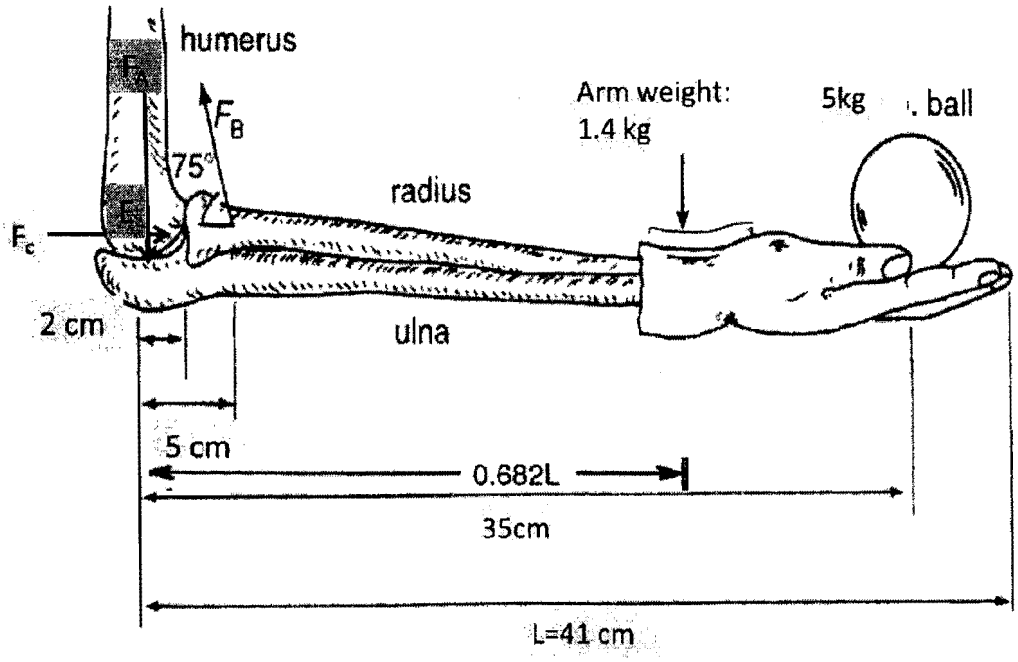
2012 Biomedical Engineering Master Entrance Exam — Biomechanics (依規定不可用計算機)

I. Define the following terms in word and/or figures (28 分)

1. Anisotropic property of materials (3%)
2. Mechanobiology (3%)
3. Lamé constant, Young's modulus, shear modulus (6%)
4. Poisson's ratio, yielding strength, ultimate tensile strength and fracture toughness (8%)
5. Reynolds number and the meaning of high and low Reynolds number. (4%)
6. Stress shielding (4%)

II. Calculation and essay questions: (72 分)

1. A 70 Kg person is holding a 5 Kg weight in his palm with the elbow fixed at 90^0 flexion. (a) What force must the biceps generate to hold the forearm in static equilibrium? (b) What force(s) does the forearm exert on the humerus? (10%)

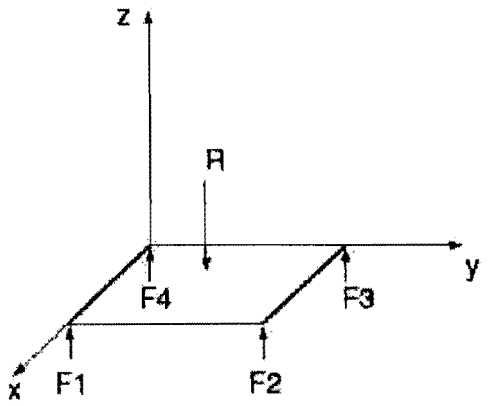


2. A total hip replacement stem breaks, but the surrounding bone is not broken. The stem is made of a strong cobalt chromium alloy which is stronger than bone. Why, then, did it break? How can one prevent stems from breaking? (8%)
3. Draw stress or strain vs time for a step loading and unloading for stress relaxation and creep curves for a viscoelastic material. (8%)
4. What are common difficulties in determining stress and strain of mechanical testing of ligament and

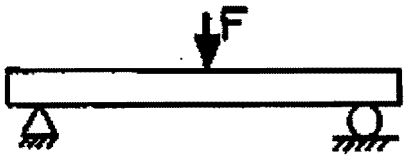
(背面仍有題目,請繼續作答)

tendon? (6%)

5. A blow on one side of the head sometimes causes injury to the opposite side of the brain. Why? (6%)
6. Please draw the stress–strain curve for a typical soft connective tissue and describe it based on its structure. (8%)
7. Kinematics measurement of human locomotion has been divided into 8 phases, please describe them and show the flexion angle of knee at all phases. (10%)
8. The force plate depicted in this figure has four sensors, one at each corner, that read the vertical forces F1, F2, F3, and F4. The force plate is 70 cm by 70 cm square. At a particular instant of the gait cycle each transducer reads F1 =210 N, F2 = 220 N, F3 = 150 N, and F4 = 180 N. Compute the resultant force and its location. (6%)



9. Please use the following 3-point bending figure to derive the tension (σ) and deflection (δ) at bottom of the beam. Use the following terms: E: modulus; span length: L; beam width: b; beam height: h; moment: M



(10%)