

**University of Salahaddin**

**College of Science**

**Department of Geology-Third year**

**Erbil-Iraqi Kurdistan Region**

**Course book-Applied Geophysics**

**(Theory and Practical)**

**Third Year Students**

**Academic Year: 2012/2013 …………………… Date: November 2017**

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**Theory Practical**

**Abdulwehab Noshad (M.Sc.)**

**Office hours**: see the schedule on the departments board and my office door

**Hall** **and lecture table:** Will be given later

**Course objective**

**1- Theory (two hours weekly)**

The course covers step by step the theoretical principles of using physical phenomena in the exploration of the subsurface in both local and regional scales. Present text books together with print media or internet articles which deal with currentsubject are used. In the third class the student should know some geological basics which are necessary to understand such as physical geology, mineralogy, petrology as well as some information got from (general geology) of the first class. Moreover the student knows something about physics and mathematics which should be in mind when studying geophysics. The course will give students a better understanding of a number of geophysical methods, each depending upon one or more of the physical properties of rocks such as density, magnetic susceptibility, velocity of seismic waves and electrical properties of rocks and fluids. The student should be able how to get data, process data and interpret in view of geology. He should be also able to use the suitable method/s for each geological problem. The methods which will be covered during the academic year are; gravimetric, magnetometric, seismic and electric.

**2- Practical (three hours weekly)**

We use to make the three practical hours follow the theoretical hours by at least one week in order to give the student enough time to apply his latest knowledge in processing and interpreting data. This is done by solving problems that are related to the theoretical knowledge. These problems cover; principles, data reduction such as terrain, drift or duirnal, Bouguer….etc, processing (regional and residual) and interpretations in gravity and magnetic methods. The same routine is repeated for seismic and electrical methods.

**Forms of Teaching**

Different forms of teaching will be used to reach the objectives of the course: power point presentations for the head titles, definitions and summary of conclusions, classification of materials and any other illustrations. Besides of that worksheets in the form of problems (mostly got from field data) will be designed to let the chance for practicing on several aspects of the course in the practical classroom. 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 and understand the required lectures immediately after getting them regularly as all of them are foundations for the course. Lecture’s notes on the power point are for supporting and are not enough for you, you should read the text book as well and participate discussions.

**Grading**

The students are required to do two or three closed book exam during the year besides short exams (quizzes) either in theoretical or practical class. The exams as well as classroom activities and attendance have 40 marks (25 theory and 15 practical). There will be a final exam out of 60 marks (40 theory and 20 practical).

**Text books**

1-Kearey, B. and Brooks, M. (1991), An Introduction to Geophysical Exploration: Blackwell Scientific Publications, 254 p. (dept. library)

2-Reynolds, J.M. (1997), An Introduction to Applied and Environmental Geophysics: John Wiley and Sons. 796p. (Gravity and Magnetic parts are present in dept. library)

3-Dorbin, M.B. (1976-1983), Introduction to Geophysical Prospecting: McGraw Hill book comparison. 630p. (dept. library)

4**-**Grant, F.S. and West, G.F. (1965), Interpretation theory in applied geophysics: New York, McGraw Hill. 583p. (College's library)

5-Mares, S. (1984), Introduction to applied geophysics: D. Reidel Pub. Co. Dordrecht- Boston- Lancaster, 581p. (College's library)

6-Sharma, V.P. (1986), Geophysical Methods in Geology: PTR Prentice Hall, New Jersy, 2nd Ed. 442p. (The Arabic copy is present in dept. library)

7-Sleep, N.H. and Fujitta, K. (1997), Principles of Geophysics: Blackwell Sci. Massachusetts, U.S. 586p. (College's library)

The student should know that the core materials of the course lecture’s notes consists of some of the above books, articles from internet and personal experience. Make sure you should borrow and read some of the materials and prepare well before going for the exams. It is good to make a daily review for given lectures.

Students are encouraged to search for any other materials that may help improve their English language ability in reading, writing, listening and speaking.

**Course programme**

The following topics will be discussed through 25-30 weeks during the academic year.

**T h e o r y**

**Introduction to Geophysics**

Definitions:Geophysics, Geophysics and Geology

Applied Geophysics, Pure Geophysics, Environmental Geophysics, Passive Geophysical Methods, Active Geophysical Methods, Exploration Geophysics methods

**Gravity Method**

Definition, Applications, Principles, Newton’s law, Acceleration of gravity

Magnitude of Gravity Anomaly

Stages of a gravity survey

Types of gravity measurements; Absolute and Relative, Units

-Gravity Corrections (Reductions):

Instrument drift, Free Air Correction, Bouguer Correction, Latitude

Correction and Terrain (Topographic) Correction

Gravimeters: stable and unstable

Field Activities:

Interpretation of Gravity Data

Separation of Anomalies

Graphical Residualizing, Mean Value Method

Qualitative and Quantitative interpretations

**Magnetic Method**

Introduction, Basic concepts and definitions:

Colom’s law, permeability, magnetic field, Intensity of magnetization,

Magnetic susceptibility, Curie temperature, Feromagnetic materials and

Remnants.

Origin of Geomagnetic field and elements

Magnetic anomalies, how do they form?

Magnetometers

Field procedure

Variations of field with time and Corrections

Interpretation of magnetic data

**Seismic Method**

Introduction, Wave Characteristics

Seismic Waves, Stress and Strain, Elasticity

Types of Seismic Waves

Body waves

Surface waves

Seismic wave velocities

Time average equation to estimate rock porosity

Ray paths in layered media

Reflection and transmission of normally incident seismic rays

Reflection coefficients, Reflection and refraction of obliquely incident rays

Snell's law

Critical refraction

Seismic data acquisition systems

Seismic energy sources, Transducers

Seismic reflection surveying

Geometry of reflected ray paths

Average velocity and total one way travel time

Single horizontal Reflector

Intercept time, Velocity determination

Moveout, Multiples

Data acquisition

Multiple shot points and, Common midpoint, Common midpoint gather

Seismic refraction surveying

Geometry of the refracted ray paths, Travel times

Calculation of the depth of the refractor

Multilayer case

Dipping layer case

Travel time calculations for a dipping refractor

**Electrical Methods**

Classification

Electrical Resistivity Method

Definitions, Ohm's Law, Current conducting ways

Apparent resistivity

Point current electrode on a homogeneous earth

Point Electrode Configuration

Electrode Spacing

Vertical Electrical Sounding (VES)

Plotting Data

Field Effects upon Measurements

Qualitative Interpretation

Quantitative Interpretations

Two-Layer Case

Multi-layer case

The Geo-electrical Sections

**P r a c t i c a l**

First semester: 10 to 13 labworks concerning solving problems in gravity and magnetic methods including principle theories, corrections, processing and interpretations.

Second semester: 10 to 13 lab works concerning solving problems in seismic and resistivity methods including theories principles, corrections, processing and interpretations.

**Learning outcome**

The student will be learned how to chose a geophysical method for solving certain geological problems, how to design the field plan and prepare logistics, how to collect data, process it and interpret in the simplest ways leaving sophisticated points for further studies.

**Final exam** will be determined by the exam board

*This* ***syllabus*** *may be subject to changes for any argent, if any changes happened the student will be notified.*

**Missed exams/quizzes:**

may be retaken only if the instructor is satisfied with the reasons given by a student for being absent from the exam/quiz. If a student has an unavoidable conflict of significance which he/she knows about in advance of an examination he/she MUST notify the instructor prior to the day of the exam. In cases of emergency (e.g., health problems) the student MUST provide sufficient evidence of the emergency (e.g., a note from a doctor) to the instructor before any action will be considered. Exams will be retaken only at the discretion of the instructor.

***Important notes for the syudent***

*a. Be prepared for class especially for labs; bring your own calculator, graph paper, ruler, pencil…etc.*

*b. The ones that do the best in the class are those that attend regularly*

*c. Turn off your cell-phone device inside the class*

*d. Pay attention and write every thing given by the instructor in the class.*

*e. Ask questions and participate discussions.*

*f. Review and compare your notes with your colleagues quietly.*

*g. Utilize textbooks and web resources.*

*h. Do your own work by yourself and use office hours (Not just before the* *exams).*

*i- Do not cheat and do not help others to cheat.*