UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2018

MMAN4200

ADDITIVE MANUFACTURING

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Xiaopeng Li (Course convenor)
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Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Consultation concerning this course is available on Monday 1300 –1800, whenever the lecturer is not otherwise engaged. Contact preferred via email; consultation is by appointment only.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Please see the course Moodle.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves 3 hours per week (h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

	Day	Time	Location
Lectures	Thursday	3:00pm – 5:00pm	Ainsworth 102 (K-J17-102)
Demonstrations	Thursday	5:00pm – 6:00pm	Ainsworth 102 (K-J17-102)

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

Additive manufacturing, also known as 3D printing, is an emerging advanced manufacturing technique which has enjoyed a rapid growth in recent years. It has been considered as a national strategic priority in many countries in Europe and North America, and this field of research is expected to grow even faster in the near future in Australia. Due to its layer-wise fabrication process, additive manufacturing is not only a disruptive technology that will complement many traditional manufacturing techniques but is also a major technique in the future to enable new business models, new products and new supply chains to flourish.

This course aims to provide an introduction to the fundamental and important aspects of additive manufacturing, in terms of additive manufacturing techniques, additive manufacturing process optimization and design for additive manufacturing. This course will also offer the students first-hand experience in additive manufacturing techniques.

The lectures from week 1 to 4 will focus on various additive manufacturing techniques up to date where you will gain basic knowledge about the history, development and fundamental engineering aspects of this technique. The lecture in week 5 will cover additive manufacturing process optimization, including materials for additive manufacturing, properties of additive manufacturing fabricated components, and applications of additive manufacturing, e.g. aerospace, automotive, biomedical, as well as arts and design. Then the lecture in week 7 will cover additive manufacturing design where you will use commercially available software to design advanced structures for additive manufacturing, and in week 10 you will work on your own project about additive manufacturing design. The lectures in weeks 11 and 12 will introduce current major applications of additive manufacturing and provide a perspective for future development of this emerging manufacturing technique. Aside from lectures and tutorials, this course also includes demonstrations where you will have first-hand experience in various additive manufacturing machines available in the School of Mechanical and Manufacturing Engineering.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		EA Stage 1 Competencies
1.	Understand the fundamental basis and nature of additive manufacturing techniques	PE1.1, PE 1.3, PE1.5, PE2.2, PE3.6
2.	Explain the principles and develop a systematic plan for additive manufacturing process optimisation	PE1.1. PE1.3, PE1.5, PE2.3, PE3.6
3.	Plan and execute appropriate design process for additive manufacturing	PE1.3, PE1.5, PE2.2, PE2.4, PE 3.2, PE3.6
4.	Be able to relate additive manufacturing to other manufacturing techniques	PE1.1, PE1.3, PE1.5, PE2.3, PE3.6

4. Teaching strategies

The subject will be presented in the form of lectures, demonstrations and labs. Each weekly class will consist of 2 hours of a tutorial example or case study during lecture, related to the material covered in the previous lecture, followed by a 1 hour demonstration. One lab project together with one lab induction and training will also be included for students to have first-hand experience in additive manufacturing.

5. Course schedule

Date	Topic	Lecture content	Demonstration/lab content	Suggested readings
Week 1	Introduction to additive manufacturing	Various additive manufacturing techniques, history, current development and fundamental engineering aspects	None	Moodle lecture notes
Week 2	Polymer additive manufacturing	Current additive manufacturing techniques for printing polymers, printing mechanisms, advantages and limitations	Review of previous lecture and exercises	Moodle lecture notes

Date	Topic	Lecture content	Demonstration/lab content	Suggested readings
Week 3	Metal additive manufacturing	Current additive manufacturing techniques for printing metals, printing mechanisms, advantages and limitations	Review of previous lecture and exercises	Moodle lecture notes
Week 4	Ceramic additive manufacturing	Current additive manufacturing techniques for printing ceramics, printing mechanisms, advantages and limitations	Review of previous lecture and exercises	Moodle lecture notes
Week 5	Additive manufacturing process optimisation	Principles and strategies for additive manufacturing process optimisation	Review of previous lecture and exercises	Moodle lecture notes
Week 6	Design for additive manufacturing	Software and design of advanced structures, preparation for weeks 7 and 8	Review of previous lecture and exercises	Moodle lecture notes
Week 7	Lab induction			
Week 8	Lab project			
Week 9	A project study and design	A case study based on polymer, metal or ceramics additive manufacturing using printers in the school lab	Project presentations	Moodle lecture notes
Middle-term Break				
Week 10	Additive manufacturing applications	Current industrial applications, link to other manufacturing techniques	Review of previous lecture and exercises	Moodle lecture notes

Date	Topic	Lecture content	Demonstration/lab content	Suggested readings
Week 11	Future of additive manufacturing	Potentials of additive manufacturing, new additive manufacturing techniques, limitations, development plans in many countries and industries	Revision and discussion	Moodle lecture notes

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes	Assessment criteria	Due data and submission requirements	Deadline for absolute fail	Marks returned
Online quizzes	1 to 5 questions every two weeks	10%	1, 2	Weekly lecture	Fortnightly, via Moodle	N/A	After the quiz closes
Assignment 1	Max 2000 words plus 10 references	25%	1, 2, 4	Lectures 1 to 5	Week 9	N/A	Week 11
Lab project	1 day	25%	1, 2, 3, 4	Refer to assignment details	Week 10	N/A	Week 11
Final exam	2 hours	40%	1, 2, 4	All course content from week 1 to 12	Exam period, date TBC	N/A	Upon release of final results

All assignments and assessment criteria will be made available on Moodle prior to the assessments.

Assignments

Assignment 1 requires each student or a group of students (depending on the number of the enrolled students) to write an essay based on given topics about additive manufacturing. The topics will be provided to the students in week 5.

For the Lab project, students will be divided into several groups and a small, flexible project will be given to each group. Each project will be focused on polymer or metal additive manufacturing where you will need to design and fabricate a real component using the 3D printers in the lab**.** You will also need to talk about how your group work together to design and fabricate the component using 3D printer in your group presentation. The assessment for the project will be based on the team work, your understanding of the 3D printing process, the quality of the final component your group print and the group presentation. **Please note: It is essential for you to attend the lab induction session in week 7**.

The final exam will be based on the lecture content of the course.

Presentation

All non-electronic submissions should have a standard School cover sheet which is available from this course's Moodle page.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 per cent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
b. Online quizzes where answers are released to students on completion, or
c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or

d. Pass/Fail assessment tasks.

Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see the Exams section on the intranet.

Calculators

You will need to provide your own calculator, of a make and model approved by UNSW, for the examinations. The list of approved calculators is shown at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see the information on UNSW's Special Consideration page.

7. Expected resources for students

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

9. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism: student.unsw.edu.au/plagiarism The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

10. Administrative matters and links

All students are expected to read and be familiar with School guidelines and polices, available on the intranet. In particular, students should be familiar with the following:

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)

- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership