國立彰化師範大學 102 學年度碩士班招生考試試題

系所：機電工程學系　　組別：甲組(選考乙)　　科目：材料力學

☆☆請在答案紙上作答☆☆　　

1. An axially loaded rod is of length *L* with Young's modulus *E* and uniform cross-sectional area *A*. The rod has fixed-free boundary condition and is subjected to an axial force *P* (tension); the force acts on the centroid of the cross section at the free end. Based on the given parameters, find
   (a) The axial rigidity of the rod. (5%)
   (b) The stiffness of the rod. (5%)
   (c) The flexibility of the rod. (5%)
   (d) The axial deflection of the rod. (5%)

2. An isotropic shaft is of length *L* with uniform solid circular cross-section of diameter *d*. The Young's modulus and shear modulus of the shaft are given by *E* and *G*, respectively. The shaft has fixed-free boundary condition and is subjected to a torque *T* acting at the free end. Based on the given parameters, find
   (a) The torsional rigidity of the shaft. (5%)
   (b) the torsional stiffness of the shaft. (5%)
   (c) the maximum shear stress acting on the shaft. (5%)
   (d) the angle of twist of the shaft. (5%)

3. Considering the one dimensional problem, an axially loaded rod with the uniform cross-sectional area *A*, the Young's modulus *E*, and the moment of inertia *I*. The rod is of length *L* and has fixed-free boundary condition. A tensile load *P* acts at distance *e* from the axial axis of the rod at the free end, where the axial axis is defined as the axis passes through the centroids of the cross sections. Please find the distance between the axial axis and the neutral axis and give the reasons. (30%)

4. Considering the plane stress problem, the working plane is the *x*-*y* plane and the in-plane stresses are known and given by σ_x, σ_y, and τ_{xy}, where σ_x and σ_y are the normal stresses in the *x* and *y* directions, respectively; τ_{xy} is the shear stress acting on the *x*-*y* plane. Determine the normal stress $\sigma_{x'}$ and the shear stress $\tau_{x'y'}$ on an inclined section with the x' face, where the x'-y' axes are rotated ccw through an angle θ w.r.t. the *x*-*y* axes. (30%)

   Note: Try to draw the corresponding plots, such as stress element diagram, the angle of inclined plane and etc., to derive your solutions.