

COURSE DESCRIPTION			
Program	Tool & Die Engineering		
Course Title	Fundamentals of Manufacturing and Tool Engineering		
Course Code	2111	Semester	II
Type of Course	Theory	Contact Hours	60
Teaching Scheme (L: T:P:R)	4:0:0:0	Credits	4
CIE Marks	40	ESE Marks	60

Introduction

The subject introduces the fundamentals of manufacturing processes and the basic concepts of Tool and Die Engineering. It covers primary and secondary manufacturing processes such as Casting, metal forming, machining, press work and joining. Special emphasis is given to sand casting, press tools, tool materials, and heat treatment which are essential for producing quality components with precision and repeatability. By studying this subject students gain a strong foundation in manufacturing principles and develop an understanding the role of Tool and Dies making in Industrial production

Course Objectives

1	To introduce the Evolution and Fundamentals of Manufacturing and Tool Engineering
2	To provide the students with fundamental knowledge of casting process with emphasize on sand casting including patterns, gating system, solidification and an overview of other casting and moulding methods
3	To familiarise the students to basic metal forming, machining and press working operations used in manufacturing
4	To provide basic knowledge of Tool materials, heat treatment and modern trends in Manufacturing

Course Pre-requisite

Topic	Course code	Course Title	Semester
Basic Physics	2002A	Engineering Physics for Mechanical, Structural and Industrial Applications	I/II

Course Outcome

CO	Course Outcome	Blooms Taxonomy Level
CO1	Explain the evolution and fundamentals of Manufacturing and Tool Engineering	Understand
CO2	Explain sand casting and other basic casting processes along with their applications	Understand
CO3	Explain the basic principle of Metal forming process, Machining and Joining process along with their application	Understand
CO4	Identify and classify Engineering materials and Tool materials. Describe about heat treatment and modern trends in Industry	Understand

CO-PO mapping

COURSE ARTICULATION MATRIX											
Course Outcomes	PROGRAM OUTCOMES										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	2	-	-	-	2
CO2	3	3	2	2	-	2	-	-	-	-	2
CO3	3	3	2	2	2	2	-	-	-	-	2
CO4	3	2	2	-	2	3	2	-	-	-	2
Total	12	10	6	4	4	9	4	-	-	-	8
Correlation Level	3	2.5	2	2	2	2.25	2	-	-	-	2

Legends: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

Teaching and Assessment Scheme

Teaching Scheme/Week				Self-learning (SS)/Week	Total Hours/Semester	Credits C	Examination Scheme					
							Theory			Practical		
L	T	P	S				CIE	ESE	Total	CIE	ESE	Total

4	0	0	0	6	60	4	40	60	100	0	0	0	100
L: Lecture (One unit is of one-hour duration with one credit), T: Tutorial (One unit is of one-hour duration with one credit), P: Practical (One unit is of one-hour duration with 0.5 credit), S: Project (One unit is of one-hour duration with 0.5 credit) SS: Self-Learning, CIE: Continuous Internal Evaluation, ESE: End Semester Examination													

Syllabus - Major Topics

Module	Title	Major Topics	Instructional Hours	
			L	T
Module I	Evolution and basics of manufacturing and Tool Engineering	Introduction and classification of manufacturing processes, safety practices in manufacturing	15	0
Module II	Casting Processes	Basics of casting, sand casting process, pattern and moulding sand, Gating and Risers, casting defects, special casting and moulding processes	15	0
Module III	Metal forming, Machining and Press work	Metal Forming Process, Machining operations, Press work and Press tool, Metal joining processes	15	0
Module IV	Tool Materials and Modern Trends	Tool Materials and Heat treatment, Jigs Fixtures and Inspection, Surface Finishing, Powder Metallurgy, CAD/CAM & CNC	15	0

Detailed Syllabus

Subtopic	Student Learning Outcome	Mode of delivery (L/T)	Mapped CO	Taxonomy Level	Instructional Hours
Module I					
Introduction to manufacturing	Explain the meaning and scope of manufacturing, role of Manufacturing Industry	L	CO1	Understand	1
Evolution of manufacturing	Describe Craft Production, Mass Production, Automation and Modern Manufacturing	L	CO1	Understand	2
Introduction to Tool and Die Engineering	Explain the definition and scope, role of Tool and Die Engineer	L	CO1	Understand	1
Classification of manufacturing process	Describe Primary Manufacturing Processes, Secondary Manufacturing Processes, Finishing Processes	L	CO1	Understand	3
Overview of Manufacturing Process	Explain Casting process, Forming process, Machining process, Joining process, Benchworking and Fitting process	L	CO1	Understand	3
Basic Manufacturing terminology	Explain the basic units and symbols Introduce the industry terms like shop floor, Tool Room, job, raw material, operation, product, batch, tool, scrap, stock, inspection	L	CO1	Understand	2
Manufacturing Industries and applications	Introduce the different type of industries like Automotive, Aerospace, Consumer goods, Heavy Engineering	L	CO1	Understand	1
Safety Practices in Manufacturing and Tool Rooms	Explain the need of safety in industry Potential source of harm, Personal protective equipment, Safety practices followed in the Industry	L	CO1	Understand	2
Module II					
Introduction to casting	Explain the Principle of casting Advantages and limitations	L	CO2	Understand	2
Sand casting processes	Describe the steps involved in sand casting Layout of sand mould	L	CO2	Understand	1
Pattern and pattern materials	Explain the purpose of patterns, Type of pattern, Pattern materials and allowances	L	CO2	Understand	2
Moulding Sand	Explain type of moulding sand, Composition of moulding sand, Properties of moulding sand	L	CO2	Understand	3
Mould core making and Riser Gating system	Explain the steps in mould preparation Describe Core and core materials, Purpose and types of Gating system and Riser	L	CO2	Understand	3
Melting, Pouring and Solidification	Explain the basics of furnace, pouring practice, cooling and solidification	L	CO2	Understand	2

Casting Defect	Explain the common defects its causes and remedies	L	CO2	Understand	1
Other casting and moulding process	Define Die casting, Centrifugal casting, Injection moulding, Blow moulding	L	CO2	Understand	1
Module III					
Introduction to Metal Forming	Explain the concept of hot working and cold working Advantages and application	L	CO3	Understand	1
Bulk metal forming	Describe Rolling, forging, extrusion, drawing (definition with figure only)	L	CO3	Understand	1
Introduction to machining process	Explain Fundamentals of machining Types of Machining operations like Turning, milling, drilling Cutting tools and Tool geometry	L	CO3	Understand	3
Basics of Press Work	Explain the Principle of press working Types of sheet metal operations Types of press	L	CO3	Understand	3
Press Tool operations	Explain different operations like Blanking, piercing, bending drawing	L	CO3	Understand	2
Bench working and fitting operations	Explain the definition of fitting operation, Tools used in fitting	L	CO3	Understand	2
Joining Process	Define Welding, brazing and soldering	L	CO3	Remember	1
Types of Welding	Explain the basics of Arc Welding, Gas welding, Resistance Welding, Thermit Welding, MIG and TIG welding	L	CO3	Understand	2
Module IV					
Engineering Materials	Describe the classification of Engineering materials Properties of materials relevant to Tool making	L	CO4	Understand	3
Tool Materials	Explain Tool steels, High speed steels, Carbides and Ceramics, Coated Tool Materials	L	CO4	Understand	
Heat treatment of Tool Materials	Explain Purpose of heat treatment Explain the basics of heat treatment like Annealing, normalizing, hardening, tempering	L	CO4	Understand	2
Jigs and Fixtures	Describe the introduction and functions of Jigs and Fixtures Difference between Jigs and Fixtures Its Application in Manufacturing	L	CO4	Understand	2
Measuring and Inspection Tools	Explain arious Linear Measuring Instruments like Steel rule, Vernier calliper, micrometer Importance of inspection	L	CO4	Understand	2
Surface finishing processes	Define surface finishing processes like Grinding, Polishing, Lapping and Honing	L	CO4	Understand	1
Powder Metallurgy	Define Powder Metallurgy Steps in Powder Metallurgy Its Advantages and application Comparison of PM with conventional process like Casting and machining	L	CO4	Understand	3
Basics of CAD/CAM & CNC	Explain the concepts of CAD/CAM CNC Machines and Advantages	L	CO4	Understand	1

Suggested Student Activities for Self-Learning

Week	Self-Learning description	Hours
Module I		
1	Study the evolution of manufacturing (Craft → Mass → Automation). Prepare a comparative chart showing features, advantages and limitations of each stage. Refer industrial examples from automotive and aerospace sectors.	6
2	Prepare a classification chart of manufacturing processes (Primary, Secondary, Finishing). Collect real component samples/images and identify the manufacturing process used.	6
3	Study safety practices in manufacturing and tool rooms. Prepare a safety checklist for a tool room and identify potential hazards with preventive measures.	6
4	Prepare short notes on basic manufacturing terminology and industrial applications. Visit a nearby workshop/tool room (if possible) or watch industrial videos and document observations.	6

Module II		
5	Study the sand casting process in detail. Draw and label a sand mould layout including cope, drag, core, gating and riser.	6
6	Prepare a comparison table of different pattern types and pattern materials. Solve numerical problems related to pattern allowances (conceptual understanding).	6
7	Study moulding sand composition and properties. Prepare a chart linking properties (permeability, refractoriness, strength) with casting quality.	6
8	Analyze common casting defects with causes and remedies. Prepare a defect identification chart with sketches/images. Study other casting processes (Die casting, Centrifugal casting, Injection moulding, Blow moulding) and compare with sand casting.	6
Module III		
9	Study metal forming processes (Hot vs Cold working). Prepare a comparison chart and list real industrial applications.	6
10	Study machining processes (Turning, Milling, Drilling). Draw tool geometry diagrams and identify tool angles. Watch CNC machining videos and write learning summaries.	6
11	Study press working operations (Blanking, Piercing, Bending, Drawing). Prepare neat sketches and identify applications of each operation in daily life products.	6
12	Study joining processes (Welding, Brazing, Soldering). Prepare a comparative table of different welding methods (Arc, MIG, TIG, Resistance, Gas). Identify safety precautions in welding.	6
Module IV		
13	Study classification of engineering materials and tool materials. Prepare a comparison table of Tool Steel, HSS, Carbides and Ceramics with properties and applications.	6
14	Study heat treatment processes (Annealing, Normalizing, Hardening, Tempering). Draw heat treatment cycle diagrams and explain purpose of each process.	6
15	Study modern trends: Jigs & Fixtures, Surface Finishing, Powder Metallurgy, CAD/CAM & CNC. Prepare a short seminar presentation (PPT) on any one modern manufacturing technology.	6
Total Self-Learning hours		90

Learning Resources

TEXT BOOK			
Sl. No.	Title	Author	Publication
1	Manufacturing Engineering and Technology	Serope Kalpakjian & Steven R. Schmid	Pearson Education
2	Manufacturing Technology, Vol. I	P. N. Rao	McGraw Hill Education
3	A Textbook of Production Technology	P. C. Sharma	S. Chand Publishing

REFERENCE			
Sl. No.	Title	Author	Publication
1	Manufacturing Processes for Engineering Materials	Serope Kalpakjian	Pearson Education
2	Production Technology	HMT	Tata McGraw Hill
3	Tool Design	Cyril Donaldson, George H. LeCain & V.C. Goold	McGraw Hill
4	Engineering Materials and Metallurgy	K. S. Rangwala	Charotar Publishing House
5	Elements of Workshop Technology Vol I & II	S. K. Hazra Choudhury, A. K. Hazra Choudhury & Nirjhar Roy	Media Promoters & Publishers

WEB RESOURCES		
Sl. No.	URL	Modules Covered
1	IIT Madras Manufacturing Process Lectures (YouTube/NPTEL)	Casting, Forming, Machining
2	MIT OpenCourseWare - https://ocw.mit.edu	Manufacturing & Materials
3	SME - https://www.sme.org	Tool Engineering & Modern Manufacturing
4	Autodesk Learning Resources - https://www.autodesk.com	CAD/CAM & CNC

Assessment Methodology - Theory

Mode	Attendance	CA1	CA2	CA3	CA4	CA5	CA6	ESE
		Self-learning activities (Module 1)	Self-learning activities (Module 2)	Self-learning activities (Module 3)	Self-learning activities (Module 4)	Series Exam (2 modules)	Series Exam (2 modules)	Written Exam (theory)
Duration						2 hours	2 hours	2.5 hours
Exam mark		15	15	15	15	50	50	60
Converted to						20	20	
Marks	5	15				20		60
Total	40							60
Tentative schedule	End of semester	By 4th week	By 7th week	By 11th week	By 14th week	8th week	15th week	End of semester

Series Examination Pattern- Theory

Time	Module	Part A	Marks	Part B	Marks	Part C (With choice)	Marks	Total
2 hours	Any one module	2	1	3	3	2	7	25
	Any one module	2	1	3	3	2	7	25
	Number	4		6		4		50

End Semester Examination Pattern of Question Paper - Theory

Duration	Module	TYPE OF QUESTIONS						Total Marks
		Part A (2 Questions from each module)		Part B 2 out of 3 questions from each module)		Part C (1 set questions with choice from each module)		
		No. of Questions	Marks (1 mark each)	No. of Questions	Marks (3 marks each)	No. of Questions	Marks (7 marks each)	
2.5 hours	1	2	2	3	6	1 set	7	15
	2	2	2	3	6	1 set	7	15
	3	2	2	3	6	1 set	7	15
	4	2	2	3	6	1 set	7	15
		8	8	12	24	4 sets	28	60