross-section right next to the center of the beam. Draw their distribution schematically on a typical cross-section. (10%)



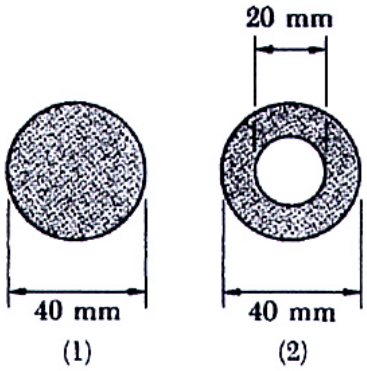
4 For the following simply supported beam with concentrated load at center. Draw the stress element showing the normal stresses, shear stresses and principal stress and maximum shear stress on the cross-section for each of the element A, B, C, D, and E located on the cross-section. (20%)



5 A compression member of 2 m effective length consists of a solid 40 mm diameter brass rod. To reduce the weight of the member by 25%, the solid rod is replaced by a hollow rod of the cross section shown. Determine

(a) The percent reduction in the critical load. (10%)

(b) The value of the critical load for the hollow rod. Use E=105 GPa. (10%)



To the following questions, please give the necessary statements, equations, drawings, or explanations, whatever you think that may enhance the understanding of your answers.

1. Please explain the difference between Impulse Response Function and Frequency Response Function. (Source: 王栢村，振動學，2001，頁 4-32)(10%)

2. What is Dunkerley's method and how to use it? Is there anything that we should be careful when using this method? (Source: Thomson, W. T. and Dahleh, M. D., *Theory of Vibration with Application*, 5th ed. 1998, pp. 358-359) (10%)

3. Explain how to obtain the complete vibration response of a linear time-invariant system subject to arbitrary excitations. (Hint: using the convolution integral) (Source: Meirovitch, L., *Principles and Techniques of Vibrations*, 1997, pp.126-129) (10%)

4. We can use Assumed-Mode Summation method (or called Assumed-Modes Method) to discretize a distributed system. What is the Assumed-Mode Summation method and how to use it. Is there anything that we should be careful when using this method? (Source: Thomson, W. T. and Dahleh, M. D., *Theory of Vibration with Application*, 5th ed. 1998, pp. 216-218. Also, Meirovitch, L., *Principles and Techniques of Vibrations*, 1997, pp.542-543) (10%)

5. Explain how to obtain the eigenvalues of a general system (The general non-conservative systems include inertia, viscous damping, gyroscopic, stiffness and circulatory force terms). What is the relationship between the eigenvalues and the stability of the general system? (Source: Meirovitch, L., *Principles and Techniques of Vibrations*, 1997, pp.167-171) (10%)