Course Type	Course Code	Name of the Course	L	T	P	Credit
DE	OMED608	Theory of Production Processes	3	0	0	3

Prerequisites
Introduction to manufacturing technology or manufacturing processes.
Course Objectives
1. Highlight scientific principles underlying key manufacturing processes: casting, forming, and welding. 2. Explain solidification, fluidity, gating, and riser concepts in casting beyond operational steps. 3. Explore mechanics of metal forming processes and their underlying physics. 4. Analyze thermal effects, weldability, residual stresses, and distortion control in welding. 5. Equip learners with theoretical insights to enhance productivity in manufacturing industries. 6. Apply core concepts to improve operations in steel plants, foundries, and forging units. 7. Move beyond mere operational steps to understand production mechanisms. 8. Foster deeper comprehension of what happens during casting, forming, and welding production.
Learning Outcome
1. Learners will be able to explain the foundational theories of casting, including solidification behavior, fluid dynamics, and defect formation. 2. Students will be equipped to analyze forming processes using mechanics- based reasoning, incorporating strain-stress relationships and material flow principles. 3. Enables a clear understanding of welding fundamentals such as heat transfer, weldability, residual stress development, distortion mechanisms, and their control. 4. Learners will be able to apply this theoretical knowledge to evaluate and improve production processes in industries focused on casting, forging, or welding, and interpret process behavior with respect to productivity, quality, and scientifically grounded design decisions.

Unit No.	Topics to be covered	No. of lecture videos	Video time (Minutes)	Learning Outcomes
1	Theory of casting and solidification, Fluidity of liquid metals.	5	166	Explain solidification behavior, metal fluidity, and casting fundamentals
2	Technology of patternmaking and mouldmaking, Pattern allowances, Testing of molding sand, cores.	5	162	Understand pattern design, mould properties, and testing methods for casting accuracy
3	Gating system design, Riser Design, different methods of calculating riser volume, Feeding distance calculations.	5	180	Design effective gating and riser systems to optimize casting quality and reduce defects
4	Theory of melting and production of ferrous and non-ferrous materials, Casting design, Casting defects	5	171	Analyze metal melting techniques, casting design rules, and identify common casting defects

5	Mechanical fundamentals of metalworking: Concept of stress and strain, stress and strain tensors, Hydrostatic and deviatoric stresses, Flow curve.	5	176	Explain basic mechanical behavior of materials under load and their relevance in forming processes
6	Yield criteria for ductile materials, plastic stress strain relationships, classification of metalworking, mechanics of metalworking.	5	167	Evaluate yielding behavior and mechanics behind various metal forming operations
7	Analysis and classification of rolling and forging processes, Force calculations in rolling and forging processes.	5	167	Analyze rolling and forging processes and perform basic force calculations
8	Analysis and classification of Extrusion process, Analysis of wire, rod and tube drawing processes, Forming defects	5	169	Understand extrusion, wire/rod/tube drawing, and predict forming-related defects
9	Classification of welding processes, Thermal effects in welding, Basic metallurgy of fusion welds, Heat affected zone in welding.	5	161	Describe welding classifications, thermal behavior, and metallurgical transformations in weld zones
10	Principles of welding processes: Arc welding, Gas metal arc welding, Solid state welding, Resistance welding, Soldering, Brazing and adhesive bonding.	5	163	Compare different welding and joining processes and understand their operational principles)
11	Residual stresses in welding, Methods of measurement of residual stresses in welding, Welding distortion and its types, Methods of reducing residual stresses and distortion in welding.	5	158	Identify sources of welding residual stresses and propose methods to minimize distortion
12	Weldability of materials: Introduction and assessment of weldability, Test for weldability, Weldability of ferrous and non-ferrous materials	5	156	Assess material weldability and select suitable tests and approaches for different alloys
	Total	60	**1996**	

Textbooks:

1. Ghosh, A., and Mallik, A.K., Manufacturing Science, Affiliated East-West Press Pvt. Ltd.
2. Heine, R.W., Loper, C.R., and Rosenthal, P.C., "Principles of Metal Casting", TMH

Reference Books

1. *Kuo, S., "Welding Metallurgy", John-Wiley & Sons Inc*
2. *Rao, P.N., Manufacturing Technology: Foundry, Forming and Welding, McGraw Hill Education (India) Private Limited.*
3. *Kalpakjian, Serope and Schmid, Steven R., Manufacturing Processes for Engineering Materials, Pearson.*