1. A) Attempt **any three** : 
   a) List any four objectives of metrology.
   b) Explain the term selective assembly.
   c) Define :
      i) Frequency distribution  
      ii) Central tendency  
      iii) Dispersion  
      iv) Variance
   d) Draw the conventional diagram of limits and fits and define the terms :
      i) Basic size  
      ii) Fundamental Deviation

   B) Attempt **any one** : 
   a) Explain with neat sketch how angle of a workpiece is measured with the help of angle dekkor.
   b) Draw the neat sketch of Gear tooth vernier calliper and write the procedure for measuring chordal tooth thickness.

2. Attempt **any four** : 
   a) In the measurement of surface roughness, heights of 20 successive peaks and valleys measured from a datum are as follows :
      45, 25, 35, 40, 25, 16, 40, 22, 25, 34, 25, 40, 20, 36, 28, 18, 20, 25, 30, 38. If the measurements were made over a length of 20 mm, determine the CLA and RMS values of the surface.
   b) Construct an angle of 33°19’15” using minimum number of angle gauges using standard angle gauge set. Draw the sketch of the arrangement.
   c) What is ‘best size of wire’? State the expression for the same, indicating meaning of each term.
   d) Draw labelled sketch of Sigma comparator.
   e) Explain ‘cost of quality’ and ‘value of quality’ with the help of graph.
3. **Attempt any four**:
   a) Differentiate between comparator and a measuring instrument (at least 4 points).
   b) Compare inspection and quality control.
   c) Interpret the meaning of 27 H₅F₆ with respect to fit and basis system.
   d) Differentiate between Line and End standard. (at least 4 points)
   e) Explain in brief two wire method for thread measurement.

4. A) **Attempt any three**: 
   a) State different SQC tools and explain any one.
   b) Why is it necessary to calibrate measuring instruments and unit gauges?
   c) Define reliability. State the factors to be considered for achieving a reliable design.
   d) Explain with neat sketch how angle is measured using clinometer.

B) **Attempt any one**: 
   a) Explain the principle and working of Taylor Hobson Talysurf with block diagram.
   b) What is LVDT? Explain its principle of working with neat sketch.

5. **Attempt any two**:
   a) Explain ‘Parkinson’s Gear Tester’.
   b) Explain following trends of $\bar{X}$ control chart.
      i) Extreme variations
      ii) Shift
      iii) Erratic fluctuations
      iv) Indication of trend
   c) Describe with neat sketch:
      i) Straightness checking using spirit level.
      ii) Alignment testing of lathe centres in vertical plane.

6. **Attempt any two**:
   a) Determine the control limits for $\bar{X}$ and R charts if $\Sigma \bar{X} = 357.50$ and $\Sigma R = 9.90$. Number of subgroups = 20. It is given that $A_2 = 0.18$, $D_3 = 0.41$, $D_4 = 1.59$ and $d_2 = 3.735$. Draw control charts and write your conclusions. Also find the process capability.
   b) In a manufacturing process, the number of defectives found in the inspection of 10 lots of 400 items each are given below:

<table>
<thead>
<tr>
<th>Lot no.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Defectives</td>
<td>2</td>
<td>0</td>
<td>14</td>
<td>3</td>
<td>1</td>
<td>18</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

   Determine the trial control limits for np chart and state whether the process is in control.
   c) Define TQM. Describe any 3 principal elements of TQM.