# UNIVERSITY COLLEGE LONDON

University of London

## EXAMINATION FOR INTERNAL STUDENTS

*For the following qualifications:*

*B.Sc.* *(Intercal)* *M.Sc.*

**Health Sciences C104 : BIOMECHANICS**

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|---|---|---|
| COURSE CODE | : | **HESCC104** |
| UNIT VALUE | : | **0.50** |
| DATE | : | **13 May 2002** |
| TIME | : | **10. 00 am** |
| TIME ALLOWED | : | **3 hours** |

**02-C0692-3**



**TURN OVER**

# HEALTH SCIENCES C104 : BIOMECHANICS

Answer **FOUR** questions out of **EIGHT** questions
Answer **EACH** question in a **SEPARATE** book.

1. Estimates of the peak levels of force occurring in the hip joint during normal walking have ranged from 3x to 8x body weight. Explain:

   a. Why are the force levels so much higher than the body weight of the person.
   b. What measurements would you need to make in order to carry out your own estimation of the force.
   c. Why there is uncertainty about the true value.

2. You have been charged with the task of designing two new femoral hip replacements (consisting of both the femoral and acetabular components). The two femoral hip replacement designs are as follows:

   a. This design is aimed at elderly patients (>75 years old) with typical degenerative changes such as osteoarthritis.
   b. This design is aimed at young (20-40 years old) active patients with severe developmental dysplasia of the hip (DDH) with femoral neck anteversion in excess of 60 degrees.

   Compare and contrast your design criteria and the selected materials in relation to your two designs. Your answer should consider a broad spectrum of design characteristics (including materials, bearing surfaces, fixation *in vivo* effects and cost effectiveness).

3. Indicate the function of the ligaments in a natural knee. Under what conditions do these ligaments rupture and what are the consequences of ligament rupture on knee motion?

4. Define and describe adhesive, abrasive, delamination and fretting wear. Indicate the relative contribution of these different types of wear to failure of hip and knee joint replacements.

5. Describe advantages and disadvantages of available orthopaedic metallic materials and associate manufacturing processes for fabricating a high performance hip replacement.

6. Articular cartilage is described as a biphasic, viscoelastic, porous, permeable material. What is the nature of this material's viscoelasticity and how does this contribute to the capacity of articular cartilage to withstand prolonged compressive loads?

7. In total hip replacements, stem-bone fit & fill, interface micromotion and migration are important indications that have often been used to evaluate stem designs.

   i. Give the definition of stem-bone fit & fill, interface micromotion and migration.

   ii. Describe their effects on long-term clinical performance of the hip stems.

   The discussion should include biomechanical consideration and biological response.

8. Concerning the biomechanics of fracture:

   i. Compare and contrast primary and secondary fracture healing.

   ii. Describe strain energy and its effects on bone fracture.

   iii. Explain why old ladies are prone to femoral neck fracture rather than femoral shaft.




**END OF PAPER**