UAB Universitat Autònoma de Barcelona	Physics for Geology Code: 101041 Credits: 10	2026/2027

Degree programme	Type	Course
Geology	FB	1

Contact lecturer

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Group languages

You can consult this information at the end of the document.

Prerequisites

If the student has not studied Physics after completing compulsory secondary education, it is advisable that they review and strengthen the basic Physics knowledge acquired during that stage. It is also recommended that they revise fundamental mathematical concepts, such as derivatives and integrals, as well as basic vector operations and elementary concepts of trigonometry.

Objectives

This course aims to provide and consolidate the fundamental Physics knowledge required to understand and successfully undertake other subjects within the Bachelor's Degree in Geology.

Specific learning objectives

1) To understand the main physical quantities and their units.

2) To understand basic physical phenomena and describe them using appropriate mathematical language.

3) To apply physical concepts, laws, and mathematical expressions to the solution of problems.

4) To relate and apply fundamental physical concepts to situations and processes relevant to Geology.

Learning outcomes

- CM17 (Determine the relevant physical parameters and magnitudes associated with problems and practical cases in geology.) Determine the relevant physical parameters and magnitudes associated with problems and practical cases in geology.
- CM18 (Organise appropriate tests to solve specific problems of basic or applied research in geology based on the principles of physics.) Organise appropriate tests to solve specific problems of basic or applied research in geology based on the principles of physics.
- KM21 (Identify the physical principles that govern and condition the Earth's dynamics.) Identify the physical principles that govern and condition the Earth's dynamics.
- KM22 (Describe the main techniques and instruments for the development of basic research and the application of geology according to the basic principles of physics.) Describe the main techniques and instruments for the development of basic research and the application of geology according to the basic principles of physics.
- KM23 (Determine the age of the Earth and of geological processes based on the physical principles of isotope decay of radioactive chemical elements.) Determine the age of the Earth and of geological processes based on the physical principles of isotope decay of radioactive chemical elements.
- SM19 (Use the different physical properties of geological materials for their identification and possible use.) Use the different physical properties of geological materials for their identification and possible use.
- SM20 (Demonstrate the ability to work in a team, selecting the most appropriate instruments or physical principles to solve a geological problem.) Demonstrate the ability to work in a team, selecting the most appropriate instruments or physical principles to solve a geological problem.
- SM21 (Accurately communicate to the general public the basic physical information associated with a geological problem.) Accurately communicate to the general public the basic physical information associated with a geological problem.

Contents

The course content is organized into ten thematic units and six seminars. At the end of each thematic unit (except the first), the main areas of Geology in which the concepts studied are applied are identified, and relevant application examples are presented.

1. Mathematical Foundations. Introduction to Physical Quantities and Their Representation

Mathematical foundations: trigonometric relationships, scalar product, vector product, derivatives, and integrals.

Introduction to physical quantities and their representation: coordinate systems, scalar and vector quantities, units, the International System of Units (SI), unit conversion, scientific notation, orders of magnitude, and significant figures.

2. Kinematics, Dynamics, and Gravitation of Point Particles

Kinematics: displacement, average velocity, and instantaneous velocity. Uniform rectilinear motion. Acceleration. Uniformly accelerated rectilinear motion (motion with constant acceleration). Two-dimensional kinematics: projectile motion. Three-dimensional kinematics. Circular motion.

Dynamics: forces in nature. Linear momentum. Newton's laws of motion (Newton's first law or law of inertia, Newton's second law, and Newton's third law or action-reaction law). Inertial mass and gravitational mass. Frictional forces. Torque. Angular momentum. Rotational dynamics.

Gravitation: planetary motion. Kepler's laws. Newton's law of universal gravitation. Earth's gravity.

Areas of Geology in which the concepts are applied: geological engineering, internal geodynamics, geophysics, geodesy, etc.

Application examples: rockfalls, slope stability, landslides, etc.

3. Work and Energy of Point Particles

Mechanical work performed by a force. Kinetic energy. Potential energy. Conservative forces. Conservation of mechanical energy and its applications. Non-conservative forces. Power.

Areas of Geology in which the concepts are applied: geological engineering, internal geodynamics, geophysics, etc.

Application examples: rockfalls, extraction of mineral resources, subsurface exploitation (natural reservoirs of water, gas, and petroleum), etc.

4. Particle Systems and Rigid Bodies: Kinematics, Dynamics, Work, and Energy. Mechanical Properties of Solids

Particle systems: center of mass. Motion of the center of mass of a system. Conservation of linear momentum. Kinetic energy of a particle system. Collisions in two dimensions.

Rigid body: kinematics and dynamics. Torque. Moment of inertia. Rolling motion. Kinetic energy of a rigid body. Conservation of linear and angular momentum.

Mechanical properties of solids: mechanical stress and strain. Tensile stress (Young's modulus). Shear stress (shear modulus).

Areas of Geology in which the concepts are applied: isostasy (compensation of the Earth's topography), rheology, etc.

Application examples: mountain building, fractures, faults, brittle and ductile deformation, diapirism, etc.

5. Fluid Statics and Fluid Dynamics

Fluid statics (hydrostatics): concept of a fluid. Density. Pressure. Hydrostatic pressure. Hydrostatic paradox. Pascal's principle. Buoyant force and Archimedes' principle.

Fluid dynamics (hydrodynamics): flow rate. Continuity equation. Bernoulli's equation. Venturi effect. Viscosity. Turbulence.

Areas of Geology in which the concepts are applied: external geodynamics (hydrogeology, glaciology, etc.), internal geodynamics, etc.

Application examples: glacier movement, lava flows, aquifers, landslides, soil liquefaction, turbidity currents, permeability of natural water, gas, and petroleum reservoirs, rivers, lakes, etc.

6. Thermodynamics: Temperature and Heat

Temperature: Celsius and Fahrenheit temperature scales. Absolute temperature scale. Thermometers. Thermal expansion. Ideal gas law. Kinetic theory of gases (molecular interpretation of temperature).

Heat: heat capacity and specific heat. Phase changes and latent heat. Heat transfer. Sign convention.

Principles of thermodynamics: first law of thermodynamics. Internal energy of ideal gases. Thermodynamic work. Pressure-volume diagram of an ideal gas: isobaric, isothermal, and adiabatic processes. Sign convention. Second law of thermodynamics.

Areas of Geology in which the concepts are applied: petrology, internal geodynamics, etc.

Application examples: cooling of rocks, evolution of magma chambers, convective motions in the mantle, geothermal energy, etc.

7. Oscillations and Waves

Oscillations: simple harmonic motion (period and frequency): mass-spring system. Relationship between simple harmonic motion and circular motion. Energy of simple harmonic motion. Simple pendulum. Damped oscillations. Forced oscillations and resonance.

Waves: wave motion and propagation. Types of waves. Huygens' principle. Harmonic waves. Energy, power, and intensity of harmonic waves. Superposition and interference of harmonic waves. Standing waves. Wave properties: transmission, reflection, refraction, absorption, dispersion, and diffraction (Young's double-slit experiment). Doppler effect. Sound and sound intensity. Nature of light. Seismic waves. Seismic prospecting.

Areas of Geology in which the concepts are applied: seismology, seismic prospecting, crystallography, geophysics, internal geodynamics, etc.

Application examples: structural characterization and phase identification by X-ray diffraction, computed tomography for the study of fossils embedded in rock matrices, etc.

8. Electric Field and Electric Current

Electric field: electric charge. Conductors and insulators. Coulomb's law. Electric field. Electric field lines. Action of electric fields on charges. Electric dipole. Electric flux. Gauss's law. Electric potential difference. Atmospheric electrical phenomena (lightning and thunder). Electric capacitance. Capacitors. Storage of electrical energy.

Electric current: motion of charges. Current density. Electrical resistance and Ohm's law. Electrical power dissipation (Joule effect). Batteries. Electric circuits. Series and parallel combinations of resistors. Equivalent resistance. Kirchhoff's rules.

Areas of Geology in which the concepts are applied: geophysical prospecting.

Application examples: morphological and structural analysis of the Earth's crust and mantle through electrical resistivity and conductivity measurements.

9. Magnetic Field

Magnetic field: force exerted by a magnetic field on a moving charge. Magnetic field generated by a moving charge. Magnetic field generated by electric currents. Magnetic field generated by a current loop. Magnetic field generated by a solenoid. Magnetic dipole moment (or magnetic moment). Magnetic flux. Electromagnetic induction.

Magnetism in matter: origin of magnetism. Magnetic moment and magnetization. Diamagnetism. Paramagnetism. Ferromagnetism. Ferrimagnetism. Antiferromagnetism. Measurement of magnetic properties using a vibrating sample magnetometer. Earth's magnetism.

Areas of Geology in which the concepts are applied: paleomagnetism, geophysical prospecting (geomagnetism), etc.

Application examples: morphological and structural analysis of the Earth's crust and mantle through measurements of local magnetic field variations, prospecting of metallic minerals, and magnetic resonance techniques for the study of fossils embedded in rock matrices, etc.

10. Structure of Matter and Radioactivity

Structure of matter: atoms, chemical elements, and the periodic table. Early atomic models. Evolution of atomic models to the current model. Origin of chemical elements. Isotopes. Electromagnetic spectrum and radiation-matter interaction. X-ray diffraction. Nuclear structure.

Radioactivity: nuclear stability. Radioactive decay. Radioactive activity. Half-life. Concentration. Decay chains. Temporal evolution of activity. Geochronology and geological dating.

Areas of Geology in which the concepts are applied: geochemistry, geochronology, etc.

Application examples: geological dating; structural characterization by X-ray diffraction; X-ray-based computed tomography; morphological characterization by X-ray fluorescence; and the use of stable and radioactive isotopes to identify and quantify geological processes, such as groundwater flow, sedimentation, and erosion, among others.

Throughout the theoretical lectures, efforts will be made to relate the physical concepts studied to examples and situations relevant to Geology, with the aim of contextualizing the course content and highlighting its applicability within this field. Likewise, the problem sets addressed during problem-solving sessions will include representative exercises from each thematic unit, a significant proportion of which will be framed within the context of the geological sciences. In addition, six practical seminars will be conducted to provide direct applications of the Physics concepts learned to the solution of problems and case studies related to Geology.

Seminar 1. Application of Kinematics

Study of the fall and detachment of rock blocks.

Seminar 2. Application of Dynamics

Study of the stability of rock slopes.

Seminar 3. Application of Gravimetry

Study of local variations in the gravitational field to obtain information about subsurface mass distributions. Applications to geodesy and isostasy.

Seminar 4. Application of Solid Mechanics, Waves, and Viscous Fluid Dynamics

Influence of the mechanical properties of solid media on the propagation of seismic waves. Earthquakes and material fracture. Dynamics of viscous fluids: movement of glaciers and lava flows, and groundwater and surface-water flow.

Seminar 5. Application of Heat Transfer by Conduction

Heat propagation in rocks and geological materials.

Seminar 6. Application of Electricity, Magnetism, and Electromagnetic Induction

Study of electrical and magnetic anomalies in the subsurface and their applications in geophysical prospecting.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Seminars	8	0.32	CM17, CM18, KM21, KM22, KM23, SM19, SM20, SM21
Individual student work	125	5	CM17, CM18, KM21, KM22, KM23, SM19, SM20, SM21
Class of problems	28	1.12	CM17, CM18, KM21, KM22, KM23, SM19
Problem solving and submission of problem sets	23	0.92	CM17, CM18, KM21, KM22, KM23, SM19, SM20, SM21
Theory classes	56	2.24	CM17, CM18, KM21, KM22, KM23, SM19

The course will be delivered through three types of learning activities:

1. Directed Learning Activities

a) Lectures

Approximately two hours per week will be devoted to lectures, during which the course content will be presented through board-based explanations supported by presentations. Student participation will be encouraged throughout these sessions, and time will be devoted to addressing questions and clarifying doubts. The presentations used in class will be made available on the Virtual Campus at least two weeks in advance.

To facilitate the understanding of physical concepts, simple experimental demonstrations, both real and virtual, will be carried out. In addition, efforts will be made throughout the course to contextualize the content within the field of Geology through examples and applications related to the geological sciences. Part of the teaching will be delivered in seminar format by members of the Department of Geology, with the aim of presenting specific applications of Physics in different areas of Geology.

b) Problem-Solving Sessions

Students will devote, on average, one hour per week to problem-solving sessions. Problem sets will be made available on the Virtual Campus at least two weeks in advance. Active student participation in the solution and discussion of the proposed exercises will be encouraged.

Attendance at lectures, seminars, and problem-solving sessions is mandatory. Students repeating the course may choose to sit only the final comprehensive resit examination. Any exceptional circumstances preventing regular attendance must be communicated to the teaching staff as soon as possible.

2. Supervised Learning Activities

During both lectures and problem-solving sessions, time will be allocated for students to solve conceptual questions and exercises under the supervision and guidance of the teaching staff.

In addition, individual or group tutorials may be arranged upon request outside scheduled class hours in order to answer questions and provide personalized academic support.

3. Autonomous Learning Activities

Achieving the learning objectives of the course requires continuous independent work by students. This includes studying the theoretical content, solving problems, preparing assessment activities, and reviewing the course materials.

Lecture presentations and problem sets will be available on the Virtual Campus at least two weeks in advance to facilitate preparation and course follow-up.

Note: Fifteen minutes of a scheduled class session will be reserved for students to complete the institutional surveys evaluating both the teaching performance of the instructors and the course itself.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Reports of resolved problems and supervised activities	0,3	4	0.16	CM17, CM18, KM21, KM22, KM23, SM19, SM20, SM21
Individual written tests	0,7	6	0.24	CM17, CM18, KM21, KM22, KM23, SM19, SM20, SM21

The course will be assessed through a continuous assessment system based on two types of activities:

A) Individual Written Examinations (70%)

Four individual written examinations (midterm tests) will be conducted, accounting for 70% of the final course grade. These examinations will include both theoretical content and exercises/problems corresponding to the period being assessed. Attendance at the examinations is mandatory.

B) Student Portfolio (30%)

The remaining 30% of the final grade will correspond to the assessment of the student portfolio, distributed as follows:

- Reports and activities completed during the seminars: 20%.
- Continuous assessment tests carried out throughout the course and submission of exercises during

problem-solving sessions: 10%.

All these activities are mandatory.

To pass the course, students must obtain a grade in all assessable activities.

The final course grade will be calculated from the combination of the grades obtained in Sections A and B.

Retake Examination

Students who have participated in all assessment activities and have not passed the course may take the retake examination (a comprehensive examination covering the entire course syllabus). The grade obtained in this examination will replace the grade corresponding to Section A, while the grade corresponding to Section B will remain unchanged.

Students who have already passed the course may also take the retake examination in order to improve their final grade.

Important: students with a final grade below 3.0 will not be eligible to take the retake examination and will automatically fail the course.

Second and Subsequent Enrolments

Students enrolled in the course for a second or subsequent time must follow the same continuous assessment system and meet the same requirements as students taking the course for the first time.

"Not Assessed" Grade

Students who have completed any assessment activity in the course will not be eligible for a "Not Assessed" grade.

Single Assessment

This course does not offer a single-assessment option.

Use of Artificial Intelligence (AI)

In this course, the use of AI tools is permitted as support in the preparation of submitted assignments. However, all submitted work must clearly demonstrate the student's own original and substantial contribution, particularly in the processing of information and data, critical analysis, interpretation of results, and formulation of conclusions.

Students must disclose whether they have used AI tools, specify which tools were used, and explain the purpose for which they were employed. A lack of transparency regarding the use of AI will be considered a breach of the principles of academic integrity and may result in a penalty in the assessment of the assignment.

Bibliography

1) Volum 1: Paul A. Tipler & Gene Mosca. "Física para la ciencia y la tecnología. Volumen 1: Mecánica, oscilaciones y ondas, termodinámica." Editorial Reverté, sisena edició, 2012.

2) Volum 2: Paul A. Tipler & Gene Mosca. "Física para la ciencia y la tecnología. Volumen 2: Electricidad y magnetismo, luz y óptica." Editorial Reverté, sisena edició, 2012.

3) "Fundamentals of Physics", David Halliday, Robert Resnick & Jearl Walker. Wiley, 10th edition, 2013.

4) "Physics for Geologists", Richard E. Chapman, Routledge, 10th edition, 2002.

5) "Física", Juan Enciso Pizarro, Schaum/McGraw-Hill Interamericana de España S.L., 2a edició, 2005 (solved problems).

Software

No specific program is required.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	annual	morning-mixed
(PAUL) Classroom practices	1	Catalan	annual	morning-mixed
(SEM) Seminars	1	Catalan	annual	morning-mixed
(SEM) Seminars	2	Catalan	annual	morning-mixed