Kasdi Merbah University – Ouargla (UKMO)

Faculty of Hydrocarbons, Renewable Energies, Earth and Universe Sciences (FHERSTU)
Department of Earth and Universe Sciences

Course Syllabus

Academic Year: 2025–2026
Level: 3rd Year Bachelor
Degree Program: Applied Geophysics
Semester: 5
Teaching Unit (UEF): 51
Course Title: Gravimetry 1
Credits: 3
Coefficient: 2
Total Hours: Lectures: 24 h | Practicals: 24 h

Course Instructor

Name: Nemer Zoubida
Position: Assistant Professor
Email: nemer.zoubida@univ-ouargla.dz

Course Objectives

The main objective of this course is to introduce students to the fundamental principles of gravimetry, a branch of geophysics that studies variations in the Earth's gravitational field and their relationship to the planet's internal structure.

At the end of the course, students should be able to:
- Understand the nature and properties of the Earth's gravitational field;
- Explain the shape and internal constitution of the Earth using gravimetric data;
- Compute and interpret Bouguer anomalies;
- Understand the principles of isostatic compensation;
- Operate and calibrate a gravimeter in both laboratory and field conditions.

Recommended Prerequisites

Basic knowledge of mathematics (vector analysis, differentiation, integration) and physics (Newtonian mechanics, field theory) from the first year of the Bachelor program is sufficient.

Course Content

- Chapter 1: The Gravitational Field
    - Newton's First Law – Gravitational Force
    - Newton's Second Law – Gravitational Field

  - Work and Gravitational Potential
  - Field Calculation – Gauss's Theorem
  - Flux through an arbitrary surface
  - Flux through a closed surface

- Chapter 2: Gravity, Tides, and Hydrostatics

  - Definition of gravity and apparent gravity
  - Gravitational tides
  - Hydrostatics, level surfaces, and the geoid

- Chapter 3: Shape and Constitution of the Earth

  - Historical works and Clairaut's theorem
  - Measurement of the Earth's circumference (Eratosthenes)
  - Clairaut's theorem
  - Definition and computation of the Bouguer anomaly
  - Systematic character of Bouguer anomalies
  - Pratt–Hayford, Airy, and Vening–Meinesz isostasy theories

- Chapter 4: Gravity Measurements

  - Absolute measurement instruments (free-fall and pendulum methods)
  - Gravimeters: principle, calibration, and drift

Laboratory and Field Practicals

- Calculation of the gravitational field
- Hydrostatics and tides – application exercises
- Isostasy – numerical exercises
- Principle of gravimeter operation
- Gravimeter calibration and preparation of a field survey
- Establishment of a reference base network
- Gravimetric corrections and density selection
- Map drawing and qualitative interpretation
- Regional–residual separation
- Quantitative interpretation and modeling

Teaching Methods

- Lectures supported by visual presentations and schematics
- Tutorials (TD) with problem-solving and applied exercises
- Laboratory and fieldwork using gravimeters
- Case studies and small interpretation projects

Assessment Methods

Continuous assessment: 40% (Assignments, participation, lab reports, mini-projects)
Final exam: 60% (Written exam with anomaly computation and interpretation problems)

Main References

- Schoeffler, J. (1975). Applied Gravimetry. Editions Technip, Paris.
- Lecture notes prepared by the course instructor.
- Research theses available at the department library.
- Telford, W.M., Geldart, L.P., Sheriff, R.E. (1990). Applied Geophysics, Cambridge University Press.

Expected Learning Outcomes

By the end of this course, students will be able to:
- Define and explain key concepts of gravity, potential, and gravimetric anomalies.
- Compute Bouguer anomalies from field measurements.
- Identify possible sources of gravity anomalies.
- Apply isostatic principles to interpret deep geological structures.
- Operate and calibrate a gravimeter and design a field survey.