

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), May 2016

B. Tech) in Civil Engineering, Semester VI



Roll No.....

CE608: GEOTECHNICAL ENGINEERING-2

Time: 3 hours

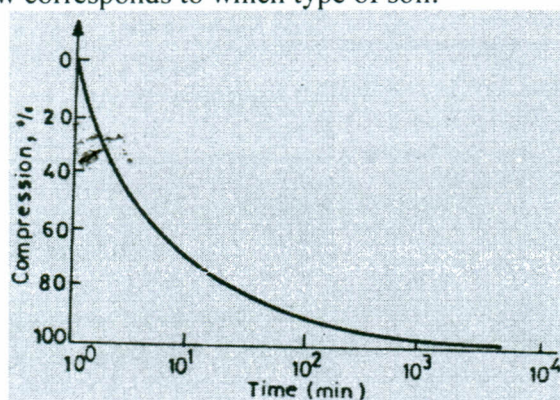
Max. Marks: 100

Instructions to students:

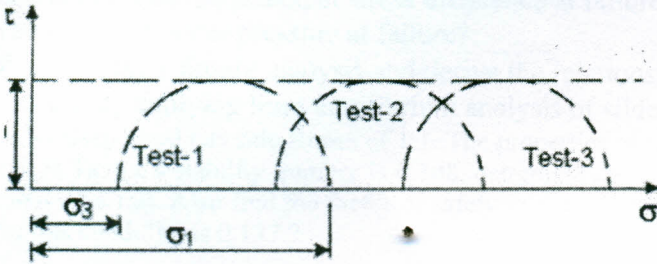
1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/graphs/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (5 questions @ 1 mark) 10

- i. Which of the options are correct for the statement: When a foundation is placed on a stratum, settlement can place due to:
(a) Lateral displacement of the soil particles from their original position,
(b) Decreases in Volume of soil mass,
(c) A combination of (a) and (b),
(d) All of the above.
- ii. The process, involving a gradual compression occurring simultaneously with a flow of water out of the mass and with a gradual transfer of the applied pressure from the pore water to the mineral skeleton is called _____.
Fill in the blank:
A. Settlement,
B. Swelling,
C. Recompression,
D. Consolidation.
- iii. Which of the options are correct for the statement: A soil is said to be pre-consolidated or over consolidated if—
a). $\sigma' < \sigma'_{pc}$ and $OCR > 1$, b) $\sigma' \leq \sigma'_{pc}$ and $OCR > 1$, c) $\sigma' > \sigma'_{pc}$ and $OCR > 1$,
d). None of the options.
- iv. The plot shown below corresponds to which type of soil:



A. (a). Sandy -Clay, (b). Sandy, (c). Silt, (d). Clay.

v.	Coefficient of Consolidation (C_v) is determined from laboratory data from: (a). Logarithm of time method, (b). Square root of time method, (c). Hyperbola method, (d). All three options (a), (b) and (c).	
vi	In Direct Shear Test the failure plane is: (a) Normal to the direction of the applied load (b) Parallel to the direction of the applied load, (c) At an angle ϕ with the principal stresses None of the above.	
vii	Ordinary Method of Slices is also known as: a). Spenser's Method, b). Janbu Method, c). Morgenstern Method, d). Fellenius Method.	
viii	In which of the Shear strength determination experiments pore water pressures can be measured in undrained tests along with capturing complete stress-strain behavior :a). Direct Shear, b) Unconfined Compression c). Triaxial d). Vane Shear	
ix	For the Mohr's circle plot below: Which of the options are correct-  (a). $\tau_f = c_{uv} = \frac{\sigma_1 - \sigma_3}{2}$, $\phi_{uv} = 0$ (b). $\tau_f = c_{uv} = \frac{\sigma_1 - \sigma_3}{2}$, $\phi_{uv} = 0$ (c). $\tau_f = c_{uv} = \frac{\sigma_1 - \sigma_3}{2}$, $\phi_{uv} = 0$ (d). $\tau_f = c_{uv} = \frac{\sigma_1 - \sigma_3}{2}$, $\phi_{uv} = 0$	
x	For a perfectly plastic clay which of the relationship is correct: (a). $\tau_f = \tan \phi * \sigma_f + C$, (b). $\tau_f = C$, (c). $\tau_f = \tan \phi * \sigma_f$, (d). $\tau_f = \tan \phi * \sigma_f - C$.	

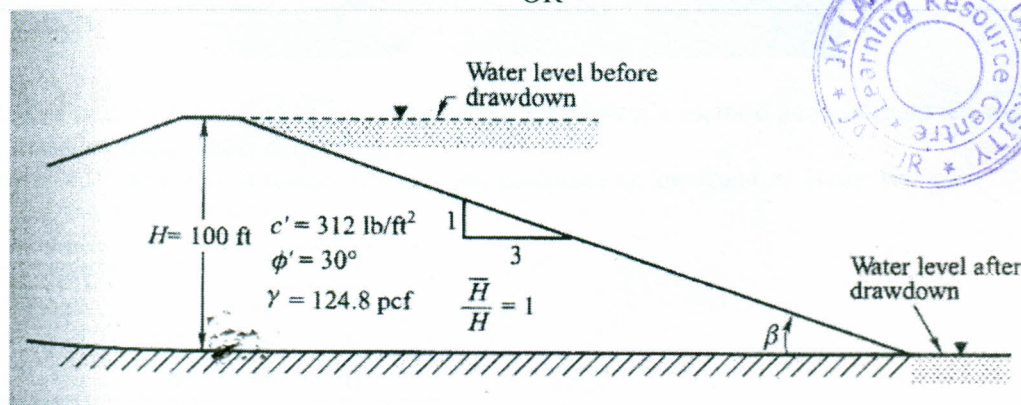


Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
Q.2A	Define sensitivity of a clay ?	
Q.2B	Explain the different modes of shear failure with the help of neat sketch?	
Q.2C	State the assumption on the side forces on slices in the following methods of slices: a). Ordinary method of slices, b). Modified Bishop's method, c). Spencer's method.	
Q.2D	What is electrical resistivity method?	
Q.3A	Explain: i) Immediate settlements; ii) Primary consolidation settlements and iii) Secondary consolidation settlements?	05

Q.3B	A clay soil, tested in a consolidometer, showed a decrease in void ratio from 1.20 to 1.10 when the pressure was increased from 0.25 to 0.5 kgf/cm ² . Calculate the coefficient of compressibility (a_v) and the coefficient of volume compressibility (m_v). Estimate the coefficient of consolidation (c_v) determined in the test for the given stress increment for 80 percent consolidation achieved in 186 days, if there is drainage only towards the top. Assume that the laboratory sample and the clay layer at the site are both subject to the same increase in stress following uniform initial pore water pressure. Also, estimate the coefficient of permeability in cm/s. If the sample tested at the site was taken from a clay layer of 3.0 m in thickness, determine the consolidation settlement resulting from the given stress increment? (Refer to Figure 1 given in Appendix).	05
Q.4A	What are the assumptions made in Terzaghi's theory? Write the expressions for ultimate bearing capacity of strip footing, square and circular footing ?	05
Q.4B	A strip footing 1.2m wide is supported on a soil with its base at a depth of 1m below ground surface. The soil properties are $C = 15 \text{ kN/m}^2$; $\phi = 28^\circ$, $\gamma_t = 18 \text{ kN/m}^3$, $\gamma' = 10 \text{ kN/m}^3$. Determine the ultimate bearing capacity if water table is i) at great depth; ii) at the level of footing; iii) at ground surface. Take, $N_c = 32.36$, $N_q = 18.58$ and $N_r = 15.7$. Use Terzaghi's theory ?	05
Q.5A	Explain Mohr-Coulomb Failure criterion and derive the analytical relationship for principle stresses (σ_1 and σ_3) and also explain how it is determined graphically?	05
Q.5B	The effective stress shear strength parameters of a completely saturated clay are: $c' = 20 \text{ kN/m}^2$; $\phi' = 25^\circ$. A sample of this clay was tested in a $\overline{UU}$ test under a cell pressure of 200 kN/m^2 and the principal stress difference at failure was 110 kN/m^2 . What was the value of pore water pressure at failure?	05
Q.6A	What is planar failure analysis and derive the relationship of Factor of Safety (F) for planar failure surface by applying limit equilibrium analysis of slide?	05
Q.6B	A 5m deep canal has side slopes of 1:1. The properties of soil are $C_u = 20 \text{ kN/m}^2$, $\phi_u = 10^\circ$, $e = 0.8$ and $G = 2.8$. If Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when the canal runs full. Also find the factor of safety in case of sudden draw down, if the Taylor's stability number for this condition is 0.137 ?	05

OR

Q.6B



Estimate the minimum factor of safety for the complete drawdown and 50% drawdown of the section shown in the Figure by referring to drawdown stability chart proposed by Morgenstern (Appendix). Compare the factor of safety estimated for complete drawdown and 50% drawdown and infer on it?

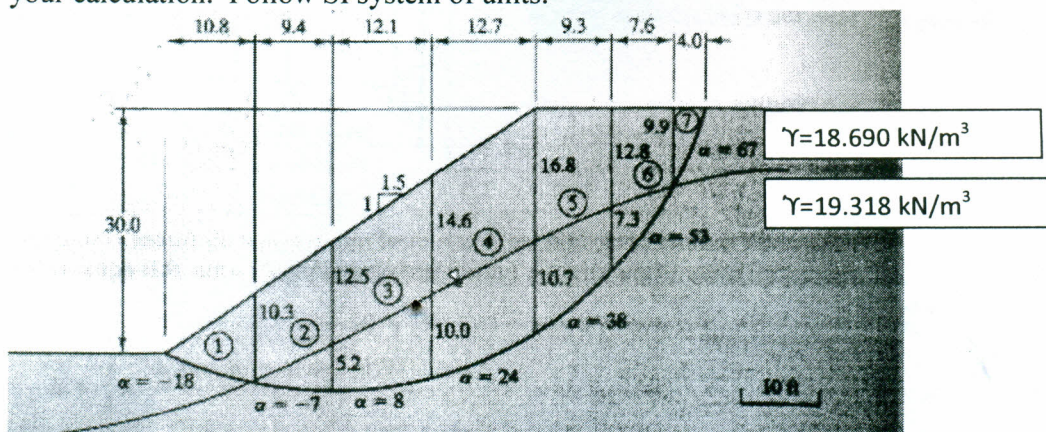
Q.7A	What is SPT? What are the corrections to be applied for field procedures and overburden pressure?	05
Q.7B	A Standard Penetration Test has been conducted on a coarse sand at a depth of 16 ft	05

below the ground surface. The blow counts obtained in the field were as follows: 0-6 in.- 4 blows; 6-12 in.-6 blows; 12-18 in.-6 blows. The tests were conducted using a donut hammer in a 6-in. diameter boring using a standard sampler with the liner installed. The vertical effective stress at the depth was 1500 lb/ft². Determine N_{60} and N_{70} and corresponding q_u value. The other data given are hammer efficiency=0.45, Borehole diameter correction=1.05, Sampler correction=1.0, Rod length correction=0.85. (Refer Appendix for C_N).

OR

Q.7B An 8.5m tall, 2:1 fill slope is to be made of soil with $c'=35\text{kPa}$, $\phi'=23^\circ$, and $\gamma=19.5\text{ kN/m}^3$. The groundwater table will be well below the toe of this slope. Using Cousins' Chart, compute the factor of safety. Does this slope meet normal stability standards? 05

Q.8A A 9.14 m tall, 1.5:1 slope is to be built as shown in Figure below. The soil is homogeneous with $c'=19.152\text{ kN/m}^2$ and $\phi'=29^\circ$. The unit weight is 18.69 kN/m^3 above the ground water table, and 19.318 kN/m^3 below. Using the OMS, perform an effective stress analysis to compute the factor of safety for the trial circle shown in Figure. In the figure the distance measurements have been given in ft kindly convert into m and use for your calculation. Follow SI system of units. 10



Q.9A Solve the previous question Q.8A using Modified Bishop's method and compare it's result with OMS method. Infer accordingly. 10

Q.9B When an undrained triaxial compression test was conducted on specimens of clayey silt, the following results were obtained: 10

Specimen No.	1	2	3
σ_3 (kN/m ²)	17	44	56
σ_1 (kN/m ²)	157	204	225
u (kN/m ²)	12	20	22

Determine the values of shear parameters considering (a) total stresses and (b) effective stresses.

Determine the parameters using both analytical and graphical method.

OR

Q.9B A specimen of sand from the subgrade of a road failed under following set of conditions: 10

	σ_3 (kg/cm ²)	σ_1 (kg/cm ²)
A	0.5	1.5
B	1.0	3.0
C	2.0	5.9

Find its friction angle?

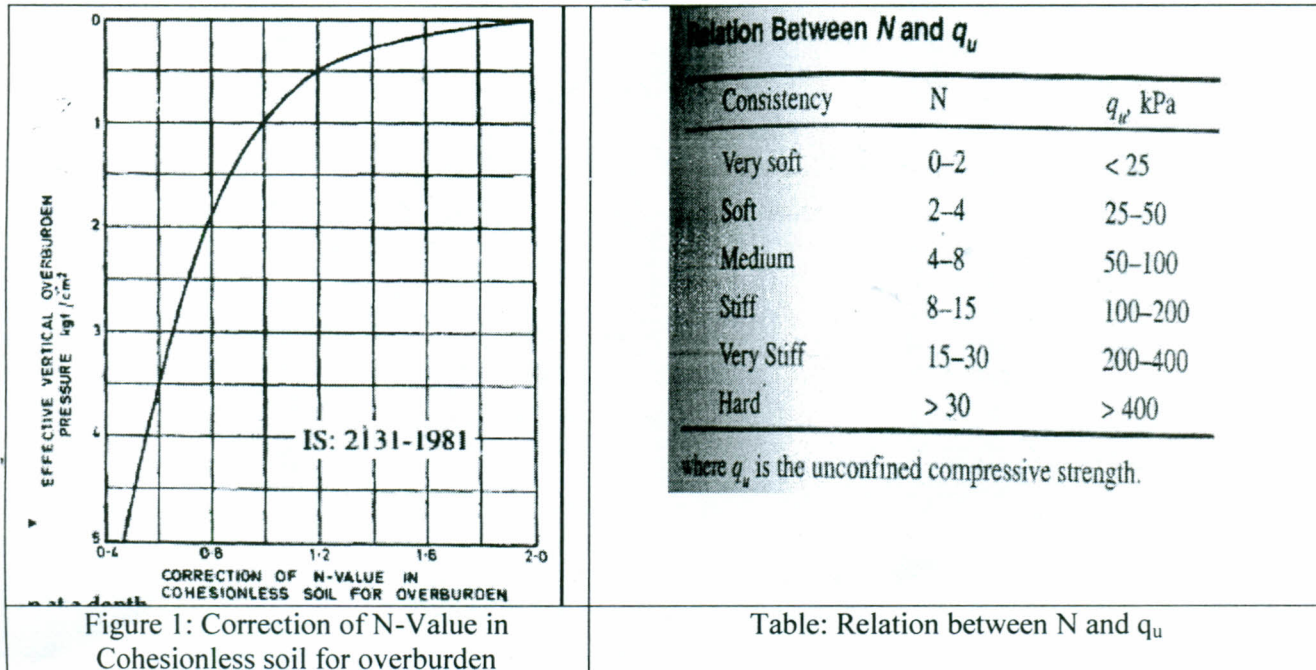
Further when the subgrade was stabilized with cement and the test was repeated. The

results were:

	σ_3 (kg/cm ²)	σ_1 (kg/cm ²)
A	0.5	2.2
B	1.0	3.9
C	2.0	7.0

Find the gain in the cohesion and also find the gain in the friction angle ?

Appendix



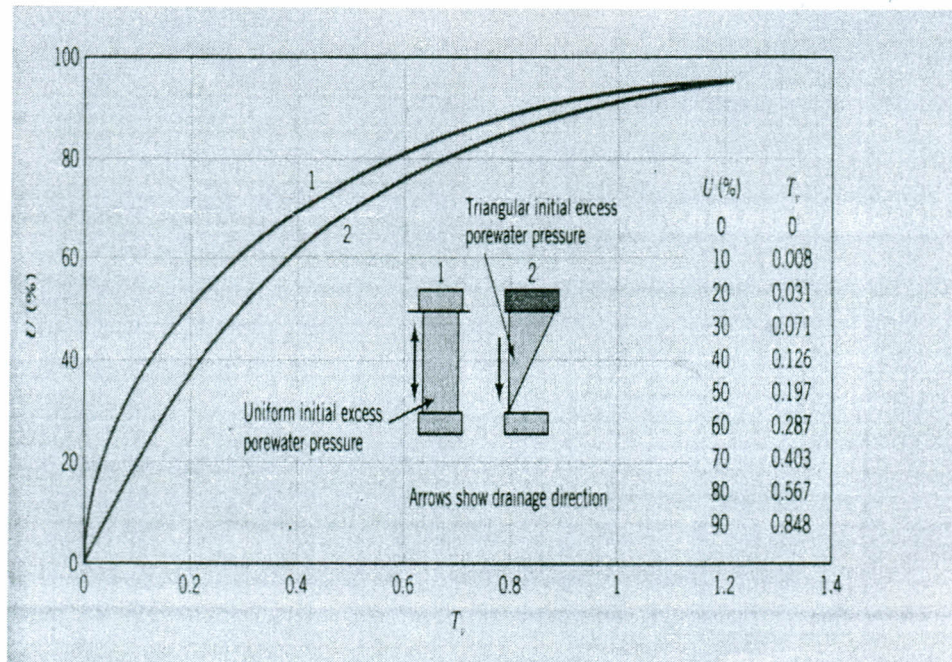


Figure.2: Degree of consolidation versus time factor (T_v)
As per Taylor (1948) solution

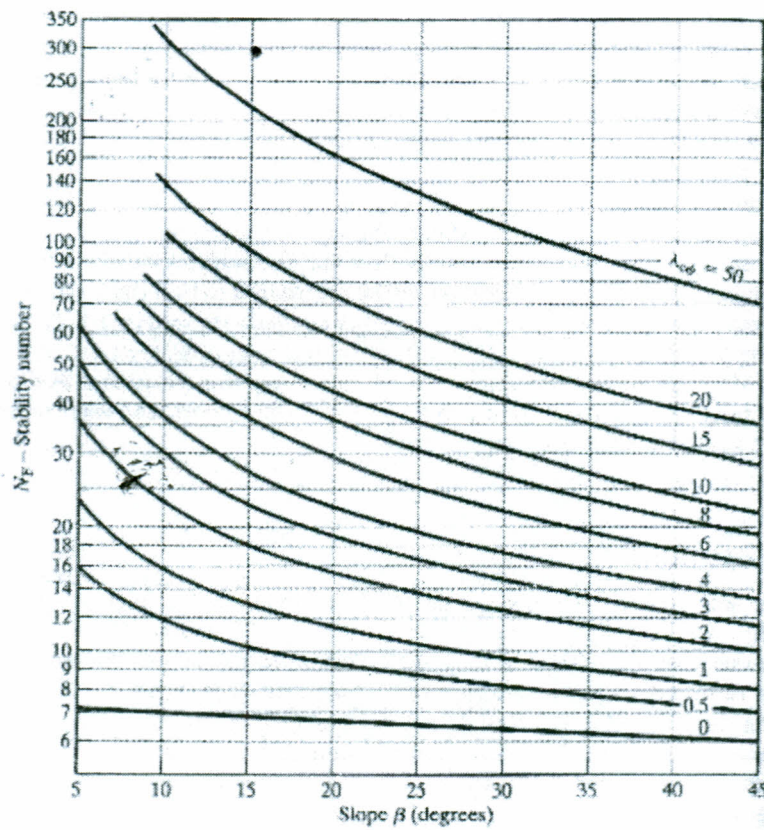


Figure3: Stability Chart for simple slopes (Cousins, 1978)