

(2 credits)

001-2-5026

| Lectures | Exercise | Laboratory | Field Trip |
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This course focuses on studying the growing environmental impact inflicted by the increased usage of nitrogen fertilizers in order to feed the growing world population. Nitrogen transformation processes (biological and industrial) contribute to global climate change through the emission of green house gases and contaminate drinking water resources, risking human health and the sustainability of the earth ecosystem. The following issues will be discussed:

- 1- Short introduction: The chemistry of the nitrogen atom and the inorganic nitrogen species.
- 2- The diversity and abundance of the microorganisms involved in nitrogen transformations.
3. The metabolic processes involved in nitrogen transformations and their impact on environmental quality (emission of green house gases and contamination of water resources), including:
 - Nitrogen fixation (biological and industrial)
 - Nitrification
 - Denitrification
 - Anammox
- 4- Regulation and control of the metabolic processes and their relative contribution to environmental contamination.
- 5- Fate of fixed nitrogen:
 - Food
 - leaching to ground water, rivers and oceans.
 - Emission to the atmosphere (ammonia, nitrous oxide, nitrogen dioxide, nitric oxide).
- 6- Nitrogen balance on land and ocean and its impact on biological processes (phosphor cycle and carbon cycle).
- 7- Applications of biological processes in schemes for nitrogen removal from water bodies for safe reuse or discharge to the environment.
- 8- Health risks of nitrogen species (in water and air).
- 9- Possible actions to reduce the use of fixed nitrogen without affecting food production.
- 10- Future trends.

Lecturer: A. Nejidat

Textbooks:

1. N.I. Kamien & N.L. Schwartz: Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management. NH, 2nd ed. 2000.
2. D. Leonard & N.V. Long: Optimal Control Theory and Static Optimization in Economics. Cambridge Univ. Press, 1992.
3. A.C. Chiang: Elements of Dynamic Optimization. Waveland Press, 2000.
4. S.P. Sethi & G.L. Thompson: Optimal Control Theory: Applications to Management Science and Economics. Kluwer, 2nd ed. 2000.
5. M.R. Caputo: Foundations of Dynamic Economic Analysis: Optimal Control Theory and Applications. Cambridge University Press, 2005. .