

**SPORT SCIENCE & MANAGEMENT**  
**SS3325 BIOMECHANICAL MODELLING AND SIMULATION**

<b>Academic Year</b>	2025-26	<b>Semester</b>	2
<b>Course Coordinator</b>			
<b>Course Code</b>	SS3325		
<b>Course Title</b>	Biomechanical Modelling and Simulation		
<b>Pre-requisites</b>	SS1025 Introduction to Sport Biomechanics		
<b>No of AUs</b>	3		
<b>Contact Hours</b>	39		

**Course Aims**

This course will focus on the biomechanics of human movement using modelling and simulation techniques. The topics covered will familiarise you with developing and applying various biomechanical models to analyse and simulate motion. The course aims to develop your understanding of biomechanical modelling and independently apply the knowledge in sport settings.

**Intended Learning Outcomes (ILO)**

By the end of this course, you should be able to:

1. explain the theoretical background of biomechanical modelling and simulation.
2. construct various types of biomechanical models.
3. conduct a project using biomechanical techniques.
4. share the findings of the biomechanics project.
5. critically evaluate the strength and weaknesses of study findings in the area of sports biomechanics.

**Course Content**

The following topics will be covered:

1. Research Methods in Biomechanics
2. Modelling Approach in Biomechanics
3. Simulation Approach in Biomechanics
4. Critique of Current Literature

## NTU Competencies & Graduate Attributes

### NTU Competencies

Character	
Competence	√
Cognitive agility	√

### NTU Graduate Attributes

Graduate Attributes	Level (i.e., basic, intermediate, advanced)
1. Problem Solving	Intermediate
2. Sense Making	Intermediate
3. Critical Thinking	Advanced

## Assessment (includes both continuous and summative assessment)

Component	ILO Tested	Weighting	Team/ Individual	Assessment Rubrics
1. Assignment	2	10%	Individual	Appendix 1
2. Laboratory Project - Presentation	2, 3,4,5	40%	Team (Team – 24%; Individual – 16%)	Appendix 2
3. Final Examination	1-5	50%	Individual	
Total		100%		

## Formative Feedback

Feedback for learning will be verbally provided during each laboratory class session, where you have the opportunity to learn techniques and apply yourselves to problems related to sport biomechanics. You will receive verbal feedback on the techniques and mistakes in the experimental work, alongside suggestions for improvement.

Upon completing the Assignment and Laboratory Project, you will receive verbal and/or written feedback on your assessed performance. Generic written feedback will be provided to the class for the Final Examination.

## Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Lectures will provide information for key learning concepts and theories and support understanding of key concepts
Laboratories	Laboratories will: <ul style="list-style-type: none"><li>• Give hands-on experiential learning to support key theories and information provided in lectures.</li><li>• Provide tasks for you to apply theory to practice.</li></ul>

	<ul style="list-style-type: none"> <li>• Allow you to discuss and assimilate the content to develop communication skills.</li> </ul>
Independent Learning	Time will be given for learning from online materials or practice in the laboratory as a part of the flip teaching approach. Online materials will support key concepts covered in lectures and laboratories. Laboratory practice will allow you to operate equipment and software effectively.
Paper Clubs	In a group discussion format, you will learn to critically appraise the strength and weaknesses of research papers in the literature.

## Reading and References

### NIE Research and Publications

1. King, M.A., Kong, P.W. & Yeadon, M.R. (2023). Differences in the mechanics of takeoff in reverse and forward springboard somersaulting dives. *Sports Biomechanics*, 22(2): 255-267.
2. King, M.A., Kong, P.W., & Yeadon, M.R. (2019). Maximising forward somersault rotation in springboard diving. *Journal of Biomechanics*, 85, 157-163.
3. Teng, P.S.P., Leong, K.F., & Kong, P.W.\* (2022). Regression model for predicting knee flexion angles using ankle angles, body mass index and generalised joint laxity. *Sports Biomechanics*.

### Other Readings and References

4. Robertson, G., Caldwell, G., Hamill, J., Kamen, G., & Whittlesey, S. (2013). *Research Methods in Biomechanics, 2E*. Human Kinetics.
5. Payton, C., & Bartlett, R. (2017). *Biomechanical Evaluation of Movement in Sport and Exercise: The British Association of Sport and Exercise Sciences Guide*. Taylor & Francis.
6. Hong, Y., & Bartlett, R. (2008). *Routledge Handbook of Biomechanics and Human Movement Science*. Routledge.
7. Winter, D. A. (2009). *Biomechanics and motor control of human movement (4<sup>th</sup> ed.)*. John Wiley & Sons, Inc.

## Course Policies and Student Responsibilities

### (1) General

You are expected to complete all assigned pre-class readings and activities, attend all classes – lecture and laboratory – punctually, submit all scheduled assignments and take tests by due dates. You are not allowed to swap laboratory groups without express permission from the course coordinator. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for sessions they have missed. You are expected to participate in all discussions and class activities unless there is a valid medical reason not to do so.

## (2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick, supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

## (3) Absence Due to Medical or Other Reasons

If you are sick and not able to complete a test or submit an assignment, you have to submit the original Medical Certificate (or another relevant document) to the Sport Science & Management (or Home School) administration to obtain official leave. Without this, the missed assessment component will not be counted towards the final grade. There are no make-ups allowed.

## (4) Attire and safety

You are expected to participate in practical laboratory activities. Some of these activities involve exercise. You are expected to wear appropriate attire for participation, obey laboratory safety rules, and take appropriate care of and return all equipment after use.

## Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognise your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion, and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [NTU Student Academic Integrity Policy and Procedures link](#) in the Student Portal for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Special note: Generative AI tools will be allowed to the extent stipulated for each assignment in the assignment instructions, and any such use must be duly referenced or disclosed.

## Course Instructors

Instructor	Office Location	Phone	Email
TBA			

**Planned Weekly Schedule**

<b>Week</b>	<b>Topic</b>	<b>ILO</b>	<b>Readings/ Activities</b>
1	Research Methods in Biomechanics: Overview and Introduction	1	References #1,#2,#3,#4
2-5	Modelling Approach in Biomechanics	1,2,5	References #1,#2,#3,#4
6	Paper Club	1, 5	Discussion
7	Assignment	2,4	
Recess Week			
8-10	Simulation Approach in Biomechanics	1,2,5	References #1,#2,#3,#4
11-12	Laboratory Project	2,3,4	Project
13	Team Presentation	2,3,4	Presentation

**Appendix 1: Assessment Criteria for Assignment (10% Final Grade – marked out of 100)**

	A+, A, A-	B+, B	B-, C+, C	D+, D	F
<b>Quality of report (max 30)</b>	Report is very clear and easy to understand. The flow of writing is coherent and logical.	Report is clear and easy to understand most of the time. The flow of writing is generally coherent and logical.	Report is unclear at times. There is some weakness in the presentation flow.	Report is unclear, and there is some difficulty in understanding the writing.	Report is unclear, and it is not possible to understand the writing.
<b>Understanding of study (max 70)</b>	Demonstrates a very good understanding of the background of the study, the study design, the analysis of the findings and the implications of the results of the study.	Demonstrates a good understanding of the background of the study, the study design, the analysis of the findings and the implications of the results of the study.	Demonstrates a basic understanding of the background of the study, the study design, the analysis of the findings and the implications of the results of the study.	Demonstrates a weak understanding of the background of the study, the study design, the analysis of the findings and the implications of the results of the study.	Does not demonstrate any understanding of the background of the study, the study design, the analysis of the findings and the implications of the results of the study.

**Appendix 2: Assessment Criteria for Laboratory Project - Presentation (40% Final Grade – marked out of 100)**

	A+, A, A-	B+, B	B-, C+, C	D+, D	F
<b>Team Assessment (60 marks)</b>					
<b>Quality of presentation (max 20)</b>	Information provided clearly answers the question set out. Presentation is clear and the flow is coherent and logical. Pace is appropriate.	Information mostly answers the question set. Presentation is mostly clear and the flow generally coherent and logical.	There are weaknesses or absences in the information provided, and the flow of presentation is unclear at times.	Much of the information provided does not answer the question, and the flow is difficult to understand.	Little relevant information and unclear flow.
<b>Demonstration of material (max 30)</b>	Able to clearly demonstrate and thoroughly explain mechanical concepts associated with sport and exercise. Able to answer questions in a poised and articulate manner with a high level of confidence.	Good demonstration and explanation of mechanical concepts associated with sport and exercise. Able to answer most of the questions clearly and with confidence.	Clear but basic demonstration and explanation of mechanical concepts associated with sport and exercise. Able to answer some of the questions clearly but lacks confidence at times.	Poor demonstration and weak explanation of mechanical concepts associated with sport and exercise. Has difficulty answering questions and lacks confidence.	Unable to demonstrate or explain mechanical concepts associated with sport and exercise. Unable to answer questions.
<b>Use of technology (max 10)</b>	Excellent use of technology to enhance the presentation.	Good use of technology to enhance the presentation.	Some use of technology to enhance the presentation.	Little use of relevant technology in the presentation.	No clear use of technology in the presentation.
<b>Individual Assessment (20 marks)</b>					
<b>Communication (max 20)</b>	Presentation is well-paced, very clear and	Presentation is well-paced, clear and easy to understand	Presentation is rushed or dull and unclear at times.	Presentation is unclear and difficult to understand.	Did not present

	easy to understand.	most of the time.			
<b>Peer Assessment (20 marks)</b>					
<b>Peer Assessment (max 20)</b>	Strong and worthwhile contribution to the team	Good and consistent contribution to the team.	Fair contribution to the team.	Poor contribution to the team.	No contribution to the team.
*All individuals within the group are expected to contribute to work involved in the planning, data collection and output. An individual's score may vary from that of the team based on feedback and observations in this area.					