COURSE DETAILS

Units of Credit: 6
Contact hours: 3 hours per week

Lecture*: Thursdays, 12:00 – 3:00 Mathews 103
Tutorial/Laboratory*: integrated Mathews 103

*Please note that these can differ from week to week - please refer to detailed COURSE PROGRAM on p. 3

Professor and Course Coordinator
Professor Melissa KNOTHE TATE
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Guest Lecturers
Joanna NG - mechanical testing in tension
email: joanna.ng@unsw.edu.au

Dan HAGEMAN - pressure mapping
email: danieljhageman@gmail.com

Lucy NGO - complex biosystems and mechanics
email: lucy.ngo@unsw.edu.au

INFORMATION ABOUT THE COURSE

This course addresses the interlinked theme of engineering tissues and smart materials by learning from Nature’s paradigms. The course goal is to use fundamentals of mechanics and strength of materials to understand the remarkable material and mechanical properties of biological materials. In addition, the course aims to develop the capacity to characterise, optimise and even create advanced functional materials using fundamental knowledge of strength of materials and by applying reverse engineering strategies for engineering of nature inspired materials. Mechanical properties inherent to specific manufacturing methods will be addressed as well as materials’ different properties in in vivo and other environments. This course aims to provide students with a foundation, based on “nature’s design and optimisation” criteria for engineering tissues and smart materials, as well as to give students the opportunity to develop their engineering innovation capabilities through a class project.

Prerequisites:
Students taking this course should have had prior exposure to mechanics and strength of materials.

Relationship to other courses in GSBmE:
This course aligns well with all four broad categories of study and research in the School, including biomaterials and tissue engineering, biomechanics, modelling and instrumentation, and medical technology.

HANDBOOK DESCRIPTION

The physical properties of materials having significance to biomedical engineering; human tissues;
skin; soft tissues; bone; metals; polymers and ceramics. The effects of degradation and corrosion. See link to virtual handbook: http://www.handbook.unsw.edu.au/undergraduate/courses/2016/BIOM9561.html

**OBJECTIVES**

**Course Objectives (C.O.):**

1: to use fundamentals of mechanics and strength of materials to understand the remarkable material and mechanical properties of biological materials

2: to develop the capacity to characterise, optimise and even create advanced functional materials using fundamental knowledge of strength of materials and reverse engineering strategies for engineering of natural materials

3: to understand mechanical properties inherent to specific manufacturing methods

4: to understand mechanical properties in *in vivo* and other environments

5: to develop your own engineering innovation capabilities

These objectives link to the following programme outcome attributes and the assessment strategies for this course.

Programme attributes' relationship to course objectives (C.O.):

- An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context (C.O. 1-5, Assessments)
- Capacity for analytical and critical thinking and for creative problem solving (C.O. 5)
- Ability to engage independent and reflective learning (C.O. 5)
- Information literacy (C.O. 1)
- Skills for collaborative and multi-disciplinary work (Group assignments, Assignment 7)
- Skills for effective communication (Week 3 Case Studies, Angel Investor Conference)

**TEACHING STRATEGIES**

The teaching strategies that will be used and their rationale, with suggested approaches to learning in the course:

| Private Study | • Review lecture material and reading materials provided  
                • Do assignments  
                • Reflect on class problems and assignments  
                • Download materials from Moodle  
                • Keep up with notices and find out marks via Moodle |
|---------------|-----------------------------------------------------------------|
| Lectures      | • Lecture notes outline what you must learn  
                • Follow worked examples  
                • Hear announcements on course changes |
| Tutorials     | • Be guided by demonstrators  
                • Practice data analysis and interpretation  
                • Ask questions |
| Assessments (tests, examinations, assignments, hand-in tutorials, innovation lab reports, etc.) | • Demonstrate your knowledge and skills  
                                                                 • Demonstrate higher understanding |
EXPECTED LEARNING OUTCOMES

Expected learning outcomes, their association with the teaching strategies and with the suggested approaches to learning. Student-centred and self-directed learning (expectations of the students, where relevant)
For each hour of contact it is expected that students will put in at least 1.5 hours of private study, i.e. 4.5 hours per week.

ASSESSMENT

Overall rationale for assessment components and their association with course objectives.
The final grade for this course will be based
50% on the average score from the assessment tasks,
20% on the Mid-term examination, and
30% on the Final Examination.

A mark of at least 40% in the final examination is required before the class work is included in the final mark. The formal exam scripts will not be returned. Students who perform poorly in the assignments and mid-term exam are recommended to discuss progress with Prof Knothe Tate during the semester.

Note: Prof Knothe Tate reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Overall rationale for assessment components and their association with course objectives.
The assessment tasks are designed to foster
• in depth engagement with the discipline as well as its relationship to other disciplines,
• the capacity to practice and hone analytical and critical thinking as well as creative problem solving,
• the ability to engage in independent and reflective learning,
• honing of skills for collaborative and multi-disciplinary work, and
• development and refinement of skills for effective communication.
The Mid-term and Final examinations are designed to assess information literacy and the capacity for analytical and critical thinking as well as to demonstrate in-depth engagement and gaining of knowledge, both within and across disciplines.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below:

ASSIGNMENTS - due at 8 a.m. prior to class

1. Assignment 1: Mechanics Primer issued on: 25/07/2016  due on: 01/08/2016
   Individual goal: score >75% on the interactive mechanics primer written by Dr. Lauren Kark
   Suggestion: budget 3 hours to test and hone your skills. You should be able to achieve this score within a 3 hour period. If not, you will likely need to do more training to bring your skills up to a level to maximise your benefit from this course. Whatever score you earn by 8 a.m. on 01/08/2016.
   100 points

   Group: each group will be given a different biological case study and wearable product to analyse and present as a virtual company, in a company video
   100 points

3. Assignment 3: Data Analysis issued on: 15/08/2016  due on: 22/08/2016
**Individual:** you will be presented with data sets acquired using the methods shown in the tutorial; the assignment will require an analysis and interpretation of the data

100 points

4. Assignment 4: Case study analyses
   issued on: 29/08/2016   due on: 05/09/2016
   **Group:** each group will be given a different biological case study and wearable product to analyse and present - mechanical properties intrinsic to manufacturing method and conditions of use should be emphasised
   100 points

5. Assignment 5: Problem set
   issued on: 05/09/2016   due on: 12/09/2016
   100 points

6. Assignment 7: Innovation lab report
   issued on: 10/10/2016   due on: 24/10/2016
   300 points

7. Pitch: Angel Investor conference
   issued on: 10/10/2016   due on: 24/10/2016
   200 points

**All submissions** through moodle, where moodle timestamp will determine time of completion.

**Penalties for late submissions:** late work will be penalised at the rate of 10% per day after the due time and date have expired.

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**COURSE PROGRAM**

**SEMESTER 2, 2017**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assessments Due</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<strong>Classical Approaches to Mechanics of Biomaterials</strong></td>
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<tr>
<td>July</td>
<td></td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<strong>How cells manufacture tissues - how well substitute materials recapitulate nature's paradigms</strong></td>
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<tr>
<td>1</td>
<td>27/07/2017</td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<strong>Mechanics of Skin and Bones</strong></td>
<td>1: Mechanics Primer&lt;br&gt;<strong>INDIVIDUAL</strong></td>
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<td>2</td>
<td>03/08/2017</td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<strong>Biological Threads (Structural Protein Fibres) and their Engineered Equivalents (Sutures)</strong></td>
<td>2: Structure-function analysis&lt;br&gt;<strong>GROUP</strong></td>
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<td>3</td>
<td>10/08/2017</td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<strong>Presentations of Biological Case Studies and Wearable Technologies</strong>&lt;br&gt;Meet at the Natural History Museum Sydney</td>
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<td>4</td>
<td>17/08/2017</td>
<td><strong>Ms. Joanna Ng</strong>&lt;br&gt;<strong>Mechanics of Materials inside the body versus wearables.</strong></td>
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<td>5</td>
<td>24/08/2017</td>
<td><strong>Prof Knothe Tate (pre-recorded lecture)</strong>&lt;br&gt;<em>Introduction &amp; start of the Engineering Innovation lab</em></td>
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<td>6</td>
<td>31/08/2017</td>
<td><strong>Prof Knothe Tate</strong>&lt;br&gt;<em>Introduction to the Neoclassical School</em>&lt;br&gt;<strong>Prof Poh Yi</strong>&lt;br&gt;<strong>Biological Materials</strong></td>
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**September**
### RELEVANT RESOURCES
- Lecture notes and additional materials provided on Moodle.

### COURSE EVALUATION AND DEVELOPMENT
Student feedback has helped to shape and develop this course, including feedback obtained from online evaluations as part of UNSW's Course and Teaching Evaluation and Improvement (CATEI) process. Changes to the course have resulted from changes in course coordination as well as the goal to include more innovation activities in the curriculum.

### 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 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/