

COURSE: General and Environmental Microbiology

ACADEMIC YEAR: 2018-2019

TYPE OF EDUCATIONAL ACTIVITY: (Basic, Characteristic, Affine, Free choiche, Other) Curricular

LECTURER: Prof. Angela Capece

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Language: Italian

ECTS: 6 (5 Lectures + 1 practicals)	n. of hours: 50 h lectures + 16 h practicals	Campus: Potenza Dept./School: School of Agriculture, Forest, Food and Environmental Sciences Program: BSc in Forestry and Environmental Sciences	Semester: 1
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#### EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The main objective of this course is to provide the students the basic knowledge of microorganisms in order to understand the role of the main microbial groups in agroforestry field.

- **knowledge and understanding:** Knowledge of the structure and physiology of a microbial cell. Knowledge of biochemistry and genetics of microorganisms. Knowledge of the role of micro-organisms agroforestry field, in particular in the global cycles of matter, in processes related to productivity and conservation of forest soil fertility. Knowledge of microbial processes for the treatment of solid and liquid wastes and for bioremediation of contaminated soils and water. Knowledge of basic techniques used in microbiology laboratories
- **applying knowledge and understanding:** Ability to identify the main macroscopic and microscopic characteristics useful to recognize a microbial species. Ability to use tools for evaluating and analyzing phenomena governing the organization and development of microorganisms and their interactions in the agroforestry field. Ability to use basic microbiological techniques and to interpret the results obtained by these methods.
- **making judgements:** Ability to analyze the microbial population of a natural habitat to identify the role played in that context. Ability to identify the most efficient microbial process in terms of environmental sustainability and eco-compatibility for bioremediation and waste treatment.
- **communication skills:** Ability to effectively communicate to forestry workers the fundamental role of micro-organisms in forestry and environmental ecosystems and their potential use to solve environmental contamination problems.
- **learning skill:** Ability to collect and interpret data from scientific publications to understand the role of microbial activities in the environment and cause and effect relationships in forest management systems and environment evolution.

#### PRE-REQUIREMENTS

To understand the material presented in this course, skills regarding general and inorganic chemistry, organic chemistry and biochemistry are needed.

#### SYLLABUS

The course is divided in 7 teaching blocks.

**Block 1. Microbial cell structure** (8 hours of lesson) Evolution and structure of microbial cells. History, definitions and glossary of microbiology. Differentiation between prokaryotic and eukaryotic cells. Cytology of the prokaryotic cell. Endospores: structure and function. Eucaryotic microbes: microalgae, mushrooms, protozoa. Microscopic techniques for observation and study of microorganisms.

**Block 2. Microbial cell physiology** (8 h lesson): Microbial nutrition: nutritional requirements (macronutrients, micronutrients and growth factors). Microbial growth: counting methods, growth curves and continuous culture, environmental factors that influence microbial growth. Microbial metabolism - Energy processes: respiration, fermentation, photosynthesis.

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**Block 3. Microorganism genetics** (4 hours of lesson): Bacterial chromosome and supplementary gene elements (plasmids and transposons). - Evolution of the bacterial genome: mutations and phenomena of horizontal gene transfer (transformation, conjugation, transduction). - Virus and bacteriophage. Genetic of eukaryotic microorganisms.

**Block 4. The role of microorganisms in the material cycles** (8 hours of lesson). The carbon cycle: degradation of cellulose, hemicellulose, lignin and other plant constituents. The nitrogen cycle: bacteria fixing the atmospheric nitrogen, the proteolytic, nitrifying and denitrifying bacteria. The sulfur cycle: sulfur mineralization, oxidation and reduction of mineral sulfur. The cycle of phosphorus, iron and manganese. Positive microorganism-plant interactions.

**Block 5. Microbial processes in the treatment of solid and liquid waste** (8 hours of lesson). Characteristics, processes and technologies of waste biomass recycling. Composting: definitions, microbes involved, environmental and technological factors. Waste water purification: active sludge oxidation, anaerobic digestion, transformation with photosynthetic microorganisms.

**Block 6. Microbial processes involved in soil and contaminated water bioremediation** (4 hours of lesson). Degradation of xenobiotic compounds. Degradation of petroleum products. Biodegradation of heavy metals. Microbial role in phytoremediation

**Block 7. Laboratory of microbiology** (16 hours, practical). Techniques to observe microorganisms. Techniques to control microorganisms. Techniques to highlight, cultivate and preserve microorganisms. Techniques to measure microbial growth.

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#### TEACHING METHODS

The course includes 40 h lectures and 16 h practical (laboratory). During practices, students will use traditional basic methods for studying the microorganisms present in natural habitats.

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#### EVALUATION METHODS

The objective of the exam is to check the level of achievement of learning outcomes previously indicated. The students attending the course need to pass two written (mid term, end of course) examinations (multiple choice, short and long text). Alternatively, for the students who are unable to pass the written examinations, it will be necessary to take an oral examination, based on knowledge regarding all the topics of the course. Furthermore, to obtain top grades (>27) the students, working in groups, will have to prepare and discuss a report on an application of microorganisms for waste utilization or environmental remediation processes, presented as oral report in order to evaluate the communication skills.

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#### TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

The teacher will provide the course material and handouts to the student. The students are also encouraged to widen their knowledge using textbooks available in the library:

- Microbiologia Generale e Agraria. 2012. A cura di Biavati B., Sorlini C. Casa Editrice Ambrosiana.
- Brock Biologia dei microrganismi. 2007. A cura di Madigan M.T., Martinko J.M. Casa Editrice Ambrosiana
- Microbiologia Agroambientale. 2005. A cura di Biavati B., Sorlini C. Casa Editrice Ambrosiana.

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#### INTERACTION WITH STUDENTS

During the first lecture, the structure and organization of the course and the evaluation procedure will be presented. The teaching material will be made available to students using a cloud storage system (Dropbox) or made available on a pen drive. The lecturer will be available for receiving students at least 2 h a week (on Monday and Thursday, approximately). Furthermore, the lecturer is available at any time for a contact with the students, after appointment by e-mail.

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#### EXAMINATION SESSIONS (TENTATIVE)<sup>1</sup>

8/07/2019, 9/09/2019, 7/10/2019, 11/11/2019, 9/12/2019, 13/01/2020, 3/02/20120, 9/03/2020, 13/04/2020, 11/05/2020, 8/06/2020, 6/07/2020, 7/09/2020

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<sup>1</sup> Subject to possible changes: check the web site of the Teacher or the Department/School for updates.



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EVALUATION COMMITTEE

Prof. Angela Capece (president), Prof. Patrizia Romano (member), Prof. Eugenio Parente (replacement member),  
Prof. Annamaria Ricciardi (replacement member)

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SEMINARS BY EXTERNAL EXPERTS    YES X    NO

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FURTHER INFORMATION

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