

系所組別： 土木工程學系丙、丁組

考試科目： 工程材料學

考試日期：0225，節次：2

1. What chemical reactions are generally involved in sulfate attack on concrete? What are the physical manifestations of these reactions? (15%)
2. Derive the upper and the lower bounds for the modulus of a composite, such as concrete. To derive the upper bound, assume that on loading, the matrix and aggregate strain by the same amount. To derive the lower bound, assume that on loading, the matrix and aggregate are stressed by the same amount. The volume fraction of the aggregate is denoted by f . (20%)
3. Sketch a stress-strain curve for a typical metal. Mark on it the Young's modulus E , the yield strength σ_y , the tensile strength σ_{ts} , and the proportional limit ϵ_f . Indicate the work done per unit volume in deforming the metal up to a strain $\epsilon < \epsilon_f$. (15%)
4. The high cycle fatigue life, N_f , of an aluminum alloy is described by
$$\sigma_a = 480(N_f)^{-0.1} ,$$
 σ_a (in Mpa) is the stress amplitude of a cyclic loading with zero mean stress. How many cycles will the material tolerate at $\sigma_a = 70\text{MPa}$ and zero mean stress? How will this change if the mean stress is 10 MPa? (15%)
5. The atomic diameter of an atom of nickel is 0.2492 nm. Calculate the lattice constant of F.C.C. nickel. The atomic weight of nickel is 58.71 g/mol. Calculate the density of F.C.C. nickel. If the same nickel atoms are packed to form a glassy structure (dense random packing), and the packing arrangement has a density of 0.636, calculate the density of glassy nickel. (15%)
6. Explain (a) fineness modulus of an aggregate (b) fine aggregates and coarse aggregates (c) Eutectoid reaction (d) strengthening mechanism of alloy (20%)