Academic Year	AY23/24	**Semester**	1&2
Course Coordinator	Lai Changquan		
Course Code	MS4642		
Course Title	Additive Manufacturing of Materials		
Pre-requisites	Must pass both MS2012 Introduction to Manufacturing Processes & MS2015 Mechanical Behaviour of Materials		
No of AUs	1		
Contact Hours	Lectures: 13 hrs		

Course Aims

The aim of this course is to provide a practical overview of Additive Manufacturing (AM) techniques and the impact of their process flows on the properties of the materials produced. Students will be taught how to critically evaluate the advantages, limitations and material compatibility of each AM technique. The coursework will provide students with the means to select the most appropriate AM technique and optimize the processing parameters for their needs. It will also include recent advances in AM to ensure students stay abreast with the most cutting-edge developments, allowing their knowledge to be relevant and industry-ready upon graduation.

This course is most suitable for material scientists and engineers who would like to understand more about the possibilities of material processing through AM and for process engineers and scientists to understand more about the effect of AM processes on the material properties.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. List and describe the 7 major categories of Additive Manufacturing (AM)
2. Understand the working principles of each technique
3. Explain the advantages and limitations of each technique
4. Explain how the process flow of each technique affects material compatibility and performance
5. Identify material defects and explain they arise
6. Demonstrate knowledge on the applicability of AM materials

Course Content

1. Introduction to Additive Manufacturing: What is it? Why is important? Latest news.
2. Additive Manufacturing: Software; Basic explanation and preparation of STL files and gcode
3. Short overview on the fundamentals of material elasticity and viscoelasticity, mechanics of materials, microstructures
4. Description of the 7 categories of Additive Manufacturing – process flow; advantages and limitations; effect on material compatibility and performance (dimensional stability, structural properties etc.)
5. Effect of processing parameters on defect formation

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weightage	Team/Individual	Assessment Rubrics
1. Continuous Assessment 1 (CA1): 2 page essay to critique an AM technique not covered in class as a test of critical thinking and understanding	1-6	• Engineering knowledge and • Problem analysis	50	Individual	• Demonstration of critical thinking skills • Communication skills in organization of content Appendix 1
2. Continuous Assessment 2 (CA2): 10 MCQ and 2 short answer questions to test knowledge	1-6	• Engineering knowledge and • Problem analysis	50	Individual	Appendix 2
Total			100%		

Formative feedback

- Self-assessment checklist provided at the end of each topic
- In-class discussion for coordinator to gauge your understanding and for you to seek clarifications.
- Conduct of written continuous assessments (CA) to measure your learning and progress. You will be informed of your CA grades.
- Low-stakes discussion during lecture classes to encourage knowledge/ idea sharing amongst peers.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture-based classes (LBC)	Course content is planned and presented to you in a systematic fashion that will help you to focus on certain key concepts, principles, and ideas. Up-to-date research content and case studies are also incorporated into the lectures increase the relevance of the coursework and pique your curiosity.
Context-based learning (CBL)	Real-world applications of Additive Manufacturing will be presented regularly, together with up-to-date information on the most recent advances so you can see the relevance of the course content to the industry.

Technology-facilitated learning (TFL)	Open-source multimedia tools as videos and animations are infused into the course content to clarify process flows in an efficient manner.
Small-group teaching (SGT)	Group discussion (~ 6 pax) will be conducted during lecture to facilitate interaction, participation and sharing of knowledge and doubts. It is designed to improve engagement and attention, as well as serve as informal feedback f learning progress.

Reading and References

1. "3D Printing and Additive Manufacturing: Principles and Applications", 5th edition, World Scientific (2017)

Course Policies and Student Responsibilities

(1) CA
Absentees must be supported by a medical certificate or other valid official documents.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Lai Chang Quan	N3 02C-68	6790 4952	cqlai@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to Additive Manufacturing	1, 2	Lecture (2h)
2	Material Extrusion	2 – 6	Lecture (2h)
3	Vat Photopolymerisation	2 – 6	Lecture (2h)
4	Sheet Lamination and Material Jetting	2 – 6	Lecture (2h)
5	Powder Bed Fusion	2 – 6	Lecture (2h)
6	Binder Jetting and Directed Energy Deposition Deadline for CA1	2 – 6	Lecture (2h)
7	CA2		CA (1h)