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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B-TECH GIE & GSE **Semester –** V
Subject (Course): ROCK MECHANICS AND GEOTECHNICAL ENGINEERING **Max. Marks** : 100
Course Code : GNEG-391 **Duration** : 3 Hrs
No. of page/s:04

All the questions of section A & B are compulsory. Attempt any TWO questions from section. C. Wherever necessary do with neat sketches.

SECTION –A

Q. 1 Explain the following terms: 2 x 5 = **10 M**

a) Fatigue strength b) Bulk Modulus c) Regolith d) Clogging e) Tenacity

Q. 2 Fill in the blanks 1 x 10 = **10 M**

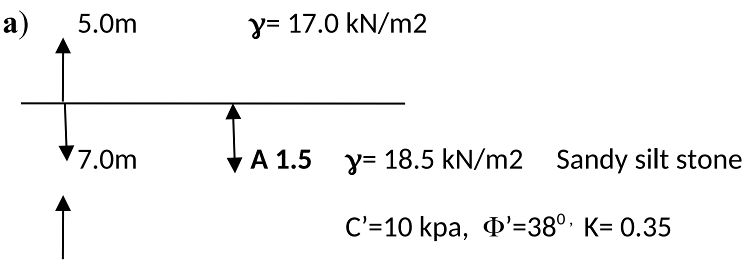
- **i.** ln a stress-strain binary diagram where the ordinate represents the increasing stress and the abscissa represents the increasing strain, a line almost parallel to the abscissa is characteristic of………………………………..
- **ii.** Rock broken beyond the limits of the last row of holes in a blast, synonymous with over break called as……………
- **iii.** The movement initiates during rotational slides whereas imbalance in forces results in…………. ………………… movements
- **iv.** The probable ranges of compressive strength for common Igneous rocks are ………………………
- **v.** An increase in lithostatic pressure causes a decrease in the volume of rocks but an increase in the ………………… of rocks
- **vi.** The Pressure rate of application of stress, temperature and amount of inter granular fluids present in the rock factors increases………………………… rocks
- **vii.** . The value of ESR is related to index of Q value to stability and security of excavation suggested by …………………. Et al 1974.
- **viii.** A state of 'soil liquefaction' occurs when the effective stress of soil is reduced to essentially zero, which corresponds to a complete loss of …………………..
- **ix.** ……………………… is the force used to generate motion between a body and a tangential surface with dry friction.
- **x.** The ……………… erosions are narrow and smaller incised shallow channel which are eroded into unprotected soil by hill slope runoff

SECTION –B

Q.3 Define liquefaction and discuss in briefly various causes, affect and prevention of liquefaction during and after geotechnical engineering's. **10 M**

Q.4 Discus in briefly the methods of blasting, damage and control measures will be taken during geotechnical excavation and blasting. **10 M**

Q. 5 **a)**



The series of shear strength test performed on above said lithology and calculated values are shown in the figure. Determine the shear strength on horizontal and vertical planes at point **A** for above given values. **6 M**

b) In the quarry Granite slab were cut and measured length is **4 meters** and **0.6 meter** diameter. It Carries a Load of **80 MN**. Given that, the modulus of elasticity is **150 GPA.** Calculate the compressive stress and strain and how much the stand stone slab is compress and young's modulus. **4 M**

Q. 6 Analyze the role of following term in rock mechanics; i) Compressive strength ii) Shear strength and iii) Poisson's ratio and volumetric strain. **10 M**

SECTION –C

Answer any two questions: **2 x 20 = 40 M**

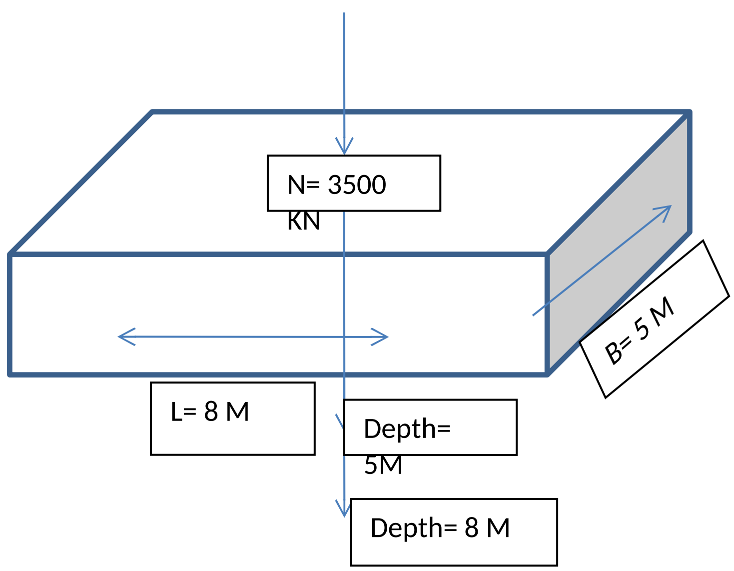
Q. 7 Describe in briefly with suitable equations and consequence of following rock mass classification in geotechnical engineering; i) RMR ii) RSR iii) SMR and iv) RQD or Q system v) GSI **20 M**

Q.8 i) A undistributed soil samples were obtained from a Boring in a proposed cut area. The average dry unit weight (γd) **111 lb/ft^3**, the average moisture content (w) **10.5%.** In the laboratory test was conduct for representative bulk samples, the result as follows; dry unit weight maximum (γd_{max}) **122 lb/ft^3** and optimum moisture content (w) **11.5 %.** A Proposed grading plan calls for cut (PPC) **12500 yd^3** and Proposed plan for fill (PPF) **13500 yd^3** and the specification for relative compaction of at least 90%. . **γ_w = 8.34 lb/gal**

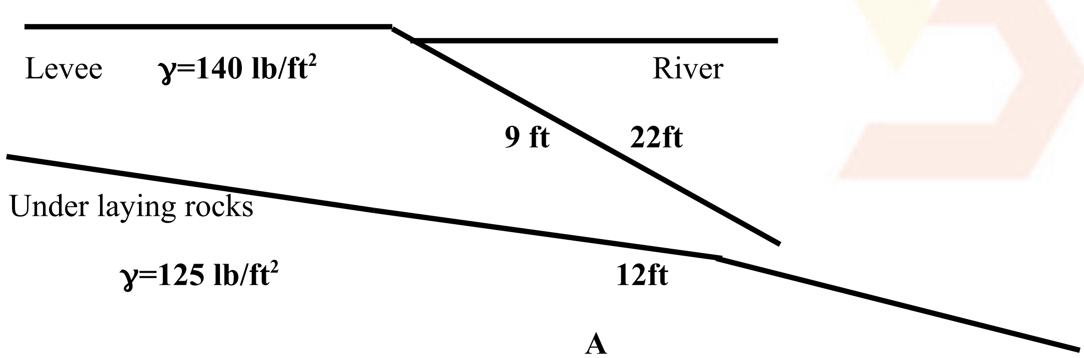
a) Compute the shrinkage factor
b) Estimate the required quantity of import or export of soils based on unit weight in tons
c) Calculate import or export in tons using the moisture content
d) Determine the required quantity of water in gallons to bring the fill soils to the optimum moisture content using relative compaction of **92%**. **14 M**

ii) The soil samples were collected from the foundation site the data as follows: Length **(20 ft)** & Height of soil **(30 ft**) layer, Initial void ratio **e0= 0.65**, Compressive index **CI = 0.385,** Effective pressure $\tilde{\sigma}$ = **1500 lb/f^{t2}**, change pressure $\Delta\tilde{\sigma}$ = **800 lb/ft^2** and secondary index Sα = **0.02.** Assume primary consolidation PC= **1.5 year** and calculate the total consolidation of the settlement of the soil layer after **5 years.**
6 M

Q. 9 a) Find the effective stress in the soil at a depth of **8 M** below the footing and then find the increase in the stress due to a drop of the WT (wall thickness) from originally 1 below the footing to **5m** below the footing**.** **I_4** = **0.096**
7 M



b)



The above figure showing proposed levee is to be built along the side of a river to protect a nearby town from flooding. If the natural soils below the levee are clean sands with **$\phi = 34^{\circ}$** and the shear stress at point **A** is **555 lb/ft^2** . Determine the factor of safety against sliding at point **A** assume point **A** is nearly horizontal **C`=0** **5 M**

c) Calculate the vertical stress for given depth **Z = 10 M** under the center of Raft **10M X 10M** for foundation with uniform Load **Q = 50 ton/m^2**. **8 M**

<u>Note: See the Table.1 for Ip Question No. 9c</u>

Table: 1 Influence Factors (I_p) for Foundation Engineering used in vertical stress calculation:

R/Z	Corner	Centre	Intermediate
0.1	0.067	0.064	0.100
0.2	0.133	0.128	0.200
0.3	0.200	0.192	0.300
0.4	0.267	0.256	0.400
0.5	0.333	0.32	0.500
0.6	0.400	0.384	0.600
0.7	0.467	0.448	0.700
0.8	0.533	0.512	0.800
0.9	0.600	0.576	0.900
1.0	0.667	0.64	1.000
1.25	1.00	0.82	1.023
1.50	1.23	0.95	1.035
1.75	1.45	1.00	1.052
2.0	1.76	1.07	1.073

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No. of page/s:03

All the questions of section A & B are compulsory. Attempt any TWO questions from section. C. Wherever necessary do with neat sketches.

SECTION –A

Q. 1 Explain the following terms: 2 x 5 = **10 M**

a) Wedge failure b) Shear modulus c) Colluvium d) Clogging e) Isentropic

Q. 2 Discribe briefly the difference between the following terms. **2 x 5 = 10 M**

i) Cohesion and Adhesion ii) Thermal diffusivity and Thermal admittance iii) Saturated density and Submerged density iv) Mudflow and Solifluction v) Chalky soil and Peaty soil

SECTION –B

Q. 3 In the quarry Granite slab were cut and measured length is **4 meters** and **0.6 meter** diameter. It Carries a Load of **80 MN**. Given that the modulus of elasticity is **150 GPA.** Calculate the compressive stress and strain and how much the stand stone slab is compress. **5 M**

Q. 4 A shale sample is **4 mm** diameter and **2M** long. A force of **12 N** is applied on the samples and it stretches **0.4 mm**. Determine the shale sample stress and strain young's modulus **5 M**

Q.5 Justify briefly how this terms studies will be helpful for geotechnical Engineering. **20 M**

a) Compressive strength b) Yield & Impact strength c) Fatigue Strength and d) Shear strength**.**

e) Poisson's ratio and young's modulus

Q.6 Justify the importance, preventive measure will be taken during earthquake, lateral shear movement, and landslide occurs due to Liquefaction. **10 M**

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SECTION –C

Answer any two questions: **2 x 20 = 40 M_**

Q. 7 Discus in briefly with suitable equations and consequence of following rock mass rating in geotechnical engineering; i) RMR ii) RSR iii) SMR and iv) RQD or Q system. **20 M**

Q. 8 a) Calculate the vertical stress for given depth **Z = 8 M** under the center of Raft **8 M X 8 M** for foundation with uniform Load **Q = 60 ton/m²**. **8 M**

b) In the foundation site the layer of clay section samples were collected and tested in the laboratory the results are as follows; length=**12ft** and width **12ft** , Initial void ratio **e_0=0.90,** compressive index **(CI)=0.3,** Effective pressure **σ' =2100 lb/ft², Δσ' =900 lb/ft²,** Secondary compressive index **(Sα) =0.03** and assume primary consolidation is **(t1)=1.5** years. Calculate the Total consolidation of settlement of the clay layer assuming **(t2) =5 years.** **6 M**

c) 4.0m γ= 17.0 kN/m2

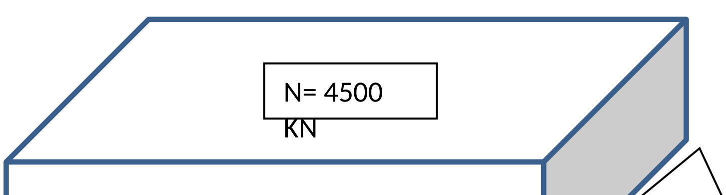
5.0m **A 1.5** γ= 18.5 kN/m2 Sandy silt stone

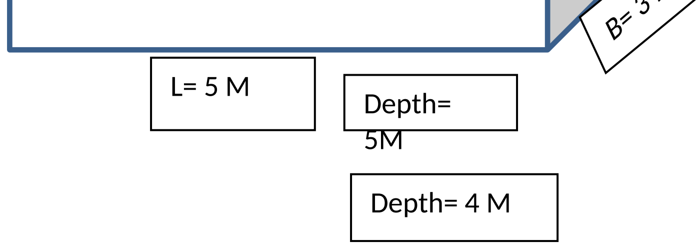
C'=15 kpa, Φ'=38⁰, K= 0.45

The series of shear strength test were performed on above said lithology and calculated values are shown in the figure. Determine the shear strength on horizontal and vertical planes at point **A** for above given values. **6 M**

Q.9 a) Discus briefly the precaution and importance of following terms in engineering construction; pre-split blasting, production blasting and control blasting. **10 M**

b) Find the effective stress in the soil at a depth of **4 M** below the footing and then find the increase in the stress due to a drop of the WT (wall thickness) from originally 1 below the footing to **5m** below the footing. **I_4 = 0.086** **7 M**





c) The sandy loam core sample was taken from soil section and analyses results were as follows: Core volume = **95cm^3** Dry soil weight = **65.56g** and standard particle density = **2.65** g/cm^3. Determine the bulk density and % pore space of the soil. **3 M**

Note: See the Table.1 for Ip Question No. 8a

Table: 1 Influence Factors (I_p) for Foundation Engineering used in vertical stress calculation:

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0.2	0.133	0.128	0.200
0.3	0.200	0.192	0.300
0.4	0.267	0.256	0.400
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