King Fahd University of Petroleum & Minerals
College of Petroleum Engineering and Geosciences
Department of Geosciences
Term 181
GEOP 502: Potential Field Methods (3-0-3)

Meeting Time	U and T (6:45 – 8:00 pm)
Meeting Location	76 – 2120

Instructor (Primary)	**Co-Instructor**
Pantelis Soupios	Abdullah Alshuhail
76 – 2245	76 – 2215
panteleimon.soupios@kfupm.edu.sa	shuhail@kfupm.edu.sa

COURSE DESCRIPTION

In-depth study of potential theory as applied to the gravity and magnetic methods of exploration, field equations and their solutions, gravity and magnetic potentials, representation of gravity and magnetic fields in spherical harmonics, regional gravity fields, acquisition, mapping and data enhancement, analysis and processing of potential field data, filtering, continuation theory of fields, 2D (profile) forward modeling and 3D (grid depth) modeling methods of the gravitational and magnetic responses of various bodies and final interpretation of gravity and magnetic data.

PREREQUISITE GEOP 404 or consent of instructor

TEXTBOOKS J. Derek Fairhead, 2015, Advances in Gravity and Magnetic Processing and Interpretation, EAGE, pp 352, ISBN9789462821750

Blakely, R.J. 1995. "Potential Theory in Gravity and Magnetic Applications" Cambridge University Press, Cambridge

Hinze, W.J., van Friese, R.R and Saad, A.H. 2013." Gravity and Magnetic Exploration: Principles, Practice and Applications", Cambridge University Press.

REFERENCES

- Telford, W., Geldart, L. and R. Sheriff. 1990. Applied Geophysics. Cambridge University Press, New York.
- Ramsey, A.S. 1964. "Newtonian Attraction", Cambridge University Press, Cambridge
- Grant, F. and West, G. 1965 "Interpretation Theory in Applied Geophysics", McGraw Hill, New York
- Nettleton, L.L. 1976. "Gravity and Magnetics in Oil Prospecting". McGraw Hill Book Co., New York

(§) supplemental materials will be distributed in the class.

COURSE OBJECTIVES:

Upon successful completion of this course, students will be able to understand and apply advanced concepts related to:

1. Field quantities, their potentials and mathematical description
2. Representation of gravity and magnetic fields in spherical harmonics
3. The analysis, processing and filtering of potential field data
4. Forward and inverse problems of potential fields
5. Modeling of 2-D and 3-D sources
6. Interpretation of potential field data

In essence, the course provides an insight into the acquisition, advanced processing and interpretation of gravity and magnetic data used in today's oil and mineral exploration industries.

COURSE GRADE

The final grade will be based on the following distribution:

Attendance & Participation	10%
Quizzes	10%
Assignments	20%
Literature Review Presentations	10%
Midterm Exam	20%
Final Exam	30%
Total	**100%**

The grading scheme (A^+ through F) followed in this course is that of the University and is described in the Graduate Bulletin (GB):

http://registrar.kfupm.edu.sa/docs/pdf/Grad_Bulletin_15-17.pdf

Attendance policy and ethic of conduct and other relevant information can be found in the GB. Students are expected to have read and understood their responsibilities and adhered to them as described therein.

COURSE OUTLINE

Topic and Associated number of Lecture (preliminary)

Part	Topics	Lectures
1	Introduction, Earth's Gravity and Magnetic Fields	**2**
2	Gravity and Magnetic Methods Principles	**2**
3	Gravity and Magnetic Anomalies types	**3**
4	Potential fields data acquisition, processing and QC	**4**
5	Mapping and data enhancement	**4**
6	Analysis and processing of potential field data	**4**
7	Forward and inverse problems of potential fields	**4**
8	Quantitative interpretation of potential fields data	**4**
9	3D modelling methods	**3**
	Total Number of Lectures	**30**

METHOD OF INSTRUCTION

There will be two lectures per week. Lecture materials will be either posted online or handed to the students on the day of the lecture. Students are encouraged to augment the class notes with additional material retrieved from references and other resources (such as articles, books).

HOMEWORK

Homework assignments will be an important element of the course. They involve mathematical manipulations as well as computer-based assignments involving real data and the sue of software packages. Most assignments only require the use of common packages (MS-Office) and others require specialized packages (Matlab and commercial geophysical modeling/inversion software). Solutions to assignments should be submitted in the form of detailed reports showing all theoretical and practical aspects as well as limitations.

HOMEWORK RULES

- No late homework or assignment will be accepted without prior consultation.

- *The homework you hand in must be neat, and must either be typed or written in pen (not pencil!)*. Please do not turn in homework that is messy or that has anything that's been erased and written over (or written over without erasing), making it harder to read. (Note: "written over without erasing" includes not just superimposing one letter written in ink on another, but writing something in pencil and then tracing over it in pen. The latter practice leads to an eye-straining "double vision" effect. Don't do it.). Anything that is difficult for me to read will be returned to you ungraded.

- Please only *write on one side of the page for your homework*.

- Work everything out for yourself on scrap paper first. Carefully rewrite what you're handing on clean sheets of white paper, *leaving wide margins (left and right and top and bottom) and enough other space for me to write comments*.

- Staple the sheets together in the upper left-hand corner. *The staple should be close enough to the corner that when I turn pages, nothing that you've written is obscured*. (If you have trouble stapling this way, you haven't left wide enough margins at the left side and/or top of the page.

- **Academic honesty:**

    - For purposes of preparing your hand-in homework, *no aid that involves anything but your own brain, your textbook, your notes, and handouts, is authorized*. You may consult with your classmates and friends for help on the homework, but you may not copy their solutions. You must hand in your own work. You may not show one another your work. Showing one another your work is not discussion/consultation.

    - *Cheating on homework or exams is unethical and is a serious violation of the University policy*. Please see the student handbook for the procedures that govern incidents of academic fraud such as cheating on a homework assignment or on an exam. Punishment for *cheating* and *plagiarism*, which includes sharing of homework, ranges from r*eceiving a zero grade for the assignment, an F for the course, and can even result in your expulsion*.

LITERATURE REVIEW PRESENTATIONS

Each student is required to deliver 2 technical presentations during the semester (timing will be announced far in advance) on topics related to the course, i.e. gravity and magnetic methods. Students should choose a paper from a reputable journal focusing on for hydrocarbon exploration and send the title (for approval) by the end of the second week. The marking rubric for the presentations will be posted to the blackboard.