1. Details of a Universal Joint are given in Fig. 1 with the parts list tabulated below.

<table>
<thead>
<tr>
<th>INDEX</th>
<th>PART</th>
<th>REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fork</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Flange</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Centre</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Pin</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Collar</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) Make the following drawings of the assembled parts in first or third angle projection:
   (i) A sectional front elevation on section plane AA.
   (ii) An end elevation viewed in the direction of arrow B.

(b) Insert the following on the drawing:
   (i) Title: UNIVERSAL JOINT.
   (ii) ISO projection symbol.
   (iii) Four leading dimensions.

(100 marks)

2. Fig. 2 shows the plan and incomplete elevation of a curved duct mounted by an offset cylinder.

(a) Draw the plan and complete the elevation.

(b) Draw the surface development of the pipe \( \text{K} \) using \( XX \) as the seam.

(c) Make a large sketch of an external grooved joint.

(50 marks)
3. (a) Draw a radial cam with minimum radius of 30 mm and clockwise rotation to give the following motion to an in-line knife edge follower:

- 0° to 90° Rise 50 mm with uniform velocity
- 90° to 120° Dwell
- 120° to 330° Fall 50 mm with simple harmonic motion
- 330° to 360° Dwell

Include the displacement diagram as part of the solution.

(b) Fig. 3 shows a textile machine mechanism. The crank AB is joined by a pin joint to the rod BE at B. BE is joined by a pin joint to the link CD at D.

Using a simple line drawing to represent the linkage:

(i) Plot the locus of point E for one revolution of the crank AB.
(ii) Design and draw the profile of a simple guard about the mechanism with a minimum clearance of 10 mm.

(50 marks)

4. (a) Using the data table below, make a fully dimensioned drawing of the machine part in Fig. 4.

<table>
<thead>
<tr>
<th></th>
<th>Screw thread:</th>
<th>Metric 60, Pitch 5.5, Length 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diameter 40,</td>
<td>Length 12</td>
</tr>
<tr>
<td>2</td>
<td>Diameter 52,</td>
<td>Length 30</td>
</tr>
<tr>
<td>4</td>
<td>Undercut 8 x 8</td>
<td>Maximum diameter 48</td>
</tr>
<tr>
<td>5</td>
<td>Taper:</td>
<td>Minimum diameter 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Length 60</td>
</tr>
</tbody>
</table>

(b) (i) Identify the gear drive shown in Fig. 5.
(ii) Name the parts 1, 2, 3, 4.
(iii) Make a neat freehand sketch showing a method used to lock A to B.

(c) Identify the standard pipe fittings (i), (ii) and (iii) shown by means of symbolic representation in Fig. 6.

(i) [Diagram]
(ii) [Diagram]
(iii) [Diagram]

(50 marks)

5. (a) Draw 4 full threads of a right hand square section, double start screwthread to the following specifications:

- Outside diameter = 120 mm
- Root diameter = 80 mm
- Lead = 80 mm

(b) With the aid of freehand sketches explain the following abbreviations:

(i) CSK
(ii) C'Bore
(iii) PCD

(50 marks)