Department of Earth Science and petroleum

College of Science

University of University

Subject: Engineering geology

Course Book – 4 Year

Lecturer's name - Dr. Nadhmia Najmaddin Majeed (Phd)

Academic Year: 2022/2023

Course Book

1. Course name	**Engineering geology**
2. Lecturer in charge	**Nadhmia Najmaddin Majeed**
3. Department/ College	**Earth Science and petroleum / Science**
4. Contact	**e-mail: Nadhmia.Majeed@su.edu.krd** **Tel: (optional) 07504686583**
5. Time (in hours) per week	**Theory: 2** **Practical: 2 (3 group)**
6. Office hours	**6 h.**
7. Course code	
8. Teacher's academic profile	Date of first assignment in University - 24 / 11/ 1981 Researcher's academic attainments - Bsc , Msc and Phd Degrees from Baghdad university 1981,1989 and 2004 respectively General specialization - Geology Specific specialization - Remote sensing - Engineering Geology Academic title - Assistant Geology, Assistant Lecturer and Lecturer 1981,1989 and 2004 respectively Supervision of Postgraduate Students - Diploma Degree Thesis title :- 1)Geotechnical Treatment of Expansive Soil by Using Marble Waste powder in Bastora and Erbil Airport areas-Erbil Governorate 1/8 /2012 2)Geotechnical Treatment of Gypsiferous soil in Makhmur Area by using limestone waste powder Jan.2015 Supervision of Postgraduate Students - Master Degree Thesis title - Geotechnical treatment of Expansive soil In Erbil City-Kurdistan Region-Iraq Publication - 1)Some Physical Properties Treatment of Expansive Soil Using Marble Waste Powder , International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 - Vol. 3 Issue 1, January – 2014 2)Mineralogy of Gypsiferous Soil and the Effect of a ddditiveLime Stone waste powder on its Physical Properties , Iraqi Journal of Science, 2020, Vol. 61, No. 1, pp: 83-91 DOI: 10.24996/ijs.2020.61.1.9 3)Enhancing Engineering Properties of Expansive Soil Using Marble Waste Powder. Iraqi Geological Journal ,2021, 54 (1E), 43-53

	, **DOI:** https://doi.org/10.46717/igj.54.1E.4Ms-2021-05-25 4)Effect of Fly ash powder on the physical properties of expansive soils. Tikrit Journal of Pure Science Vol. 27 (4) 2022. DOI: http://dx.doi.org/10.25130/tjps.27.2022.053
9. Keywords	Engineering geology, soil mechanic, geologic hazard , slope stability

10. Course overview:

▪ The importance of studying the subject

Engineering Geology is the application of geology to engineering studies to ensure that the geological factors related to the location, design, construction, operation and maintenance of engineering works are recognized and taken into account.

Engineering Geology provide geological and geotechnical recommendations, analysis and design related to human development and different types of structures. The engineering geologist's realm is essentially about earth-structure interactions or investigating how earth or earth processes impact human-made structures and human activities.

▪ Understanding of the fundamental concepts of the course

Students should develop an appreciation of geologic processes and their influence civil engineering works, acquire knowledge of the most important rocks and minerals and be able to identify them, and interpret geological maps with an emphasis on making construction decisions. Geological concepts relevant to civil engineering and the building environment. Introduction to minerals; igneous, sedimentary and metamorphic rocks, their occurrence, formation and significance. General introduction to physical geology and geomorphology, structural geology, plate tectonics, hydrogeology, rock core logging site investigation techniques for construction. Associated laboratory work on minerals, rocks and mapping.

11. Course objective:

The primary purpose of this course is to give students in engineering geology, understanding of earth materials and their properties, and the natural processes that act on those materials and affect manmade structures. This knowledge will be applied to various examples from Civil Engineering and Reclamation. A secondary course goal is based upon the assumption that most of you in this class will deal professionally with geologists in your careers. Thus an understanding of the terms and methods used by geologists will better enable you to better communicate with geoscientists .

12. Student's obligation

student attend classes for two hours, read the required lectures, teachers notes regularly as all of them are foundations for the course.

In this course, the students will be evaluated by exams and classroom discussions

13. Forms of teaching

Different forms of teaching will be used to reach the objectives of the course : power point presentation for the head titles and definitions and summary of conclusions, classification of materials and any other illustration. There will be classroom discussions and the lecture will give enough background to translate ,solve ,analyze and evaluate problems sets ,and different issues discussed throughout the course. To get the best of the course ,it is suggested that the student attend classes as much as possible ,read the required lectures,

teachers notes regularly as all of them are foundations for the course. Lectures notes are for supporting and not for submitting the reading material including the handouts . Try as much as possible to participate in classroom discussions ,preparing the assignments given in the course

14. Assessment scheme

- The total mark will be **100%**.
- The final mark of semester is **50%**, and divided to:

15% for theoretical part [exam(**10**) + classroom discussions (**5**)]
35% for practical part; also the practical mark is divided to two marks: exam and reports.

- The final theoretical exam is from **50%** .

15. Student learning outcome:

- Able to apply the principles of mathematics, natural science, and engineering principles to solve engineering problems related to materials originating from within the earth (surface water), groundwater (ground water/hydrogeology), minerals, rocks, hydrocarbon fluids) and earth phenomena/geological phenomena (natural phenomena on the surface and below the earth's surface that occur due to the structure and composition of the earth), as well as engineering problems involving and/or caused by earth phenomena;
- Able to find sources of engineering problems on earth phenomena as well as engineering problems involving and/or caused by earth phenomena; associated hazards.
- Able to design and carry out geological mapping and analyze mapping data to design geological models by utilizing science and technology developments.

16. Course Reading List and References:

- Key references:

1-Text Book : Principles of Engineering Geology ,Robert B. Johnson and Jerome V. DeGraff

- Useful references:

1- Principles of Geotechnical Engineering Eighth Edition, SI BRAJA M. DAS, KHALED SOBHAN .
2- Engineering Geology An Environmental Apprroach , Perry H. Rahn.
3-Soil mechanics .

- Magazines and review (internet):

Geotechnical and Geological Engineering - Springer

17. The Topics:	Lecturer's name
Week 1 Definition, Geologic Fundamentals , Rocks , Minerals , and soils, investigation Fundamentals, Engineering soil , Soil scientist, Geologic soil , soil development , The importance of soil **Week 2** Soil For Engineering purposes ,Volume and weight Relationships , Cohesive and Non cohesive Soils , grain size analysis **Week 3** grain size analysis , Atterberg limits , Determination of Liquid Limit , Casagrandy Method **Week 4** Cone Pentrometer Method , determination of the plastic	Dr.Nadhmia Najmaddin Majeed 2 hrs. per week ex: 15/1/2023

limit and plasticity index of soils, Soil classification ,Unified soil classification (USC) **Week 5** The importance of clay mineralogy , The engineering properties of soil , Shear strength **Week 6** Shear Strength in Noncohesive Soils , Shear Strength in Cohesive Soils **Week 7** Measuring Shear Strengths, Compressibility, Consolidation **Week** 8 Engineering properties of rocks, intact rocks and rock mass, intact rocks , Rock Strength , Failure ,Rupture , Strength criterion , Compressive Stress ,Shear Stress,Tensile Stress, Compressive Strength , Shear Strength . **Week 9** Tensile Strength ,rock deformation , Deformation , Stiffness , Stress , Strain , Kinds of Strain **,** **Week 10** Poisson's ,deformation behavior of rock , dynamic elastic moduli **Week 11** rock mass , rock mass characterization , evaluation of the engineering properties of a rock mass , Discontinuities in Rock Masses **Week 12** Rock slope stability-analysis , Basic mechanics and types of rock slope failures , Planar Failure Analysis , Stability analysis. **Week 13** Wedge Failure , - Kinmatic Analysis of wedge failure , Stability analysis of Wedge Failure **Week 14 Dams** **Week 15**	
18. Examinations:	

Q1) Write about the following:- (12marks)

1-The coarse grain soil classification according to unified soil classification system.

1)If less than 5 percent passes the no. 200 sieve, the material is a well graded or poorly graded sand or gravel with the symbols GW, GP, SW, or Sp G-gravel S-sand W-well-graded p-poorly graded

The well-graded (W) or poorly graded(P) designation is based on the coefficient of uniformity (Cu) and coefficient of concavity (Cc) which are computed from data obtained from the grain-size distribution curve.

2)If between 5&12 percent of the material passes no. 200 sieve, the soil given dual symbols as

GW-GC SW-SC GP-GC SP-SC
GW-GM SW-SM GP-GM SP-SM

3)If more than 12 percent of the material passes no. 200 sieve, the soil is classified as one of the following

GM, GC, SM, or SC

The material contains either silt (M) or clay (C). The latter symbols are obtained by determining the liquid and plastic limits of the soil and the location of the resulting coordinates on the plasticity chart

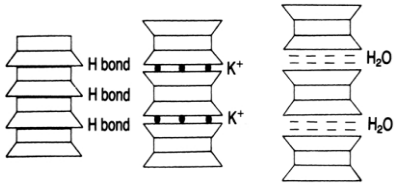
2-The important structural groups of clay minerals for engineering purposes.

1-Kaolinite group - generally non expansive 2) Mica-like group - includes illites and vermiculites, which can be expansive but generally do not pose significant problems. 3) Smectite group – include montmorillonites , which are highly expansive and are the most trouble some clay minerals.

1-Kaolinite group Kaolinite Kaolinite crystals consist of silica tetrahedron and aluminum octahedron sheets. The bonding between successive layers is by van der Waals forces and hydrogen bonds. The bonding is sufficiently strong that there is no interlayer swelling in the presence of water .

2- Mica-like group Illite Illite has a basic structure consisting of a sheet of alumina octahedrons between and combined with two sheets of silica tetrahedrons. In the octahedral sheet there is partial substitution of aluminum by magnesium and iron, and in the tetrahedral sheet there is partial substitution of silicon by aluminum. The combined sheets are linked together by fairly weak bonding due to (non - exchangeable) potassium ions held between them

3)Smectite group Montmorillonite Montmorillonite is formed from weathering of volcanic ash under poor drainage conditions or in marine waters. The basic building sheets for smectite are the same as for illite except there is no potassium ion present. The space between the combined sheets is occupied by water molecules and exchangeable cations. There is a very weak bond between the combined sheets due to these ions. Considerable swelling of montmorillonite can occur due to additional water being absorbed between the combined sheets



Q2) 1 Determine the plasticity index. If the liquid limit (35.9) and the plastic limit data are:-weight of can. with moisture soil(17.2), weight of can. with dry soil(15.6) and weight of can. (8.3). (6 marks)

Water content = (weight of wet soil - weight of dry soil)/ (weight of dry soil - weight of can) *100

= (17.2-15.6)/(15.6-8.3)*100 =21.92

plasticity index= 35.9-21.92=13.98

3- Compute the coefficient of uniformity and concavity if the effective size are
D_{10} (0.096), D_{30}(0.16) D_{60} (0.24) (5 marks)
Cu=D60/D10 = 0.24/0.096= 2.5
Cc= (D30)2 /(D_{60} * D_{10})= (0.16)2 /(0.24 *0.096) = 1.11

Q3) Correct the wrong statements:- (12 marks)

1-The Prefix symbol for coarse-grained soils in the soil classification system refers to grain size

2- The grain sizes of soil particles finer than those retained on the no. 200 sieve are generally subjected to hydrometer test.

3- Between the plastic limit and liquid limit ,the soil behaves as liquid material.

4- Uniformly or poorly graded distribution curve deposited by water or wind because the grains are of similar size.
The curves poorly graded and deposition may have occurred due to flooding this is because certain grain sizes are almost absent. Such distribution are called gap graded.

5-From relationship between the moisture content and the cone penetration ,the moisture content recorded at penetration of 20mm called Liquid limit.

Q4) Complete the followings :- (10 marks)

1- If (60) percent of soil are fine grain, the soil is classified as CL , ML ,CH ,MH
.

2- Total volume of soil(V)= volume of soilds(Vs) + volume of voids(Vv)
volume of voids = volume of water(V) + volume of air(Va)
Total volume of soil(V)=Vs+ Vw+Va

3 Shear strength measured directly by direct shear testing

4- steps in an investigation
1) formulation 2) Data collection 3) interpretation 4- communication.

5- The Mohr-Coulomb failure linear equation $\tau_f = c + \sigma_n \tan Ø$
(τ_f) -shear stress for soils on a failure plane, The expression
$\sigma_n \tan Ø$- is the coefficient of internal friction of the material.
Ø- angle of internal friction σ_n - normal stress C - cohesion

6- The methods of grain size analysis are 1- Sieve analysis 2- Hydrometer

Q5) prove failure angle (θ) = 45 + Ø /2 (5 marks)

$2\beta + 2\theta = 180$ ---------1
$2\beta + Ø + 90 = 180$-------2
$\therefore 2\beta + 2\theta = 2\beta + Ø + 90$
$2\theta = 90 + Ø$
$\theta = 45 + Ø/2$

19. Extra notes:

The Department of Earth Sciences and Petroleum lacks the financial possibility and the lack of cars to carry out scientific and field trips

20. Peer review

Assistant Professor Dr. Muhamed Fakhri Omer