Faculty of Engineering Science and the Built Environment

Department of Applied Science

LONDON SOUTH BANK UNIVERSITY

Session : 2010/11

Course No	Course Title Stream	Year Mode
1092	BSc (Hons) Sports Product Design 4FS00	3
836	BSc (Hons) Sport and Exercise Science 3FS00	3

Unit : Biomechanics 3

Reference : SSS_3_993

Date : 18th January 2010

Time : 10.00

Time Available : 3 Hours

Instructions to Candidates

Answer TWO questions.
All questions carry equal marks.

Calculators may be used provided they are noiseless, cordless, not pre-programmed by the candidate and cannot receive or transmit data remotely.

Answer **all** questions in the answer book **NOT** on this paper.

Answer **two** from the four questions. Each question is worth 50 marks.

Question One

The body is in a continual process of self-optimisation and self-organisation. An important feature in this process is the effect of load on the human system.

a. Explain the role of load in the development and adaptation of the human musculoskeletal system

(10)

b. Describe and explain the 'role' of frequency in relation to force propagation characteristics during human motion.

(15)

c. Outline and explain the mechanical features and considerations associated with the structures in and around the knee joint in relation to 'dealing with' load.

(25)

Question Two

Gait has been defined as "the manner or style of walking, rather than the walking process itself" (Whittle, 2003, p.43). Therefore, it is necessary to characterise the mechanics of the gait cycle and highlight how the musculoskeletal system responds in this cycle, to ensure that walking is both effective and efficient.

a. Describe and explain the mechanical characteristics of a normal gait cycle

(20)

b. *Figure 2.1* illustrates a Power Spectral Density profile for barefoot gait, measured from accelerations at the shank. Interpret the profile and explain what differences may occur for such a measure in shod gait.

(10)

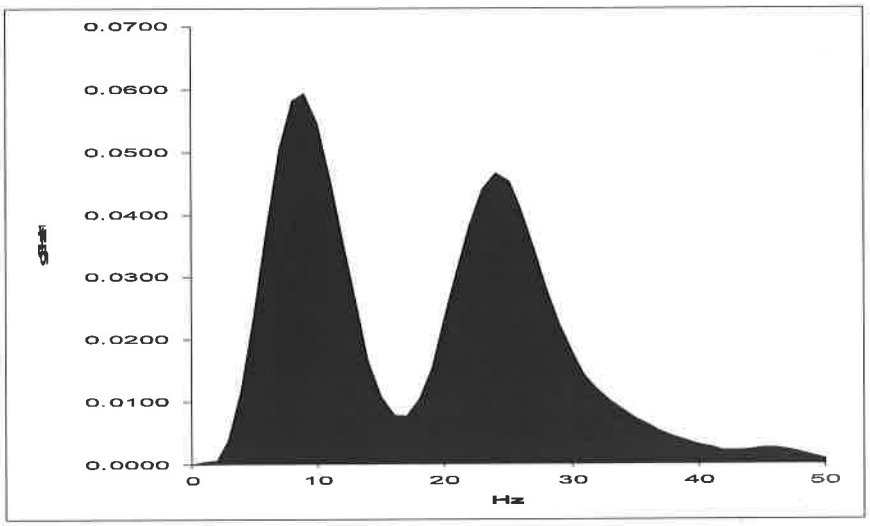

Figure 2.1 PSD for barefoot gait (load response phase).

c. Discuss and explain the mechanics and shock absorbing properties of the foot in an active barefoot system.

(20)

Question Three

a. Explain the applications and limitations of mathematical modelling in the biomechanical analysis of the human musculoskeletal system.

(10)

b. Explain the process by which the flexion characteristics about the elbow joint can be modelled based on assumptions associated to Hill's model.

(15)

c. *Figure 3.1* illustrates a simple model representation of the upper arm and lower arm together with a biceps muscle.

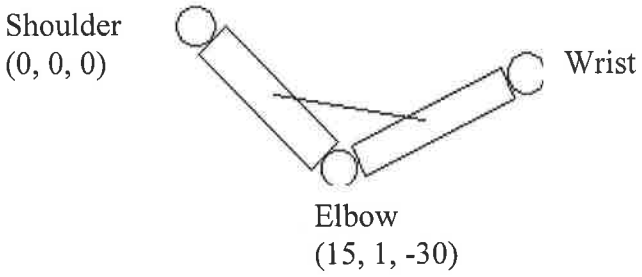

Figure 3.1 Model representation of biceps muscle

Co-ordinates of Origin, (7, 0.5, -16).
Co-ordinates of Insertion, (23, 1, -22).

Calculate muscle length and velocity of contraction (both in metres) for each instant outlined in Table 1. Briefly discuss the findings.

t	0	0.02	0.04	0.06	0.08	0.1
θ	160	143	118	109	101	98

Where t is time and θ is the angle at the elbow.

(25)

Question Four

a. Explain the importance of segmental contribution in human motion, providing example and illustrations.

(10)

b. Explain the characteristics and importance of the following mechanical variables in relation to assessing segmental contribution.

- Kinematic data
- Joint centres of rotation
- Inertial properties of segments
- Directly measured forces

(15)

c. Identify the role of these variables in the process of inverse dynamics and illustrate it diagrammatically, outlining limitations throughout.

(25)