## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3.1</td>
<td>Specifications of CNC milling machine</td>
<td>43</td>
</tr>
<tr>
<td>Table 3.2</td>
<td>Specifications of surface roughness tester</td>
<td>44</td>
</tr>
<tr>
<td>Table 3.3</td>
<td>Feasible ranges of milling parameters for the proposed work materials...</td>
<td>45</td>
</tr>
<tr>
<td>Table 3.4</td>
<td>Specifications of the milling tool</td>
<td>45</td>
</tr>
<tr>
<td>Table 3.5</td>
<td>Machining time and surface roughness for the given milling parameters in Brass</td>
<td>46</td>
</tr>
<tr>
<td>Table 3.6</td>
<td>Machining time and surface roughness for the given milling parameters in Aluminium</td>
<td>47</td>
</tr>
<tr>
<td>Table 3.7</td>
<td>Machining time and surface roughness for the given milling parameters in Copper</td>
<td>48</td>
</tr>
<tr>
<td>Table 3.8</td>
<td>Machining time and surface roughness for the given milling parameters in Mild Steel</td>
<td>50</td>
</tr>
<tr>
<td>Table 3.9</td>
<td>Specifications of CNC lathe</td>
<td>52</td>
</tr>
<tr>
<td>Table 3.10</td>
<td>Feasible ranges of turning parameters for the proposed work materials...</td>
<td>53</td>
</tr>
<tr>
<td>Table 3.11</td>
<td>Specifications of the turning tool</td>
<td>53</td>
</tr>
<tr>
<td>Table 3.12</td>
<td>Machining time and surface roughness for the given turning parameters in Brass</td>
<td>54</td>
</tr>
<tr>
<td>Table 3.13</td>
<td>Machining time and surface roughness for the given turning parameters in Aluminium</td>
<td>55</td>
</tr>
<tr>
<td>Table 3.14</td>
<td>Machining time and surface roughness for the given turning parameters in Copper</td>
<td>56</td>
</tr>
<tr>
<td>Table 3.15</td>
<td>Machining time and surface roughness for the given turning parameters in Mild Steel</td>
<td>58</td>
</tr>
<tr>
<td>Table 3.16</td>
<td>Minimum and maximum surface roughness values observed</td>
<td>59</td>
</tr>
</tbody>
</table>
Table 5.1 Values of cutting parameters for single pass turning operation...........76
Table 5.2 Optimal result of SA.................................................................82
Table 5.3 Optimal result of GA...............................................................84
Table 5.4 Optimal result of PSO.............................................................85
Table 5.5 Optimal result of MA.............................................................87
Table 5.6 Optimal result of HA.............................................................88
Table 5.7 Results of various optimization technique..............................89
Table 5.8 Values of cutting parameters for multi-pass turning operation........91
Table 5.9 Production cost for various depth of cut using SA....................96
Table 5.10 Production cost for various depth of cut using GA.................97
Table 5.11 Production cost for various depth of cut using PSO..............98
Table 5.12 Values of cutting parameters for surface grinding operation.....98
Table 5.13 Results of SA at various R_a value and 2% surface damage value...102
Table 5.14 Results of SA at various surface damage value and R_a=0.25μm...102
Table 5.15 Results of GA at various R_a value and 2% surface damage value...104
Table 5.16 Results of GA at various surface damage value and R_a=0.25μm...104
Table 5.17 Results of PSO at various R_a value and 2% surface damage value...106
Table 5.18 Results of PSO at various surface damage value and R_a=0.25μm...106
Table 5.19 Computational time...............................................................106
Table 5.20 Results of various technique in single pass turning operation.....107
Table 5.21 Results of various technique in multi-pass turning operation.....108
Table 5.22 Results of various technique in surface grinding operation.....109
Table 6.1 Optimized milling parameters and minimized machining time for the desired surface roughness value in Brass.................................115
Table 6.2 Optimized milling parameters and minimized machining time for the desired surface roughness value in Aluminium

Table 6.3 Optimized milling parameters and minimized machining time for the desired surface roughness value in Copper

Table 6.4 Optimized milling parameters and minimized machining time for the desired surface roughness value in Mild Steel

Table 6.5 Optimized turning parameters and minimized machining time for the desired surface roughness value in Brass

Table 6.6 Optimized turning parameters and minimized machining time for the desired surface roughness value in Aluminium

Table 6.7 Optimized turning parameters and minimized machining time for the desired surface roughness value in Copper

Table 6.8 Optimized turning parameters and minimized machining time for the desired surface roughness value in Mild Steel

Table 7.1 Validated experimental results of machining time and surface roughness for the given PSO based optimized milling parameters in Brass

Table 7.2 Validated experimental results of machining time and surface roughness for the given PSO based optimized milling parameters in Aluminium

Table 7.3 Validated experimental results of machining time and surface roughness for the given PSO based optimized milling parameters in Copper

Table 7.4 Validated experimental results of machining time and surface roughness for the given PSO based optimized milling parameters in Mild Steel

Table 7.5 Validated experimental results of machining time and surface roughness for the given PSO based optimized turning parameters in Brass

Table 7.6 Validated experimental results of machining time and surface roughness for the given PSO based optimized turning parameters in Aluminium

Table 7.7 Validated experimental results of machining time and surface roughness for the given PSO based optimized turning parameters in Copper

Table 7.8 Validated experimental results of machining time and surface roughness for the given PSO based optimized turning parameters in Mild Steel
List of Figures

Figure 1.1 Research Scheme……………………………………………………………………7
Figure 3.1 MCV-400 CNC milling machine………………………………………………………43
Figure 3.2 Surface roughness tester………………………………………………………………44
Figure 3.3 LT-20 CNC lathe……………………………………………………………………52
Figure 5.1 Number of iterations Vs production time using SA……………………………81
Figure 5.2 Number of iterations Vs production cost using SA……………………………82
Figure 5.3 Number of iterations Vs COF using SA…………………………………………82
Figure 5.4 Number of iterations Vs production time using GA……………………………83
Figure 5.5 Number of iterations Vs production cost using GA……………………………83
Figure 5.6 Number of iterations Vs COF using GA…………………………………………83
Figure 5.7 Number of iterations Vs production time using PSO…………………………84
Figure 5.8 Number of iterations Vs production cost using PSO…………………………85
Figure 5.9 Number of iterations Vs COF using PSO………………………………………85
Figure 5.10 Number of iterations Vs production time using MA………………………86
Figure 5.11 Number of iterations Vs production cost using MA………………………86
Figure 5.12 Number of iterations Vs COF using MA………………………………………86
Figure 5.13 Number of iterations Vs production time using HA………………………87
Figure 5.14 Number of iterations Vs production cost using HA………………………88
Figure 5.15 Number of iterations Vs COF using HA………………………………………88
Figure 5.16 Comparison of results in single pass turning operation…………………89
Figure 8.15  Actual Vs predicted machining time in turning – Mild Steel.........152

Figure 8.16  Actual Vs predicted surface roughness in turning – Mild Steel.........152