Ecology; Chemistry & Microbiology

MODULE TITLE	Ecology; Chemistry & Microbiology
LECTURER(S)	Dr Zorana Naunovic
ECTS VALUE	6
PREREQUISITES	Physics, first degree courses in Chemistry and/or Biology and Microbiology (1st year undergraduate degree courses or equivalent), Mathematical Analysis or consent of instructor
COREQUISITES	
DURATION OF MODULE	13 weeks

TOTAL STUDENT STUDY TIME

Overall, the module is expected to involve students in approximately 150 hours of learning, including 12x 2.5-hour lectures; 40 hours assignments; 80 hours private study.

WEB LINK http://www.water-msc.org/en/wrem102.htm

AIMS

This module aims to introduce basic concepts of sustainability, chemistry and microbiology as they pertain to environmental engineers. The module establishes the foundation needed for the understanding the scientific principles behind environmental engineering designs and operation.

Ecology

- To study ecology from the standpoint of human impact on natural surroundings
- To introduce the concept of the ecological footprint and sustainability
- To familiarize students with the impact of individual's behavioral and consumption patterns on the environment
- To introduce the concept of the corporate sustainability
- To introduce the sustainability issues facing large cities

Chemistry

- To develop an understanding of basic chemical concepts and terminology
- To introduce the fundamentals of chemistry for environmental engineers
- To develop knowledge of chemical representation, concentration calculations, balancing of reactions, oxidation reduction reactions, redox half reactions, chemical equilibrium, conductivity and ionic strength, chemical kinetics, gas laws and reaction rates and solubility
- To develop an understanding of order of chemical reactions and equilibrium
- To develop an understanding of chemical kinetics and reaction types
- To develop an understanding of basic water chemistry

Microbiology

- To introduce the fundamentals of microbiology for environmental engineers
- To describe characteristics of microbial populations (bacteria, algae, fungi, protozoa, other)
- To describe growth of microorganisms and to introduce the subject of identification and enumeration of microorganisms

- To introduce the fundamentals of water borne disease transmission and protection against this
- To review the basics of agents of disease: bacterial pathogens, viral pathogens, protozoan pathogens, and other vectors of disease
- To develop an understanding of indicators of faecal contamination and the concept of indicator organisms
- To develop an understanding of microbial kinetics in the context of their use in pollution control and wastewater treatment

INTENDED LEARNING OUTCOMES

1. Subject Specific Knowledge, Understanding and Skills

By the end of this module, the students should:

Ecology

- Understand how individuals, corporations and cities impact the environment
- Have gained insight into how individuals, corporations and cities can mitigate their detrimental impact on the environment
- Have ideas how sustainability principles can be applied in different areas

Chemistry

- Have a basic understanding of the fundamentals of chemistry for environmental engineers
- Fundamental understanding of chemical equilibrium and relevant gas laws and solubility of substances in water
- Basic understanding of causes and consequences of environmental pollution and chemical fundamentals behind them
- Understanding of chemical kinetics and reaction types
- Understanding of basic water chemistry

Microbiology

- Have a basic understanding of the fundamentals of microbiology for environmental engineers
- Be able to differentiate different between different microbial species and their roles in wastewater treatment
- Have knowledge of the fundamentals of water borne disease transmission
- Understand the concept of indicator organisms
- Understand microbial kinetics concepts

2. Core Academic Skills

By the end of this module, the students should:

a) Be able to analyze the impacts various entities have on the environment and be able to formulate ideas on how to mitigate these impacts

b) Have acquired the fundamental knowledge of basic science principles at the foundation of environmental problems

c) Have acquired the ability to do the necessary calculations and basic modelling skills for solution of environmental pollution

3. Personal and Key Skills

By the end of this module, the students should have:

a) improved further the necessary skills for independent learning

b) enhanced report and presentation skills

c) acquired an ability to function in multi-national teams

d) acquired a basic ability to develop process level models for important environmental reactions and to do appropriate level analysis of typical environmental problems

LEARNING/TEACHING METHODS

The module includes a mix of lectures, instructed readings and assignments. The module also encompasses interactive learning exercises utilizing internet resources.

ASSIGNMENTS

10 assessed coursework assignments (2,500 equivalent words including graphs and tables).

ASSESSMENT

Examination paper (60%), Course work assignments (40%).
3-hour examination, open notes and books.

SYLLABUS PLAN (Lectures: 2.5-hours each)

1. Ecological Footprint

2. Corporate sustainability

3. Sustainable cities

4. Fundamental concepts in chemistry

5. Chemical reactions

6. Solutions and the gas laws

7. General water chemistry

8. Chemistry applied to water and wastewater treatment processes

9. Introduction, structure, classification, metabolism, function and environmental significance of microorganisms

10. Microbial growth kinetics

11. Waterborne-disease transmission and control

12. Role of microorganisms in wastewater treatment processes

INDICATIVE BASIC READING LIST

All the students are provided with a comprehensive set of course notes covering all the course material.

EXTENDED READING LIST

1. Sawyer, C.N., McCarty, P.L. and Parkin, G.F. (2003) Chemistry for Environmental Engineering and Science, 5th Edition, McGraw-Hill Professional.
2. O'Neil, P. (1993). Environmental Chemistry, Chapman and Hall.
3. Lester, J.N. and Birkett, J.W. (1999) Microbiology and Chemistry for Environmental Scientists and Engineers. 2nd Edition, E & FN Spon, London.
4. Tchobanoglous, G., Burton, F.L. and Stensel, H. D. (2003) Wastewater Engineering – Treatment and Reuse, Metcalf and Eddy Inc., 4th Edition, McGraw-Hill.

5. Letterman, R.A. (1999) Water Quality and Treatment: A Handbook of Community Water Supplies, American Water Works Association, 5th Edition, McGraw-Hill.

AUTHORS

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