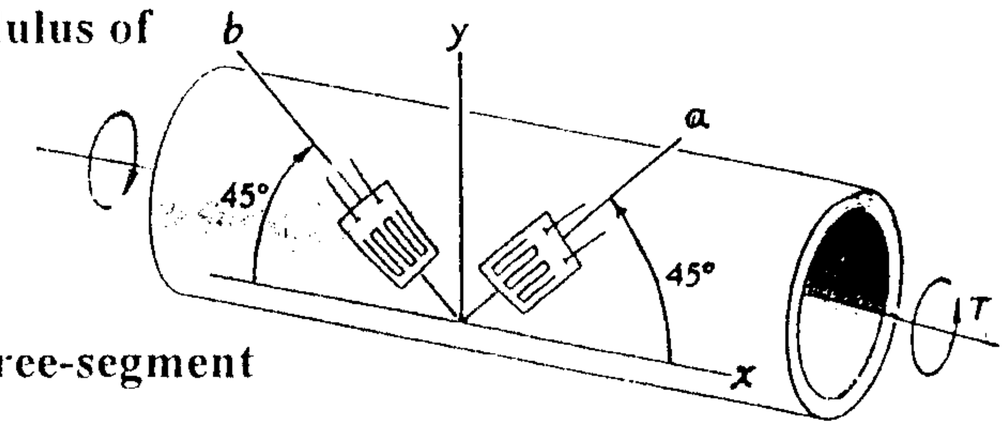
國立臺灣科技大學

八十九學年度碩士班招生考試試題

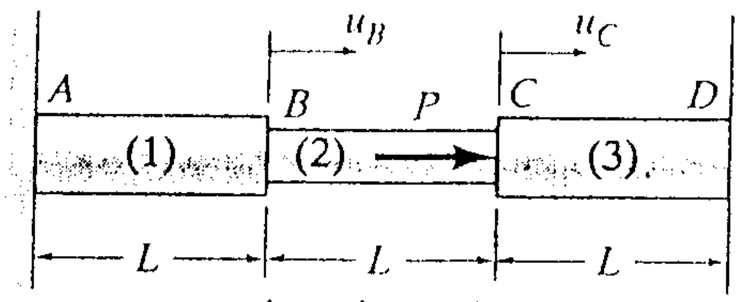
系所組別： 機械工程系甲組、機械工程系乙組

科　目： 材料力學

1. A torsion load cell (to measure torque $T$) is constructed by mounting two strain gages on a tubular shaft, with gages oriented at $\pm 45^\circ$ to the axis of the tube. The gages are wired so that the measurement circuit gives an output $\varepsilon_t = \varepsilon_b - \varepsilon_a$. Determine the relationship between the applied torque $T$ and the measured strain difference, $\varepsilon_t$, if the tube has the following properties: $d_o$ = outer diameter, $d_i$ = inner diameter, $E$ = modulus of elasticity, and $\nu$ = Poisson's ratio. (25%)



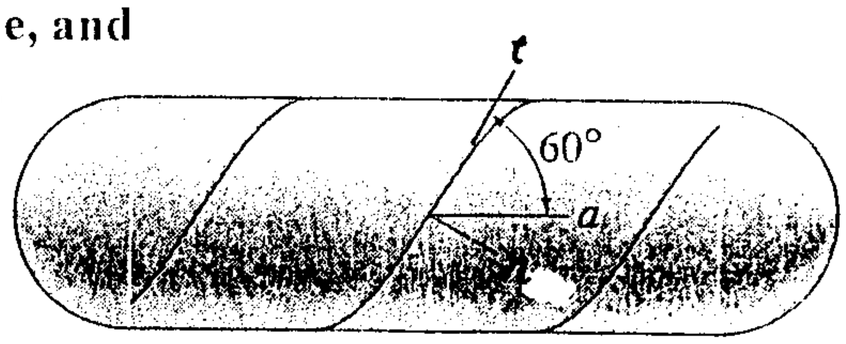

2. A single axial force $P$ is applied at node $C$ of the three-segment rod.
   (a) Determine the axial displacements $u_B$ and $u_C$ of nodes $B$ and $C$ respectively.
   (b) Determine the forces $F_1$, $F_2$, and $F_3$ in the three segments of the rod. (25%)




$A_1 = A_3 = 2A$, $A_2 = A$ } cross-sectional area

$E$ = constant = Young's modulus

3. A cylindrical pressure vessel 2.50 $m$ in diameter is fabricated by shaping two 10-$mm$-thick steel plates and butt-welding the plates along helical arcs. The maximum internal pressure in the pressure vessel is 1200 $kPa$. For this pressure level, calculate the following quantities:
   (a) the axial stress and hoop stress;
   (b) the maximum shear stress; and
   (c) the normal stress, $\sigma_n$, perpendicular to the weld line, and the shear stress, $\tau_{nt}$, tangential to the weld line. (25%)




4. A couple, $M_B$, is applied to a uniform, propped cantilever beam at $B$.
   (a) Determine the reactions at $A$ and $B$.
   (b) Determine the deflection at the midpoint ($x = L/2$). (25%)