GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2018-2019

Microbiology (I001842)

Course size (nominal values; actual values may depend on programme)

Credits	5.0	Study time	150 h
Contact hrs	60.0 h		

Course offerings and teaching methods in academic year 2018-2019

A (semester 2)	Dutch	lecture	30.0 h
		practicum	25.0 h

Lecturers in academic year 2018-2019

Soetaert, Wim	LA25	lecturer-in-charge

Offered in the following programmes in 2018-2019	crdts	offering
Bachelor of Science in Bioscience Engineering (main subject Agricultural Sciences)	5	A
Bachelor of Science in Bioscience Engineering (main subject Cell and Gene Biotechnology)	5	A
Bachelor of Science in Bioscience Engineering (main subject Chemistry and Food Technology)	5	A
Bachelor of Science in Bioscience Engineering (main subject Environmental Technology)	5	A
Bachelor of Science in Bioscience Engineering (main subject Land and Forest Management)	5	A
Joint Section Bachelor of Science in Bio-Engineering	5	A

Teaching languages

Dutch

Keywords

Bacteria, fungi, yeasts, viruses, morphology, physiology, nutrition, genetics, metabolism, taxonomy, immunology

Position of the course

This course lays the foundation of the fundamental knowledge of microorganisms: bacteria (bacteriology), yeast and fungi (mycology) and viruses (virology). The morphology, physiology, nutrition, taxonomy and genetics of both useful and harmful microorganisms are discussed in detail. The principles of immunology and the control of unwanted microorganisms are explored as well. The basic techniques, specific for microbiology, are teached in the practicals.
Every engineer in biosciences should have knowledge on the general principles of microbiology.

Contents

Chapter 1 - Microbiology, study of microorganisms
1.1 What is microbiology?
1.2 Importance of microorganisms
1.3 History of microbiology
1.4 Microscopy
Chapter 2 – Microbial diversity
2.1 Evolutionary history of microorganisms
2.2 Morphological diversity
2.3 Metabolic diversity
Chapter 3 – Cell structure en function in bacteria and Archaea
3.1 Cell morphology
3.2 Cell dimensions and relative smallness
3.3 Het cytoplasmatic membrane
3.4 Transport and transport systems

3.5 The cell wall of bacteria
3.6 Capsules and slime layers
3.7 Fimbriae and pili
3.8 Cell inclusions
3.9 Gas vesicles
3.10 Endospores
3.11 Microbial locomotion
Chapter 4 - Nutrition, culture en metabolism of microorganisms
4.1 Microbial feed
4.2 Growth media
4.3 The microbial metabolism
Chapter 5 – Microbial growth
5.1 Cell growth and binary fission
5.2 Peptidoglycan synthesis and cell division
5.3 Bacterial population growth and kinetics
5.4 Microbial growth curve
5.5 Measuring microbial growth
5.6 Effect of temperature on microorganisms
5.7 Effect of pH on microorganisms
5.8 Osmotic effects on microorganisms
5.9 Effect of oxygen on microorganisms
Chapter 6 - Metabolic diversity: phototrophy, autotrophy, chemolithotrophy
6.1 Photosynthesis
6.2 The Calvin Cycle
6.3 Other autotrophic pathways
6.4 Chemolithotrophy
6.5 Nitrification
Chapter 7 - Metabolic diversity: Catabolism of organic compounds
7.1 Fermentation
7.2 Anaerobic respiration
7.3 Oxygen as direct reactant and the oxidation of hydrocarbons
7.4 Methylotrophs and methanotrophs
7.5 Hexose, pentose and polysaccharide metabolism
7.6 Metabolism of organic acids
7.7 Lipid metabolism
Chapter 8 – Nutrient cycles, bioremediation an symbiosis
8.1 The carbon cycle
8.2 The nitrogen cycle
8.3 De sulfur cycle
8.4 The iron cycle
8.5 Biodegradation and bioredemediation
Chapter 9 – Microbial symbioses
9.1 Lichens
9.2 Legume-root nodule symbiosis
9.3 Agrobacterium and crown gall disease
9.4 Mycorrhizae
9.5 Animals as microbial habitat
9.6 Microbial ecosystems in undersea hydrothermal vents
Chapter 10 - Microbial diversity and evolution
10.1 The formation of Earth and the early evolution
10.2 Microbial taxonomy
Chapter 11 – Proteobacteria
Purple phototrophic bacteria
Purple-sulfur bacteria
Nitrification
Sulfur and iron oxidizing bacteria
H2 oxidizing bacteria
Methano- and methylotrophy
Acetic acid bacteria
Nitrogen fixating bacteria
Neisseria group
Enterobacteria
Vibrio and Photobacterium group
Unusual morphologies of bacteria
Sulfate and sulfur reducing proteobacteria
Chapter 12 - Bacteria: Gram-positive en other Bacteria
non-sporulating G+ bacteriën
Sarcina
Lactic acid bacteria
Endospore-forming G+ bacteria: Bacillus and Clostridium
Mycoplasmas: cell wall-lacking bacteria
Actinobacteria

Cyanobacteria
Planctomyces
Flavobacteria
Green sulfur bacteria
Spirochaetes
Deinococci
Hyperthermofilic bacteriën
Chapter 13 – Archaea
Fylogenetic overview
Euryarchaeota
Crenarchaeota
Chapter 14 – Industrial biotechnology
14.1 Industrial microorganisms and their products
14.2 Primairy en secondary metabolites
14.3 Large-scale fermentation
14.4 Upscaling industrial fermentations
14.5 Antibiotics: isolation and characterization
14.6 Industrial production of penicillines
14.7 Vitamines and amino acids
14.8 Steroids through biotransformations
14.9 Industrial enzymes
14.10 Fermentative production of wine
14.11 Brewing, destilling and bulk alcohol
14.12 Production of vinegar
14.13 Production van citric acid
14.14 Production of Baker's yeast
14.15 Mushrooms
Chapter 15 – Waste water treatment, water purification and waterborne microbial diseases
15.1 Public health and water quality
15.2 Waste water treatment
15.3 waterborne diseases
Chapter 16 – Virology
Introduction
Structure of viruses
growth and counting of viruses
Viral replication
Classification of viruses
Viral diversity
Chapter 17 – Genetics
Genetic map of E. coli chromosome
Plasmids
Mutations en mutants
Molecular basis of mutations
Mutation rates
Mutagenesis
Genetic recombination
Transformation
Transduction
Conjugation
The formation of Hfr strains and chromosome mobilization
Gene transfer in Archaea
Mobile DNA: transposable elements
Chapter 18 – Eukaryotic micobial cells
Eukaryotic cell structure and nucleus
Mitochondria en hydrogenosomes
Photosynthetic organelle: the chloroplast
Connection between mitochondria & chloroplasts and bacteria
Other organelles and eukaryotic cell structures
Phylogenetic lineages of Eukarya
Euglenozoa
Stramenopiles
Cercozoa and Radiolaria
Amoebozoa
Nutrition and physiology of fungi
Fungal reproduction en phylogeny
Ascomycetes
Basidiomycetes
Unicellular red algae
Unicellular green algae
Chapter 19 – Control of microbial growth
Heat sterilization

Radiation
Filter sterilization
Effect of microbial agents on growth
Chemical antimicrobial agents for external use
Chemotherapeutics
Antibiotics
Antimicrobial drug resistance
The search for new antibiotics
Chapter 20 - Microbial interactions with humans
Overview of human-microorganism interactions
The normal microflora of the skin / mouth / gastrointestinal tract / other regions
Pathogenicity
Exotoxins
Endotoxins
Innate resistance to infection
Chapter 21 – Basics of immunology
The cells and organs of the immune system
The innate immunity
Adaptive immunity
Immunogens en antigens
Properties of immune response
Antibodies
Inflammation, fever and septic shock
Natural and artificial immuniteit
Chapter 22 - Diagnostic microbiology and immunology
Polyclonal and monoclonal antilibodies
Serology
Agglutination
Fluorescent antibodies
Chapter 23 – Principles of epidemiology
Epidemiology basics
Infectuous disease transmission
The AIDS-pandemic
Healthcare-associated infections
Public healthcare
Biological warfare and biological weapons

Initial competences

Microbiology builds on the following final competences of course units: 'Chemistry 1: structure of matter', 'Chemistry 2: reactivity of matter', 'Botany 1: morphology, anatomy and diversity', 'Earth Sciences', 'Biochemistry and Molecular Biotechnology' and 'Chemistry 3: Organic chemistry – structure'; or the final competences were acquired in another way.

Final competences

1 Have insight in the cell structure and function of bacteria.
2 Have insight in the composition of nutrient media.
3 Have insight in the metabolisms of different microorganisms.
4 Have insight in the microbial diversity of microorganisms.
5 Have insight in of the basic principles and applications of industrial biotechnology (fermentation products, metabolites, etc).
6 Have insight in the general principles of virology.
7 Have insight in microbial genetics
8 Have insight in eukaryotic microorganisms
9 Have insight in the control of microbial growth.
10 Have insight in basic immunological principles.
11 Have insight in the basics of pathogens and epidemiology
12 Master the basic techniques for microbiological laboratory research

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, practicum

Extra information on the teaching methods

Lecture, Practical

Learning materials and price

• Handbook: MADIGAN M.T., MARTINKO J.M., BENDER K.S, BUCKLEY, D.H. and STAHL D.A.(2013). Brock Biology of Microorganisms (14th edition). Pearson International edition (ISBN-13: 978-0-321-89739-8) – student organization VLK: €51
• Labnotes and syllabus for practical exercises – student organization VLK: €4

References

• MADIGAN M.T., MARTINKO J.M., BENDER K.S, BUCKLEY, D.H. and STAHL D. A.(2013). Brock Biology of Microorganisms (14th edition). Pearson International edition (ISBN-13: 978-0-321-89739-8)

Course content-related study coaching

The students can ask questions personally or by email to the professor or the assistants.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination

Examination methods in case of periodic evaluation during the second examination period

Written examination

Examination methods in case of permanent evaluation

Participation, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is not possible

Calculation of the examination mark

Theoretical exam (periodic evaluation): 80%
Practicum (periodic evaluation): 10%
Practicum (permanent evaluation): 10%
Students who eschew periodic and/or permanent evaluations for this course unit may be failed by the examiner.