****

**Department of Geology……………………….**

**College of …Science…………………………….**

**University of …Salahaddin……………………….**

**Subject: …Hydrogeology……………………………….**

**Course Book – 4th year (Year 4)**

**Lecturer's name Dr Imaddadin Omer Hassan**

**Academic Year: 2019/2020**

|  |  |
| --- | --- |
| **1. Course name** | **Hydrogeology** |
| **2. Lecturer in charge** | **Dr.imaddadin omer hassan** |
| **3. Department/ College** | **Geology / Science** |
| **4. Contact** | **e-mail: imad\_geol@ yahoo.com** **Tel: 0750 4450525** |
| **5. Time (in hours) per week**  | **Theory: 2** **Practical: 3**  |
| **6. Office hours** | **30** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **B.Sc. (1974-1975)****M.Sc. (1988(****PhD. (1998)** |
| **9. Keywords** | **Hydrogeology** |
| **10. Course overview:** Desired Course Outcomes:1.The student should be able to define the main topics of hydrology and hydrogeology. 2.The student should be able to identify and understand the different terms and subjects of hydrogeology.3.The student should be able to have an idea about different types of water resources including surface and groundwater 4.The student should understand and learn about the different methods for determining water quality and quantity.5.The student should understand the relationship between the surface and groundwater.6.The student should be able to understand the aquifer classification and well drilling methods and techniques . Different teaching methods and techniques should be used including power point(data show) , green board and magic pens for drawing illustrations and sketches, figures for better explanations of subjects, discussions…etc. Hydrogeology subject is the complementary of engineering geology ,therefore , the distribution of the subject marks are as following:Seasonal Examination Theoretical hydrogeology Applied Hydrogeology 12.5 marks 7.5 marksFinal Examination 20 marks 10 marksTotal marks equal to (50 marks)  |
| **11. Course objective:**The course will cover the different topics of hydrology and hydrogeology . In this course, the students will be able to understand the important of Water, where Water is the elixir of life, without it life is possible. People use surface water in places where there is a source of it such as rivers, streams, lakes and so. Groundwater is very important especially where there is no surface water; people depend on surface and ground water for several purposes such as drinking industrial, agriculture and irrigation. Students will be interested From where the water coms and the processes effect the water by studying the water cycle .The most important processes are precipitation, evaporation and evapotranspiration, infiltration and percolation. Also student will understand the important of quantity and quality of water by studying water balance and hydrochemistry , this study let the student to be responsible to save water and leave it clean. This course is very important for all geology students in there practical life after they graduate most places need a Hydrologist such as Dam directory, Groundwater directory and water resources companies in public and private sectors and other directories.  |
| **12. Student's obligation**The student’s obligation during the course is attendance in the class or lab for about three hours for studying the practical part of the course. Every lab there are many exercise to solve after a brief explaining for the theoretical part and then students must write a report with a discussion of what they did in the lab. There are marks on the attendance of the students and on the work of the students and on their reports.  |
| **13. Forms of teaching**1. Data show . 2.Green or black board. 3.White board and magic pens. |
| **14. Assessment scheme** There will be one examination via the course, quizzes some times, in addition the student should be ready for negotiation .The attendance, classroom activities, and reports, discussions . ؟‌ |
| **15. Student learning outcome:**In this course student learn the important of Water and how to respect this resource that god gave us and how to protect it from reducing and pollution. Water is the elixir of life, without it life is possible, people depend on surface and ground water for several purposes such as drinking industrial, agriculture and irrigation, so it is necessary for student to understand the important of quantity and quality of water and to be responsible to save water and leave it clean.There are many directories and water resources companies in public and private sectors where geology students can attend after they graduate such as Dam directory, Groundwater directory and water resources directory, so this branch is very important for the practical life after graduation where most places need a Hydrologist..  |
| **16. Course Reading List and References‌:**References of the subject1-Groundwater Hydrogeology , 1980, David K. Todd.2-Applied Hydrogeology , 1994, C.W. Fetter.3-Hydrogeology , 1966, Davis & De Wiest.4-Hydrology for Engineers , Geologists ,1997 ,Sergio E. Serrano.4-In addition to many other references. |
| **17. The Topics:** | **Lecturer's name** |
| 1st week The main references of the subject ,definitions of hydrology and hydrogeology, Water on the land, Hydrologic Cycle , Minor cycle, Inner cycle, systematic representation of Hydrologic Cycle.2nd weekCauses of precipitation, Types of rainfall , Frontal precipitation, Convective precipitation, Orographic precipitation , Instruments for measurement of rainfall(Rain Gauges), Ordinary rain gauges , Recording rain gauges .3rd week The time of rainfall , Average rainfall depth , The Arithmetic Mean Method, The Thiessen Polygon Method , The Isohyetal Method , Hydrometeorological Water Balance, Water availability elements , Water losses elements , Water Losses elements .4th weekEvaporation And Evapotranspiration , Potential evapotranspiration, Thornthwaite Method, Blaney-Criddle Method , Kharrufa Method , Water Surplus and Water Deficit .5thweek Infiltration , Infiltration Terminologies, Factors Affecting Infiltration Rate , Modeling Infiltration, Horton Equation (1939), Kostiakov’s model, Philip’s model , Philip Equation, Green-Ampt Equation, Nikolov (1983) classification .6th week Measurement of Infiltration, Infiltrometer , Rainfall Simulator , Flooding Type , Hydrograph Analysis , ring infiltrometer , the tension infiltrometer.7th week STREAM DISCHARGE , Manning Equation , methods for measuring the river discharge, Mid-section method , The mean section method, Dilution Gauging Method .8th weekDescription of hydrograph , Factors affecting flood hydrograph , Hydrograph Separation or Base flow Separation methods, Terms for description the nature of surface runoff , Relationship Between GW & SW . 9th week Classification Of Formations According to their porosity and permeability , Classification of Aquifers according to its situation and water table , Classification of aquifers according their horizontal extension and shape . 10th weekHydrogeologic Rock Unit , Porosity , Specific yield , Hydrogeologic rock units classified according its porosity , factors controlling the porosity of the rx and soils .11th week Permeability and Coefficient of Permeability , Hydraulic Conductivity Estimation , horizontal conductivity , vertical conductivity , Transmissivity ,storativity, Specific storage, Storativity or Storage Coefficient .12th week Darcy's Law, Reynolds Number, Homogeneity and Isotropy, Flow Net . 13th weekWell hydraulics , steady flow in a confined aquifer, steady flow in un confined aquifer.14th weekWater quality ,chemical , physical , and biological ,chemical analysis of water samples, Graphical representation of Water Chemical analysis.15th week Types of wells , advantages of drilling mud, well completion , well development.  | Lecturer's nameex: (2 hrs)ex: 14/10/2015 |
| **18. Practical Topics (If there is any)** |  |
| Week 1: Exercises for point measurement of precipitation by using histograms (bar-graphs) and continuous curves. Estimation of missing precipitation data by using normal ratio method.Week 2: Determining the effective depth precipitation for a basin by using the arithmetic mean, Isohyetal and Thiessen methods. Week 3:Determining the monthly potential evapotraspiration by using data of temperature and sunshine by using Thornthwait, Blany Cridle and Kharofa method. Then determining the water surplus and water deficit.Week 4: Exercises to determine infiltration rates and infiltration capacity by using Davis equation with illustrating the relation between infiltration rates and time on normal graph paper. Week 5: Determining the total discharge for a cross sectional area of a steam by using data of velocity and depth for several stations and by using Mean and Mid section methods.Week 6: Exercises to separate base flow for a stream discharge hydrograph by using Straight line method, Fixed base length method, Variable slope method and Kunkles method.Week7: Monthly Examination. Week 8: Relation between water level in streams and ground water level in three types of streams: Influent, Effluent and Equifluent streams by constructing ground water level maps and drawing cross sections for the streams.Week 9: Exercises to study the three types of Aquifers: confined, Unconfined and Perched aquifer by drawing stratigraphic cross section for subsurface data of several wells oriented in same direction.Week 10: Exercises to determine the aquifer characteristics (discharge , transsmisivity ,hydraulic conductivity). Week 11: Determining aquifer characteristics by using three point problem .Week 12:Exercises to prepare a flow net by using equipotential lines and flow lines and determining aquifer discharge by using flow net.Week13: Well Hydraulics Pumping tests. Three methods (Theis, Jacob and Chow method) are used to determine transsmissivity and storage coefficient for an aquifer by using data of drawdown from an observation well.Week14: Presentation of chemical analysis results for groundwater by using several diagrams.Week15: Review for all labs.Week16: Monthly Examination.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Lecturer's nameDr imaddadin omer hassan |
| **19. Examinations:*****The examination will contain different types :***1-Explanations.2-True or false.3-Drawings and sketches and its labling . 4-Multiple choice.5-Interpretation ,giving the reasons. |
| **20. Extra notes:**None. |
| **21. Peer review پێداچوونه‌وه‌ی هاوه‌ڵ** .‌‌  |

**Course Book**