Graduate School of Biomedical Engineering

UNSW Engineering

BIOM9541

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email			

Name	Email			

Course Details

Units of Credit 6

Summary of the Course

Ever wondered how Lord of the Rings or Avatar were created? How athletes might analyse the biomechanics of their movements to improve performance? Or about how advances in wearable technology, phone apps and smart garments can be used to detect, analyse and predict injuries and health issues or even help people with Parkinson's disease walk with confidence?

This course introduces students to the methods used in the analysis of human movement in medicine and health, including applications in sport biomechanics and musculoskeletal modelling. Methods to analyse body segment and joint kinematics, joint kinetics, work and power, muscle forces and associated energy cost will be covered.

Applications of biomechanics in clinical, occupational and recreational areas will be presented. Highlights include access to Neuroscience Research Australia's state-of-the-art 3D motion capture lab for the MoCap laboratory sessions. In case of COVID restrictions, illness or misadventure, options will be available for students to participant remotely with dedicated online support provided for 2022. Our focus is to offer the best possible learning and teaching experience with a focus on hands on and in-person learning experiences where possible.

Course Aims

The aims of this course are to:

1. Develop understanding of the field of human movement science and diverse applications in medicine, health and sport.
2. Introduce students to the fundamentals of anatomy and biomechanics.
3. Develop fundamental understanding of 3D motion capture, gait analysis and musculoskeletal modeling.
4. Introduce students to advances in wearable and mobile technologies for biomechanical analysis of human movement.
5. Enable students to critically apprise technologies used for biomechanical analysis of human movement.
6. Provide an engaging environment for students to self-organise their learning and develop team collaboration skills for engineering projects.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Analyse human movement using mechanical principles	PE1.1, PE1.2, PE1.3
2. Design and perform experiments that evaluate human movement	PE1.1, PE2.1, PE2.4, PE3.1, PE3.6
3. Critically analyse experimental outcomes in broader context	PE1.4, PE1.5, PE2.3

4. Online Flexible Learning: for remote students there is also the choice of participating through "Online Flexible Learning" approaches, whereby students can submit Powerpoint demonstrations of their work instead of attending schedulled laboratory sessions and doing inperson/ZOOM demonstrations.

5. State-of-the-art Laboratories: BIOM9541 is excited to have access to Neurosicience Research Austrlia's (NeuRA) state-of-the-art 10-camera VICON 3D Motion Capture Lab. In T3, three face-to-face lab sesssions will be held at NeuRA a 5-minute walk from UNSW.

6. Beta-testing mobile technologies: BIOM9541 has also secured a beta testing licence for SPLYZA Motion an AI driven smart phone app for biomechanical analsysis of human motion. This provides additional flexibility for online students to conduct experiments in the comfort of their home environments.

7. Wearble technology will be used to investigate different ways to analyse human movement.

8. Fun Kahoot Quizzes that provide light-hearted repetition of key concepts that will help you cement the new knowledge and revise for the final exam.

Private Study	

quizzes with incentives. Online help and class collaboration is further provided and encouraged to develop engineering leadership and teamwork skills.

Suggested approach to learning. This course requires you to understand the lecture material and then apply the knowledge to biomechanical applications. It is important to understand the fundamental concepts as soon as possible and to ask for help if you do not understand. Complete all the lectures and if something is unclear, please ask questions. Make sure you review lecture notes and read all material that is suggested or handed out. Class participation through attendance at tutorials, laboratories and group work is expected and will allow for alternative methods of absorbing the relevant information.

No previous biomechanics experience? Not a problem. As part of this course you also get access to an online Introductory Biomechanics course for your reference.

Additional Course Information

Biomechanics is the study of the effect of mechanical phenomena (forces, velocities, accelerations, energies, power, momenta, moments, friction, fatigue and failure) on human bodies. It relies on an understanding of mechanics and applies the fundamentals of mechanics to the structure and function of the human body.

Biomechanics is used in a diverse range of disciplines including biology, ergonomics, engineering, physiology, medicine, and mechanical physics. Many professionals – engineers, designers, physical therapists, oral and orthopaedic surgeons, cardiologists, and aerospace engineers – use practical applications of biomechanics.

Biomechanics has application in all areas of health care and medical problem solving that require physical manipulation. It may be the major area of concern in some instances (e.g. artificial joints, prosthetics and orthoses, mechanisms of physical injury) or it may be a vital adjunct to another area (e.g. design of an implantable pacemaker or specialist surgical tools).

This course covers in depth the methods used in the analysis of the biomechanics of the human musculoskeletal system. Methods to analyse body segment and joint kinematics, joint kinetics, work and power, muscle forces and associated energy costs will be covered. Applications of biomechanics in clinical, occupational and recreational areas will be presented.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Weekly Online Quizzes and Discussion Board Posts	10%	Weekly	1, 4, 6
2. OpenSim Model Demonstrations	10%	Weeks 1, 3, 4 & 7	1, 2, 4, 6
3. Industry Engagement and Mobile Technology Report	10%	Week 4	1, 2, 3, 4, 5, 6
4. Computational Laboratory Report	10%	Week 9	1, 4, 6
5. Individual Motion Capture Projects	30%	Weeks 6, 7 and 10	1, 2, 3, 4, 5, 6
6. Final Exam	30%	Exam Week	1, 2, 3, 4, 5

Assessment 1: Weekly Online Quizzes and Discussion Board Posts

Due date: Weekly

Weekly Progress (7%). The purpose is to ensure you are making timely progress through the online units. You will note that each online Moodle unit has a number of questions embedded throughout it. Your answers to these questions will be logged and recorded in the grade book. You will receive one credit (1%) for each unit if you complete with a score of at least 80% before your schedulled laboratory class of the same week (up to a maximum of 7 credits). It is expected that you complete the online Moodle unit before your laboratory session that week. You are then expected to enhance your learning experience by discussing the week's Moodle content with your demonstrator at the laboratory session.

Yay and Boo (3%) is a lighthearted assessment that will allow you to share your triumphs and failures with your colleagues by posting your results to the class Moodle forum. The purpose is to enhance BIOM9541 engagement. There will be three opportunities throughout the semester to participate in the Yay and Boo assessment. Yay and Boo opportunities will appear in three of the software laboratories (SL1, SL2 and SL3). You will be given the opportunity to share your triumph or failure with your colleagues on the discussion board. Each post published before the deadline will earn you one credit (1%). Don't miss out!

Assessment 2: OpenSim Model Demonstrations

Due date: Weeks 1, 3, 4 & 7

Attendance for all Software Laboratory sessions (SL1, SL2, SL3 and SL4) is compulsory. Failure to attend the laboratory class will mean that you cannot receive a grade for any of the assignments associated with this assessment component.

The four software laboratories provide you with an opportunity to analyse and simulate human movement. You will be introduced to the analysis of human movement using OpenSim, a freely available software. You will use the 3D MoCap data you collect during the laboratory session at NeuRA in week 2 as well as sample data provided to perform various analyses of human movement. You will be assessed based on your model and your group responses.

The mark breakdown for each Software Laboratory (2.5%) will be as follows:

- Model quality (1.5%)
  - 0 for no model
  - 0.5 for working model with major errors
  - 1 for working model with minor errors
  - 1.5 for working model without errors

- Group responses (1%)
  - 0 for minimal effort
  - 0.5 for some effort, but more required
  - 1 for good effort (Note all group members will receive the same mark)

"Online Flexible Learning" Students will be required to submit through Moodle a working demo of thier model using Powerpoint instead of attending a session and will submit group reports to the dedicated online support demonstrator.

Assessment 3: Industry Engagement and Mobile Technology Report

Start date: Week 3
Due date: Week 4

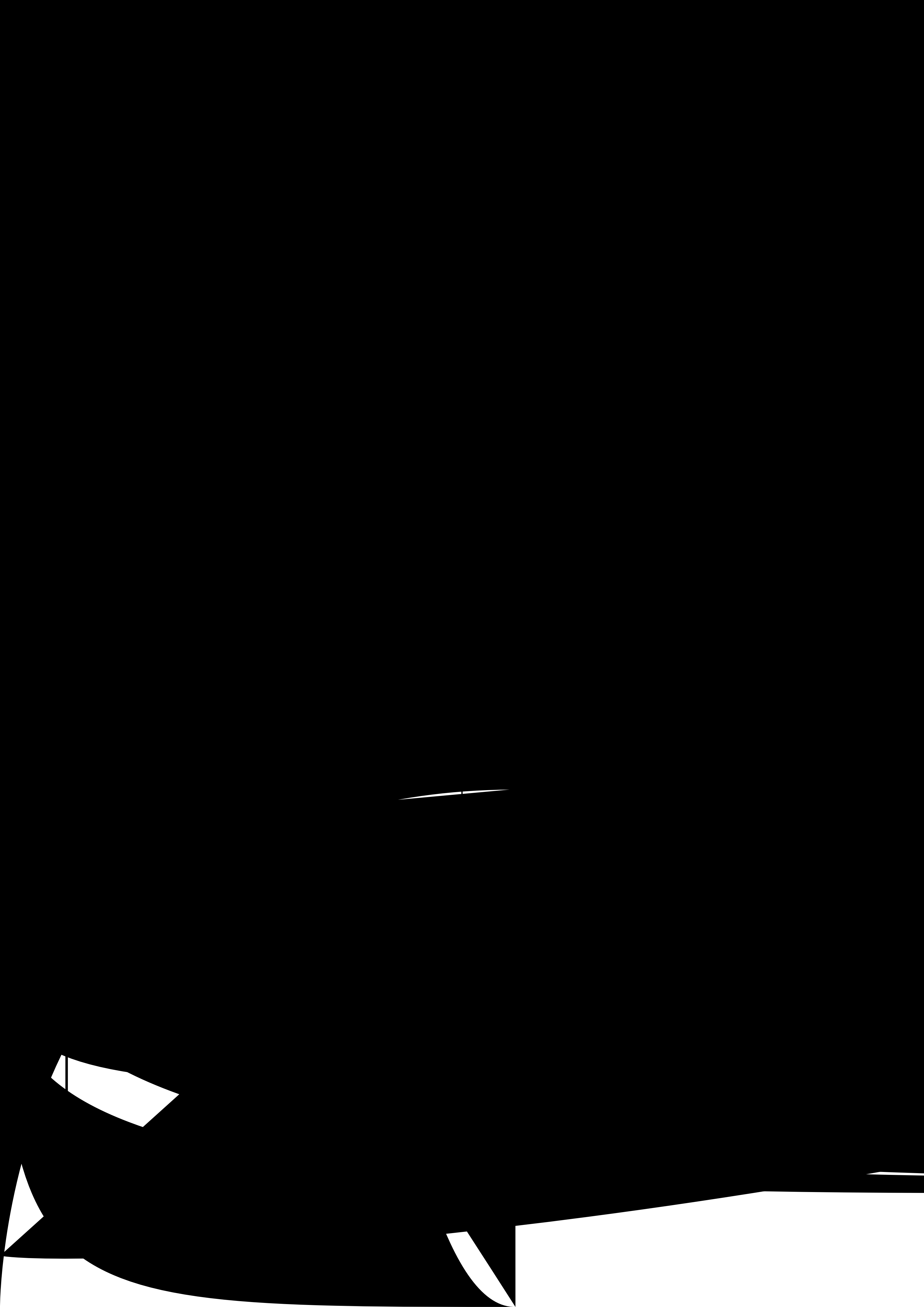
Your team must choose between Beta testing the SPLZA motion app (Apple users only) or Investigating the accuracy of another health app (all phone users). Only one report per team is required and shoud focus on either:

Beta test the SPLYZA Motion (10%)

Students will beta test the SPLYZA Motion mobile phone app and produce a short report for SPLYZA.

the course and will be open-book. You will be provided with an equation sheet during the exam, which will be made available to you well before to the exam so you know what to expect. Marks will be awarded for correct answers and for the quality of your working, which will have to be photographed and uploaded during the exam per ich will have to be photographed and

Week 1: 12 September - 16 September		



Resources

Prescribed Resources

Online Flexible Learniung students and Thursday Laboratory students should bring their own laptop computer to Software and Computational Laboratories with OpenSim and other core software installed. OpenSim and other core software is available on the SAM518 computers and these will be used for the Tuesday and Wednesday laboratory sessions.

Recommended Resources

The recommended background text for this course are:

- Robertson, D.G.E. et al. Research methods in biomechanics. First (or second) edition, Human Kinetics, 2004 (or 2016).
- Winter, D.A. Biomechanics and motor control of human movement. Third edition, John Wiley & Sons, Inc., 2005.

Other useful reference books that are held in the UNSW Library are:

- Enderle, J.D. and J.D. Bronzino, Introduction to biomedical engineering, Third edition, Academic Press, 2012.
- Meriam, J.L. and L.G. Kraige, Engineering mechanics, Sixth edition, John Wiley & Sons, 2008.

Students seeking additional resources can also obtain assistance from the UNSW Library at http://library.unsw.edu.au/.

Additional readings and recommended websites will be listed on Moodle when required.

Course Evaluation and Development

Student feedback has helped to shape and develop this course, including feedback obtained from on-line evaluations as part of UNSW’s myExperience process. Your feedback is much appreciated and taken very seriously. Continual improvements are made to the course based in part on such feedback and this helps us to improve the course for future students. Informal student feedback is also sought frequently throughout the semester and used to assist in the progression of the course.

Laboratory Workshop Information

Students will be required to sign COVID19 safe declarations before attending any face-to-face laboratory sessions at NeuRA's state-of-the-art MoCap lab, which includes evidence of vaccination.

Submission of Assessment Tasks

Laboratory reports and major assignments will require a Non Plagiarism Declaration Cover Sheet.

Assignments should be submitted on time. A daily penalty of 5% of the marks available for that assignment will apply for work received after the due date. Any assignment more than 5 days late will not be accepted. The only exemption will be when prior permission for late submission has been granted by the Course coordinator. Extensions will be granted only on medical or compassionate grounds under extreme circumstances.

Academic Honesty and Plagiarism

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise will have their names entered on a plagiarism register and will be liable to disciplinary action, including exclusion from enrolment.

It is expected that all students must at all times submit their own work for assessment. Submitting the work or ideas of someone else without clearly acknowledging the source of borrowed material or ideas is plagiarism.

All assessments which you hand in must have a Non Plagiarism Declaration Cover Sheet. This is for both individual and group work. Attach it to your assignment before submitting it to the Course Coordinator or at the School Office.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at: https://student.unsw.edu.au/plagiarism

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	
PE2.2 Fluent application of engineering tech complex engineers PE2.1 Application of established enginee	