

UNIT I

Chapter 1 : Casting Process

1-1 to 1-87

Introduction to casting processes, Patterns : Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification, Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent (or Pressure Die) mould casting, Investment casting, Centrifugal casting, Continuous casting

1.1	Introduction to Manufacturing Process.....	1-2
1.2	Types of Manufacturing Process	1-2
1.3	Introduction to Casting Process.....	1-3
1.4	Pattern	1-4
1.4.1	Types of Pattern.....	1-4
1.4.2	Pattern Materials.....	1-9
1.4.3	Pattern Allowances.....	1-11
1.5	Moulding Materials	1-13
1.6	Moulding Sand.....	1-14
1.6.1	Types of Moulding Sand	1-14
1.6.2	Properties or Characteristics of Moulding Sand	1-16
1.6.3	Important Composition of the Moulding Sand	1-18
1.7	Moulding	1-19
1.7.1	Process or Steps for Making Mould.....	1-19
1.7.2	Different Types of Moulds	1-20
1.8	Types of Moulding Methods	1-22
1.9	Moulding Equipment's	1-26
1.10	Core	1-28
1.10.1	Properties / Characteristics of Good Quality Core.....	1-28
1.10.2	Types of Cores.....	1-29
1.10.3	Making of Cores.....	1-30
1.11	Melting Practices and Furnaces.....	1-31
1.12	Gating System	1-39
1.12.1	Elements of the Gating System.....	1-39
1.12.2	Types of Gating Systems.....	1-40

1.13 Risers in Casting	1-41
1.13.1 Types of Riser.....	1-42
1.13.2 Riser Design and Placement.....	1-43
1.14 Principles of Cooling and Solidification of Castings	1-55
1.14.1 Solidification of Pure Metals.....	1-56
1.14.2 Solidification of an Alloy.....	1-57
1.14.3 Estimation of Solidification Time (Rate)	1-57
1.15 Solidification Shrinkage	1-58
1.16 Directional and Progressive Solidification.....	1-59
1.17 Heating of Molten Metal	1-60
1.18 Pouring of Molten Metal	1-61
1.18.1 Factors Affecting Pouring of Molten Metal	1-61
1.18.2 Analysis of Pouring.....	1-61
1.19 Cleaning and Finishing, Defects and Remedies, Inspection Techniques	1-63
1.19.1 Some Common Method used for Cleaning and Finishing	1-63
1.19.2 Inspection of Casting.....	1-64
1.19.3 Casting Defects and Remedies.....	1-65
1.20 Casting Process	1-72
1.20.1 Pressure Die Casting.....	1-73
1.20.2 Centrifugal Casting.....	1-76
1.20.2.1 Types of Centrifugal Casting.....	1-77
1.20.3 Investment Casting.....	1-78
1.20.4 Continuous Casting.....	1-80
1.20.5 Special Types of Casting.....	1-81
1.21 Metals used for Casting.....	1-84
1.22 University Questions and Answers.....	1-85

UNIT II

Chapter 2 : Metal Forming Processes

2-1 to 2-61

Plastic deformation. Stress-strain diagram for different types of material, Hot and Cold working, Factors affecting plastic deformation, Yield criteria, Concept of flow stress, Forming Limit diagram

Rolling Process : Rolling terminology, Friction in rolling, Calculation of rolling load

Forging : Open and closed die forging, Forging operations

Extrusion : Types, Process parameter

Wire and Tube Drawing : Wire and tube drawing process, Die profile Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes

2.1	Introduction to Metal Forming Process.....	2-2
2.1.1	Bulk Forming Process.....	2-2
2.1.2	Sheet Metal Forming Process.....	2-3
2.2	Hot and Cold Working	2-3
2.2.1	Hot Working.....	2-3
2.2.2	Cold Working.....	2-5
2.2.3	Difference between Hot and Cold Working.....	2-6
2.2.4	Warm Working or Forming	2-6
2.3	Stress-Strain Diagram	2-7
2.3.1	Stress Strain Diagram for Brittle, Ductile and Plastic Materials.....	2-10
2.3.2	Plastic Flow of Metals	2-11
2.3.3	Factors Affecting Plastic Deformation	2-11
2.4	Yield Criteria.....	2-12
2.4.1	Tresca yield criterion	2-13
2.4.2	Von-Mises criterion or distortion energy theory	2-14
2.4.3	Comparison Between Tresca’s and Van-Mises Criteria.....	2-15
2.5	Forming Limit Diagram (FLDs).....	2-15
2.6	Rolling Process.....	2-16
2.6.1	Hot Rolling.....	2-17
2.6.2	Cold Rolling	2-17
2.6.3	Difference between Hot Rolling and Cold Rolling Process.....	2-18
2.6.4	Flat and Shape Rolling Process	2-19
2.7	Types of Rolling Mills.....	2-20
2.7.1	Two High Rolling Mills	2-20
2.7.2	Three High Rolling Mills.....	2-21
2.7.3	Four High Rolling Mills.....	2-21
2.7.4	Tandem Rolling Mills	2-22
2.7.5	Cluster Rolling Mills	2-22
2.7.6	Planetary Rolling Mills	2-22
2.7.7	Universal Rolling Mills	2-23
2.7.8	Difference between Universal Rolling Mills and Planetary Rolling Mills	2-23
2.7.9	Defects in Rolled Components.....	2-24
2.8	Rolling Process Analysis.....	2-25
2.8.1	Rolling terminology.....	2-25

2.8.2	Calculation of friction and load in rolling process.....	2-26
2.9	Forging Process.....	2-32
2.9.1	Classification of Forging.....	2-33
2.9.2	Open Die Forging.....	2-35
2.9.2.1	Operations Involved in Open-die Forging.....	2-35
2.9.2.2	Analysis of Open-die Forging.....	2-36
2.9.3	Closed or Impression Die Forging.....	2-38
2.9.4	Difference between Open Die Forging and Closed Die Forging.....	2-39
2.9.5	Roll Forging.....	2-39
2.9.6	Swaging.....	2-40
2.9.9	Defects in Forged Components.....	2-42
2.10	Extrusion Process.....	2-43
2.10.1	Types of Extrusion Operations.....	2-44
2.10.2	Difference between Direct and Indirect Extrusion.....	2-46
2.10.3	Difference between Hot and Cold Extrusion.....	2-46
2.10.4	Defects in Extruded Components.....	2-47
2.10.5	Analysis of Extrusion Process Parameters.....	2-47
2.11	Wire and Tube Drawing Process.....	2-51
2.11.1	Types of Drawing Operations.....	2-52
2.11.2	Die Profile.....	2-54
2.11.3	Defects in Wire or Tube Drawing operation.....	2-54
2.11.4	Analysis of Rod Drawing.....	2-55
2.12	Friction and Lubrication in Metal Forming.....	2-58
2.13	University Questions and Answers.....	2-59
>	Model Question Paper (In sem).....	M-1 to M-2

UNIT III

Chapter 3 : Sheet Metal Forming

3-1 to 3-66

Types of sheet metal operations, Press working equipment and terminology, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Bending dies, Methods of reducing forces, Formability and forming limit diagrams.

3.1	Sheet Metal Working Process.....	3-2
3.2	Shearing or Cutting Process.....	3-3

3.2.1	Difference between Punching, Blanking and Piercing	3-7
3.2.2	Principle of Sheet Metal Cutting or Shearing.....	3-8
3.3	Bending or Deformation Process	3-8
3.3.1	Types of bending operations.....	3-9
3.4	Deep (Cup) Drawing Process	3-13
3.5	Punch and Die.....	3-14
3.5.1	Press Working Equipment and Terminology	3-15
3.5.2	Types of Dies.....	3-16
3.5.3	Comparison of Compound Dies, Combination Dies and Progressive Dies.....	3-19
3.5.4	Types of Punches.....	3-20
3.5.5	Materials used for Dies and Punches	3-20
3.6	Press Machine or Tools	3-21
3.6.1	Types of Press Machines	3-21
3.7	Die Design for Piercing, Drawing, Bending and Blanking.....	3-25
3.7.1	Terminology used in Die Design.....	3-25
3.7.2	Die Design for Drawing Operation	3-28
3.7.3	Die Design for Bending Operation.....	3-40
3.7.4	Die Design for Blanking Operation.....	3-42
3.8	Methods of Reducing Forces	3-44
3.9	Centre of Pressure	3-50
3.10	Stripping Layout.....	3-56
3.11	Formability and Forming Limit Diagrams (FLDs).....	3-62
3.12	University Questions and Answers.....	3-63

UNIT IV

Chapter 4 : Welding Processes

4-1 to 4-62

Classification of joining processes, Welding terminology and types of joints, Arc Welding Processes : Principles and equipment's of Single carbon arc welding, FCAW, TIG, MIG, SAW Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding, Gas Welding and Cutting, Soldering, brazing and braze welding Welding Metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies

4.1	Introduction to Joining Process.....	4-2
4.2	Classification of Joining Process.....	4-2
4.3	Hybrid Joining	4-8
4.4	Welding Process	4-9

4.4.1	Welding Terminology.....	4-11
4.4.2	Types of Welding Process.....	4-11
4.4.3	Applications of Welding.....	4-12
4.4.4	Advantages of Welding.....	4-13
4.4.5	Disadvantages of Welding.....	4-13
4.5	Gas Welding.....	4-13
4.5.1	Oxygen-acetylene Gas Welding.....	4-13
4.5.2	Flames in Gas welding.....	4-14
4.5.3	Gas Welding Techniques.....	4-16
4.5.4	Equipment's used in Gas welding Technique.....	4-18
4.5.5	Applications of Gas Welding.....	4-19
4.5.6	Advantages of Gas Welding.....	4-19
4.5.7	Disadvantages of Gas Welding.....	4-19
4.5.8	Gas Cutting.....	4-20
4.6	Arc Welding Process.....	4-20
4.6.1	Arc Welding Equipment's.....	4-21
4.6.2	Significance of Polarity in Arc Welding.....	4-21
4.6.3	Applications of Arc Welding.....	4-22
4.6.4	Advantages of Arc welding.....	4-22
4.6.5	Disadvantages of Arc Welding.....	4-22
4.7	Different Types of Arc welding.....	4-23
4.7.1	Carbon Arc Welding.....	4-23
4.7.2	Shielded Metal Arc Welding (SMAW).....	4-24
4.7.3	Gas Tungsten Arc Welding (GTAW or TIG).....	4-25
4.7.4	Metal Inert Gas Arc Welding (MIG).....	4-26
4.7.5	Differences between MIG and TIG welding.....	4-27
4.7.6	Flux Cored Arc Welding (FCAW).....	4-28
4.7.7	Submerged Arc Welding (SAW).....	4-29
4.7.8	Plasma Arc Welding.....	4-30
4.7.9	Stud Welding.....	4-31
4.8	Resistance Welding.....	4-33
4.9	Types of Resistance Welding.....	4-34
4.9.1	Spot Welding.....	4-34
4.9.2	Seam Welding.....	4-36

4.9.3	Projection Welding.....	4-37
4.9.4	Heat Balance in Resistance welding.....	4-38
4.9.5	Difference Between Arc Welding, Gas welding and Resistance welding.....	4-39
4.10	Solid State Welding Processes.....	4-39
4.10.1	Friction Welding.....	4-39
4.10.2	Explosive Welding.....	4-41
4.11	Thermit Welding or Thermo Chemical Welding.....	4-43
4.12	Radiant Energy Welding Processes.....	4-44
4.12.1	Electron Beam Welding.....	4-44
4.12.2	Laser Beam Welding.....	4-46
4.13	Soldering Process.....	4-47
4.14	Brazing Process.....	4-49
4.15	Braze Welding.....	4-50
4.16	Difference between Welding, Soldering and Brazing Process.....	4-51
4.17	Types of Welded Joints.....	4-52
4.18	Welding Positions.....	4-54
4.19	Welding Metallurgy and Heat Affected Zone.....	4-55
4.20	Weld Inspection.....	4-57
4.21	Welding Defects.....	4-58
4.22	University Questions and Answers.....	4-60

UNIT V

Chapter 5 : Processing of Polymers

5-1 to 5-28

Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion

Moulding : Compression moulding, Transfer moulding, Blow moulding, Rotation moulding, Injection moulding - Process and equipment **Extrusion of Plastic** : Type of extruder, extrusion of film, pipe, Cable and Sheet - Principle Pressure forming and Vacuum forming

5.1	Introduction to Polymer.....	5-2
5.1.1	Advantages of Polymers.....	5-2
5.1.2	Disadvantages of Polymers.....	5-3
5.1.3	Applications of Polymers.....	5-3
5.2	Classification of Polymers.....	5-3
5.3	Types of Polymers based on Molecular Forces.....	5-6
5.3.1	Thermoplastics.....	5-6

5.3.2	Thermosetting Plastic	5-7
5.3.3	Difference between Thermoplastic and Thermosetting Plastic	5-8
5.4	Processing of Plastics	5-8
5.5	Compression Moulding	5-9
5.6	Transfer Moulding	5-10
5.6.1	Difference between Transfer moulding and Compression moulding	5-11
5.7	Injection Moulding	5-12
5.7.1	Types of Injection Moulding.....	5-13
5.7.2	Working of Injection Moulding	5-14
5.8	Blow Moulding	5-15
5.9	Thermoforming	5-16
5.9.1	Vacuum Thermoforming.....	5-17
5.9.2	Pressure Thermoforming.....	5-17
5.9.3	Mechanical Thermoforming.....	5-18
5.10	Rotation Moulding	5-19
5.11	Extrusion Process	5-21
5.11.1	Type of extruder:.....	5-22
5.11.2	Methods of Extrusion	5-23
5.12	Reaction Injection Moulding.....	5-26
5.13	University Questions and Answers.....	5-27

UNIT VI

Chapter 6 : Manufacturing of Composites

6-1 to 6-39

Introduction to composites, Composite properties, Matrices, Fiber reinforcement Composite Manufacturing Processes: Hand lay-up Process, Spray lay-up, Filament winding process, Resin transfer moulding, Pultrusion, and Compression moulding process, Vacuum impregnation process, Processing of metal matrix composites, Fabrication of ceramic matrix composites, Carbon-carbon composites, Polymer matrix and nano-composites

6.1	Introduction to Composites	6-2
6.1.1	Properties of Composite Material.....	6-3
6.1.2	Advantages over Metallic Materials.....	6-4
6.1.3	Disadvantages over Metallic Materials.....	6-4
6.2	Applications of Composites.....	6-4
6.3	Classification of Composites	6-8
6.3.1	Classification Based on the Reinforcement.....	6-8

6.3.2	Classification Based on the Matrices	6-10
6.4	Processing of Polymer Matrix Composites	6-10
6.4.1	Open Molding	6-11
6.4.2	Closed Molding	6-13
6.5	Processing of Metal Matrix Composites.....	6-17
6.5.1	Solid State Processing	6-18
6.5.2	Liquid State Processing	6-18
6.5.3	In-Situ Processing	6-19
6.6	Fabrication of Ceramic Matrix Composites	6-19
6.6.1	Chemical Vapor Infiltration(CVI)	6-19
6.6.2	Liquid Phase Infiltration	6-20
6.6.3	Polymer Infiltration and Pyrolysis (PIP)	6-21
6.6.4	Sol-gel Infiltration	6-22
6.7	Comparison Between Polymer Matrix , Metal Matrix and Ceramic Matrix Composites	6-23
6.8	Fabrication of Carbon-Carbon Composites	6-24
6.9	Introduction to Nanomaterials	6-26
6.10	Classification of Nanomaterials	6-27
6.11	Processing or Synthesis of Nanomaterials.....	6-28
6.11.1	Mechanical Milling or Grinding.....	6-28
6.11.2	Sol-gel Process	6-29
6.11.3	Chemical Vapour Deposition (CVD)	6-30
6.11.4	Physical Vapour Deposition (PVD).....	6-31
6.12	Applications of Nanomaterials.....	6-32
6.13	Nanocomposites	6-34
6.14	Classification of Nanocomposites:	6-34
6.15	Applications of Nanocomposites	6-35
6.16	Introduction to Smart Materials.....	6-36
6.17	Classification of Smart Materials.....	6-36
>	Model Question Paper (End sem).....	M-1 to M-3