Department of Earth sciences and petroleum

College of Science

University of Salahaddin

Subject: Near surface geophysics

Course Book – Year 4 / First semester

Lecturer's name: Sirwa Qader Smail (M.Sc)

Academic Year: 2022/2023

Course Book

1. Course name	Near surface geophysics
2. Lecturer in charge	Sirwa Qader Smail
3. Department/ College	Earth sciences and petroleum / Science
4. Contact	e-mail: sirwa.gardi@su.edu.krd Tel: 07504753127
5. Time (in hours) per week	Theory: 2 Practical: 2
6. Office hours	6 hours per week
7. Course code	
8. Teacher's academic profile	My name is Sirwa Qader Smail; I worked in University of Salahaddin since 2003 as researcher assistance in Department of Geology. I got M.Sc. Degree in Geophysics from Salahaddin University/Department of geology in 2010. I have been lecturer since 2017. I participated in studying many subjects such as; practical environmental Geology (Environmental science department), practical Crystallography, practical Rock forming minerals, Practical Clay mineralogy, Industrial geology and geophysics. In addition to these I participated in summer field course and supervised many undergraduate research students. I teached theoretical and practical Clay Mineralogy, Industrial Geology for fourth year class and electrical resistivity method for forth year class (First course). I have teached Practical Geophysics (Gravity and magnetic) for third year (First course), theoretical and practical seismic and resistivity course (Second course).
9. Keywords	Ohm's law, Resistance, Resistivity, Schlumberger array, Wenner array, Vertical electrical sounding (VES), Profiling.

10. Course overview:

Geo-electrical methods are applied to map the resistivity structure of the underground. Rock resistivity is of special interest for hydrogeological purposes: it allows, e.g., to discriminate between fresh water and salt water, between soft-rock sandy aquifers and clayey material, between hard rock porous/fractured aquifers and low-permeable claystones and marlstones, and between water-bearing fractured rock and its solid host rock. These techniques are used extensively in the search for suitable groundwater sources and also to monitor types of groundwater pollution; in engineering surveys to locate sub-surface cavities, faults and fissures, permafrost, mineshafts, etc.; and in archaeology for mapping out the areal extent of remnants of buried foundations of ancient buildings, amongst many other applications.

The understandings of the fundamental concepts of the subject were carried out by the direct application of the theoretical part in laboratory. Therefore, this subject will be important to the students after graduation in many fields like agriculture, environment, archaeology, mineral exploration and engineering.

11. Course objective:

The essential objective of the course of Near surface geophysics is to give an overview for students on this method and its advantages, applications and finding the main cause for a lot of problems like: detecting subsurface structures, cavities, faults and weak zones, also detecting contamination zone and finding the best location for drilling water well. In addition, by this method the depth of groundwater level, the thickness of aquifer and groundwater flow direction can be determined.

12. Student's obligation

Throughout this course, the students contribute in the laboratory by asking and answering. Also they assign by homework during each laboratory. Most of the students attend to the laboratory. All of the students are committed in their exams and instructions.

13. Forms of teaching

Different forms of teaching are used during the course, like:

- White board and power point presentation for the titles, sub-titles and conclusions, in addition to figures and plates, in practical part.
- Homework is given for students during course in practical part.
- Practicing on the resistivitimeter instrument and data measurement.
- Data processing and interpretation in the geosoftware laboratory.

14. Assessment scheme

Grading:

There is one practical exam at the end of the semester, in addition to quiz exams during course.

- The final mark of semester is **50%**, and divided to:

15% for theoretical part, and

35% for practical part; also the practical mark is divided to two marks: exam and reports.

- The final exam is from **50% (50%** on theory).

Therefore the total mark will be **100%**.

15. Student learning outcome:

Near surface geophysics course is related with many other geological specializations. During this course the student learn details things about this relation, in addition to application of electrical resistivity in the future. Geophysics in general is used as a tool to determine characteristics of subsurface materials without seeing them directly Therefore, it is very important for student to have an enough idea about the principle of this method, taking data, processing and interpretation (conversion raw data to the geological materials).

16. Course Reading List and References:

- Kearey, P., Brooks, M. and Hill, I, (2002). An introduction to geophysical exploration. 3rd Eddition, Black well Science Ltd, 262p.
- Kirsch, R., (2006). Grounwater Geophysics. A Tool for Hydrogeology. Springer Berlin Heidelberg New York, 493p.
- Knodel, K., Lange, G. and Voigt, H. J., (2007). Environmental Geology. Handbook of Field Methods and Case Studies. Hannover Federal Institute for Geosciences and Natural Resources, Springer Books, 1357p.

- Mussett, A. E. and Aftab khan, M., (2000). Looking Into the Earth: An Introduction to Geological Geophysics. Cambridge University Press, 470p.
- Parasnis, D.S., (1997). Principles of Applied Geophysics. Chapman and Hall 5th ed. 429p.
- Reynolds, J.M., (2011). An Introduction to Applied and Environmental Geophysics. Jhon witey and Sons. 796p.
- Telford, W.M., Geldart, L.Pi and Sheriff, R.F. (1990). Applied Geophysics. Cambridge University Press Second Edition, 770p.

17. The Topics:	**Lecturer's name**
Week 1: Introduction, Geophysics, Objectives and Near surface geophysics **Week 2:** Electrical methods, Direct current resistivity method, Applications **Week 3:** Theoretical basics of electrical resistivity method, Resistance and Apparent Resistivity, Principles of electrical resistivity method, Petro-physical basics **Week 4:** Electrode spreads, Current penetration depth versus electrode spacing **Week 5:** Field operation of electrical resistivity method, Survey design, Influence of noise during measurement **Week 6:** Data processing, Interpretation (Qualitative and Quantitative) **Week 7:** Types of electrical sounding curves (Qualitative interpretation) **Week 8:** Geo-electrical section (Quantitative interpretation) **Week 9:** Geological interpretation, Limitations of resistivity interpretation **Week 10:** 2D electrical resistivity tomography, 2D electrical surveys – Data acquisition, presentation and arrays **Week 11:** 2D forward modeling program **Week 12:** 2D inversion program **Week 13:** 2D Field examples **Week 14:** 2D section interpretation **Week 15:** 3D electrical resistivity tomography	Sirwa Qader Smail 2 hrs. per week
18. Practical Topics	**Lecturer's name**
Week 1: Course outline and Ohm's law Week 2: Resistance & Apparent resistivity Week 3: Archie's law Week 4: Resistivity measurement with Wenner & Schlumberger array Week 5: IPI2win software Week 6: Interpretation of resistivity data	Ms. Sirwa Qadir Smail 2 hrs. per week

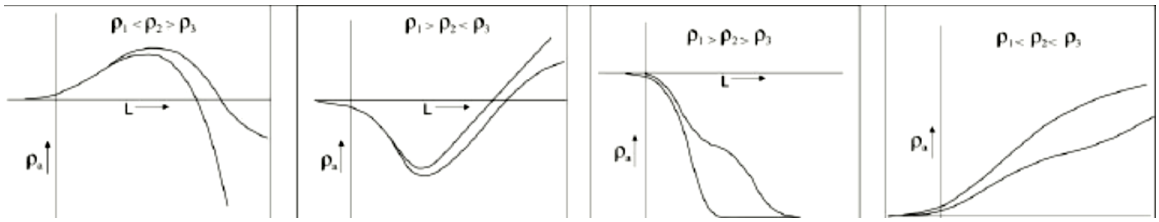
A. Qualitative interpretation Week 7: Interpretation of resistivity data B. Quantitative interpretation Week 8: pseudo-section & Modelling software Week 9: Examination. Week 10: Geo- electrical sections Week 11: Geo-electrical section interpretation Week 12: Applications of resistivity method Week 13: Geo-electrical section (Environment) Week 14: Geo-electrical section (Hydrogeology) Week 15: Geo-electrical section (Engineering)	

19. Examinations:

Q\ What is apparent resistivity and how can you determine it?

Q\ What is the difference between Schlumberger and Wenner array geometrically?

Q\ Write the type of curve for the following VES curves?



Q\ Given the following information and the accompanied master curve, it is required to interpret it. These data are collected using wenner configuration.

a (m)	ρa (Ω.m)
6	130
10	104
20	70
40	50
62	49
100	48
200	47

20. Extra notes:

The course book lacks to the problems which affect the educational process. These problems include the large number of students in each stage, diminution of instruments, and absence of appropriate rooms for lecturers to develop themselves. Finally, about the department of geology absence of financial support to carry out scientific trips and field course in a typical situation.

21. Peer review

Dr. Harbe Anwer and M. Abdulwahab Nawshad