Faculty of Engineering Science and the Built Environment

Department of Applied Science

LONDON SOUTH BANK UNIVERSITY

Session : 2007/8 No: 219

Course No	Course Title / Stream	Year / Mode
2219	BSc (Hons) Pre-Clinical Studies with Sport & Exercise Science 1FS00	1
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 : 15 January 2008

Time : 10.00

Time Available : 3 Hours

Instructions to Candidates

Answer <u>TWO</u> 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** questions from four.
Each question is worth 50 marks.

Question One

a). Explain the characteristics and importance of the following mechanical variables in relation to an inverse dynamics approach to calculating load at a joint.

i). Kinematic data
ii). Joint centres of rotation
iii). Inertial properties of segments
iv). Directly measured forces

(15)

b). Explain the role of inverse dynamics in calculating joint load and apply the following data to illustrate and calculate joint reaction forces and net moment at the ankle joint, explain the results. (GRF is Ground Reaction Force)

Subject Body Mass: 77 kg   Foot segment: 2% BM
Vertical GRF: 1200 N   Horizontal GRF: -140 N
Segmental Vertical acceleration: 30 $m.s^{-2}$
Segmental Horizontal acceleration: -25 $m.s^{-2}$
Angular acceleration: 80.5 $rad.s^{-2}$
Moment of Inertia: 0.006 $Kg.m^2$
Moment arms from force to associated axes:
Vertical GRF: 0.04 m
Horizontal GRF: 0.02 m
Vertical joint reaction force: 0.065 m
Horizontal joint reaction force: 0.038 m

(20)

c). Discuss and explain the limitations and assumptions related to the Inverse Dynamics approach to calculating joint load.

(15)

Question Two

The construction and function of the knee joint is crucial for the efficient and effective performance of lifestyle tasks that require the transferral of bodyweight from one point to the next.

a). Discuss the statement with particular reference to the role of the ligaments, tendons and articular cartilage at the knee joint in 'taking up' force during normal locomotor activity.

(30)

b). Explain the 'Cause and Effect' and 'Empirical' approaches to injury.

(20)

Question Three

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

(10)

b). *Table 1* highlights angular data specific to the internal angle of the knee for normal gait in 3 conditions. Use co-ordinate data given to calculate respective muscle length and velocity of contraction for each condition. Discuss your findings.

Co-ordinates of Hip: (0, 0, 0)
Co-ordinates of Knee: (15, 1, -30)
Co-ordinates of Muscle Origin: (7, 0.5, -16)
Co-ordinates of Muscle Insertion: (23, 1, -22)

Table 1 Knee angle data (degrees) collected at 50 Hz

Condition	**Initial contact (IC)**	**IC + 1 Frame**	**IC + 2 Frames**
High Heels	165	161	154
Trainers	170	167	162
Barefoot	158	150	148

(25)

c). Explain how alterations associated to pathological characteristics of gait may change kinematic and kinetic variables, outlining the importance of each variable provide examples throughout.

(15)

......Question Four over the page

Question Four

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

(20)

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

(15)

c). Explain the importance of functional variation and functional stability in relation to a gait cycle, giving examples throughout.

(15)