NIRMA UNIVERSITY

Institute:	Institute of Design
Name of Programme:	Bachelor of Design (Product and Interaction Design Prog.)
Course Code:	2DD204CC25
Course Title:	Manufacturing Processes II
Course Type:	Core
Year of introduction:	2025-26

L	T	Practical component				C
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Course Learning Outcomes (CLO):

At the end of the course, the student will be able to:

1. Identify and classify metals, polymers, and composites used in product design (BL 1)
2. Apply knowledge of material properties to justify design and manufacturing choices (BL 3)
3. Analyze material behavior through experimentation (BL 4)
4. Evaluate manufacturing processes for sustainability and usability in product development (BL 5)

Contents

Teaching Hours (Total 75)

Unit 1 **Introduction to Materials – Metals, Polymers, and Composites:** **3**

- **Role of materials in design**: Why material selection matters.
- **Fundamental properties of materials**: Strength, hardness, elasticity, thermal and electrical properties.
- **Comparing metals, plastics, and composites**: Key differences and uses in design.
- **Sustainability & recyclability**: Lifecycle impact and environmental concerns.

Unit 2 **Metals – Properties and Processing:** **4**

- **Types of metals**: Ferrous vs. non-ferrous (steel, aluminum, copper, titanium).
- **Manufacturing processes for metals**: Casting, rolling, forging, extrusion, machining, welding.
- **Surface treatments**: Powder coating, anodising, polishing.

Unit 3	**Polymers – Types, Behavior, and Applications** • **Thermoplastics vs. Thermosets**: Properties and real-world applications. • **Manufacturing techniques**: Injection molding, thermoforming, extrusion, 3D printing. • **Degradation & sustainability**: How polymers react to heat, UV, and mechanical stress.	**4**
Unit 4	**Composites – Material Behavior and Performance** • **What are composites?** Understanding fiber-reinforced polymers (FRP), carbon fiber, fiberglass. • **Fabrication techniques**: How composites are made (lay-up, vacuum bagging, compression molding).	**4**

Suggested List of Practical **42 hours**

Sr. No.	**Practical Work**
1.	Identify and compare the weight, texture, and finish of common metals using a digital scale and magnifying glass.
2.	Perform scratch, bend, and tap tests on metal samples to assess hardness, flexibility, and sound characteristics.
3.	Test flexibility and brittleness of various plastic samples by bending to specific angles until deformation or breakage.
4.	Heat a small thermoplastic strip with a heat gun/hair dryer and record changes in moldability and surface texture.
5.	Identify and handle different composite samples (e.g., fiberglass, carbon fiber) and calculate weight-to-strength ratio.
6.	Compare the deflection of a metal rod, plastic rod, and composite strip under the same applied weight.
7.	Cut, shape, and join two different materials (e.g., plastic + metal) using safe workshop tools.
8.	Visit an in-house or nearby workshop to observe basic manufacturing processes and replicate a scaled-down process with safe materials.

Suggested field visits: Field visits to Industries. **18 hours**

Self Study:

Suggested Readings/References:

Books:

1. Ashby, M. F. & Jones, D. R. H. (2012). Engineering Materials 1: An Introduction to Properties, Applications, and Design. Butterworth-Heinemann.
2. Kalpakjian, S. & Schmid, S. (2018). Manufacturing Engineering and Technology (8th Edition). Pearson.
3. Groover, M. P. (2020). Fundamentals of Modern Manufacturing: Materials, Processes, and Systems (7th Edition). Wiley.
4. Strong, A. B. (2006). Plastics: Materials and Processing (3rd Edition). Pearson.
5. Ever J. Barbero (2017). Introduction to Composite Materials Design (3rd Edition). CRC Press.

Online Resources:

1. MIT OpenCourseWare – Materials Science & Manufacturing Processes.
2. YouTube Channels: The Engineering Mindset, Smarter Every Day, The Efficient Engineer.
3. NPTEL – Materials Science & Manufacturing Processes – Lecture series on material behavior and manufacturing techniques.
4. Material Databases: MatWeb, CES EduPack, Plastic Europe Database.