

KATHMANDU UNIVERSITY  
End Semester Examination  
March/April, 2017

Marks scored:

Level : B.E.  
Year : III

Course : CIEG 304  
Semester : I

Exam. Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date APR 13 2017

SECTION "A"

[20 Q × 0.5 = 10 marks]

1. Which of the following statement is true for an overflow dam?
  - a) Stream flow in headwater tends downward.
  - b) Vortex zone forms in headwater upper layer.
  - c) The flow approaches the dam & climbs up the weir.
  - d) The mean velocity in upper reach decreases as the flow approaches the dam.
2. Which of the following load is classified as exceptional load?
  - a) Wave pressure
  - b) Seismic force
  - c) Silt pressure
  - d) Uplift pressure
3. Cavitation occurs due to:
  - a) Lowering of atmospheric pressure to liquid's vapor pressure
  - b) Lowering of local pressure to atmospheric pressure
  - c) Lowering of vapor pressure to atmospheric pressure
  - d) Lowering of local pressure to the liquid's vapor pressure
4. A temporary dam made during construction activity is called as:
  - a) Cofferdam
  - b) Detention dam
  - c) Storage dam
  - d) Check dam
5. For an overflow dam the velocity of approach is 5 m/s and depth of water above crest is 3m. Taking unit weight of water as  $10 \text{ kN/m}^3$ , water pressure acting at crest level is:
  - a)  $30 \text{ kN/m}^2$
  - b)  $12.74 \text{ kN/m}^2$
  - c)  $17.26 \text{ kN/m}^2$
  - d)  $42.74 \text{ kN/m}^2$
6. Water depth at u/s of dam is 20m and there is no water at d/s. The base of dam is 40m wide & length of tension crack from heel is 5m. The total uplift force acting on base is:
  - a) 4000 kN
  - b) 3500 kN
  - c) 4500 kN
  - d) 5000 kN
7. The most economical type of an arch dam is:
  - a) Constant radius arch dam
  - b) Constant angle arch dam
  - c) Constant center arch dam
  - d) Variable radius arch dam
8. In multiple step method of gravity dam design, low dam lies within limits of:
  - a) Zone IV
  - b) Zone III
  - c) Zone V
  - d) Zone VI
9. If the eccentricity at base of gravity dam is zero, the normal stress distribution will be:
  - a) Linearly varying compressive stress from zero at heel to maximum at toe
  - b) Uniform compressive stress throughout the base of dam
  - c) Linearly varying compressive stress from maximum at heel to zero at toe
  - d) Uniform tensile stress throughout the base of dam
10. A transition filter is provided between the core & shell in zoned earthen dam to:
  - a) Provide stability to dam
  - b) Make the construction easy
  - c) Increase shear strength of soil
  - d) Prevent piping

11. The limiting height for gravity dam is given by the relation:  
 a)  $H = \frac{f}{\gamma_w(\gamma_c + 1)}$       b)  $H = \frac{f}{\gamma_c(\gamma_w + 1)}$       c)  $H = \frac{f}{\gamma_c(\gamma_w - 1)}$       d)  $H = \frac{f}{\gamma_w(\gamma_c - 1)}$
12. The most critical condition for upstream slope of an earthen dam occurs:  
 a) When there is steady seepage condition inside body of dam  
 b) When water level in reservoir rises up  
 c) When there is no water in the reservoir  
 d) When there is sudden drawdown of reservoir water
13. Total discharge from flow net can be calculated using the relation:  
 a)  $q = kH \frac{N_f}{N_d}$       b)  $q = \sqrt{kH} \frac{N_f}{N_d}$       c)  $q = kH \frac{N_d}{N_f}$       d)  $q = \sqrt{kH} \frac{N_d}{N_f}$
14. According to Terzaghi, the filter criteria that should be satisfied between any two adjacent layer is:  
 a)  $\frac{D_{15,filter}}{D_{15,base}} < 4 \text{ to } 5 < \frac{D_{15,filter}}{D_{85,base}}$       b)  $\frac{D_{15,base}}{D_{85,filter}} < 4 \text{ to } 5 < \frac{D_{15,base}}{D_{15,filter}}$   
 c)  $\frac{D_{15,filter}}{D_{85,base}} < 4 \text{ to } 5 < \frac{D_{15,filter}}{D_{15,base}}$       d)  $\frac{D_{85,filter}}{D_{15,base}} < 4 \text{ to } 5 < \frac{D_{15,filter}}{D_{15,base}}$
15. Which type of fishway provides natural fish spawning habitat?  
 a) Baffle      b) Vertical slot      c) Pool & weir      d) Rock ramp
16. The seepage line that touches the base of the dam along its way to downstream is called:  
 a) Creep line      b) Phreatic line      c) Equipotential line      d) Flow line
17. The crest of auxiliary spillway is kept:  
 a) Higher than the main spillway  
 b) Lower than the main spillway  
 c) At the same level of main spillway  
 d) Slightly above the design maximum water level
18. Which of the following statement is true for phreatic line in an earthen dam?  
 a) At entry point, phreatic line is parallel to the upstream face.  
 b) The presence of pervious foundation below the base of dam influence the position of the phreatic line in the dam drawn assuming that the foundation is impervious.  
 c) When a horizontal blanket or rock toe is provided, the phreatic line tends to emerge vertically at the exit.  
 d) The pressure at any point on phreatic line depends on the water depth of u/s reservoir.
19. The primary purpose of controlling the under seepage is:  
 a) To reduce foundation uplift pressure  
 b) To prevent the foundation material from piping  
 c) To reduce the loss of water from reservoir  
 d) To increase the stability of structure
20. For a downstream slope of an earthen dam, unit cohesion of soil material is  $20 \text{ kN/m}^2$ , angle of internal friction is  $26^\circ$ , total normal component of weight is  $4500 \text{ kN/m}$ , total tangential component of weight is  $2000 \text{ kN/m}$ , total pore water pressure on slip surface is  $800 \text{ kN/m}$  & length of slip surface is  $55 \text{ m}$ . The factor of safety of slope against sliding is:  
 a) 1.65      b) 1.16      c) 1.84      d) 1.45

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F. M. : 40

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Year : III  
Time : 2 hrs. 30 mins.

SECTION "B"

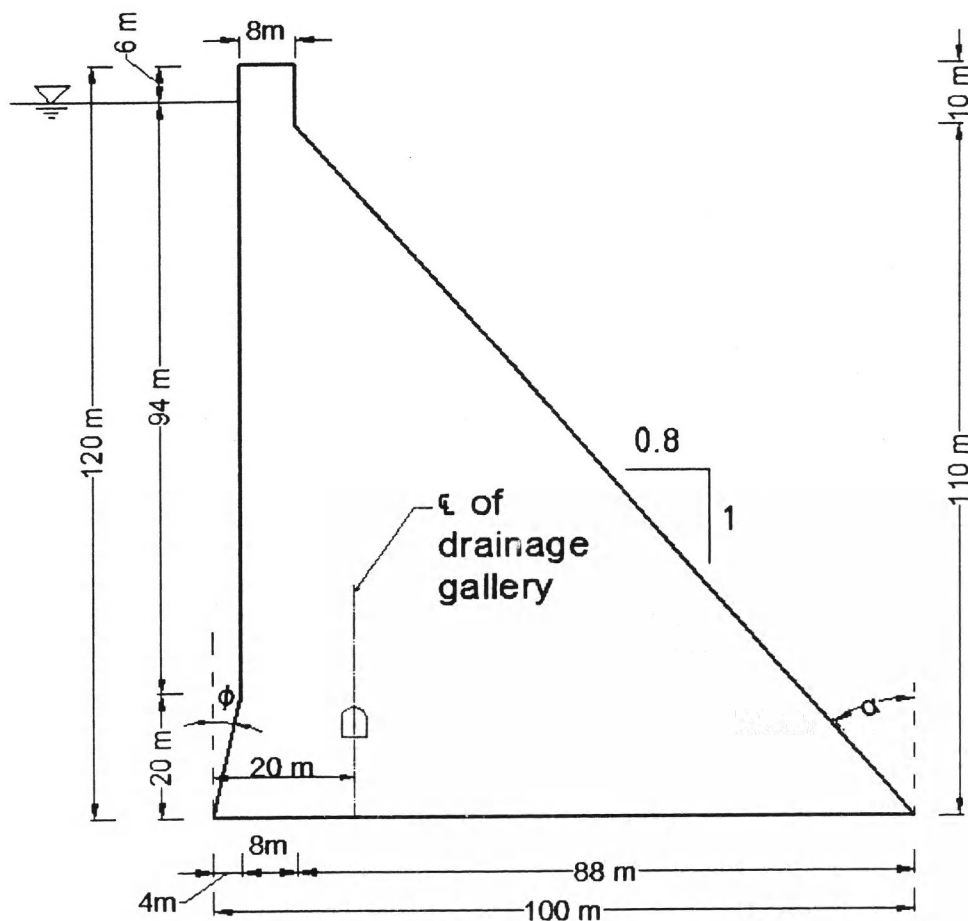
Attempt *ALL* questions.

1. Describe the mechanical action of flow on hydraulic structures with diagrams. [3]
2. Write short notes on: [5]
  - a) Tension crack in gravity dam
  - b) Joints in gravity dam
3. Design a 50 m high constant angle arch dam by thin-cylinder theory for a valley 30 m wide at the base & 150m wide at the height of 50m. Allowable stress in concrete is 5 MPa. Assume 1.5 m thickness at the top. Take central angle of  $133^{\circ} 34'$  & unit weight of water as  $10 \text{ kN/m}^3$ . [3]
4. Describe various types of earthen dam with a neat sketch. [4]

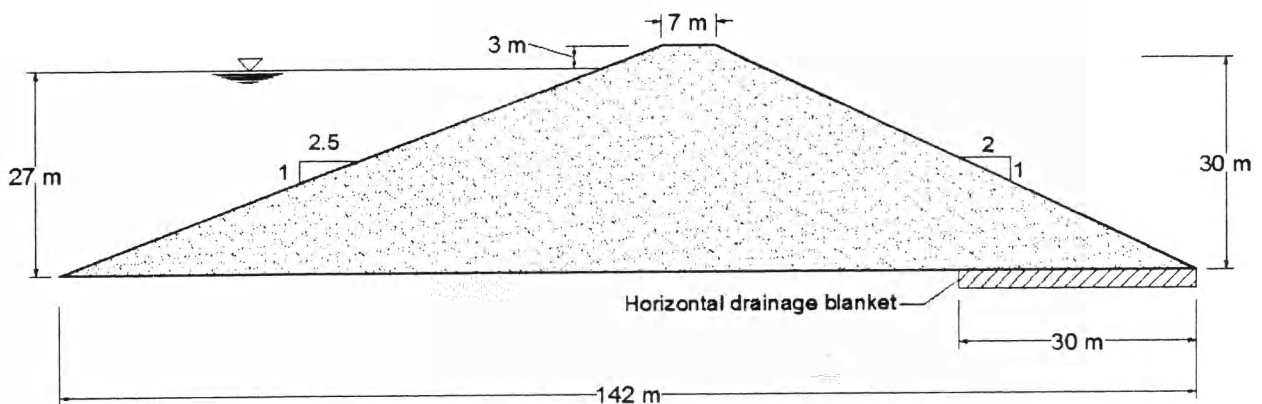
OR

Describe various drainage systems in an earth dam. Why the drainage systems are provided with filter? Explain.

5. List various classifications of spillways. Describe the main, auxiliary and emergency spillway briefly. [3]
6. Write short notes on: [5]
  - a) Fish passing structures
  - b) Chemical piping in rock foundation
7. Determine the principal stresses at the toe & heel of the dam shown in figure. Drainage gallery is located at 20m from heel of dam & there is no tail water. Consider the following datas: [8]
  - a) Unit weight of concrete,  $\gamma_c = 25 \text{ kN/m}^3$
  - b) Unit weight of water,  $\gamma_w = 10 \text{ kN/m}^3$
  - c) Horizontal earthquake coefficient,  $\alpha_h = 0.1$



8. Locate the phreatic line in the earth dam shown in figure below. Also determine the seepage discharge per meter length of dam. Take  $k = 4 \times 10^{-6}$  m/s. [5]



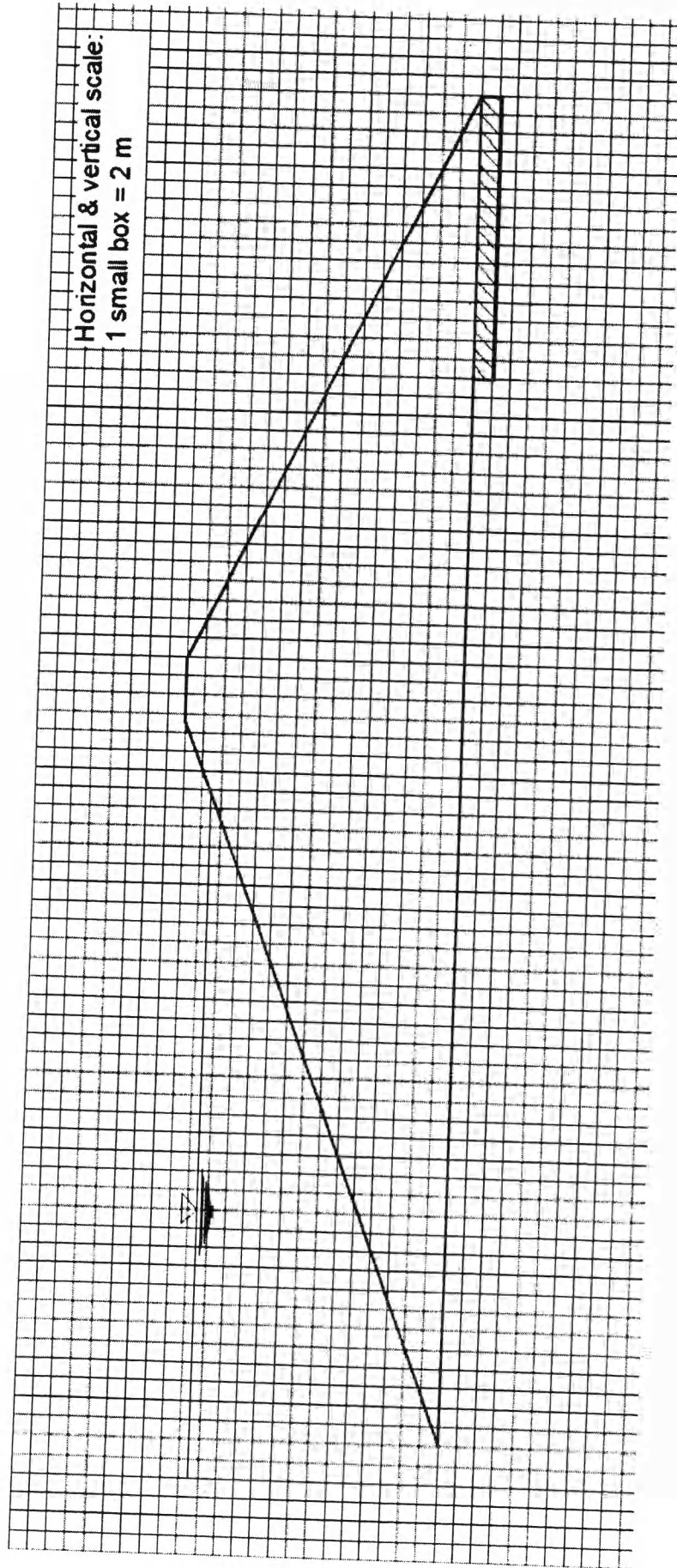
Use the drawing sheet provided with this question paper to draw the graph.

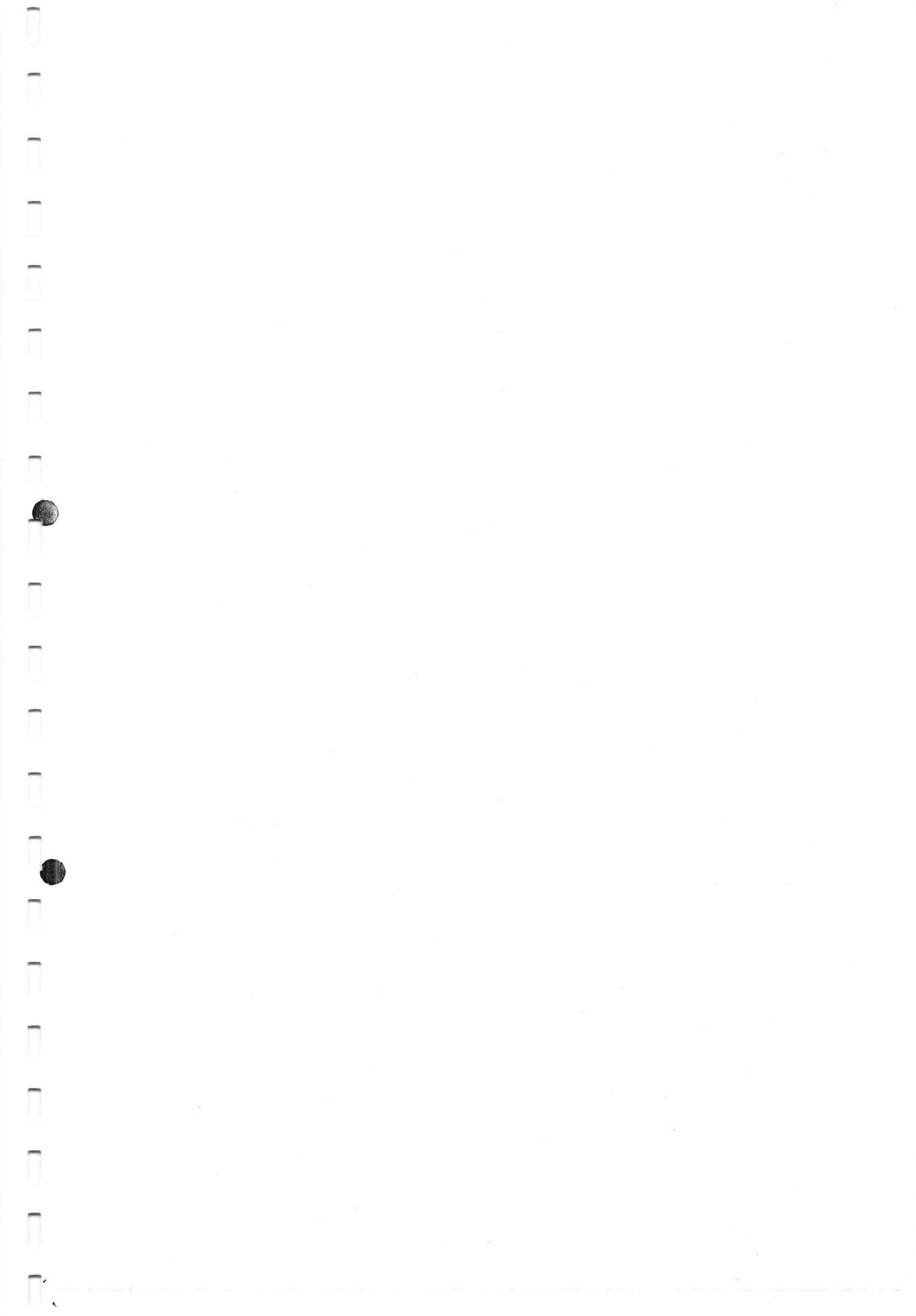
9. In order to find the factor of safety of d/s slope during steady seepage, the section of a homogeneous earth dam was drawn to a scale of  $1\text{cm} = 10\text{m}$  and the following results obtained on a trial circle: [4]
- Area of N-rectangle =  $12.15\text{ cm}^2$
  - Area of T-rectangle =  $6.50\text{ cm}^2$
  - Area of U-rectangle =  $4.82\text{ cm}^2$
  - Length of Arc,  $L = 11.60\text{ cm}$
- The dam material has the following properties:
- Effective angle of friction,  $\Phi = 26^\circ$
  - Unit Cohesion,  $c = 0.2\text{ kg/cm}^2$
  - Unit weight of soil,  $\gamma_{\text{soil}} = 2\text{ g/cm}^3$
  - Unit weight of water,  $\gamma_w = 1\text{ g/cm}^3$
- Determine the factor of safety of slope.

APR 13 2017

CIEG-30  
Table

This sheet is to be attached with your answer sheet.





Formula table: (To be provided during subjective type question)

$P = \frac{h_1^2 - h_2^2}{2} \gamma_m \tan^2 \left( 45^\circ - \frac{\phi_1}{2} \right)$	$h_w = 0.032\sqrt{VF} + 0.763 - 0.271(F)^{1/4}$
$\gamma_m = \frac{\gamma_D(h_1 - h_2) + \gamma_F h_2}{h_1}$	$\tan \phi_1 = \frac{\gamma_m h_1 \tan \phi + c}{\gamma_m h_1}$
$\zeta_{sh.pile(1)} = \frac{a_1}{T_1} + 1.5 \frac{S_1}{T_2} + \frac{0.5 \frac{S_1}{T_2}}{1 - \frac{0.75 S_1}{T_2}}$	$\zeta_{inlet} = \zeta_{outlet} = \zeta_{sh.pile} + 0.44$
$S_1 = c + \gamma_F h_2 \tan \phi$ $S_2 = c + \gamma_m h_1 \tan \phi$ <p>At point of max. shear,</p> $S_B = c + \gamma_{av} h \tan \phi$	$\zeta_{hor(2)} = \frac{L_1 - 0.5(S_1 + S_2)}{T_2}$ $q = \frac{H}{\Sigma \zeta} k$
$\gamma_{av} = \frac{\gamma_D h + \gamma_F h_2}{h + h_2}$ $h = 0.6h', S_{max} = 2S_{av}$ $p_n = \frac{\Sigma V}{b} \left( 1 \pm \frac{6e}{b} \right)$	$FOS = \frac{cL + \tan \phi \Sigma(N - U)}{\Sigma T}$
$S.F.F = \frac{\mu \Sigma V + bq}{\Sigma H}$	$\sigma_{heel} = p_n \sec^2 \phi - (p + p_s) \tan^2 \phi$
$\sigma_{toe} = p_n \sec^2 \alpha - (p' - p_s') \tan^2 \alpha$	$p_{sy} = C_y \alpha_n \gamma_w H$
$C_y = \frac{C_m}{2} \left[ \frac{y}{H} \left( 2 - \frac{y}{H} \right) + \sqrt{\frac{y}{H} \left( 2 - \frac{y}{H} \right)} \right]$	$P_{sy} = 0.726 p_{sy} \cdot y$
$M_{sy} = 0.299 p_{sy} \cdot y^2$	$C_m = 0.735 \frac{\theta}{90^\circ}$ $y = \sqrt{2xy_o + y_o^2}$ $y_o = \sqrt{b^2 + h^2} - b$

