Course Code	DR3008
Course Title	Advanced Development and Prototyping
Pre-requisites	DR3006 Product Design III *(applies to ADM students only)* OR MA4831 Computer-Aided Engineering *(applies to MAE students only)*
No of AUs	3
Contact Hours	39 hours studio contact

Course Aims

This intermediate level course will allow you to conceptualize, develop, detail and build functional prototypes for various types of products. You will be taught principles on how to design for manufacturing and be introduced to various prototyping techniques. This course will prepare you in creating functional prototypes for product design projects undertaken in year 4 of your studies.

Intended Learning Outcomes (ILO)

By the end of the course, you should be able to:

1. Describe design for manufacturing and various types of techniques used for the creation of functional product prototypes.
2. Develop a range of manual and digital techniques and processes in order to create functional product prototypes.
3. Apply prototyping techniques to create functional prototypes for a variety of product designs.
4. Present your prototyping design project in a clear and cohesive manner through visual presentations and virtual/ physical objects.
5. Constructively discuss and critique on prototyping and presentation techniques employed in your own work and the work of your peers.

Course Content

What is a prototype?
You will be introduced to different types and characteristics of prototypes and their use throughout different stages of the product development process.

Design for manufacturing
You will be introduced to principles and material characteristics for the designing of parts for manufacturing. You will also be taught to consider various fastening and joining techniques used for parts made from a variety of materials.

Prototyping techniques
You will be introduced to various manual and digital techniques and workflows for creating prototypes; technologies such as 2-dimensional and 3-dimensional computer numerical control (CNC) machining, rapid prototyping, 3-dimensional scanning, and reverse engineering will be covered. Strategies for iteration, assembly, fastening & joining, and material substitution will also be covered.

Prototyping design projects
You will apply design for manufacturing knowledge and prototyping techniques to realize design

prototyping projects based on various themes.

Assessment (includes both continuous and summative assessment)

Component	ILO Tested	Programme LO	Weighting	Team/ Individual
Continuous Assessment 1 20% **Project 1: Low fidelity prototype**	1,2,3,4	N.A	20	Individual
Continuous Assessment 2 20% **Project 2: CNC Machined product prototype**	1,2,3,4	N.A	20	Individual
Rapid Prototyping Product Final Project 40% As a team: - Individual contribution 20% - Team contribution 20%	1,2,3,4	N.A	40	Individual or Team
Participation 20%	5	N.A	20	Individual
Total			100%	

Reading and References

1. Ashby, Michael F., and Kara Johnson. *Materials and design: the art and science of material selection in product design*. Butterworth-Heinemann, 2013.
2. Cuffaro, Dan, and Isaac Zaksenberg. *The Industrial Design Reference & Specification Book: Everything Industrial Designers Need to Know Every Day*. Rockport Publishers, 2013.
3. Hallgrimsson, Bjarki. *Prototyping and modelmaking for product design*. London: Laurence King, 2012.
4. Lesko, Jim. *Industrial design: Materials and manufacturing guide*. John Wiley & Sons, 2007.
5. Thompson, Rob. *Prototyping and low-volume production*. Thames &Hudson, 2011.

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

(2) Punctuality

You are expected to be punctual for all classes. If you are more than 30 minutes late, you will be deemed as absent and will not be able to sign on the attendance register.

(3) Absenteeism

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

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.

Planned Weekly Schedule*

*Subject to adjustment by instructor according to the teaching situation, students' progress, public holidays and unforeseeable circumstances. A revised schedule will be issued to students at the start of the semester.

Week	Topic	Course LO	Readings/ Activities
1	**Introduction** Overview of course What is a prototype?	2, 3	**Introductory Lecture** What is a prototype? Type of prototypes and uses **Project 1: Low fidelity prototype**
2	**Prototyping Techniques 1** Manual prototyping techniques Fastening & joining for low fidelity prototypes	1,2,3,4	**Lecture: Manual prototyping techniques** **Project 1: Low fidelity prototype** Continuous assessment and feedback throughout production.

3	**Prototyping Techniques 2** 2D CNC machining **Project 1 presentation**	1, 2, 3, 4, 5	**Lecture: 2D CNC machining** **Project 1: Low fidelity prototype** Low fidelity prototype presentation
4	**Prototyping Techniques 3** 3D CNC machining **Design for Manufacture 1** Fastening & joining for flat parts	1, 2, 3, 4	**Lecture: 3D CNC machining** **Project 2: CNC Machined product prototype**
5	**Design for Manufacture 2** Plastics and molding	1, 2, 3, 4	**Lecture: Plastics and molding** **Project 2: CNC Machined product prototype** Continuous assessment and feedback throughout production.
6	**Design for Manufacture 3** Fastening & joining for molded parts	1, 2, 3, 4	**Lecture: Plastics and molding** **Project 2: CNC Machined product prototype** Continuous assessment and feedback throughout production.
7	**Project Workshop**	1, 2, 3, 4	**Project 2: CNC Machined product prototype** Continuous assessment and feedback throughout production.
8	**Project 2 presentation**	1, 2, 3, 4, 5	**Project 2: CNC Machined product prototype** Prototype presentation with documentation
9	**Prototyping Techniques 4** Rapid Prototyping	1, 2, 3, 4	**Lecture: Rapid Prototyping** **Project 3: Rapid Prototyping product prototype**
10	**Prototyping Techniques 4** 3D Scanning/ Reverse Engineering	1, 2, 3, 4	**Lecture: 3D Scanning and Reverse Engineering** **Project 3: Rapid Prototyping product prototype** Continuous assessment and feedback throughout production.
11	**Design for Manufacture 3** Metal materials	1, 2, 3, 4	**Lecture: Metal materials** **Project 3: Rapid Prototyping product prototype** Continuous assessment and

			feedback throughout production.
12	**Project workshop**	1, 2, 3, 4	**Project 3: Rapid Prototyping product prototype** Continuous assessment and feedback throughout production.
13	**Project 3 presentation**	1, 2, 3, 4, 5	**Project 3: Rapid Prototyping product prototype** Prototype presentation with documentation