Ex/CE/PC/H/T/316/2024

# B.E. CIVIL ENGINEERING THIRD YEAR FIRST SEMESTER EXAM-2024
## GEOTECHNICAL ENGINEERING II(HONS.)
## PART-I ( 50 Marks)

Time : Three hours **[ Answer All the Questions]** Full Marks : 100

( 50 Marks for each Part)

Use separate answer script for each Part

[Assume any data reasonably wherever necessary]

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**1.(a)** A 5-m-thick clay layer, drained at the top only, has some sand drains. A uniform surcharge is applied at the top of the clay layer. Calculate the average degree of consolidation for combined vertical and radial drainage after 100 days of load application, given $C_{vr} = C_v = 4$ mm$^2$/ min, $d_c = 2$m, and $r_w = 0.2$m. Use the equal-strain solution.

**(b)** Redo the above problem assuming that there is some smear around the sand drains and that $r_s = 0.3$m and $k_h/k_s = 4$.

**[CO2]**

Given (symbols carry usual meaning):

$$U_r = 1 - \exp\left[\frac{-8T_r}{F(n)}\right], \quad F_n = \frac{n^2}{n^2-1}\ln(n) - \frac{3n^2-1}{4n^2}$$

$$U_r = 1 - \frac{u_{av}}{u_i} = 1 - \exp\left(\frac{-8T_r}{m'}\right), \quad m' = \frac{n^2}{n^2-S^2}\ln\left(\frac{n}{S}\right) - \frac{3}{4} + \frac{S^2}{4n^2} + \frac{k_h}{k_s}\left(\frac{n^2-S^2}{n^2}\right)\ln S$$

Avg. degree of consolidation vs Time factor for vertical consolidation:

| $U(\%)$ | $T_v$ | $U(\%)$ | $T_v$ |
|---|---|---|---|
| 5 | 0.002 | 55 | 0.238 |
| 10 | 0.008 | 60 | 0.287 |
| 15 | 0.018 | 65 | 0.342 |
| 20 | 0.031 | 70 | 0.403 |
| 25 | 0.049 | 75 | 0.477 |
| 30 | 0.071 | 80 | 0.567 |
| 35 | 0.096 | 85 | 0.684 |
| 40 | 0.126 | 90 | 0.848 |
| 45 | 0.159 | 95 | 1.129 |
| 50 | 0.197 | 100 | $\infty$ |

[15]

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**2. (a)** Discuss the stress conditions in soil during consolidation and shearing stage in CU test and also draw and explain the Mohr's circle for NC and OC clay.

**(b)** A consolidated-drained (CD) triaxial test was conducted on a normally consolidated clay. The results are as follows:

$\sigma_3 = 110\ kPa$

$(\Delta\sigma_d)_f = 172$ kPa

Determine: (i) Angle of internal friction, $\varphi'$ and (ii) Angle θ that the failure plane makes with the major principal plane.

**[CO3]**

[8+7]

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**3.** A layer of clay 6m thick is drained on its top surface only and has a uniform initial excess pore water pressure distribution. The coefficient of consolidation of clay is 0.15m$^2$/month. Using a numerical method determine the average degree of consolidation that the layer will undergo 36 months after the commencement of consolidation.

**[CO5]**

[20]

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[ Turn over

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**(Name in full)**

**PAPER ××××**

**Time: Three hours** **Full Marks =100**

**(50 marks for part I and 50 Marks for part II)**

*Use a same Answer-Script for each part*

***Part –II***

- ***Answer any 25 MCQ only from the available 30 MCQs. Each MCQ is carrying 1 mark.***
- ***Some MCQ question may have more than one correct alternative, so examine each alternative of each MCQ before giving your choice of the concerned MCQ.***
- ***Giving all alternatives of any MCQ as your choices as correct answers of the concerned MCQ, will lead to zero marks for the concerned MCQ.***
- ***If anyone attempts more than 25 MCQ, then the first 25 MCQ will be evaluated and considered only and the other extra MCQ will not be evaluated and will not be considered.***
- ***Either Question 31 or Question 32 (apart from the MCQ questions in this part) has to be answered.***
- ***Then Question 33 has to be answered. This question is mandatory.***
- *Assume reasonable data if it is not supplied.*
- *Maintain neatness.*
- All drawings-must be drawn by pencil.
- *All the notations used here for their conventional meanings.*
- *No code etc. will be needed to answer the questions of this part.*

✓***Instructions (with examples) for giving answers to MCQ in this part:***

***Suppose you have to answer following MCQ in your answer script:***

*MCQ 1) Name of the present prime minister of the India*
*a) Jawaharlal Nehru,*
*b) Narendra Modi,*
*c) Manmohan Singh,*
*d) None of the above.*

*MCQ 2) Virat Kohli is*
*a) Captain of the Indian Cricket team,*
*b) Husband of Anuska Sharma,*
*c) President of the BCCI,*
*d) All of the above.*

*MCQ 3) Within the last few months*
*a) Israel attacked Palestine,*
*b) IIC World Cup has been started,*
*c) China attacked India,*
*d) All of the above.*
*.....*

***Then during giving answer in your answer scripts, you have to give the answers of the above MCQ in the following style only:***

*Part –II*

*Answer to MCQ 1) : b) Narendra Modi,*
*Answer to MCQ 2) : b) Husband of Anuska Sharma,*
*Answer to MCQ 3) : a) Israel attacked Palestine,*
*b) IIC World Cup has been started,*

Form A: Paper-setting Blank *Ref No. Ex/CE/PC/H/T/316/2024*

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.....

*Note:*
*(A) In MCQ 2, if anyone give alternative "a)" as one of the correct alternative, he/ she is wrong as Virat Kohli was (not "is") Captain of the Indian Cricket team. So, read each word of the alternatives very carefully before giving your answer.*

*(B) In MCQ 3, if anybody either alternative "a)" or alternative "b)" as the correct alternative, he/ she will get 0.5 marks as there were two correct alternatives.*

*(C)There is no negative marking for choosing wrong alternative as your choice in any MCQ.*

**Group- A**

**Choose the correct alternative/ alternatives for any 25 MCQ from the following 30 MCQ:**

| ***Question*** | ***CO*** | ***Marks*** |
|---|---|---|
| 1) Soils are aggregates of<br>(A) Rock Grains<br>(B) Mineral grains<br>(C) Rock Grains with water<br>(D) None of the above | CO1 | *1* |
| 2) Rocks are raw sources for<br>(A) Construction materials aggregates<br>(B) Construction stones<br>(C) Decorative stones<br>(D) All of the above | CO1 | *1* |
| 3) Rock mechanics is concerned with<br>(A) Geotechnical engineering<br>(B) Properties of rocks<br>(C) Engineering mechanics<br>(D) All of the above<br>(E) (A) and (B) above | CO1 | *1* |
| 4) A rock that is not weathered is called "fresh" when the weathering grade is<br>(A) weathering grade VI<br>(B) weathering grade I<br>(C) weathering grade III<br>(D) None of the above | CO1 | *1* |
| 5) The thickness of weathered zone is generally more in<br>(A) Arid areas<br>(B) Tropical areas<br>(C) Sea shore areas<br>(D) Desert areas | CO1 | *1* |
| 6) Evaluation of the site geology of rocks are usually done by conducting<br>(A) surface mapping<br>(B) boreholes<br>(C) trenches<br>(D) All of the above | CO1 | *1* |

Form A: Paper-setting Blank *Ref No. Ex/CE/PC/H/T/316/2024*

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***Use a same Answer-Script for each part***

| | | |
|---|---|---|
| 7) Blasting is required for excavation in case of<br>(A) Soil<br>(B) Rock like soils<br>(C) Rock<br>(D) All of the above | CO1 | *1* |
| 8) The material in situ which can be seen as an "assemblage" of blocks of intact rock material separated by discontinuities, fractures, etc., are termed as:<br>(A) Rock,<br>(B) Rock mass,<br>(C) Rock assemblage,<br>(D) None of the above | CO1 | *1* |
| 9) Uncertainties are inherent when dealing with rock masses and such uncertainties are due to<br>(A) Uncertainties in the material itself<br>(B) Uncertainties in data collection and testing<br>(C) Uncertainties in model prediction<br>(D) All of the above<br>(E) (A) and (B) above | CO1 | *1* |
| 10) ISRM stands for<br>(A) International Society for Rock Mechanics,<br>(B) International Society for Rock Material,<br>(C) International Society for Rock Management,<br>(D) Both (A) and (B) | CO1 | *1* |
| 11) Model and predict the behaviors of the rock mass are essential when rock mass is:<br>(A) subjected to fast weathering actions<br>(B) subjected to the new loads<br>(C) subjected to water inflow within that<br>(D) None of the above | CO1 | *1* |
| 12) Rock properties can be:<br>(A) Time-dependent,<br>(B) Scale-dependent,<br>(C) Temperature dependent,<br>((D) All of the above<br>(E) (A) and (B) above | CO1 | *1* |
| 13) Assessment of the engineering properties of the rocks involves:<br>(A) Testing samples of intact rock in the laboratory<br>(B) Conducting concerned field tests<br>(C) Arial photography<br>(D) None of the above | CO1 | *1* |
| 14) The compressive strength of an intact rock is usually determined by testing:<br>(A) A cylindrical specimen with slenderness ratio 3 | CO1 | *1* |

Form A: Paper-setting Blank *Ref No. Ex/CE/PC/H/T/316/2024*

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(B) A cylindrical specimen with slenderness ratio 2
(C) A square specimen with slenderness ratio 3
((D) A square specimen with slenderness ratio 2
(E) (B) and (D) above

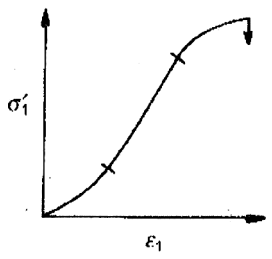
15) Geological processes can be CO1 *1*
(A) mechanical
(B) hydrological
(C) thermal
(D) All of the above

16) Rock mechanics has become a separate discipline (with the first treatise) in the year CO1 *1*
(A) 1947,
(B) 1957,
(C) 1967,
(D) None of the above

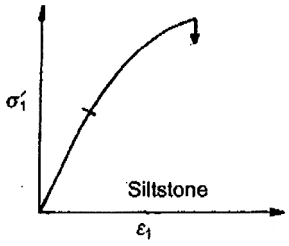
17) The design methods in rock engineering can vary depending on CO1 *1*
(A) Five perspectives
(B) Four perspectives,
(C) Three perspectives
(D) None of the above

18) In general, plastic elastic plastic curve is being represented by: CO1 *1*

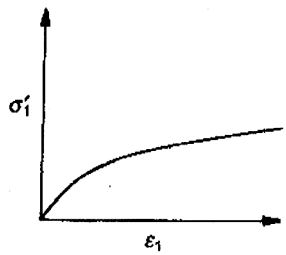
(A)




(B)




(c)




(D) None of these

19) In good rock mass condition, the moduli ratio in the fifth cycle of loading and unloading CO1 *1*
(A) becomes almost 1.6
(B) becomes almost 1.4
(C) becomes almost one
(D) None of the above

Form A: Paper-setting Blank *Ref No. Ex/CE/PC/H/T/316/2024*

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| | | |
|---|---|---|
| 20) In compressive strength test, the possible likely modes of failure of intact rocks are<br>(A) Five<br>(B) Four<br>(C) Three<br>(D) None of the above | CO1 | *1* |
| 21) To get universal engineering classification of rocks, the classification system must meet<br>(A) Two requirements<br>(B) Three requirements<br>(C) Four requirements<br>(D) None of the above | CO1 | *1* |
| 22) Geophysics involves<br>(A) The application of physics principles<br>(B) The study of the Earth<br>(C) The application of principles of chemistry<br>(D) All of the above | CO1 | *1* |
| 23) For Unweathered/unaltered rock, there is:<br>(A) No visible signs of alteration in the rock material out and fracture planes may be stained or discoloured<br>(B) Visible signs of alteration in the rock material out and fracture planes may be stained or discoloured<br>(C) No visible signs of alteration in the rock material out and fracture planes may not be stained or discoloured<br>(D) None of the above | CO1 | *1* |
| 24) In Geo-technology related with rock mechanics, one has not to give so much importance on<br>(A) Fluids within the rock masses<br>(B) Nature of rock<br>(C) Soil deposits<br>(D) Rock masses | CO1 | *1* |
| 25) Non-uniqueness of the geophysical data is considered as<br>(A) Limitation<br>(B) Advantageous<br>(C) Disturbing<br>(D) None of the above | CO1 | *1* |
| 26) For rock mass classification, classification system is:<br>(A) Simple and meaningful in terminology<br>(B) Functional for general use in solving the whole variety<br>(C) Containing a lot of case histories<br>(D) None of the above | CO1 | *1* |
| 27) RMR is sum of | CO1 | *1* |

Form A: Paper-setting Blank Ref No. Ex/CE/PC/H/T/316/2024

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(A) Two separate ratings
(B) Four separate ratings
(C) Six separate ratings
(D) None of the above

28) In general, rock and rock mass properties cannot be assigned to a design calculation with the same degree of certainty as for other types of engineering materials such as concrete or steel for: CO1 *1*
(A) Two reasons
(B) Three reasons
(C) Four reasons
((D) More than four reasons

29) Modulus of Deformation is needed mainly due to CO1 *1*
(A) Non elastic behaviour of jointed rock mass
(B) Non elastic behaviour of intact rock material
(C) Presence of gouge material in the rock mass
(D) Probability of presence of pockets in rock mass

30) The ***ratio of the modulus value of intact rock material to the modulus value of rock mass***, generally lies within the range of: CO1 *1*
(A) 5 to 10
(B) 5 to 15
(C) 5 to 20
(D) 10 to 20

**Group- B**

**Answer either question number 31 or question number 32. If anyone answers both 31 and 32, then 31 will be evaluated and considered only and 32 will not be evaluated and will not be considered.**

| | ***Question*** | ***CO*** | ***Marks*** |
|---|---|---|---|
| (31) (a) | What are the difference between "rock" and "rock mass"? | CO1 | 3 |
| (b) | What are the fields of applications of rocks? | CO1 | 6 |
| (c) | For most engineering projects involving rocks, discuss the main objectives of rock mechanics. | CO1 | 6 |
| (d) | Write short notes on "RMR". | CO1 | 5 |
| (32) (a) | "In general, rock and rock mass properties cannot be assigned to a design calculation with the same degree of certainty as for other types of engineering materials such as concrete or steel."- explain the reasons behind this statement. | CO1 | 6 |
| (b) | Write short notes on engineering classifications of rock and rock mass. | CO1 | 3 |
| (c) | What is the difference between: i) Modulus of elasticity of rock mass and ii) Modulus of deformation of rock mass, | CO1 | 5 |
| (d) | Calculate the value of modulus in deformation in kg/ cm 2 for the following Plate Load Test data (for rocks) using relevant formula: Applied Load = 250 kg, Poisson's ratio = 0.45, Constant related to | CO1 | 6 |

Form A: Paper-setting Blank Ref No. Ex/CE/PC/H/T/316/2024

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square shaped plate = 0.95, Deformation corresponding to load = 0.1 cm, area of Plate = 900 $cm^2$

**Group- C**

**Answer question number 33. This is mandatory question.**

(33) (a) Write notes on Triaxial test on rock specimen. CO3 5

***End of Questions***