NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
ENVIRONMENTAL ENGINEERING PROGRAM

BO141 – BIOGEOCHEMISTRY

I. GENERAL INFORMATION

CODE	**:**	BO141 – Biogeochemistry
SEMESTER	**:**	7
CREDITS	**:**	02
HOURS PER WEEK	**:**	04 (Theory – Laboratory)
PREREQUISITES	**:**	Biodiversity and Geology
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

Study the interaction between geochemical compounds and living organisms. It develops topics to know the functioning of living beings, from the level of cellular organization to the ecosystem they make up. It explains many of the current environmental problems (climate change, destruction of the ozone layer, pollution), and of essential processes for our society (crop production, waste recycling, purification).

The course corresponds to the Specific Studies Area, is theoretical and practical, aims to provide students with the basis to have the foundations on the biogeochemistry evolution, compartments and flows on a planetary, temporal and ecosystemic scale, principle of conservation of mass, processes involved in the biogeochemical cycles. Alteration of biogeochemical cycles, biogeochemistry of terrestrial and aquatic ecosystems. Biogeochemical models.
The course contains the following topics: Concept of biogeochemistry. Biogeochemical focus: Biosphere, lithosphere, atmosphere. Biogeochemistry of macroelements and trace elements. Climate change and biogeochemical cycles. Biogeochemistry of terrestrial ecosystems. Biogeochemistry of aquatic ecosystems. Biogeochemistry of arid ecosystems and coupled to the groundwater. Biogeochemical applications.

III. COURSE OUTCOMES

General outcomes:
At the end of the course the student will:

- Know the theoretical-practical fundamentals of biogeochemistry, as a result of the dynamic interaction of inorganic and biological substances and how they are affected by anthropogenic activities.

Specific outcomes:
At the end of the course the student will:

- Analyze the effects of life on the Earth chemistry and the anthropogenic impact on the environment

- Analyze the interactions between atmosphere, biosphere, hydrosphere and lithosphere, including the physical, chemical and biological processes that act in the transport and transformation of different elements (carbon, nitrogen, hydrogen, oxygen, phosphorus, sulfur).

- Recognize the main pollutants in the environment.
- Propose situations where biogeochemical processes are evident
- Analyze scenarios where the biogeochemical processes have been altered by anthropogenic activities, and global change.

IV. LEARNING UNITS

1. **BIOGEOCHEMICAL INTRODUCTION / 4 HOURS**
   Origin of the elements in the universe, life, biogeochemical cycles. Concepts. Factors that influence the biogeochemical cycles. Historical development of biogeochemistry.

2. **BIOSPHERE / 4 HOURS**
   Carbon cycle: photosynthesis, respiration, net primary productivity.

3. **LITHOSPHERE / 4 HOURS**
   Geochemical and mineral elements, importance of silicon, iron and calcium. Formation of rocks from magma.

4. **ATMOSPHERE / 4 HOURS**
   Atmosphere: composition, circulation. Physics of atmospheric gases

5. **MACROELEMENTS BIOGEOCHEMISTRY / 4 HOURS**
   Global cycles: water, carbon, nitrogen, phosphorus, sulfur, silica and calcium. Comparison of the biogeochemical processes of carbon in aquatic and terrestrial ecosystems

6. **TRACE ELEMENTS BIOGEOCHEMISTRY / 4 HOURS**
   The cycle of copper, zinc, selenium and molybdenum

7. **CLIMATE CHANGE AND BIOGEOCHEMICAL CYCLES / 4 HOURS**
   Anthropic alteration of global cycles: causes and consequences. Global perspectives of anthropogenic interference. Responses from coupled biogeochemical cycles and climate change.

8. **AQUATIC ECOSYSTEM BIOGEOCHEMISTRY (LAKES, RIVERS, SEA AND WETLANDS / 4 HOURS.**
   Biogeochemical differences in lakes, rivers, sea and wetlands. Flow of nitrogen, phosphorus and carbon in aquatic ecosystems. Global change and effects on biogeochemistry of nutrients in rivers, lakes, sea and wetlands

9. **TERRESTRIAL ECOSYSTEMS BIOGEOCHEMISTRY / 4 HOURS**
   Availability, absorption and use of nutrients in plants. The biogeochemical cycles in vegetation: flows and compartments involved. Balance production-breathing. Study methods. Modeling of the carbon cycle in terrestrial systems. Role of vegetation in the global balance of terrestrial systems: source or sink of CO2? Current perspectives.

10. **BIOGEOCHEMISTRY IN ARID ECOSYSTEMS / 4 HOURS**
    The regulation of the partition of water in arid zones and its consequences in the productivity of the ecosystem and availability of water for the inhabitants.

11. **BIOGEOCHEMICAL APPLICATIONS / 4 HOURS**
    ACIDIFICATION: Pyrite in the context of the sulfur cycle. Formation and diagnosis of sulphate-acid soils. Impact of the oxidation of pyrite on the environment.

12. **BIOGEOCHEMICAL APPLICATIONS / 4 HOURS**

EUTROPHYING: Eutrophication in continental waters, current perspectives. Interactions between cycles. Biogeochemical cycles and climate change: the example of marine fertilization as a mechanism to attenuate the atmospheric increase of CO2. Biogeochemical processes and elimination of nitrogen and phosphorus from eutrophic waters in wetlands around Mar Menor: experimental results in mesocosms

V. LABORATORIES AND PRACTICAL EXPERIENCES

- Workshop 1: Technical visits to aquatic ecosystems, terrestrial ecosystems
- Workshop 2: Interpretation of biogeochemistry in ecosystems
- Workshop 3: Experiments of altered biogeochemical cycles.

VI. METHODOLOGY

The course is developed in theory sessions, practice.
Theoretical classes: Involves master classes with active participation between the teacher and the student.
Practical classes: It implies the development of exercises. A research work will be assigned to each student, presenting an exhibition of this research.
Field laboratory: Visits are made to areas where ecosystems are found.

VII. EVALUATION FORMULA

The learning will be evaluated through the "F" system.

- Partial Exam: Weight 1
- Final Exam: Weight 2
- Average of Practices / Workshops: Weight 1.

Calculation of the Final Average:

$$FA = \frac{PE + 2FE + \frac{QP1 + QP2 + W1 + W2}{4}}{4}$$

PE: Partial Exam; FE: Final Exam, QP: Qualified Practice, W: Workshop

VIII. BIBLIOGRAPHY

- American Public Health Association. APHA-ANWA-WCPF, (1992). Métodos normalizados para el análisis de aguas potables y residuales. Díaz de Santos. España.
- Barnes, R. S. y K. H. Mann, (1980). Fundamentals of aquatic ecosystems. Blackwell Scientific Pub. Oxford.
- Bhatt, J. L., (1991). Oceanography. Exploring the Planet Ocean. D. Van Nostrand Co. New York, USA.
- Contreras E. F., (1994). Manual de Técnicas Hidrobiológicas. Ed. Trillas.

- Barnes, R.S. y K.H. Mann, 1980. Fundamentals of aquatic ecosystems. Blackwell Scientific Pub. Oxford. 229 p.

- Grant Gross, M. 1972. Oceanography a view of the earth. Prentice Hall Inc. New Jersey. 581 p.