GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2020-2021

Gene Technology and Molecular Diagnostics (I002522)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

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

Credits 6.0 **Study time 180 h** **Contact hrs** 60.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	English	Gent	seminar: practical PC room classes	5.0 h
			excursion	5.0 h
			practicum	20.0 h
			lecture	30.0 h

Lecturers in academic year 2020-2021

Kyndt, Tina	LA25	lecturer-in-charge
De Mey, Marjan	LA25	co-lecturer
Van Damme, Els	LA25	co-lecturer

Offered in the following programmes in 2020-2021	**crdts**	**offering**
Bachelor of Science in Bioscience Engineering (main subject Cell and Gene Biotechnology)	6	A

Teaching languages

English

Keywords

Cloning techniques, expression vectors, cDNA- and genomic libraries, DNA-, RNA- and protein-analysis techniques, PCR applications, molecular markers, gene isolation, gene- and genome analysis

Position of the course

Molecular biotechnology is being used to specifically alter organisms and therefore the DNA sequence must first be cloned. On the other hand a variety of molecular techniques is being used to study living organisms or to identify individuals or specific characteristics. A plethora of molecular methods have been optimised and others are being developed constantly.This course will describe and discuss a variety of molecular techniques explaining the basic concepts but also following the latest trends.

Contents

Theory
Introduction
1.1. Gene technology and molecular diagnostics
1.2. Pro- en eukaryotic genomes
1.3. Gene expression

DNA hybridisation
2.1. Southern blotting
2.2. Probe technology, detection
2.3. In situ DNA hybridisation
2.4. Colony hybridisation
2.5. Macro- and micro-array (chip) technology

PCR and Q-PCR
3.1. Basic principles of PCR

3.2. Problems of PCR
3.3. Technical variations of PCR
3.4. Non-PCR amplification methods
3.5. Semi-quantitative PCR, real-time PCR, and digital droplet PCR
3.6. PCR applications

DNA sequencing
4.1. Sanger sequencing
4.2. NGS or 2nd generation sequencing
4.3. Next Next generation sequencing or Third generation sequencing
4.4. Comparison of the different methods
4.5. Applications of high-throughput sequencing

Identification and analysis of genes
5.1. Identification based on DNA similarity
5.2. Identification based on expression patterns
5.3. Identification based on encoded protein
5.4. Identification based on mutation or polymorphism
5.5. Molecular/biochemical analysis of a gene
5.6. Functional analysis of a gene through deletion or over-expression

Analysis of genetic variation through DNA-polymorphisms
6.1. Molecular markers introduction
6.2. Molecular markers techniques applied on the whole genome
6.3. Specific DNA regions
6.4. Applications in crop protection, analysis of relationship and breeding
6.5. Comparative overview
6.6. Breeding or biotechnology?

Gene expression analysis
7.1. RNA extraction and run-on
7.2. Analysis of transcripts through hybridisation
7.3. Analysis of transcripts through sequence analysis
7.4. Q-RT-PCR.
7.5. RNA fingerprints
7.6. Reporter genes

Protein analysis
8.1. Protein extraction and purification
8.2. Protein electrophoresis
8.3. Detection of proteins using antibodies
8.4. Tandem affinity purification
8.5. In vitro transcription and translation systems
8.6. Yeast2Hybrid systems
8.7. Proteomics

Recombinant DNA
9.1. Enzymes involved in recombinant DNA
9.2. Restriction enzyme dependent DNA assembly methods
9.3. Restriction enzyme independent DNA assembly methods
9.4. Transformation
9.5. cDNA synthesis and libraries
9.6. Genomic libraries
9.7. Clone analysis

Cloning vectors and their application
10.1. Basic structure of a vector
10.2. Expression vectors for protein production
10.3. Examples of recombinant proteins: enzymes, therapeutics, vaccines, etc.
10.4. Expression vectors for metabolite production
10.5. Examples of metabolites: biofuels, bulk chemicals, therapeutics, etc.

Exercises:
1 PC-practicum
2 PCR, RT-PCR and Q-PCR, reporter genes
3 Guest speaker from industry

Initial competences

Gene Technology and Molecular Diagnostics builds on certain learning outcomes of course unit Biochemistry and Molecular Biology ; or the learning outcomes have been achieved differently

Final competences

1 to have knowledge on genome structure and genetic diversity at the molecular level
2 to utilise techniques for analysis of DNA, RNA and proteins with interpretation of the results
3 to have insight in genome structure, gene structure, gene expression and regulation of gene expression
4 to know the techniques for expression of inactivation of genes
5 to search and analyse DNA sequences in data bases, to search for data in other scientific data bases
6 to execute tasks on DNA and RNA analysis in the frame of a scientific problem
7 to be able to select the best analytical molecular technique for the analysis of a problem
8 to be able to recognise the most important elements on a DNA-vector and to understand the function of it
9 to work accurately in molecular lab experiments and to critically analyse the results
10 to be able to critically compare the advantages and disadvantages of different molecular analysis techniques
11 to know correct terminology in molecular genetics and recombinant DNA
12 to ethically reflect on opportunities and problems associated with DNA analysis
13 to be aware of possibilities of molecular techniques and the importance of communication to society
14 to have an idea about the possible job profiles for bio-engineers in cel and gene biotechnology
15 to be able to understand and compare the high throughput sequencing techniques
16 work in a team for experimental work and reporting--- Klik om te editeren ---

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

Excursion, lecture, practicum, seminar: practical PC room classes

Extra information on the teaching methods

in case visits to companies are not possible, the company is invited to give a presentation to the students

Learning materials and price

A syllabus is available. Powerpoint via minerva.

References

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Course content-related study coaching

Additional information or explanation can be obtained by personal contact or by email or Minerva and during the excercises.

Evaluation methods

end-of-term evaluation and continuous assessment

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

Written examination with open questions, oral examination

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

Written examination with open questions, oral 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 possible in modified form

Calculation of the examination mark

Theory: period aligned evaluation: 80%
Exercises: non-period aligned evaluation: 20%

Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examinator.
Students that are legally absent for some practical exercises do not have to catch this up later, but can get some theoretical questions to be answered. Illegal absence to the practical exercises will lead to a total score (theorie+exercises) of maximum 9/20, regardless of the score for the theory. If less than 9/20 is scored, one cannot pass this course anymore. If the total score would be more than 10/20, this score will be reduced to the highest non-pass score.