

CHAPTERS	CONTENTS	PAGE NO
1	INTRODUCTION TO MANUFACTURING	01
	1.0. Introduction	01
	1.1. Concept of Manufacturing	02
	1.2. Classification of Manufacturing Processes	05
	1.2.1. Primary Manufacturing or Shaping Process	06
	1.2.2. Secondary Manufacturing Processes	06
	1.2.3. Forming Processes	06
	1.2.4. Advanced Manufacturing Processes	07
	1.2.5. Machining Process	07
	1.2.6. Joining Process	09
	1.2.7. Forming	10
	1.2.8. Casting Process	11
	1.2.9. Definition of Some Other Supplementary Operation Associated to Primary & Secondary Manufacturing	13
	1.3. Deformation Process	15
	1.3.1. Rolling	16
	1.3.2. Extrusion Process	17
	1.3.3. Hot Working Process	17
	1.3.4. Cold Working	18
	1.4. Coating and Deposition	21
	1.4.1. Chemical Deposition	21
	1.4.2. Physical Deposition	21
	1.5. Cleaning and Surface Cleaning of Manufactured Articles	22
	1.6. Adhesive Bonding	23
	1.6.1. Type of Joint for Adhesive Bonding	24
	1.7. Fastening	26
	1.7.1. Permanents Fastening	26
	1.7.2. Temporary Fastening	26

2	METAL CUTTING AND MACHINING	28
	2.0. Metal Machining	28
	2.1. Purpose of Machining	28
	2.2. Principle of Metal Machining	29
	2.3. Metal Chips	30
	2.3.1. Continuous Chips	31
	2.3.2. Discontinuous Chips	32
	2.3.3. Continuous Chips with Built-up Edge (BUE)	33
	2.3.4. Serrated Chip	34
	2.4. Type of Metal Machining	34
	2.4.1. Orthogonal Cutting Method	35
	2.4.2. Oblique Cutting Method	35
	2.4.3. Pure Orthogonal Cutting	36
	2.5. Cutting Tool for Machining Process	36
	2.5.1. Single Point Cutting Tools	36
	2.5.2. Right Hand and Left Hand Cutting Tool	38
	2.5.3. Nomenclature of Single-Point Tools	39
	2.5.4. Demonstration of Angles	40
	2.5.5. Impact of Cutting Tool Angles	42
	2.6. Important Element of Metal Machining	44
	2.6.1. Cutting Speed	44
	2.6.2. Feed Rate	45
	2.6.3. Depth of Cut	45
	2.6.4. Metal Removal Rate	45
	2.6.5. Specific Metal Removal Rate	46
	2.6.6. Roughing Cut	46
	2.6.7. Finishing Cut	46
	2.7. Calculation of Shear Angle	46
	2.7.1. Shear Angle	46
	2.7.2. Shear Plane	46

	2.7.3. Relationship between Cutting Velocity	50
	2.8. Metal Cutting Force Analyses	51
	2.8.1. Lee & Shaffer Theory for Orthogonal Cutting	55
	2.8.2. Power & Specific Energy Calculation During Machining Operation	56
	2.9. Tool – Life	57
	2.9.1. Tool Life Equations	58
	2.9.2. Tool Wear	60
	2.10. Wear Mechanisms	61
	2.10.1. Flank Wear	62
	2.10.2. Nose Wear	63
	2.10.3. Crater Wear	63
	2.10.4. Tool Wear Due to Plastic Deformation	63
	2.10.5. Notch Wear	64
	2.10.6. Ultimate Wear	64
	2.10.7. Abrasive Wear	64
	2.10.8. Adhesive Wear Mechanism	64
	2.10.9. Diffusion Wear	64
	2.10.10. Chemical Wear	65
	2.11. Thermal Cracking	65
	2.12. Machinability	66
	2.13. Machinability Improvement of Work Materials	68
	2.14. Cutting Tool Material	69
	2.15. Coated Carbides	71
	2.15.1. Classification of Carbide Tools	71
	2.15.2. Advantage of Carbides Cutting Tools	71
	2.16. Cermet's	72
	2.17. Cast Alloys	72
	2.18. Diamond Tools	72
	2.19. Cubic Boron Nitride (cBN)	73

	2.20. Advantage of Alloying Elements	74
	2.21. Cutting Fluids	74
	2.21.1. Emulsion	74
	2.21.2. Cutting Oil	75
	2.21.3. Lard Oil	75
	2.21.4. Mineral Oil	75
	2.21.5. Mineral-Lard Cutting Oil Mixture	76
	2.21.6. Sulfurized Fatty-Mineral Oil	76
	2.21.7. Soluble Cutting Oils	76
	2.21.8. Soda-Water Mixtures	76
	2.21.9. White Lead and Lard Oil Mixture	76
	2.21.10. Chemical Cutting Fluid	76
	2.21.11. Gaseous Cutting Fluids	77
	2.22. Methods of Application	77
	2.23. Selection of Cutting Fluid	78
	2.24. Surface Roughness	78
	2.25. Measurement of Surface Texture	80
	2.25.1. Surface Roughness Evaluation	80
	2.26. Economics of Metal Cutting	81
	2.27. Model Preparation for Optimization	85
	2.28. Introduction to Lathe Machine Tool	88
	2.28.1. Classification of Lathe Machine	89
	2.29. Speed Lathe	90
	2.30. Centre Lathe or Engine Lathe	90
	2.31. Bench Lathe	91
	2.32. Tool Room Lathe	91
	2.33. Turret Lathes	93
	2.34. Capstan Lathe	95
	2.35. Automatic Lathes	96
	2.36. Extension-Type Lathes	97

	2.37. Special Purpose Lathes	97
	2.38. CNC Lathe Machine	98
	2.39. Constructional Features of Lathe Machine	98
	2.40. Thread Cutting Mechanism	106
	2.41. Accessories of Lathe Machine	107
	2.42. Face Plates	115
	2.42.1. Drive Plates	116
	2.43. Mandrels	116
	2.44. Angle Plates	117
	2.45. Rests	118
	2.46. Lathe Operations	119
	2.47. Specification of Lathe Machine	131
	2.48. Calculation of Taper Turning Angle	133
	2.49. Taper Turning Method	134
	2.49.1. Taper Turning Manufacturing by Swiveling the Compound Rest	134
	2.49.2. Taper Turning Manufacturing with Tailstock Set Over Method	135
	2.49.3. Taper Turning Manufacturing by Broad Nose Form	136
	2.49.4. Taper Turning Manufacturing by Taper Turning Attachment	136
	2.50. Thread Cutting on Lathe Machine	137
	2.51. Screw Thread Cutting	139
	2.52. Thread Designations	140
	2.53. Introduction to Drilling Machine	141
	2.54. Constructional Features of Drilling Machine	141
	2.55. Classification of Drilling Machine	143
	2.56. Types of Drilling Tools	154
	2.57. Selection of Twist Drill	157

	2.58. Drilling Tool Nomenclature	158
	2.59. Drilling Machine Operations	160
	2.60. Size and Specification of Drilling Machine	165
	2.61. Cutting Speed	166
	2.62. Feed	166
	2.63. Torque & Thrust in Drilling Operation	167
	2.64. Drill Holding Devices	168
	2.65. Work-piece Holding Devices	171
	2.66. Cutting Fluids for Drilling Operations	175
	2.67. Drill Material	175
	2.68. Application of Drilling Machines	176
	2.69. Introduction to Grinding Wheel Operation	178
	2.70. Grinding Wheel	178
	2.71. Structure of a Grinding Wheel	179
	2.72. Coding of a Grinding Wheel	180
	2.73. Metal Cutting Operation	180
	2.74. Composition of a Grinding Wheel	181
	2.75. Grit Size or Grain Size	184
	2.76. Grade	186
	2.77. Bond & Bonding Process	188
	2.78. Pore	190
	2.79. Grinding Wheel Standard	191
	2.80. Grinding Wheel Marking	191
	2.81. Type of Grinding Machines	194
	2.82. Utility Grinding Machines	195
	2.83. Floor Stand Grinder Machine	195
	2.84. Bench Type Grinding Machine	196
	2.85. Portable Grinder Machine	197
	2.86. Abrasive Belt Grinding Machine	198
	2.87. Form Grinding Machine	198

	2.88. Cylindrical Grinding Machine	199
	2.89. Type of Feed Application	200
	2.90. Universal Centre Type Grinder	202
	2.91. Internal Grinding Method	202
	2.92. Surface Grinding Machine	205
	2.93. Tool and Cutter Grinder Machine	208
	2.94. Shapes and Size of a Grinding Wheel	210
	2.95. Selection of Grinding Wheel	213
	2.96. Basic Parameter of Grinding Operation	215
	2.96.1. Cutting Speed (vc)	216
	2.96.2. Wheel Speeds	216
	2.96.3. Work-Speed (WS)	217
	2.96.4. Work-Piece Speed	217
	2.96.5. Depth of Cut	218
	2.96.6. Cross-Feed	218
	2.96.7. Infeed	218
	2.97. Machining Time	219
	2.98. Grinding Allowances	219
	2.99. Glazing and Loading	220
	2.100. Grinding Wheel Dressing	220
	2.101. Abrasive Wheel Dresser	222
	2.102. Reactive Dressing	223
	2.103. Truing	224
	2.103.1. Diamond Truing Tool	224
	2.103.2. Single Point Diamond Truing Tools	224
	2.103.3. Multi-point Diamond Truing Tool	225
	2.103.4. Single Point Diamond Truing Tools	226
	2.104. Balancing of Grinding Wheel	227
	2.105. Special Grinding Operations	227
	2.105.1. Cleaning Operation	227

	2.105.2. Polishing	227
	2.105.3. Buffing	228
	2.105.4. Lapping	228
	2.105.5. Honing & Super-Finishing	229
	2.106. Grinding Fluids	229
	2.107. Introduction to Shaper Machine	229
	2.108. Construction & Working of Shaper Machine	230
	2.109. Working of Shaper Machine	230
	2.110. Types of Shapers Machine	234
	2.111. Specification of Shaper	238
	2.112. Shaper Mechanism	238
	2.113. Hydraulic Shaper Mechanism	243
	2.114. Automatic Table Feeding Mechanism of Shaper	244
	2.115. Shaper Operation	245
	2.116. Shaper Cutting Tools	253
	2.117. Shaper Speeds, Feeds and Depth of Cut	253
	2.118. Introduction to Planer Machine	254
	2.119. Types of Planer Machine	255
	2.120. Standard Housing Planer	255
	2.121. Open Side Planer	256
	2.122. Pit Planer	257
	2.122.1. Edge Type or Plate Type Planer	258
	2.122.2. Divided Table Planer	258
	2.123. Planer Machine Construction	259
	2.124. Working Principle of Planer	261
	2.125. Specification of Planner Machine	262
	2.126. Cutting Speed, Feed, Depth of Cut and Machining Time	262
	2.127. Planner Mechanism	263
	2.128. Feeding Mechanism	266
	2.129. Feed Mechanism by Electrical Drive	267

	2.130. Automatic Feed Mechanism	267
	2.131. Planer Tools	268
	2.132. Planer Operation	269
	2.133. Difference between Shaper and Planer	270
	2.134. Introduction to Slotter Machine	270
	2.135. Construction of Slotter Machine	270
	2.136. Type of Slotter Machine	272
	2.137. Feed	272
	2.138. Introduction to Milling Machine	273
	2.139. Construction of Milling Machine	273
	2.140. Classification of Milling Machine	276
	2.141. Vertical Milling Machine	279
	2.142. Horizontal Milling Machine	280
	2.143. Planer Type Milling Machine	282
	2.144. Special Milling Machines	283
	2.145. CNC Milling Machine	284
	2.146. Milling Machine Specifications	285
	2.147. Types of Milling Operations	285
	2.148. Milling Parameter	294
	2.149. Direction of Cutter Rotation	295
	2.150. Milling Cutter Material	297
	2.151. Milling Cutter Nomenclature	298
	2.152. Types of Teeth	299
	2.153. Selection of Milling Cutters	300
	2.154. Classification of Milling Cutters	300
	2.155. Plain Milling Cutters	303
	2.156. Side Milling Cutters	304
	2.157. Angle Milling Cutters	306
	2.158. End Milling Cutters	307
	2.159. Function of Flutes	309

	2.160. Woodruff Key Slot Milling Cutters	310
	2.161. Fly Cutter Milling	310
	2.162. Formed Cutters	311
	2.163. Convex Milling Cutters	312
	2.164. Concave Milling Cutters	312
	2.165. Corner Rounding Milling Cutter	312
	2.166. Gear Milling form Cutters	313
	2.167. Hobbing form Milling Cutter	315
	2.168. Thread Milling Cutter	315
	2.169. Special Shaped-Formed Milling Cutter	316
	2.170. Milling Machine Attachments and Accessories	316
	2.171. Universal Milling Attachment	317
	2.172. Milling Accessories	318
	2.173. Indexing	320
	2.174. Plain Indexing	320
	2.175. Indexing Plate	321
	2.176. Universal Dividing Head	322
	2.177. Optical Dividing Head	323
	2.178. Direct Indexing	323
	2.179. Simple Indexing Method	324
	2.180. Compound Indexing	325
	2.181. Differential Indexing Method	325
	2.182. Milling Work-holding Devices	327
3	METAL CASTING PROCESS	353
	3.0. Introduction	353
	3.1. Casting Process Diagram	354
	3.2. Classification of Casting Process	355
	3.2.1. Expendable Mould Casting	355
	3.2.2. Sand Mould Casting	356
	3.2.3. Green Sand Mould	359

	3.2.4. Dry Sand Moulding	360
	3.2.5. Skin - dried Moulding	362
	3.3. Shell Mould Casting	362
	3.4. Expanded Polystyrene Mould Casting	365
	3.5. Investment Casting	366
	3.6. Vacuum Casting	369
	3.7. Plaster Mould Casting	370
	3.8. Ceramic Mould Casting	371
	3.9. Permanent Mould Casting Process	372
	3.10. Pressure Die Casting	374
	3.11. Low Pressure Die-Casting	378
	3.12. High Pressure Die Casting	379
	3.13. Slush Casting	379
	3.14. Dies or Metal Mould Material	379
	3.15. Squeeze Casting	380
	3.16. Centrifugal Casting	381
	3.17. True Centrifugal Casting	383
	3.17.1. Semi-Centrifugal Casting	383
	3.18. Continuous Casting	384
	3.19. Flux	387
	3.20. Furnaces for Casting Process	387
	3.21. Importance of Fluidity	393
	3.22. Solidification of Metals in Moulds	394
	3.23. Solidification of Alloys	396
	3.24. Eutectic Alloys	397
	3.25. Rate of Solidification	397
	3.26. Cores	399
	3.27. The Following Types of Cores are Very Practical in Use	399
	3.28. Core Box	404
	3.29. Core Print	406

	3.30. Chaplet	407
	3.31. Core Paste and Filler	408
	3.32. Core Sand	409
	3.33. Binders	409
	3.34. Types of Core Sands	410
	3.35. Mixing of Core Sands	411
	3.36. Core Making	411
	3.37. Core Box Allowances	413
	3.38. Colour Codification for Patterns and Core Boxes	413
	3.39. Classification of Moulding Sand	413
	3.40. Components of Moulding Sand	416
	3.41. Binder	418
	3.42. Moisture	418
	3.43. Miscellaneous Ingredient	418
	3.44. Properties of Moulding Sand	420
	3.45. Preparation of Sand	422
	3.46. Sand Conditioning	422
	3.47. Tempering of Sand	422
	3.48. Mixing of the Sands	422
	3.49. Preparation of Sand Mould	423
	3.50. Vents	425
	3.51. Gating System in Mold	425
	3.52. Gating System Design	426
	3.53. Casting Defects & Possible Corrective Action	426
	3.54. Finishing of Metal Casting	433
	3.55. Recommendation for Casting Design	434
	3.56. Inspection of Castings	435
	3.56.1. Dimensional Inspection	435
	3.56.2. Visual Inspection	436
	3.56.3. Pressure Testing	436

	3.56.4. Magnetic Testing	436
	3.56.5. Magnetic Particle Inspection	436
	3.56.6. X-Ray Radiography	436
	3.56.7. Liquid-Penetration Inspection	437
	3.56.8. Ultrasonic Testing	437
4	PATTERN MAKING	446
	4.0. Pattern	446
	4.1. Pattern Making	446
	4.2. Pattern Materials	447
	4.3. Metal Pattern	449
	4.4. Plastic Pattern	449
	4.5. Plaster Pattern	450
	4.6. Wax Pattern	450
	4.7. Types of Pattern	451
	4.7.1. Single-piece or Solid Pattern	451
	4.7.2. Two-piece or Split Pattern	452
	4.7.3. Cope and Drag Pattern	453
	4.7.4. Loose Piece Pattern	453
	4.7.5. Match Plate Pattern	454
	4.7.6. Gated Pattern	454
	4.7.7. Sweep Pattern	455
	4.7.8. Follow Board Pattern	456
	4.7.9. Skeleton Pattern	456
	4.8. Segmental Pattern	457
	4.8.1. Lagged-up Pattern	457
	4.8.2. Multipiece Pattern	458
	4.8.3. Master Pattern	458
	4.9. Pattern Allowances	458
	4.9.1. Shrinkage Allowance	459
	4.9.2. Machining Allowance	460

	4.9.3. Draft Allowance	460
	4.9.4. Distortion Allowance	461
	4.9.5. Rapping or Shake Allowance	461
	4.10. Colour Coding for Patterns	462
	4.11. Pattern Design Considerations	462
	4.12. Introduction to Forging Process	463
	4.13. Classification of Forging Processes	464
	4.14. Mechanical Press Forging	469
	4.14.1. Hydraulic Forging Press	469
	4.14.2. Drop Forging Process	470
	4.14.3. Drop Forging on Hydraulic Presses	471
	4.14.4. Drop Forging by Crank Presses	471
	4.14.5. Drop Forging on Horizontal Forging Machines	471
	4.15. Power Forging	474
	4.16. Machine Forging	474
	4.17. Seamless Rolled Ring Forging	475
	4.18. Precision Die Forging	476
	4.19. Forging Equipment's	477
	4.20. Forging Operations	487
	4.21. Forging Heating & Cooling	492
	4.22. Forging Furnaces	492
	4.23. Forging Defects	495
	4.24. Forgeability	496
	4.25. Advantages, Disadvantage & Application of Forging Method	497
	4.26. Applications of Forging	498
5	PRESS WORKING & ROLLING PROCESS	502
	5.0. Introduction to Press Working	502
	5.1. Press Working Terminology	502
	5.2. Press Tool Components	505
	5.3. Classification of Press	505

	5.4. According to the Method of Actuation	506
	5.4.1. Fly Press	506
	5.4.2. Power Press	506
	5.4.3. In Hydraulic Press	507
	5.4.4. Crank & Connecting Rod Mechanism for Power Press	508
	5.4.5. Eccentric Drive	508
	5.4.6. Knuckle Press	509
	5.4.7. Toggle Press	509
	5.4.8. Cam Drive	510
	5.4.9. Screw Press Drive	510
	5.4.10. Rack and Pinion Press	511
	5.5. Press Working by Means of Gap Frame	511
	5.5.1. Straight Side Frame	511
	5.5.2. Incline Frame Press	512
	5.5.3. Gap Frame Press	512
	5.5.4. Open End Press	513
	5.5.5. Adjustable Bed Type Press	513
	5.5.6. Horn Press	513
	5.6. Transmission of Power from Motor to Crankshaft	514
	5.6.1. Direct Drive Press	514
	5.6.2. Flywheel Driven Presses	514
	5.6.3. Single Geared Drive Presses	514
	5.6.4. Double Geared Drive Presses	514
	5.7. According to the Purpose of Use	514
	5.8. Size & Specifications of a Press Tool	514
	5.9. Punch & Dies for Press Working Operation	515
	5.10. Classification of Dies	517
	5.11. According to Method of Operation	517
	5.11.1. Simple Die	517
	5.11.2. Compound Die	518

	5.11.3. Combination Die	519
	5.11.4. Progressive Die	520
	5.11.5. Transfer Die	521
	5.11.6. Shuttle Die	521
	5.12. Working of Cutting Die and Metal Cutting Operation	522
	5.13. Stock Feeding Mechanism	523
	5.14. Safety Devices of Press Machine	524
	5.15. Cutting Force	526
	5.16. Energy Required for Press Working Operation	526
	5.17. Work Done in Shearing Operation	527
	5.18. Maximum Length of Punch	527
	5.19. Drawing Pressure	527
	5.20. Blank Holding Force	527
	5.21. Bending Pressure	527
	5.22. Power Consumption in Press Machine	528
	5.23. Punch – Dies Material Properties	528
	5.24. Press Working Metal or Material	529
	5.25. Press Tool Operations	530
	5.26. Introduction to Rolling Operations	538
	5.27. Metal Recrystallisation & Metal Working Status	539
	5.28. Hot Rolling Process	539
	5.29. Cold Rolling	542
	5.30. Rolling Mills	543
	5.30.1. Two High Rolling Mills	543
	5.30.2. Three High Rolling Mills	544
	5.30.3. Four - High Rolling Mill	544
	5.30.4. Cluster Mill	545
	5.30.5. Tandem Rolling Mill	546
	5.30.6. Continuous Rolling Mill	546
	5.31. Roll Material & Thickness Reduction	547

	5.32.Special Rolling Operation or Processes	547
	5.32.1. Shape Rolling	547
	5.32.2. Ring Rolling	548
	5.32.3. Thread Rolling	548
	5.32.4. Skew Rolling	549
	5.32.5. Transverse Rolling	550
	5.32.6. Roll Piercing or Seam Less Tubing	550
	5.32.7. Planetary Mill	551
	5.33.Cold –Rolling	551
	5.34.Difference between Hot Rolling & Cold Rolling Process	553
	5.35.Hot Spinning	554
	5.36.Cold Spinning	554
	5.37.Application of Cold Spinning & Hot Spinning Process	554
6	WELDING PROCESS	565
	6.0. Introduction Welding Process	565
	6.1. What will be Going on During the Welding Process	566
	6.2. Classification of Welding Process	566
	6.2.1. Plastic Welding	566
	6.2.2. Fusion Welding Process	567
	6.2.3. Cold Welding	567
	6.3. ARC Welding Process Equipments	571
	6.4. Principle of ARC Welding	573
	6.5. ARC Welding Current & Voltage	575
	6.6. Polarity	576
	6.7. Straight Polarity & Reversed Polarity	577
	6.8. Manual Metal ARC Welding (MMA)	577
	6.9. Carbon ARC Welding	579
	6.10.Inert Gas ARC Welding Process	580
	6.11.Tungsten Inert Gas Welding (TIG)	580
	6.12.TIG Welding Torches	581

	6.13.Process Parameters of TIG Welding	584
	6.14.Advantages of TIG Welding	585
	6.15.Applications of TIG Welding	586
	6.16.Gas Metal ARC Welding (GMAW)	586
	6.17.Submerged ARC Welding (SAW)	588
	6.18.Plasma ARC Welding	590
	6.19.Type of Plasma ARC Welding Process	592
	6.19.1. Non-transferred Plasma ARC Welding	592
	6.19.2. Transferred Plasma ARC Welding	593
	6.19.3. Advantages & Disadvantage	593
	6.20.Electro-slag Welding	594
	6.21.Atomic Hydrogen Welding	595
	6.22.Thermit Welding	596
	6.23.Resistance Welding	598
	6.24.Spot Welding	598
	6.25.Seam Welding	599
	6.26.Resistance Projection Welding	600
	6.27.Butt Welding	600
	6.28.Percussion Welding	602
	6.29.Gas Welding	602
	6.29.1. Oxy-acetylene Gas Welding	603
	6.29.2. Process	605
	6.30.Gas Flame	606
	6.30.1. Neutral Flame	606
	6.30.2. Reducing or Carburizing Flame	606
	6.30.3. Oxidizing Flame	607
	6.31.Radiant Energy Welding	607
	6.31.1. Electron Beam Welding (EBW)	607
	6.31.2. Laser Beam Welding (LBW)	609
	6.32.Ultrasonic Welding Process	610

	6.33. Friction Welding Process	611
	6.34. Stud Welding Process	611
	6.35. Flux - Cored ARC Welding (FCAW)	613
	6.36. Welding Defects	613
	6.37. Filler Materials or Electrodes	616
	6.38. Flux Coating Material	617
	6.39. Electrode Sizes	618
	6.40. Merits of Flux Coating Electrodes	618
	6.41. Important Points	618
	6.42. Fluxes	619
	6.43. Composition of Fluxes	620
	6.44. Flux may be Selected on the Following Basis	620
	6.45. Safety & Precaution in Welding Process	621
	6.46. Gas Cutting	622
	6.47. Oxy - Fuel Cutting Method	623
	6.48. Cutting Operation Procedure	624
	6.49. ARC Cutting Method	625
	6.50. Explain the Metal Cutting Operation by Using Gas Cutting Method	626
	6.51. Safety & Precautions in Cutting Operations	628
	6.52. Brazing	630
	6.52.1. Brazing Equipment's & Procedure	631
	6.52.2. Brazing Flux	631
	6.53. Soldering	632
	6.53.1. Soldering Procedure	632
	6.53.2. Soldering Iron	632
	6.54. Some Specific Point Regarding to Welding Operation	633