

Course Type	Course Code	Name of the Course	L	T	P	Credit
DE	OMED605	Materials Processing (Casting, Forming and Welding)	3	0	0	3

Prerequisites
Bachelor/Master/PhD students having background in Mechanical Engineering/Production Engineering/Manufacturing Technology
Course Objectives
1. To understand the basics of the metals casing, welding and forming processes 2. To understand the underlaying principles. 3. To understand the material properties after these processing of materials
Learning Outcome
1. Students will understand the fundamental principles of metal casting processes including solidification and defect minimization. 2. Students will identify key variables affecting casting quality and select appropriate molding techniques. 3. Students will explain plastic deformation mechanisms in bulk forming processes like forging, rolling, and extrusion. 4. Students will analyze force, power, and temperature requirements for various forming operations. 5. Students will describe fusion and solid-state welding principles, including heat sources and joint preparation. 6. Students will evaluate weld imperfections, residual stresses, and testing methods for weld integrity. 7. Students will compare processing parameters across casting, forming, and welding to optimize material properties. 8. Students will apply knowledge to design manufacturing sequences for simple components using these processes.

Unit No.	Topics to be covered	No. of lecture videos	Video time (Minutes)	Learning Outcomes
1	Introduction to Materials processing - 1 Materials and microstructure evolutions Basics of heat conduction and fluid flow - I Basics of heat conduction and fluid flow – II; Numerical problems	6	215	Understand the fundamentals of materials processing
2	Introduction to Materials processing - 2 Solidification processing - I Solidification processing – II; Numerical problems	5	206	Understanding of Solidification science and technology of metals and alloys.
3	Overview of casting, welding and forming processes. Casting and Welding; Numerical problems. Material forming; Numerical problems	6	275	Understanding of Metals shaping processes and numerical problems.
4	Melt processes – Casting - 1 Processing of metals, polymers and ceramics; Case studies. Shape casting, extrusion and injection molding; Case studies	4	125	Understanding of polymer shaping processes.
5	Melt processes – Casting - 2 Blow molding and fused deposition modeling; Case studies. Sand casting, lost foam & cooled molds; Case studies	6	168	Understanding of metals casting processes.

6	Melt processes – Fusion welding Arc, laser and electron beam welding; Case studies. Advanced welding processes; Case studies. Metallic wire additive manufacturing; Case studies	6	264	Basic mechanism and heat sources for the melting process
7	Solid processes – Bulk deformation Mechanical responses of metals and polymers; Numerical problems. Hot working and cold working; Case studies. Hot rolling of steel; Case studies	5	190	Understanding of the basics of hot, cold and warm working processes.
8	Solid state deformation: Solid state welding; Case studies. Ball Milling and friction Consolidation; Case studies	2	141	Solid state welding and different case studies to understand the working principles.
9	Powder processing Powder compaction; Case studies. Powder additive manufacturing; Case studies. Powder treatment.	3	191	Powder processing to fabricate different metal parts.
10	Non-conventional processing Colloidal processing and coating; Case studies. Dispersions and additive processes; Case studies	2	122	Understanding of various coating processes.
11	Steel processing Steel making and single crystal production; Case studies, Steel fluid flow analysis . Steel solidification	2	131	Insight of the steel making process, steel melting and solidification processes.
12	Processing of electronics, magnetic and optic materials Electronics material processing; Case studies. Magnetic material processing; Case studies. Optic material processing; Case studies	3	157	Understanding the Processing of electronics, magnetic and optic materials.
Total		50	2185	

Text books:

1. Lorraine F. Francis, Materials Processing, Academic Press, 2016
2. John E. Neely and Thomas J. Bertone: Practical Metallurgy and Materials of Industry, 6th Ed, Prentice Hall, 2002.
3. D S Porter, K E Esterling and M Y Sherif, Phase Transformation in Metals and Alloys, 3rd Ed., CRC Press, 2016.

Reference Books

1. Sindo Kou, Welding Metallurgy, Wiley Interscience, 2nd Ed., 2003.
2. John D Verhoeven, Fundamentals of Physical Metallurgy, John Wiley & Sons, 1975
3. Vladimir B. Ginzburg, Steel-Rolling Technology: Theory and Practice, 1st Ed, CRC Press, 1989