



Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Earth and Atmosphere Sciences (cód. 195)

Branch Geology

1st Year - 1st Semester

Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
FIS0691L	Physics 1.1	Physics	5	Semester	136
QUI1090L	General Chemistry	Chemistry	6	Semester	156
LLT1412L	Elementary A1 English I	Linguistics	0	Semester	45
FIS2195L	Dynamics of Earth I: Atmospheric and Ocean	Physics	6	Semester	156

1st Year - 2nd Semester

Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
FIS0692L	Physics 1.2	Physics	5	Semester	136
GEO0756L	History and Earth Evolution	Geosciences	6	Semester	156
LLT1413L	Elementary A1 English II	Non Available	0	Semester	45
GEO2179L	Mineralogy	Geosciences	6	Semester	162
GEO2196L	Earth Dynamics II: from the Nucleus to the Crust	Physics Geosciences	8	Semester	208

2nd Year - 3rd Semester

Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0730L	Analysis and data treatment in Earth and Atmosphere Sciences	Physics Geosciences	6	Semester	162
GEO0737L	Earth Dynamics III: Superficial Processes	Geosciences	3	Semester	80
INF0878L	Programming	Informatics	6	Semester	156
GEO2194L	Geological Materials	Geosciences	8	Semester	208
Group of Free Options					

2nd Year - 4th Semester

Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0740L	Geohistory and Sedimentary Basins	Geosciences	9	Semester	234



2nd Year - 4th Semester
Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0743L	Field Geology I	Geosciences	3	Semester	78
GEO2180L	Hydrogeology	Geosciences	6	Semester	162
FIS0698L	Earth Physics	Physics	6	Semester	156
FIS0694L	Atmospheric Physics	Physics	6	Semester	156

3rd Year - 5th Semester
Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO2182L	Earth Deformation	Geosciences	8	Semester	208
FIS2183L	Climate Change and Climate	Physics	3	Semester	156
GEO0761L	Geochemical Systems	Geosciences	6	Semester	156
GEO2181L	Georesources	Geosciences	8	Semester	208
FIS2193L	Applied Geophysics	Physics	6	Semester	156
FIS0731L	* Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312

3rd Year - 6th Semester
Branch Geology

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS0731L	Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0746L	Environment Geology and Planning	Geosciences	6	Semester	156
GEO0750L	Marine Geology	Geosciences	6	Semester	156
GEO0766L	GISS in Earth Sciences	Geosciences	6	Semester	156
GEO0745L	Engineering Geology	Geosciences	6	Semester	159
GEO0744L	Field Geology II	Geosciences	6	Semester	156

Branch Geophysics Sciences

1st Year - 1st Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
FIS0691L	Physics 1.1	Physics	5	Semester	136
QUI1090L	General Chemistry	Chemistry	6	Semester	156
LLT1412L	Elementary A1 English I	Linguistics	0	Semester	45
FIS2195L	Dynamics of Earth I: Atmospheric and Ocean	Physics	6	Semester	156



1st Year - 2nd Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
FIS0692L	Physics 1.2	Physics	5	Semester	136
GEO0756L	History and Earth Evolution	Geosciences	6	Semester	156
LLT1413L	Elementary A1 English II	Non Available	0	Semester	45
GEO2179L	Mineralogy	Geosciences	6	Semester	162
GEO2196L	Earth Dynamics II: from the Nucleus to the Crust	Physics Geosciences	8	Semester	208

2nd Year - 3rd Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0730L	Analysis and data treatment in Earth and Atmosphere Sciences	Physics Geosciences	6	Semester	162
GEO0737L	Earth Dynamics III: Superficial Processes	Geosciences	3	Semester	80
INF0878L	Programming	Informatics	6	Semester	156
GEO2194L	Geological Materials	Geosciences	8	Semester	208
Group of Free Options					

2nd Year - 4th Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0740L	Geohistory and Sedimentary Basins	Geosciences	9	Semester	234
GEO0743L	Field Geology I	Geosciences	3	Semester	78
GEO2180L	Hydrogeology	Geosciences	6	Semester	162
FIS0698L	Earth Physics	Physics	6	Semester	156
FIS0694L	Atmospheric Physics	Physics	6	Semester	156

3rd Year - 5th Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO2182L	Earth Deformation	Geosciences	8	Semester	208
FIS2183L	Climate Change and Climate	Physics	3	Semester	156
FIS0720L	Mathematic Methods for Physics	Physics	6	Semester	156
GEO2181L	Georesources	Geosciences	8	Semester	208
FIS2193L	Applied Geophysics	Physics	6	Semester	156
FIS0731L	* Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312



3rd Year - 6th Semester
Branch Geophysics Sciences

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS0731L	Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312
GEO0744L	Field Geology II	Geosciences	6	Semester	156
Group of Options					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0766L	GISS in Earth Sciences	Geosciences	6	Semester	156
MAT2184L	Computational Methods	Mathematics	6	Semester	156
FIS0725L	Seismology	Physics	6	Semester	156
FIS0681L	Analysis and Signal Processing	Physics	6	Semester	156

Branch Atmospheric and Space Science

1st Year - 1st Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
FIS0691L	Physics 1.1	Physics	5	Semester	136
QUI1090L	General Chemistry	Chemistry	6	Semester	156
LLT1412L	Elementary A1 English I	Linguistics	0	Semester	45
FIS2195L	Dynamics of Earth I: Atmospheric and Ocean	Physics	6	Semester	156

1st Year - 2nd Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
FIS0692L	Physics 1.2	Physics	5	Semester	136
GEO0756L	History and Earth Evolution	Geosciences	6	Semester	156
LLT1413L	Elementary A1 English II	Non Available	0	Semester	45
GEO2179L	Mineralogy	Geosciences	6	Semester	162
GEO2196L	Earth Dynamics II: from the Nucleus to the Crust	Physics Geosciences	8	Semester	208

2nd Year - 3rd Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0730L	Analysis and data treatment in Earth and Atmosphere Sciences	Physics Geosciences	6	Semester	162
GEO0737L	Earth Dynamics III: Superficial Processes	Geosciences	3	Semester	80
INF0878L	Programming	Informatics	6	Semester	156
GEO2194L	Geological Materials	Geosciences	8	Semester	208



2nd Year - 3rd Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Group of Free Options					

2nd Year - 4th Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0740L	Geohistory and Sedimentary Basins	Geosciences	9	Semester	234
GEO0743L	Field Geology I	Geosciences	3	Semester	78
GEO2180L	Hydrogeology	Geosciences	6	Semester	162
FIS0698L	Earth Physics	Physics	6	Semester	156
FIS0694L	Atmospheric Physics	Physics	6	Semester	156

3rd Year - 5th Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO2182L	Earth Deformation	Geosciences	8	Semester	208
FIS2183L	Climate Change and Climate	Physics	3	Semester	156
FIS0720L	Mathematic Methods for Physics	Physics	6	Semester	156
GEO2181L	Georesources	Geosciences	8	Semester	208
FIS2193L	Applied Geophysics	Physics	6	Semester	156
FIS0731L	* Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312

3rd Year - 6th Semester
Branch Atmospheric and Space Science

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS0731L	Project /Final Assignment / Introduction to investigation	Physics Geosciences	12	Semester	312
GEO0744L	Field Geology II	Geosciences	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GEO0766L	GISS in Earth Sciences	Geosciences	6	Semester	156
MAT2184L	Computational Methods	Mathematics	6	Semester	156
FIS0712L	Introduction to Physical Oceanography	Physics	6	Semester	156
FIS0707L	Solar and Planetary Physics	Physics	6	Semester	156
FIS2178L	Dynamics of Atmospheric	Physics	6	Semester	156



Conditions for obtaining the Degree:

*** TRANSLATE ME: Ciência da Terra e da Atmosfera

Para obtenção do grau de licenciado em Ciência da Terra e da Atmosfera é necessário obter aprovação a 156 ECTS em unidades curriculares obrigatórias e 24 ECTS em unidades curriculares optativas de acordo com a especialização escolhida (Especialização em Geologia; Especialização em Ciências da Atmosfera e do Espaço e Especialização em Ciências Geofísicas), distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC Obrigatórias num total de 29 ECTS

2º Semestre

5 UC Obrigatórias num total de 31 ECTS

2º Ano

3º Semestre

4 UC Obrigatórias num total de 23 ECTS

1 UC Optativa livre num total de 6 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

4 UC Obrigatórias num total de 25 ECTS

1 UC Optativas a escolher de acordo com a especialização escolhida num total de 6 ECTS

6º Semestre

2 UC Obrigatórias num total de 18 ECTS

UC Optativas a escolher de acordo com a especialização escolhida num total de 12 ECTS

Program Contents

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Linear Algebra and Geometry I (MAT0900L)

Systems of linear equations.

Matrices.

Determinants.

Vector spaces.

Linear applications.

Eigenvalues and eigenvectors.

Geometry of plane and space.

Quadratic forms.

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Mathematical Analysis I (MAT0905L)

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Physics 1.1 (FIS0691L)



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General Chemistry (QUI1090L)

Course contents

1. Introduction

1.1 Models of atoms

The principal quantum number

Atomic orbitals

Hydrogen atom

Orbital Energies

Electronic structure of polielectronic atoms

The building-up Principle. The Aufbau rule. Exclusion Principle of Pauli. Hund's rule

1.2 The Periodic Table

Periodic classification of the elements.

Electronic structure and the Periodic Table

Periodic variation in physical properties

Effective nuclear charge

Atomic and ionic Radius

Ionization Energy, Electronegativity and electron Affinity

2. Chemical Bonding

2.1 Lewis structures. Octet Rule.

2.2 Bond types: ionic, covalent and metallic

2.3 The Ionic Bond

Ionic bond formation.

Ions interaction

Lattice energy of ionic compounds

Ionic solids

Polarizability and the ionic character of ionic bonds

2.4 The Covalent Bond

2.4.1 Lewis structure for polyatomic species

The concept of Resonance

Formal charge

Electronegativity and Polar bonds

2.4.2 Covalent bond strength.

The variation of bond strength. Dissociation energy. Bond length.

2.4.3 Exceptions to the Octet Rule: radicals and biradicals; expanded valence shell, incomplete octet

2.4.4 Coordinative covalent bond. Complexes and coordination compounds.

Ligands. Coordination number.

Chelate; bi- and polidentate ligands.

2.4.5 Molecular shape and structure

The VSEPR model

Molecules with lone pairs on the central atom

Valence Bond Theory

Hybridization of orbitals

Hybridization in a more complex molecules

Characteristics of double bonds

Benzene ring and Kekule structures

Polyatomic molecules

Polar molecules

2.5 Metallic bond

Band theory. Conductor and semiconductors.

Metals properties

3. Properties of gases, Liquids and Solids

3.1.1 Properties of gases

Pressure

Boyle's Law. Charles and Gay-Lussac's Law

Avogadro Principle.

3.1.2 The Ideal Gas model. Equation of Ideal Gases.

Gas density

3.1.3 Mixture of gases. Partial Pressure and Dalton's Law

3.1.4 Real Gases. Deviation from linearity.



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Elementary A1 English I (LLT1412L)

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Dynamics of Earth I: Atmospheric and Ocean (FIS2195L)

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Mathematical Analysis II (MAT0906L)

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Physics 1.2 (FIS0692L)

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History and Earth Evolution (GEO0756L)

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Elementary A1 English II (LLT1413L)

A) Topics (classes will be structured around 7 units of the book New Headway Beginner, student's book and workbook):
Where I live; Times past; We had a great time!; I can do that!; Please and thank you; Here and now; It's time to go!

B) Grammar practice and language functions: There is/are; Prepositions; was/were born; Past simple irregular verbs; can/can't; Adverbs; Requests and offers; I'd like; some and any; like and would like; Present Continuous; Present Simple and Present Continuous; Future plans.

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Mineralogy (GEO2179L)

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Earth Dynamics II: from the Nucleus to the Crust (GEO2196L)

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Analysis and data treatment in Earth and Atmosphere Sciences (GEO0730L)

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Earth Dynamics III: Superficial Processes (GEO0737L)



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Programming (INF0878L)

Introduction to programming in Python.
Using the interpreter in script and interactive mode.
Variables, expressions and instructions.
Definition and Use of Functions.
Control structures.
Native data structures.
Sequential data structures: lists, tuples, and strings.
Associative data structures: dictionaries.
Basic concepts of input / output (I / O).
File manipulation.
Graphic interface.
Using to libraries / modules.
Libraries with advanced functionality for scientific calculation.
Program development.

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Geological Materials (GEO2194L)

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Geohistory and Sedimentary Basins (GEO0740L)

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Field Geology I (GEO0743L)

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Hydrogeology (GEO2180L)

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Earth Physics (FIS0698L)

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Atmospheric Physics (FIS0694L)

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Earth Deformation (GEO2182L)



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Climate Change and Climate (FIS2183L)

The climate and the climate system, climate characterization and climate classification systems; The climate of Portugal. The greenhouse effect of the atmosphere and the energy balance on Earth. The general circulation of the atmosphere and the oceans: Observations and simplified models, Ocean-Atmosphere Interaction phenomena. Brief history of the climate. Radiative forcing and the atmospheric composition: The concept of radiative forcing, the natural and anthropogenic radiative forcing. Feedback mechanisms and climate sensitivity. Recent observed climate changes. Climate change detection and attribution of causes. Introduction to climate models. Climate projections: methodology, emission scenarios, global and regional climate projections.

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Geochemical Systems (GEO0761L)

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Georesources (GEO2181L)

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Applied Geophysics (FIS2193L)

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Project /Final Assignment / Introduction to investigation (FIS0731L)

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Environment Geology and Planning (GEO0746L)

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Marine Geology (GEO0750L)

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GISS in Earth Sciences (GEO0766L)

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Engineering Geology (GEO0745L)

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Field Geology II (GEO0744L)



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Mathematic Methods for Physics (FIS0720L)

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Computational Methods (MAT2184L)

The interactive programming system for symbolic and numerical computation, and data manipulation and visualization. Mathematical models, numerical algorithms and mathematical problems.

Implementation of some basic numerical algorithms.

Fundamentals of numerical computation: floating point systems, errors, conditioning, convergence, stability.

Resolution of nonlinear equations.

Solving systems of linear and nonlinear equations.

Interpolation and approximation of functions.

Derivation and numerical integration.

Numerical methods of optimization.

Introduction to numerical solution of ordinary differential equations.

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Seismology (FIS0725L)

1) Complements of continuum mechanics.

2) Equations of motion.

3) wave propagation inside the Earth.

4) Internal waves, surface waves.

5) inelasticity and anisotropy.

6) Earth eigenmodes.

7) Seismic Source.

8) synthetic seismograms.

9) Analysis of seismic data.

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Analysis and Signal Processing (FIS0681L)

1. Analysis of discrete and continues time series;

2. Applications of multivariate analysis to geophysics;

3. Principles and techniques of signal treatment geophysics;

4. Fast Fourier Transforms (FFT), Z transforms Laplace transforms;

5. Deconvolution

6. Filter design and transfer function;

7. Spectral analysis.

8. Applications.



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Introduction to Physical Oceanography (FIS0712L)

Introduction{\}

- 1.1. Physical Oceanography: Goals and basic concepts{\}
- 1.2. The Ocean as a physical system and its role in the hydrological cycle{\}
- 1.3. Main mechanisms that force the ocean movements{\}
- 1.4. The different scales in the ocean circulation{\}

Physical properties of the seawater{\}

- 2.1. Some thermodynamic properties of the seawater{\}
- 2.2. Stratification and stability of the ocean{\}
- 2.3. Acoustic properties of the seawater{\}
- 2.4. Light in the ocean{\}

Budgets, fluxes and conservation equations of the ocean{\}

- 3.1. Fluxes across the ocean surface. Solar radiation{\}
- 3.2. Heat balance and the mean temperature distribution in the ocean{\}
- 3.3. Balance of mass and the mean salinity distribution in the ocean{\}
- 3.4. The equation of continuity{\}
- 3.5. Formation, evolution and mixing of water masses. Thermohaline analysis. {\}

Ocean dynamics{\}

- 4.1. The equation of motion in oceanography
- 4.2. Analysis of the individual terms of the equation of motion{\}
- 4.3. Scaling the equation of motion{\}
- 4.4. Hydrostatic equilibrium{\}
- 4.5. Barotropic and baroclinic conditions{\}
- 4.6. Geostrophic currents{\}

Particular aspects of the ocean circulation{\}

- 5.1. Inertial flow{\}
- 5.2. Wind driven circulation: the Ekman solution{\}
- 5.3. Coastal upwelling{\}
- 5.4. Convergence and divergence in the ocean{\}
- 5.5. Vorticity{\}

Ocean circulation off the Iberian Peninsula{\}

- 6.1. Seasonality of the atmospheric forcing{\}
- 6.2. Ocean circulation patterns{\}
- 6.3. Similarity with other Eastern Boundary Current Systems

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Solar and Planetary Physics (FIS0707L)

(i) - Astrophysics and the Universe (summary): (i.1) Introduction. Basic Concepts in Astronomy and Astrophysics. (i.2) Formation and Evolution of our Universe.

(ii) - Physics of the Sun (ii.1) Introduction to the structure of the Sun, (ii.2) Atmosphere of the Sun

(ii.3) Internal structure of the Sun, (ii.4) Theory of helioseismology (ii.5) Comments in helioseismology (ii.6) Evolution of the Sun as a star, (ii.7) Solar Neutrinos, (ii.8) Sun-Earth Interaction (ii.9) the Solar System: the Sun and its evolution.

(iii) - The solar system and its constituents: (iii.1) The planets (iii.2) Other constituent bodies, (iii.3) The spatial distribution of bodies in the solar system (iii.4) The dynamics of the solar system.

(iv) - Planetary formation and evolution: (iv.1) Formation of the Solar System: The solar disk, (iv.2) Formation of the Solar System and the conservation of angular momentum (iv.3) Formation of the Solar System and the origin of planets and asteroids.

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Dynamics of Atmospheric (FIS2178L)