

系所組別： 土木工程學系甲、丙、丁組

考試科目： 材料力學

考試日期： 0307，節次： 1

※ 考生請注意：本試題 可 不可 使用計算機

1. Make the reasonable assumptions; derive the shear stresses in beam of rectangular cross section.

$$\tau = \frac{VQ}{bI}$$

where  $\tau$  = shear stress,  $V$  = shear force,  $Q$  = first moment,  $b$  = width of beam, and  $I$  = moment of inertia. (20%)

2. Referring to Figure 2, the measured strains at the point A of a steel plate are
- $\epsilon_a = 60(10^{-6})$
- ,
- $\epsilon_b = 100(10^{-6})$
- ,
- $\epsilon_c = 200(10^{-6})$
- . Let the Young's modulus
- $E_{st} = 200$
- GPa, Poisson's ratio
- $\nu_{st} = 0.3$
- .

(1) Find the in-plane principal strains and principal directions. (12%)

(2) Find the in-plane principal stresses. (8%)

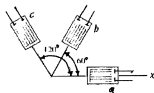
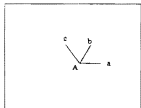


Figure 2

3. Referring to Figure 3, a cantilever beam of length
- $2L$
- with a flexural rigidity
- $EI$
- is fixed at point A. There is a gap
- $\Delta$
- between the free end B and support C. A mass
- $m$
- with a speed of
- $v_0$
- strikes the point D.

(1) Find the impact factor of this beam. (10%)

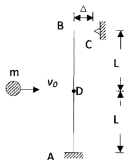
(2) Find the speed  $v_0$  which will let the free end B just touch the support C. (10%)

Figure 3

(背面仍有題目,請繼續作答)

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4. Referring to Figure 4, a rod of length  $L$  is hinged at the left end, with a rotational spring also attached there. The stiffness of the rotational spring is  $K$ .
- (1) Assume the rod is rigid. Determine the critical value of  $P$ , which causes instability of the system. (5%)
  - (2) Let the rod be flexible and elastic, with a flexural rigidity  $EI$ . Derive the characteristic equation for determining the critical value of  $P$ . (10%)
  - (3) Find the correct value of  $P_{cr}$  for a column when  $K \rightarrow \infty$  (5%)

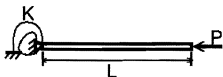


Figure 4

5. Referring to Figure 5, a propped beam with a flexural rigidity  $EI$  is a roof member which also supports a ponding water load. The water level at the supports is  $h$ , and inside the span it is  $h+y$ . Because of continuing rain the water level always reaches the top parapet. The distributed load due to the water is  $w = S\gamma(h+y)$ , where  $S$  is the spacing of the beams and  $\gamma$  is the specific gravity of water.
- (1) Find the governing differential equation and boundary conditions of this beam. (5%)
  - (2) What is the critical ponding parameter  $S\gamma L^4/EI$ . (15%)

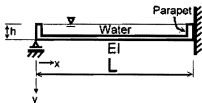


Figure 5