BIOM9711 Modelling Organs, Tissues and Devices
Session 1, 2015

COURSE DETAILS

<table>
<thead>
<tr>
<th>Units of Credit</th>
<th>6</th>
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<tbody>
<tr>
<td>Contact hours</td>
<td>3 hours per week</td>
</tr>
<tr>
<td>Lecture</td>
<td>Wednesday, 9:00 – 10:00, Room 518, Level 5, Samuels Bldg (F25)</td>
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<tr>
<td>Tutorial/Laboratory</td>
<td>Wednesday, 10:00 – 12:00, Room 518, Level 5, Samuels Bldg (F25)</td>
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<tr>
<td>Course Coordinator</td>
<td>A/Prof Socrates Dokos</td>
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<td></td>
<td>email: <a href="mailto:s.dokos@unsw.edu.au">s.dokos@unsw.edu.au</a></td>
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<td></td>
<td>office: Room 506, Samuels Bldg</td>
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<td></td>
<td>phone: 9385 9406</td>
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<tr>
<td>Demonstrators</td>
<td>Mr Uphar Chamoli</td>
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<tr>
<td></td>
<td>email: <a href="mailto:u.chamoli@unsw.edu.au">u.chamoli@unsw.edu.au</a></td>
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<tr>
<td></td>
<td>Ms Kejia Wang</td>
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<tr>
<td></td>
<td>email: <a href="mailto:kejia.wang@unsw.edu.au">kejia.wang@unsw.edu.au</a></td>
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INFORMATION ABOUT THE COURSE

Welcome to BIOM9711: Modelling Organs, Tissues and Devices. This course provides a practical overview of computational modelling in bioengineering, focusing on a range of applications including electrical stimulation of neural and cardiac tissue, implantable drug delivery, cancer therapy, biomechanics, blood flow, and 3D surface techniques for realistic modelling of organs, tissues and devices. You will be introduced to the basic principles of modelling and simulation of dynamic physical systems using ordinary and partial differential equations.

Lecture notes will be available on-line from the Moodle module set up for this course. Weekly assignments and on-line quizzes given during the weekly tutorial/laboratory sessions are assessable. Along with the lectures, these will serve as the basis for the computer-based final exam at the end of Session to ascertain your ability to implement and solve a given bioengineering model. Finally, students will also undertake a major modelling project in an area of their choice.

This course is largely a standalone course within GSBmE, serving as a practical introduction to computational modelling in bioengineering. Basic modelling theory and principles are also covered in other GSBmE courses such as BIOM9060 Biomedical Systems Analysis, BIOM9311 Mass Transfer in Medicine, BIOM9701 Dynamics of the Cardiovascular System, BIOM9541 Mechanics of the Human Body and BIOM9621 Biological Signal Analysis.

You will be taught in the GSBmE Green Room (Room 518) using the Windows XP operating system with Matlab and COMSOL Multiphysics mathematical software. The computer laboratories will be accessible using a swipe card system based on your student card (the same system that will give you access to the building and the lifts).

We hope you find this course useful and enjoyable, serving as a stimulus for your own further explorations in the fascinating and boundless field of bioengineering modelling!

HANDBOOK DESCRIPTION

See link to virtual handbook:
OBJECTIVES
This course aims to provide a practical overview of computational modelling in bioengineering, focusing on a range of applications of importance to modelling organs, tissues and devices. The assessment strategy consisting of weekly assignments, on-line quizzes, a major modelling project and computer-based exam, will help foster the following UNSW Engineering graduate attributes:
- The skills involved in scholarly enquiry (through the major project)
- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context (through weekly quizzes, assignments, and the major project)
- Capacity for analytical and critical thinking and for creative problem solving (through weekly quizzes, assignments, major project and computer-based exam)
- Ability to engage independent and reflective learning (through weekly assignments and the major project)
- Information literacy (through the major project)
- Skills for effective communication (through the major project report)

TEACHING STRATEGIES
This course will be taught via weekly lectures, tutorials and computer labs. Students will be expected to apply theory covered in lectures to solving the assignment exercises. Assessments and feedback of these assignment submissions will be regularly provided to the students. Weekly on-line quizzes will help reinforce theory given in previous lectures and tutorials.

Students learn modelling principles effectively via exposure to a broad range of modelling examples reinforced through computer-based and theory assignments. Hence, a large proportion of this course is dedicated to tutorial/laboratory sessions. Feedback provided by demonstrators is important in teaching correct understanding of practical modelling principles. In addition, students will gain extensive modelling experience by implementing a full biomedical model from the literature as a major project.

The following table provides examples of learning approaches highly recommended for this course:

<table>
<thead>
<tr>
<th>Private Study</th>
<th>Lectures</th>
<th>Tutorials</th>
<th>Weekly Assessments (on-line quizzes, assignments)</th>
<th>Major Project</th>
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<tbody>
<tr>
<td>Review lecture material.</td>
<td>Find out what you must learn</td>
<td>Be guided by demonstrators</td>
<td>Learn and be familiar with previous lectures</td>
<td>Read a range of modelling papers from journal articles, and choose a project from early in the course</td>
</tr>
<tr>
<td>Implement example Matlab/COMSOL models from the lectures, and make sure you understand these.</td>
<td>Follow worked examples</td>
<td>Practice solving set problems</td>
<td>Demonstrate higher understanding and problem solving</td>
<td>Consult with the course coordinator on your choice of model.</td>
</tr>
<tr>
<td>Read additional material pertaining to Matlab or COMSOL, to master use of these.</td>
<td>Hear announcements on course changes</td>
<td>Ask questions</td>
<td>Reflect on how to implement your model, read the implementation of others from the literature, and ask questions.</td>
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EXPECTED LEARNING OUTCOMES

By the end of this course, you will have gained a solid understanding of:

- Systems of ordinary and partial differential equations and their application to modelling biomedical systems.
- Formulating relevant equations for bioengineering models.
- Computational techniques for solving models.
- Simulating models using Matlab and COMSOL Multiphysics finite-element software.
- Implementing a range of bioengineering models including, electrical stimulation of excitable tissues, models of drug delivery and heat flow, as well as modelling solid and fluid biomechanics.
- Implementing a complex bioengineering model of your choice from the literature.

For each hour of contact, it is expected that you will put in at least 1.5 hours of private study. You will need to spend substantial time in the computer laboratory implementing computer-based assignments in COMSOL and Matlab, as well as the major project in COMSOL.

ASSESSMENT

The assessment scheme for the course will be:

Weekly Assignments (10) 25%
Weekly On-line Quizzes (10) 15%
Major Modelling Project 30%
Computer-Based Exam 30%

Details of each assessment component, the marks assigned to it, and the dates of submission are set out below:

WEEKLY ASSIGNMENTS, ON-LINE QUIZZES AND MAJOR PROJECT

1. Assignment 1: (2.5%) issued on: 4-3-2015 due on: 11-3-2015
2. On-Line Quiz 1: (1.5%) issued on: 11-3-2015 due on: 11-3-2015
3. Assignment 2: (2.5%) issued on: 11-3-2015 due on: 18-3-2015
4. On-Line Quiz 2: (1.5%) issued on: 18-3-2015 due on: 18-3-2015
5. Assignment 3: (2.5%) issued on: 18-3-2015 due on: 25-3-2015
6. On-Line Quiz 3: (1.5%) issued on: 25-3-2015 due on: 25-3-2015
7. Assignment 4: (2.5%) issued on: 25-3-2015 due on: 1-4-2015
8. On-Line Quiz 4: (1.5%) issued on: 1-4-2015 due on: 1-4-2015
9. Assignment 5: (2.5%) issued on: 1-4-2015 due on: 15-4-2015
10. On-Line Quiz 5: (1.5%) issued on: 15-4-2015 due on: 15-4-2015
11. Assignment 6: (2.5%) issued on: 15-4-2015 due on: 22-4-2015
12. On-Line Quiz 6: (1.5%) issued on: 22-4-2015 due on: 22-4-2015
13. Assignment 7: (2.5%) issued on: 22-4-2015 due on: 29-4-2015
14. On-Line Quiz 7: (1.5%) issued on: 29-4-2015 due on: 29-4-2015
15. Assignment 8: (2.5%) issued on: 29-4-2015 due on: 6-5-2015
16. On-Line Quiz 8: (1.5%) issued on: 6-5-2015 due on: 6-5-2015
17. Assignment 9: (2.5%) issued on: 6-5-2015 due on: 13-5-2015
19. Assignment 10: (2.5%) issued on: 13-5-2015 due on: 20-5-2015
20. On-Line Quiz 10: (1.5%) issued on: 20-5-2015 due on: 20-5-2015
21. Major Project: (30%) issued on: 4-3-2015 due on: 29-5-2015
Note that late submission of weekly assignments will incur a penalty deduction of 20% per day. For the major project, late submission will incur a penalty deduction of 10% per day. For the on-line quizzes, only your best 8 out of 10 quiz marks will go toward your final assessment.

**COURSE PROGRAM**

The program of lecture topics and assignment submission dates is as follows:

### SEMESTER 1, 2015

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assessments Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4-3-2015</td>
<td>Introduction to Modelling in Bioengineering</td>
<td>11-3-2015</td>
</tr>
<tr>
<td>2</td>
<td>11-3-2015</td>
<td>Systems of Ordinary Differential Equations</td>
<td>18-3-2015</td>
</tr>
<tr>
<td>3</td>
<td>18-3-2015</td>
<td>Partial Differential Equations</td>
<td>25-3-2015</td>
</tr>
<tr>
<td>4</td>
<td>25-3-2015</td>
<td>Finite-Element Method I</td>
<td>15-4-2015</td>
</tr>
<tr>
<td>5</td>
<td>1-4-2015</td>
<td>Finite-Element Method II</td>
<td>15-4-2015</td>
</tr>
<tr>
<td>6</td>
<td>15-4-2015</td>
<td>Modelling Electrical Stimulation of Tissue</td>
<td>22-4-2015</td>
</tr>
<tr>
<td>7</td>
<td>22-4-2015</td>
<td>Models of Diffusion and Heat Transfer</td>
<td>29-4-2015</td>
</tr>
<tr>
<td>8</td>
<td>29-4-2015</td>
<td>Solid Mechanics</td>
<td>6-5-2015</td>
</tr>
<tr>
<td>9</td>
<td>6-5-2015</td>
<td>Fluid Mechanics</td>
<td>13-5-2015</td>
</tr>
<tr>
<td>10</td>
<td>13-5-2015</td>
<td>Multiphysics Modelling</td>
<td>20-5-2015</td>
</tr>
<tr>
<td>11</td>
<td>20-5-2015</td>
<td>3D Modelling From Anatomical Images</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>27-5-2015</td>
<td>Case Example: Modelling Human Lumbar Spine</td>
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### RELEVANT RESOURCES

- **Recommended textbooks:**

- **Recommended on-line software tutorials:**
  - A downloadable pdf chapter on solving systems of ordinary differential equations (ODEs) using Matlab, from the text Numerical Computing with Matlab, by Cleve Moler, is at [www.mathworks.com/moler/odes.pdf](http://www.mathworks.com/moler/odes.pdf)
  - COMSOL also has a large set of example models in its model library, including complete documentation and model files, which can be accessed within the software itself.
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 Course and Teaching Evaluation and Improvement (CATEI) process. You are highly encouraged to complete such an on-line evaluation toward the end of Session. Feedback and suggestions provided will be important in improving the course for future students. Changes to the course from previous comments received have included more hands-on model examples in lectures and in the laboratories.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at: https://my.unsw.edu.au/student/resources/KeyDates.html

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

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS

Refer to the School website available at: http://www.engineering.unsw.edu.au/biomedical-engineering/