※ 考生請注意：本試題不可使用計算機

1.　(a) Discuss the effect of water-to-cement ratio on the quality of hardened concrete and explain why this effect happens. (10%)

(b) What is the typical water-to-cement ratio for normal strength concrete? (5%)

(c) Define mineral admixtures, and explain what mineral admixtures do in a concrete mixture. (10%)

2.　Three of the important properties of aggregates are (i) porosity (ii) particle shape and (iii) maximum–size-aggregate. For each of them, define the property and explain the significance of the property with respect to the use of aggregate in a concrete mixture.　(15%)

3.　Draw the iron-carbon phase diagram showing the liquid, liquid-solid and solid phases. Explain why carbon is added to steel. (20%)

4.　A cylindrical rod with a length of 400 mm and a cross-sectional area of 100 mm^2 is to be subjected to a tensile load. The rod must not experience plastic deformation or an increase in length more than 1 mm when a load of 25 KN is applied. Which of the four materials listed are possible and justify your answers. (10%)

Material	Elastic modulus (GPa)	Yield strength (MPa)	Tensile strength (MPa)
Copper	110	248	290
Aluminum alloy	70	255	420
Steel	200	450	551
Brass alloy	101	350	420

5.　(a) What is the atomic packing factor? What is the information needed for computing it? (8%)

(b) Explain the classes of defects in crystal structures. (6%)

(c) Sketch a S-N curve of a metal alloy for fatigue failure. Specify the regimes of high and low cycle fatigue. (8%)

(d) Explain the creep behavior of materials. What are the important factors of the creep rate, and why? (8%)