AllM901: hands-On Practical Learning and Training in Additive Biofabrication

Subject Outline
Autumn, 2016
On-Campus
Wollongong

Subject Information
Credit Points: 12
Pre-requisite(s): Nil
Co-requisite(s): Nil
Restrictions: Nil
Contact Hours: As per subject database

Subject Contacts
Subject Coordinator/Lecturer

<table>
<thead>
<tr>
<th>Name:</th>
<th>Assoc. Prof. Michael Higgins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Innovation Campus, AllM Building, Room 236</td>
</tr>
<tr>
<td>Telephone:</td>
<td>61 2 4221 3989</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:mhiggins@uow.edu.au">mhiggins@uow.edu.au</a></td>
</tr>
<tr>
<td>Consultation mode and times:</td>
<td>Email for appointment</td>
</tr>
</tbody>
</table>

Student Support and Advice
For general enquiries please contact the StudentHub 41:

Location: 41.138B
Telephone: 61 2 4221 3492
Email: smah-students@uow.edu.au
Student Consultation and Communication

University staff receive many emails each day. In order to enable them to respond to your emails appropriately and in a timely fashion, students are asked to observe basic requirements of professional communication:

**Consider what the communication is about**
- Is your question addressed elsewhere (e.g. in the subject outline or, on the eLearning site)?
- Is it something that is better discussed in person or by telephone? This may be the case if your query requires a lengthy response or a dialogue in order to address. If so, see consultation times above and/or schedule an appointment.
- Are you addressing your request to the most appropriate person?

**Specific email subject title to enable easy identification of issue**
- Identify the subject code of the subject you are enquiring about (as staff may be involved in more than one subject) put this in the email subject heading. Add a brief, specific query reference after the subject code where appropriate.

**Professional courtesy**
- Address the staff member appropriately by name (and formal title if you do not yet know them).
- Use full words (avoid ‘text-speak’ abbreviations), correct grammar and correct spelling.
- Be respectful and courteous.
- Allow 3 – 4 working days for a response before following up. If the matter is legitimately urgent, you may wish to try telephoning the staff member (and leaving a voicemail message if necessary) or inquiring at the School Office.
- Please ensure that you include your **full name and student number** and identify your practical class or tutorial group in your email so that staff know who they are communicating with and can follow-up personally where appropriate.
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Section A: General Information

Subject Learning Outcomes

On completion of this subject, students should be able to:

1. analyse and evaluate the characterisation of biomaterials, biopolymers and bio-inks and the ensuing products during workflow processes;
2. explain the operating principles of additive biofabrication techniques;
3. implement a workflow process to produce a 3D structure, prototype or device using additive biofabrication;
4. demonstrate advanced technical skills in investigating, analysing and synthesising information, problems, concepts and theories;
5. exercise critical thinking and judgement in the generation and evaluation of innovative technology and related business ideas and solutions;
6. evaluate the application of knowledge and skills associated with additive biofabrication techniques in professional practice and/or further learning;
7. communicate advanced knowledge and the significance of outcomes resulting from the planning and execution of a substantial research-based initiative.

Subject Description

The subject will provide hands-on practical training and research experience within the laboratories of the Australian Institute for Innovative Materials (AIIM). Major activities of the practicals will include: Developing and characterising biopolymer, bio-ink and printable formulations; Hands-on training and operation of various additive biofabrication instrumentation such as rapid prototypers, reactive printers, extrusion printers, metal printers, coating techniques, bioplotters and live cell printers. Participation in workflow process, including design of software models and their integration through to printing 3D objects and post-production. Independently-driven projects will enable student to freely design and create 3D structures/objects and critically evaluate their potential for innovative technology, commercial and business opportunities.

eLearning Space

This subject has materials and activities available via eLearning. To access eLearning you must have a UOW user account name and password, and be enrolled in the subject. eLearning is accessed via SOLS (student online services). Log on to SOLS and then click on the eLearning link in the menu column. For information regarding the eLearning spaces please use the following link: http://uowblogs.com/moodlelab/files/2013/05/Moodle_StudentGuide-1petpo7.pdf

Lecture, Tutorial, Laboratory Times

On-Campus Delivery:

1. Printing Demonstrations and Lab Activities (June-August), AIIM Processing and Devices Facility & Labs, Innovation Campus)

Readings, References and Materials

Textbooks

eBook “3D Bioprinting: Printing Parts for Bodies” Wallace et al. see link - https://3dbioprint.atavist.com/3dbioprinting?promo

Free Online Course: “3D Bioprinting: Printing Parts for Bodies” See link - https://www.futurelearn.com/courses/bioprinting

Prescribed Readings (includes eReadings)

Nil
Materials
Lab Coat
Safety Classes
Enclosed Shoes

Recommended Readings


Recent Changes to this Subject
Nil

Laboratory Safety Guidelines
The rules below are general rules that are required in laboratories.
- Before commencing your project you are to ensure that you understand specific procedures for the laboratory in which you work.
- You will need to fill out a risk assessment form before commencing any experiments (confer with your laboratory supervisor).
- Never use any equipment or attempt any experiment without checking the safety implications with your laboratory supervisor or experienced delegated laboratory worker.
- Undergraduate students are not permitted to work after hours unless there is appropriate approval and supervision.

List of Topics Covered
The following are examples of the topics to be covered in this course. This is not an exhaustive list and will be subject to change.

1. 3D Computed Aided Design (CAD)/Solidworks
2. Polymers/Metals for Printing
3. Biopolymers/Hydrogels
4. Extrusion Printing
5. Inkjet Printing
4. Cell Printing
## Section B: Assessment

### Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Item</th>
<th>Form of Assessment</th>
<th>Due Date</th>
<th>Return/Feedback Due Date</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment 1</td>
<td>Printing Demonstration</td>
<td>TBA</td>
<td>Nil</td>
<td>N/A</td>
</tr>
<tr>
<td>Assessment 2</td>
<td>CT Extraction and Printing Activity</td>
<td>TBA</td>
<td>21 days from date of submission</td>
<td>10%</td>
</tr>
<tr>
<td>Assessment 3</td>
<td>Interim Research Presentation</td>
<td>6 months from starting date (September)</td>
<td>Release of results</td>
<td>20%</td>
</tr>
<tr>
<td>Assessment 4</td>
<td>Interim Research Report</td>
<td>6 months from starting date (September)</td>
<td>Release of results</td>
<td>70%</td>
</tr>
</tbody>
</table>

### Details of Assessment Tasks

Assessment tasks will be marked using explicit criteria that will be provided to students prior to submission.

<table>
<thead>
<tr>
<th>Assessment 1</th>
<th>Printing Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due date</td>
<td>09/05/16</td>
</tr>
<tr>
<td>Weighting</td>
<td>N/A</td>
</tr>
<tr>
<td>Submission</td>
<td>Nil</td>
</tr>
<tr>
<td>Type of Collaboration</td>
<td>Group Activity</td>
</tr>
<tr>
<td>Length</td>
<td>2 x 2 hr demonstration sessions in laboratory</td>
</tr>
</tbody>
</table>

**Details**

- **Session 1:**
  - Fdm Printing – Basic to commercial systems
  - Polyjet printing
  - Part layout and orientation
  - Material choices
  - System operation – As part of session students will be guided in how to prepare and produce a part on the printing systems

- **Session 2:**
  - Introduction to DICOM data to stl translation (Materialise Mimics software demo)
  - Introduction to file preparation and repair (Materialise Magics software demo)
  - Selective laser Melting – As part of session students will be guided in how to prepare and produce a part on the selective laser melting system

**Style and format**

Group Activity with printing demonstrations

**Subject Learning Outcomes**

SLO4, SLO5

**Marking Criteria**

Nil
### Assessment 2

<table>
<thead>
<tr>
<th>Due date</th>
<th>TBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighting</td>
<td>10%</td>
</tr>
<tr>
<td>Type of Collaboration</td>
<td>Individual Assessment</td>
</tr>
<tr>
<td>Length</td>
<td>Completion of Allocated Tasks</td>
</tr>
<tr>
<td>Details</td>
<td>The student will be provided with access to open source DICOM segmentation software and given guidance on the basic operation of Materialise Magics to allow repair and manipulation of .STL files</td>
</tr>
<tr>
<td>Style and format</td>
<td>Details will be made available by the demonstrator</td>
</tr>
<tr>
<td>Subject Learning Outcomes</td>
<td>SLO1, SLO2, SLO3, SLO6, SLO7</td>
</tr>
<tr>
<td>Marking Criteria</td>
<td>The marking criteria will be made available by the subject coordinator</td>
</tr>
</tbody>
</table>

### Assessment 3

| Due date | 6 months from starting date (September) |
| Weighting | 20% |
| Submission | Research Presentation |
| Type of Collaboration | Individual Assessment |
| Length | 20 min Presentation (including questions/project discussions) |
| Details | Student presentations will be delivered to supervisors and clinical partners in the Masters of Biofabrication. Presentations will provide background to the research project, details of research progress and timelines of scheduled tasks for the project. |
| Style and format | Research Presentation in Workshop Format |
| Subject Learning Outcomes | SLO5, SLO7 |
| Marking Criteria | The assessment will be based on both presentation skills and content |

### Assessment 4

| Due date | 6 months from starting date (September) |
| Weighting | 70% |
| Submission | Submit a hardcopy to your supervisor |
| Type of Collaboration | Individual Assessment |
| Length | No more than 20 pages |
| Details | The student will prepare an interim report to demonstrate background knowledge of their project, research progress and a timetable of scheduled tasks. The report will include an introduction/literature review on the research topic, statement of proposed research and aims, summary of progress/results, timetable of experimental plan and references |
| Style and format | Written Report |
| Subject Learning Outcomes | SLO7 |
| Marking Criteria | The marking criteria will be made available by the subject coordinator |
Minimum Requirements for a Pass in this Subject
To receive a clear pass in this subject a total mark of 50% or more must be achieved. In addition, failure to meet any of the minimum performance requirements is grounds for awarding a Technical Fail (TF) in the subject, even where total marks accumulated are greater than 50%.

The minimum performance requirements for this subject are:
- attempt all assessment tasks
- pass the final assessment task
- meet the minimum participation requirements set out below.

Minimum Student Attendance and Participation
Student attendance at tutorials, practicals, seminars and/or simulations is is strongly recommended.

Scaling
Scaling may occur in this subject at the end of session by the Unit Assessment Committee and/or Faculty Assessment Committee (FAC). Marks will only be scaled to ensure fairness/parity of marking across groups of students. Scaling will not affect any individual student's rank order within their cohort. For more information refer to Assessment Guidelines – Scaling:

Late Submission
Late submission of an assessment task without an approved extension of the deadline is not acceptable. If you are unable to submit an assessment due to extenuating circumstances (e.g. medical grounds or compassionate grounds), you can make an application of academic consideration. Not all circumstances qualify for academic consideration. For further details about applying for academic consideration visit the Student Central webpage:

Late Submission Penalty
Late submission of an assessment task without an approved extension of the deadline is not acceptable. Marks will be deducted for late submission at the rate of 10% of the total possible marks for that particular assessment task per day. This means that if a piece of work is marked out of 100, then the late penalty will be 10 marks per day (10% of 100 possible marks per day). The formula for calculating the late penalty is the total possible marks x 0.10 x number of days late. For the purposes of this policy a weekend (Saturday and Sunday) will be regarded as two days.

No marks will be awarded for work submitted after the assessment has been returned to the students.

System of Referencing Used for Written Work
The Author-Date (Harvard) referencing system should, unless otherwise specified for a particular assessment (check Details of Assessment Tasks), be utilised. A summary of the Harvard system can be accessed on the Library website at: http://public01.library.uow.edu.au/refcite/style-guides/html/

Use of Internet Sources
Students are able to use the Internet to access the most current information on relevant topics and information. Internet sources should only be used after careful critical analysis of the currency of the information, the role and standing of the sponsoring institution, reputation and credentials of the author, the clarity of the information and the extent to which the information can be supported or ratified by other authoritative sources.
Plagiarism
The full policy on Academic Integrity and Plagiarism is found in the Policy Directory on the UOW website.

“The University's Academic Integrity and Plagiarism Policy, Faculty Handbooks and subject guides clearly set out the University's expectation that students submit only their own original work for assessment and avoid plagiarising the work of others or cheating. Re-using any of your own work (either in part or in full) which you have submitted previously for assessment is not permitted without appropriate acknowledgement. Plagiarism can be detected and has led to students being expelled from the University.

The use by students of any website that provides access to essays or other assessment items (sometimes marketed as 'resources'), is extremely unwise. Students who provide an assessment item (or provide access to an assessment item) to others, either directly or indirectly (for example by uploading an assessment item to a website) are considered by the university to be intentionally or recklessly helping other students to cheat. This is considered academic misconduct and students place themselves at risk of being expelled from the University."

Submission of Assessments
Refer to the submission requirements under the details of the individual assessments. Students should ensure that they receive a receipt acknowledging submission. Students will be required to produce this in the event that an assessment task is considered to be lost. Students are also expected to keep a copy of all their submitted assessments in the event that re-submission is required.

Assessment Return
Students will be notified when they can collect or view their marked assessment. In accordance with University Policy marked assessments will usually only be held for 21 days after the declaration of marks for that assessment.
Section C: General Advice

Students should refer to the Faculty of Science, Medicine and Health website for information on policies, learning and support services and other general advice.

University Policies
Students should be familiar with the following University policies:

a. Code of Practice – Teaching and Assessment

b. Code of Practice – Research, where relevant

c. Student Charter

d. Code of Practice – Student Professional Experience, where relevant

e. Academic Integrity and Plagiarism Policy

f. Student Academic Consideration Policy

g. Course Progress Policy

h. Graduate Qualities Policy

i. Academic Complaints Policy (Coursework and Honours Students)

j. Policy and Guidelines on Non-Discriminatory Language Practice and Presentation

k. Workplace Health and Safety, where relevant

l. Intellectual Property Policy

m. IP Student Assessment of Intellectual Property Policy, where relevant

n. Student Conduct Rules and accompanying Procedures or Research Misconduct Policy for research students

Student Support Services and Facilities
Students can access information on student support services and facilities at the following link. This includes information on “Academic Support”, “Starting at University,” “Help at University” as well as information and support on “Career’s and Jobs”. http://www.uow.edu.au/student/services/index.html
Student Etiquette
Guidelines on the use of email to contact teaching staff, mobile phone use in class and information on the university guide to eLearning ‘Netiquette’ can be found at http://www.uow.edu.au/student/elearning/netiquette/index.html

Version Control Table

<table>
<thead>
<tr>
<th>Version Control</th>
<th>Release Date</th>
<th>Author/Reviewer</th>
<th>Approved By</th>
<th>Amendment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20160106</td>
<td>A/Prof Michael Higgins – Subject Coordinator</td>
<td>Sonia Losinno – ADE Nominee</td>
<td>Final AII901 Autumn 2016 Subject Outline</td>
</tr>
</tbody>
</table>