

COURSE TITLE	RAPID CASTING
COURSE CODE	01ME0704
COURSE CREDITS	4

Objective:

- 1 This course aims to implement additive manufacturing, simulation, testing, and methoding process in metal casting.

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply the principles of rapid casting to develop moulds and patterns for industrial applications.
- 2 Identify application of additive manufacturing in high - precision sector.
- 3 Analyze moulding process for metal filling process.
- 4 Analyze metal behavior using destructive testing and interpret results as per industrial standards.
- 5 Apply NDT and metallurgical tests to inspect materials and interpret ferrous microstructures.
- 6 Apply casting simulation and analyze process parameters; implement automation using sensors and microcontroller.

Pre-requisite of course: Manufacturing Process 1 & 2

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	4	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Pattern Making Type of pattern, allowance, pattern material, 3D printing technologies in aerospace components, automotive parts, Working and specifications of 3D printers, Metal 3D printing.	6
2	Methoding Types of sand used in metal casting, sand testing, properties of sand,, Types of molds, core making, design consideration in core making, Design considering in mold making, Feeder/riser design, different feed aids, effect of feed aids on metal casting. , Optimum cavity layout, Complexity analysis and computation	8

Contents : Unit	Topics	Contact Hours
3	Inspection and Testing Introduction of destructive, testing, Mechanical properties of metals, Tensile testing, compressive testing, bending testing hardness testing, Impact testing, various standards for testing. , Introduction of NDT, Methods of NDT i.e. Liquid penetration Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography Test, Eddy Current Testing, Spectrometer, XRF analyzer, Micro-structural analysis of various ferrous metals	8
4	Automation and Simulation Introduction to basic parameters of casting, Parting line Selection, , Design parameters of core and core print, Design of Feeding and Filling System. , Introduction to Automation and IoT, Sensors, Data Acquisition, microcontroller	6
Total Hours		28

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Development of 3D model using CAD software. Development of 3D model using CAD software.	2
2	Fabrication of 3D printed model for casting patten Fabrication of 3D printed model for casting patten	2
3	Calculate the mesh size and permeability of moulding sand. Calculate the mesh size and permeability of moulding sand	2
4	Computation of Feeder size. Computation of Feeder size.	2
5	Computation of Gating system. Computation of Gating system.	2
6	To perform the mold making process using green sand moulding and chemical moulding. To perform the mold making process using green sand moulding and chemical moulding.	2
7	Perform Destructive Testing for ferrous material. Perform Destructive Testing for ferrous material.	2
8	Perform Non-Destructive Testing for ferrous material Perform Non-Destructive Testing for ferrous material	2
9	Perform metallurgical analysis of microstructure for ferrous material. Perform metallurgical analysis of microstructure for ferrous material.	2
10	Perform simulation for sand casting component. Perform simulation for sand casting component.	2
11	Perform simulation for investment casting component. Perform simulation for investment casting component.	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
12	Experimental study on sensor performance using microcontroller. Experimental study on sensor performance using microcontroller.	2
Total Hours		24

Textbook :

- 1 Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker,, Springer, 2015
- 2 Metal Casting: Computer-Aided Design and Analysis, B. Ravi, PHI Learning Pvt. Ltd., , 2005
- 3 Material Testing Laboratory Manual for Quality Control, Ravichawla C.B., Kukreja, Kishore K. , Standard Publishers Distributors, 2000

References:

- 1 3D Printing and Additive Manufacturing: Principles and Applications, , 3D Printing and Additive Manufacturing: Principles and Applications, , Chee Kai Chua, Kah Fai Leong, World Scientific Publishing, 2017
- 2 Additive Manufacturing for the Aerospace Industry, Additive Manufacturing for the Aerospace Industry, Rodney Boyer, F. H. Froes, Elsevier., 2019
- 3 Principles of Metal Casting, Principles of Metal Casting, Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, McGraw-Hill Education, 2000
- 4 Manufacturing Science, Manufacturing Science, Amitabha Ghosh, Ashok Kumar Mallik, East-West Press Pvt. Ltd, 2017
- 5 Mechanical Testing of Engineering Materials, Mechanical Testing of Engineering Materials, Kyriakos Komvopoulos , Cognella, Inc, 2017
- 6 Getting Started with Arduino, Getting Started with Arduino, Massimo Banzi, Michael Shiloh, Maker Media, 2015
- 7 Textbook of Material Science and Metallurgy, Textbook of Material Science and Metallurgy, O.P. Khanna, Dhanpat Rai & Co, 2010
- 8 Mechanical Metallurgy, Mechanical Metallurgy, George E. Dieter, McGraw Hill Education, 2017

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
0.00	0.00	35.00	35.00	30.00	0.00

Instructional Method:

- 1 Power Point Presentation and Experiment Process

Supplementary Resources:

- 1 https://onlinecourses.nptel.ac.in/noc25_me130/preview
- 2 https://onlinecourses.nptel.ac.in/noc25_me151/preview
- 3 <https://thors.com/manufacturing-courses/manufacturing-processes/castings/gating-and-risering-basics/>
- 4 <https://www.udemy.com/course/metal-casting-techniques-materials-and-product-design-afs/>
- 5 https://onlinecourses.nptel.ac.in/noc23_me48/preview
- 6 <https://store.anycubic.com/pages/firmware-software>
- 7 <https://ultimaker.com/software/ultimaker-cura/>