

BMEE302L	Metal Casting and Welding	L	T	P	C
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Pre-requisite	BMEE209L, BMEE209P	Syllabus version			
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Course Objectives					
1. To provide an insight on the casting fundamentals and processes.					
2. To impart knowledge on the welding processes for developing various joints.					
Course Outcomes					
At the end of the course, the student will be able to					
1. Interpret the solidification characteristics for designing gating system.					
2. Demonstrate working principle of various casting processes.					
3. Use various melting practices and explore casting defects.					
4. Apply suitable welding process for different functional requirements.					
5. Examine weld defects and suggest suitable methods to assess weld quality.					
Module:1	Casting Fundamentals	7 hours			
Solidification of pure metals and alloys. Mechanism of columnar and dendritic growth. Concept of progressive and directional solidifications. Solidification time and Chvorinov's rule. Principles of fluid flow: Bernoulli's theorem and law of mass continuity. Gating system-components and functions. Design of the gating System. Different types of gates. Gating ratio and its functions. Definition and functions of the riser. Types of risers and their application. Design of riser. Aspiration effect. Use of insulating material and exothermic compounds in risers.					
Module:2	Expendable Mould Casting	6 hours			
Sand casting – Types and properties of sand – Types, features and steps involved in sand mould – Pattern making, pattern allowances – Mould and Core materials – Core making, chaplets – Sand-moulding machines – Procedural steps and applications of Shell mould casting, Plaster and Ceramic mould casting, Lost-foam Casting, Investment mould casting.					
Module:3	Permanent Mould Casting	5 hours			
Procedural steps and applications of Vacuum casting, Slush casting, Low-pressure casting, Die-casting – hot chamber and cold chamber, Centrifugal casting, Squeeze casting, Thixomolding and Rheocasting, Casting Techniques for single-crystal components.					
Module:4	Melting Technology and Casting Defects	6 hours			
Melting furnaces for ferrous and non-ferrous foundries. Electric and fuel fired furnaces. Induction Furnaces; Types of Furnaces, Electromagnetic Stirring, power supplies; Recent developments in energy considerations. Melting practice – ferrous, non-ferrous metals and alloys and composites. Melting practices; Fluxing, inoculation, degassing and grain refinement treatments. Control of pouring temperature Heat treatments of castings, Shop floor melt quality tests.					
Residual stresses and Casting defects and factors responsible for them. Different inspection and testing methods to evaluate the casting.					
Module:5	Joining Processes	8 hours			
Classification of welding processes – Fusion welding: Oxy-fuel gas welding - types of flames and uses, Arc welding: power sources -methods of arc initiation and maintenance, arc stability, duty cycle, metal transfer. Non-consumable electrode - GTAW, PAW, AHW. Consumable electrode - SMAW, SAW, GMAW, FCAW, EGW, ESW. Electrodes and its coatings. Beam welding (EBW & LBW).					
Solid State welding: Cold welding and roll bonding, Ultrasonic welding, Friction welding, Friction stir welding, Resistance welding, Explosion welding, Diffusion welding, Thermit welding.					
Brazing, Soldering and adhesive bonding: Principle of Operation, advantages, Limitations and application.					
Module:5	Fundamentals of welding	5 hours			

Solidification of the weld metal, Heat flow in welding, Metallurgical transformation in and around weldment, Implication of cooling rates, Heat affected zone (HAZ), Shielding gases, Classification of Filler metals and Fluxes, Weldability of plain carbon steels, Low Carbon Steels, Stainless steels and Aluminium Alloys.			
Module:7	Welding Defects and Testing		6 hours
Spatter, Under-cutting, and over lapping Crack- Initiation and Propagation - Incomplete Penetration, Inclusions, Porosity and blowholes, Lack of fusion, Distortion (Distortion and residual stresses, Concept of distortion, Types of distortion, Control of welding distortion) causes and remedies for weld defects. Testing and Inspection of welding: Visual Inspection, Weldability, Destructive testing of welds, Non-destructive testing of welds and Hot Cracking Tests.			
Module:8	Contemporary Issues		2 hours
		Total Lecture hours:	45 hours
Text Books			
1.	John K.C, Metal casting and Joining, 2015, PHI publications.		
2.	P. L. Jain, Principles of Foundry Technology, 2009, 5th edition, TMH Publications.		
3.	Parmar R.S, Welding Engineering and Technology, 2013, Khanna Publishers.		
Reference Books			
1.	Serope Kalpakjian, and Steven Schmid, Manufacturing Engineering and Technology, 2020, 8 th edition, Pearson education.		
2.	P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, 2003, 2nd Edition.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Recommended by Board of Studies		09-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022