INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Department of Civil Engineering (2nd Year B.Tech.)

End Semester Examination (April 2012)

Water Resources Engineering (CE20006)

Time: **3 Hrs.** Full Marks: **50** No. of Students: **80 (approx)**

Notes:

Answer all the questions. Make suitable assumptions wherever necessary and write it clearly in your answer sheet. Start the answer of each question on a new page.

1. Elevation, storage and discharge relationship for a reservoir is as follows:

Elevation (m)	Storage ($x10^6$ m^3)	Outflow discharge (m^3/s)
50	3.45	0
50.5	3.49	8
51	3.88	22
51.5	4.28	40
52	4.78	61
52.5	5.37	85
52.75	5.53	98
53	5.86	112

When the reservoir level is at 50.5 m, the following flood hydrograph arrives to the reservoir:

Time (hr)	0	6	12	18	24	30	36
Discharge (m^3/s)	10	15	25	23	16	12	11

Route the flow and obtain (i) outflow hydrograph (in tabular form only) (ii) attenuation and lag between inflow and outflow peaks.

(15 marks)

2. 1.5 hectres of crop field (root zone depth = 1.25 m) is to be irrigated in 8 hours. Field measurements shows that the field penetration varies linearly from 1.25 m at the head end of the field to 0.8 m at the tail end. Water application efficiency is 85% and available moisture holding capacity of the soil is 20 cm per meter depth of soil. Water conveyance efficiency through the channels from head regulator to the field is 80%. Determine the discharge requirement at the head regulator in cumec. Also determine the water distribution efficiency.

(10 marks)

3. Determine the pressure at A, B, C, D, E and F as shown in the Figure 1 (page 2) and draw the hydraulic gradient line from upstream to downstream. Also determine the exit gradient at the downstream end. Thickness of the floor slab is 500 mm. Equations/informations provided in the figure 2 (page 2) can be used.

(15 marks)

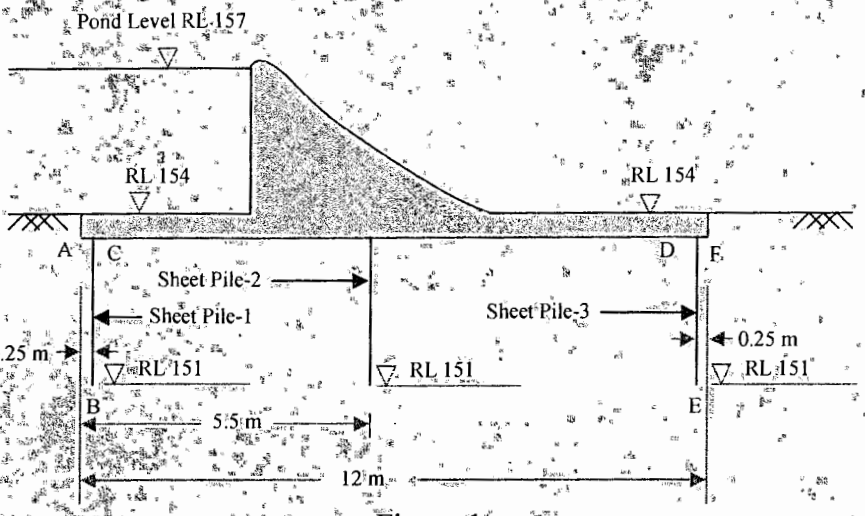
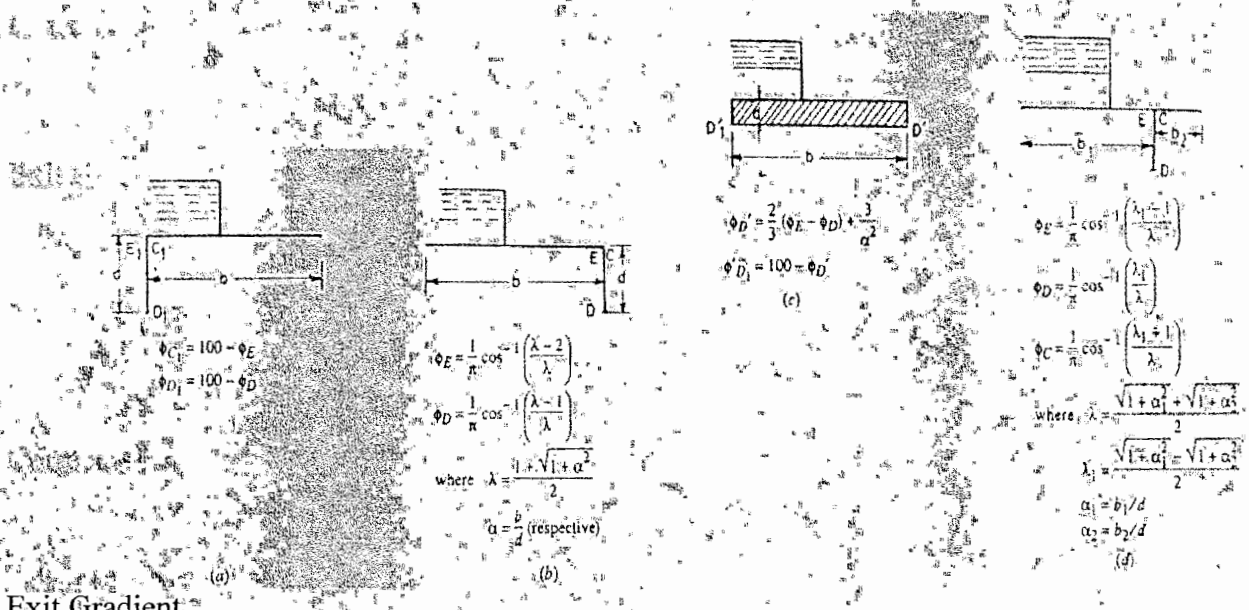


Figure 1



Exit Gradient

$$G_E = \frac{H}{d}\cdot\frac{1}{\pi\sqrt{\lambda}}$$

where $\lambda = \dfrac{1+\sqrt{1+\alpha^2}}{2}$

and $\alpha = \dfrac{b}{d}$

Correction of interference $C = 19\sqrt{\dfrac{D}{b'}}\left(\dfrac{d+D}{b}\right)$

Figure 2 (all formulae with usual notational meaning)

4. Section of a gravity dam (non-overflow portion) built of concrete (weight of concrete = 24 kN/m^3) is shown in figure 3.

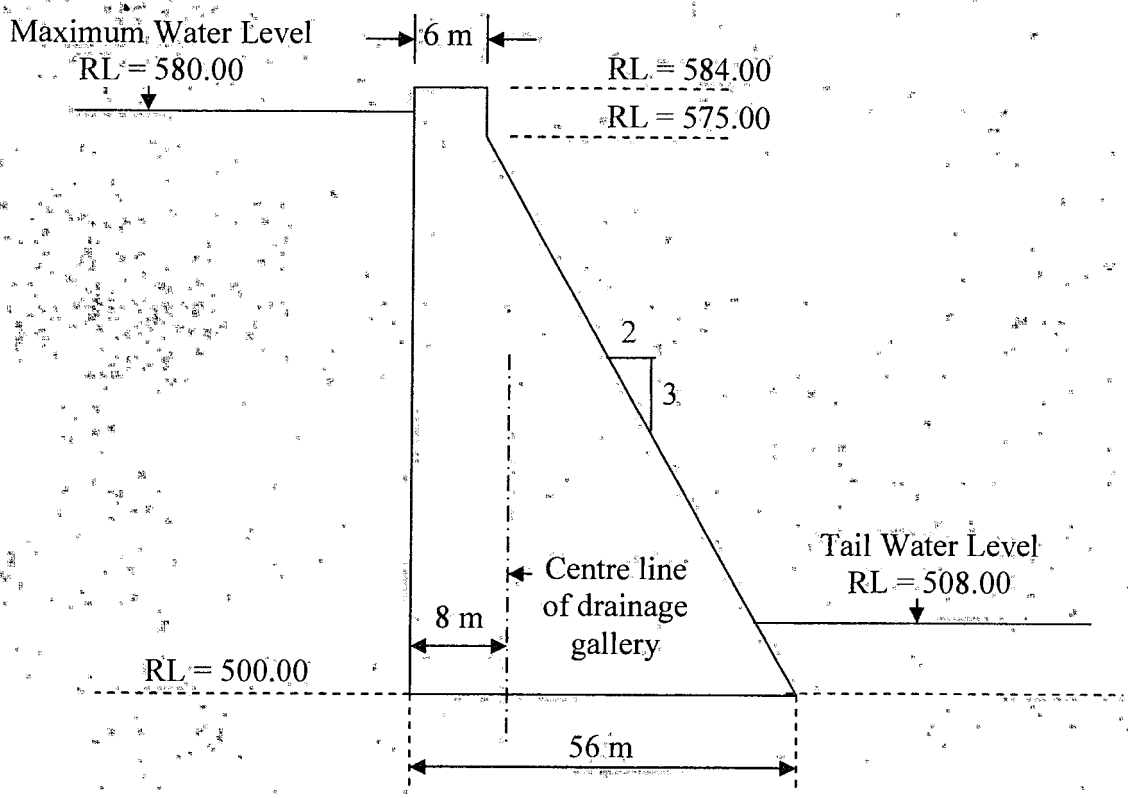


Figure 3

Calculate (neglecting earthquake effects):
(i) The maximum vertical stresses at the heel and toe of the dam.
(ii) The major principal stress at the toe of the dam.
(iii) The intensity of shear stress on a horizontal plane near the toe.

(10 marks)

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