SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 16.01.2021

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

Course No. : **MF F343**
Course Title : **Casting and Welding**
Instructor-in-Charge : **TUFAN CHANDRA BERA**
Practical Instructors : **Ashish Kumar Srivastava, Amresh Kumar**

1. Course Description:

Casting processes, pattern and mould design, metal melting and handling, metallurgical aspects of casting, metal flow and heat transfer, analysis of casting defects. Injection moulding of plastics. Gas cutting and welding processes including its physics, chemistry and metallurgy, power source characteristics, different welding techniques, selection of welding processes, destructive and non-destructive testing of weldments, welding standards and codes, analysis of welded joints, brazing and soldering.

2. Scope and Objective of the Course:

In-depth comprehension about casting and welding processes which are the basic pillar of manufacturing is mandatory for a mechanical or manufacturing engineer. The casting and welding processes are common, broad and versatile operation in part manufacturing and their importance are indispensible in modern product manufacturing. This course aims

- To nurture fresh talents and transform them to competent manufacturing engineers by studying various casting and welding processes in detail.
- To develop the theoretical and practical knowledge base about the fundamentals of casting and welding processes and their role in product manufacturing.
- To analyze each and every manufacturing process to improve overall productivity.
- To analyze the process for obtaining desired dimensional as well as geometrical accuracy of the part as per design requirement and evaluate the product performance.

3. Text Books:

T1. **R. W. Heine, C. R. Loper and P. C. Rosenthal, "Principles of Metal casting",** Tata McGraw-Hill Publication, II Edition, 2004.
T2. **P. N. Rao, "Manufacturing Technology Vol-1",** Tata McGraw-Hill Publications, III Edition, New Delhi.
T3. **R. L. Little, "Welding and Welding Technology",** Tata McGraw-Hill Publications, I Edition, New Delhi.

4. Reference books:

R1. **A. Ghosh and A. K. Mallik, "Manufacturing Science",** East-West Press Private Limited, New Delhi, 2008.
R2. **S. Kalpakjian and S. R. Schmid, "Manufactuirng Processes for Engineering Materials,"** Pearson Education, New Delhi, Fifth Edition, 2011.
R3. **E. R. Bohnart, "Welding Principles and Practices",** Tata McGraw-Hill Publication, Fourth Edition, 2014, New Delhi.
R4. **J. F. Lancaster. "Metallurgy of Welding,** Woodhead Publications, VI Edition, 1993.

5. Course Plan:

Module No.	Lecture Session	Reference	Learning Outcomes
1. Introduction to casting and welding	L1.1 Introduction to casting & welding and its importance in part & product manufacturing.	T1-1 T2-(1-2), R1-1	Get to know about importance of casting and welding in product manufacturing and controlling of manufacturing properties of materials during casting and welding.
	L1.2 Controlling of manufacturing properties during casting and welding.		
2. Mold making process	L2.1 Various elements in mold making process and their attributes.	T1-(1-7), T2-3, R1-2	Understanding about pattern, core and mold materials, their importance in molding making process and eventually sound casting.
	L2.2 Pattern classification, pattern allowances and coding systems for pattern.		
	L2.3 Importance of core and core making process.		
	L2.4 Molding materials, various standard testing of molding materials		
3. Design of gating system for Casting	L3.1 Various elements of gating system for Casting	T1-9, T2-4, R1-2.4	Comprehension about various elements of gating system and design of gating system for sound casting.
	L3.2 Design of pouring basin, sprue and sprue base well in gating system		
	L3.3 Design of runner and runner extension in gating system		
	L3.4 Design of in-gates and calculation of pouring time.		
	L3.5 Design of riser and importance of chill in castings		

4. Cooling and solidification during casting	L4.1 Mechanism of solidification, Freezing of pure metals. L4.2 Mechanism of solidification for alloys.	T1-8, R1-2.5	Familiarization of the mechanism of solidification, freezing of pure metals and alloys.
5. Melting and casting quality	L5.1 Procedure of melting casting materials and Identification of casting defects and remedies L5.2 Analysis of casting defects & remedies and inspection of casting defects	T1-19, T2-5, R1-2.3 R1-2.6	Comprehension about melting practice, casting cleaning, casting defects & inspection techniques.
6. Foundry practices of different materials	L6.1 Casting of Magnesium, Copper & its alloys. L6.2 Casting of Steel alloys.	T1-(12-15)	Understanding about casting of magnesium, copper & its alloys, steel alloys.
7. Product design for sand casting	L7.1 Various aspect in product design for sand casting	T2-5	Understanding of design aspect in sand casting.
8. Special Casting Processes	L8.1 Various casting process such as shell moulding, precision investment, permanent mould. L8.2 Various casting process such as Die Casting, Vacuum die casting, Low pressure Die-casting, Centrifugal Casting	T2-6, R1-2.7, R2-5.	Familiarization of shell moulding, Precision Investment, Permanent Mould, Die Casting, Vacuum die casting, Low pressure Die-casting, Centrifugal Casting.
9. Rapid tooling and rapid casting	L 9.1 Introduction to rapid tooling and rapid casting.	T2-3	Use of rapid tooling in casting and rapid casting process.
10. Introduction to welding process	L10.1 Introduction to welding process, its importance in product manufacturing. L10.2 Gas welding and its attributes L10.3 Gas cutting and its attributes	T2-9 T3-1, R1-5.2, R2-12 R1-5.3, R2-12	Understanding about principles of solid/liquid state joining. Familiarization of equipments, operations, joining processes, ferrous welding, nonferrous metals, gas cutting.

11. Arc welding	L11.1 Fundamentals of shield arc welding L11.2 Arc structure and power characteristics L11.3 Study of electrode, flux and operation.	T3-1 T3-2 R1-5.5, R2-12	Get to know about electrodes, equipments, operations, weld symbols, submerged arc welding, carbon arc welding.
12. Welding symbols and design	L12.1 Welding symbols and joints L12.2 Design of weld joints	T2-9 T3-2	Understanding about Welding symbols and design
13. Gas shield arc welding	L13.1 Study of SAW and TIG L13.2 Study of MIG welding L13.3 Study of electroslag and electrogas welding	T3-3, R1-5.5	Get to know about equipments, TIG & MIG operation.
14. Solid state welding	L14.1 Principle of solid state welding and resistance welding L14.2 Study of various resistance welding processes L14.3 Study of cold, ultrasonic, friction, explosion and diffusion welding	T2-9 T3-4	Get to know about solid state welding and various resistance welding.
15. Other Welding Processes	L15.1 Other Welding Processes and modern welding processes,	T3-4, R1-5.5, R2-12	Comprehension about plasma Arc, Resistance, Electroslag & Electrogas welding, Solid state bonding, Electron Beam, Laser, Thermit & Explosive welding
16. Brazing and soldering.	L16.1 Brazing and soldering	R2-12, R1-5	Get to know about applications and limitations of brazing and soldering.
17. Welding defects and welding metallurgy	L17.1 Weld Defects and Inspection L17.2 Study of welding metallurgy	T3-5, R1-5.6, R2-12	Understanding about weld defects, destructive and NDT methods for identification of welding defects and comprehension about welding metallurgy.

Lab experiments and open ended part manufacturing:

i) Investigation on Input Current in Arc Welding.
ii) Investigation on weld bead quality of various materials in carburizing flame.
iii) Welding Design.
iv) TIG and MIG Welding Process.
v) Determination of Compressive and Shear Strength of Green Sand.
vi) Determination of deformation & toughness of Green Sand.
vii) Determination of permeability number of Green Sand.
viii) Determination of Grain Fineness Number of sand.

6. Evaluation Scheme:

Component	Duration	Weightage (Mark)	Date & Time	Remarks
Mid Semester Test	90 min	30% (30)	---	Open book
Class Assignments & Surprise Quiz		10% (10)	----	Open book
Comprehensive Examination	2 hours	40% (40)	12/05/2021 FN	Open book
Lab Practical	Semester long	20% (20)	---	Lab Experiments and Lab Test

After completing this course the students will be able to

i) Select suitable casting process for common part manufacturing.
ii) Control process parameters to obtain desired surface quality of a part in casting process.
iii) Improve overall process productivity in various casting processes.
iv) Selection of proper welding process for product fabrication.
v) Control process parameters to obtain desired part quality in welding process
vi) Select the most suitable manufacturing process for product manufacturing by considering workpiece material, quality and cost of the part etc.

Closed Book Test: No reference material of any kind will be permitted inside the exam hall.

Open Book Exam: Use of any printed / written reference material (books and notebooks) will be permitted inside the exam hall. Loose sheets of paper will not be permitted. Computers of any kind will not be allowed inside the exam hall. Use of calculators will be allowed in all exams. No exchange of any material will be allowed.

7. Chamber Consultation Hours:

To be announced in the class.

8. Notices:

All notices related to the course will be displayed on Notice Board of Mechanical Engineering Department only.

9. Make-up Policy:

Make-up will be granted **ONLY** in genuine cases with prior permission. The request application for make-up test **MUST** be reached to the Instructor-in-charge before commencement of the scheduled test along with **DOCUMENTARY PROOF**. No make-up will be allowed for the Surprise Quiz Tests.

10. Note:

It will be the responsibility of the individual student to be regular in maintaining the self study schedule as given in the course handout, attend lectures and the lab demonstration as per the schedule announced in Nalanda. Mid Semester Test and Comprehensive Examination are according to the Evaluation Scheme given in the respective Course Handout. If the student is unable to appear for the Regular Test/Examination due to genuine exigencies, the student must refer to the procedure for applying for Make-up Test/Examination.

Instructor-in-Charge
MF F343