COURSE DETAILS

Units of Credit 6
Contact hours 3 hours per week

Lecture* Mondays, 9:00 – 11:00  Pioneer Theatre, AGSM

Tutorial/Laboratory* Mondays, 11:00 – 12:00 Pioneer Theatre, AGSM or TBA (To Be Announced)
*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 Lecturer
Dr. Patricia Flanagan, Senior Lecturer, UNSW Art & Design
email: patricia.flanagan@unsw.edu.au

Demonstrators
Joanna NG - mechanical testing in tension
email: joanna.ng@unsw.edu.au

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

Lillian KNOTHE - computer-controlled weaving
email: lilyknothe@gmail.com

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/BIOC9561.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 \textit{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:

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

<table>
<thead>
<tr>
<th>skills</th>
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<tr>
<td>• Demonstrate higher understanding and problem solving</td>
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<td>• Demonstrate critical analysis</td>
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**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 sum of the scores from each of 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

2. Assignment 2: Structure - Function Analysis
   - issued on: 01/08/2016  due on: 01/08/2016
   - **Group**: each group will be given a different biological case study and wearable product to analyse and present
   - 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

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

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

**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 1, 2014**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assessments Due</th>
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<tbody>
<tr>
<td>July</td>
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</table>
| 1    | 25/07/2016 | Prof Knothe Tate - Introduction  
*Nature's Materials and the Engineering of Smart, Functional Materials that Emulate Them* | |
| August |      |       |                 |
| 2    | 01/08/2016 | Prof Knothe Tate - Foundation in Mechanics  
*Biological Threads (Structural Protein Fibres) and their Engineered Equivalents (Sutures)* | 1: Mechanics Primer
INDIVIDUAL |
| 3    | 08/08/2016 | Prof Knothe Tate and Dr Flanagan  
*Presentations of Biological Case Studies and Wearable Technologies* | 2: Structure-function analysis
GROUP |
| 4    | 15/08/2016 | Prof Knothe Tate and Dr Flanagan  
*Tissue Inspired Textiles to Promote Well Being*  
DEMONSTRATIONS  
Weaving and Mechanical Testing and Pressure Monitoring Demonstrations | |
| 5    | 22/08/2016 | Dr Flanagan - **Class at Paddington Campus**  
*Responsive Textiles*  
DEMONSTRATIONS  
3D scanning, printing and moulding | 3: Data analysis
INDIVIDUAL |
| 6    | 29/08/2016 | Prof Knothe Tate  
*How cells manufacture tissues - how well substitute materials recapitulate nature's paradigms*  
*Mechanics of Materials inside the body versus wearables.* | |

**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](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/