Instructions to Candidates:
You should have the following for this examination
- Answer Booklet
This paper consists of FIVE questions. Answer question ONE (Compulsory) and any TWO questions
Maximum marks for each part of a question are as shown
This paper consists of TWO printed pages

Question One (Compulsory)

a) Using illustrations, explain what a hydrograph is and highlight its main components. (12 marks)

b) Briefly discuss the unit hydrograph concept and highlight the assumptions considered. (8 marks)
c) Outline FOUR activities that could influence base flow (8 marks)

d) Define “Flow Routing” (2 marks)

**Question Two**

a) Outline the factors that affect the shape of a flood hydrograph (10 marks)

b) For a rectangular basin with a single channel centrally located and flowing along the longer side of the basin, (Length = 15km, width = 10km). Define and compute:
   (i) Form factor
   (ii) Circularity ratio
   (iii) Elongation ratio (10 marks)

**Question Three**

a) The ordinates of 1-hr UH from a water shed are given in the table below. Using S-curve approach, derive a 2 hr UH and as well as estimate the area of the water shed. (UH = Unit Hydrograph) (10 marks)

<table>
<thead>
<tr>
<th>Time h</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>UH(m3/s.cm)</td>
<td>0</td>
<td>1.0</td>
<td>15</td>
<td>40</td>
<td>20</td>
<td>7.5</td>
<td>2.5</td>
<td>1</td>
</tr>
</tbody>
</table>

b) Outline factors initiating and modifying floods and highlight measures for reducing flood damage. (10 marks)

**Question Four**

a) (i) Define “Return Period” (5 marks)
   (ii) What is the probability that a T-year return period event will occur at least once in N-years? (5 marks)

b) Explain the relationship between channel geometry and flow characteristics (10 marks)

**Question Five**

a) Briefly describe the concept of reservoir routing (8 marks)

b) A reservoir for detaining flood flows is 4.356ha in horizontal area, has vertical sides and has 5m diameter reinforced concrete pipe as the outlet structure. The headwater – discharge relation for the outlet pipe is given in the table 1 below. Use level pool routing method to calculate the reservoir outflow from the inflow hydrograph given in table 2. Then plot storage out-flow function. (12 marks)

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elevation (m)</strong></td>
</tr>
<tr>
<td><strong>Discharge (m3/s)</strong></td>
</tr>
</tbody>
</table>

Cont’d.

<p>| Elevation (m) | 8.5 | 9   | 9.5 | 10.0 |
| Discharge (m3/s) | 242 | 253 | 264 | 275 |</p>
<table>
<thead>
<tr>
<th>Time (min)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
<th>130</th>
<th>140</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow (m³/sec)</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>17</td>
<td>30</td>
<td>43</td>
<td>60</td>
<td>78</td>
<td>97</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 2