BMEE302L	Metal Casting and Welding	L	T	P	C
		3	0	0	3
Pre-requisite	**BMEE209L, BMEE209P**	**Syllabus version**			
		1.0			

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, 8th 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

BMEE302P	Metal Casting and Welding Lab	L	T	P	C
		0	0	2	1
Pre-requisite	**BMEE209L, BMEE209P**	**Syllabus version**			
		1.0			

Course Objectives

1. To provide an insight on foundry practices.
2. To impart practical exposure on the effect of welding parameters on joint characteristics.

Course Outcome

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

1. Assess the properties of moulding sand and demonstrate the melting practices.
2. Evaluate the effect of welding parameters on microstructure and weld quality.
3. Investigate the weldability of various materials.

Indicative Experiments	
1.	Determination of permeability, shear strength and compression strength of the given foundry sand.
2.	Determination of the grain fineness of the given foundry sand.
3.	Determination of clay content for the given moulding sand sample and to study the variation of compression strength for various moisture contents.
4.	Determination of flowability for the given foundry sand.
5.	Prepare the mould for the given pattern with the core using two boxes and three – box moulding process.
6.	Foundry melting practice – demonstration.
7.	To study the effect of heat input on microstructure of weld metal and HAZ of Al / Ni alloys performed under GTAW process.
8.	To study the effect of FSW process parameters (tool rotational speed, axial load, and travel speed) on the butt welding of Al alloy.
9.	Study the bead on plate experiment (bead profile, penetration, and its dilution) on Austenitic stainless steel by using GMAW process.
10.	To study the weldability of plastic material using ultrasonic welding machine.
11	To study the residual stress measurement of the friction stir welded specimen (Demonstration).
12.	Effect of shielding gases on the weld performance of GMAW process. (Case study)
	Total Laboratory Hours **30 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.
3.	Lab Manual prepared by course faculty

Reference Books

1.	Srinivasan N. K., 'Foundry Technology', 1986, Khanna Publications
2.	Richard L Little, Welding and welding technology, 2020, Mc Graw Hill

Mode of assessment: Continuous assessment, FAT, Oral examination

Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022