NANYANG TECHNOLOGICAL UNIVERSITY

Teaching, Learning and Pedagogy Division

Reg. No. 200604393R

COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2018/19	**Semester**	1 & 2
Course Coordinator	Associate Professor Zhou Wei (Semester 1) Assistant Professor Su Pei-Chen (Semester 2)		
Course Code	MA2004		
Course Title	Manufacturing Processes		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lectures: 26 hours Tutorials: 13 hours		
Proposal Date	17 May 2018		

Course Aims

This course aims to provide you with a basic understanding of the manufacturing processes used in industry. These include their fundamental principles, theory, quality issues and applications. Dimension and surface measurement is also included.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, you should be able to:

1. Describe the applications of common dimensional and surface measuring equipment.
2. Select basic manufacturing processes for manufacturing a component, for example by casting or polymer shaping or machining or sheet metalworking.
3. Apply metal casting fundamentals (e.g. solidification, riser design).
4. Calculate forces for sheet metalworking processes (cutting, bending and drawing).
5. Use metal-cutting theory to calculate forces, power and energy, select suitable tool materials and determine suitable machining conditions.
6. Explain the differences between the different joining processes (e.g. welding, brazing, soldering, and adhesive bonding)
7. Apply welding fundamentals (e.g. effect of heat and pressure) to select suitable welding processes.
8. Explain the key processing steps of microelectronics manufacturing.
9. Understand Industry 4.0 and its impact on future manufacturing.

Course Content

	Topic	Hours
1.	**Overview of manufacturing and Introduction to Industry 4.0** Introduction to manufacturing. Materials and manufacturing processes. Trends in manufacturing. Introduction to Industry 4.0.	1
2.	**Dimensions and surfaces measurement** Dimensions and tolerances. Conventional measuring instruments and gages. Surfaces and measurement.	2

3.	**Casting** Fundamentals of metal casting. Metal casting processes. Casting quality and design consideration.	4
4.	**Shaping processes for polymers** Properties of polymer melts. Extrusion. Injection, compression, transfer and blow moldings. Thermoforming.	3
5.	**Sheet metalworking** Cutting. Bending. Drawing and other operations.	3
6.	**Materials Removal Processes** Theory of metal cutting. Machining operations and machine tools. Cutting tool technology.	5
7.	**Joining processes** Fundamentals of welding. Welding processes and weld quality. Brazing, soldering and adhesive bonding.	4
8.	**Microelectronics manufacturing** Overview of IC processing. Silicon processing. Lithography. Layer processes. Integrating fabrication step. Electronics packaging.	4

Assessment (includes both continuous and summative assessment)

Component	**Course LO Tested**	**Related Programme LO or Graduate Attributes**	**Weighting**	**Team/ Individual**	**Assessment rubrics**
1. Continuous Assessment 1 – Quiz 1	LO1 – LO4	* EAB SLO a, b, c	20%	Individual	
2. Continuous Assessment 2 – Quiz 2	LO5 – LO7	EAB SLO a, b, c	20%	Individual	
3. Final Examination – Restricted Open Book;1 double sided A4 reference sheet; 2.5hrs	LO1-LO9	EAB SLO a, b, c	60%	Individual	
Total			100%		

* EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes. The list is below:

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems

b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural

sciences, and engineering sciences.

c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Formative feedback

The feedbacks are given through the face to face tutorial sessions with tutors. Additional Lecture briefings are also given during designated lecture hours to give review of the contents and take questions in person with you.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Online Lecture	Online lectures provide content knowledge, theory and explanation on each topic in the syllabus with appropriate examples. Practice questions to the key concepts are included in the online lecture

	modules to ensure your understanding of most important concepts
Tutorial	Tutors provide guidance to solve sample tutorial problems in class. There will be opportunity for you to ask questions.
In-class Lecture	Offered in selected weeks for additional review practice questions discussion. You can have opportunities to meet main lecturers for consultation.

Reading and References

Textbook

1. Groover Mikell P, Principles of modern manufacturing. 5th ed. SI version. John Wiley, 2013.

References

1. Kalpakjian S and Schmid S R, Manufacturing engineering and technology, 7th edition, Pearson, 2013.

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct.

The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of mental health and wellbeing. These policies and codes concerning students can be found in the following link.
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

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

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Planned Weekly Schedule

Week	Topic	Course LO	Readings / Activities
1	Introduction Dimensions	2 1	Main Textbook Chapter 1, 1.1, 1.2, 1.3 and 1.6
2	Dimensions Casting	1 3	Main textbook: Chapter 6, Sections 6.1~6.5
3	Casting	3	Chapter 7 − 7.1, 7.2, 7.3
4	Casting Sheet Metal Forming	3 4	Chapter 8 − 8.2.4, 8.3.1, 8.3.3, 8.5, 8.7 Chapter 3 − 3.1.1, 3.1.4
5	Sheet Metal Forming	4	Chapter 16 − 16.1, 16.2, 16.3
6	Polymers	2	Chapter 10 − 10.1, 10.2.1, 10.2.3, 10.6,
7	Polymer Process Welding & Joining	2 6, 7	Chapter 10 − 10.7, 10.8.1, 10.9, 10.10 Chapter 25 - 25.1, 25.2, 25.3 , 25.4
8	Welding & Joining	6, 7	Chapter 26 – 26.1, 26.2, 26.3, 26.4, 26.5, 26.6, 26.7, 26.8
9	Welding & Joining Machining	6, 7 5	Chapter 27 – 27.1, 27.2, 27.3 Chapter 17 - 17.1, 17.2
10	Machining	5	Chapter 17 – 17.3, 17.4, 17.5 Chapter 19 – 19.1, 19.2, 19.3
11	Machining, Introduction to Industry 4.0	5, 9	Chapter 18 – 18.1, 18.2, 18.3, 18.4
12	Microelectronics Manufacturing	8	Chapter 30 – 30.1, 30.2, 30.3, 30.4, 30.5
13	Microelectronics Manufacturing	8	Chapter 30 - 30.6,30.7 Chapter 31 – 31.1, 31.2, 31.3