ANNEE : 3ème année / 3rd year - 60 ECTS

SEMESTRE : 1er semestre / 1st semester - 30 ECTS

PARCOURS : Parcours standard / standard track - 30 ECTS

UE : SHS, Langues et Sport 3BS S1 / SHS, Languages and Sport 3BS S1 - 7 ECTS

EC : Economie d'Entreprise / Business Economics - 1.00 ECTS

EC : Ethique 1 : Introduction à l'éthique technologique et à la responsabilité sociétale de l'ingénieur / Ethic 1 - 1.00 ECTS

UE : Biologie 3BS S1 / Biology 3BS S1 - 8 ECTS

EC : Microbiologie générale / General Microbiology - 2 ECTS

EC : Biologie Générale / General Biology - 2 ECTS

EC : Biologie Cellulaire / Cell Biology - 2 ECTS

EC : Physiologie 1 : Mécanismes de l'homéostasie / Physiology 1 : Mechanisms of homeostasis - 2 ECTS

UE : Informatique, Mathématiques et Statistiques 3BS S1 / Computer Science, Mathematics and Statistics 3BS S1 - 8 ECTS

EC : Remise à niveau en mathématiques - ECTS

EC : Biostatistiques 1 : Intervalles de confiance et tests paramétriques usuels / Usual Confidence Intervals and Parametric tests - 3 ECTS

EC : Informatique 1 : Introduction à l'automatisation de traitement de données / Computer Sciences 1 : Introduction to data processing automation - 2.50 ECTS

EC : Biomathématiques 1 : Modélisation de dynamiques biologiques par équation différentielles ordinaires / Modelling biological dynamics - 2.50 ECTS

UE : Chimie Biochimie 3BB S1 / Chemistry Biochemistry 3BB S1 - 7 ECTS

EC : Biochimie Structurale / Structural Biochemistry - 2.0 ECTS

EC : Chimie Physique / Physical Chemistry - 2 ECTS

EC : Chimie Organique / Organic Chemistry - 3 ECTS

SEMESTRE : 2ème semestre / 2nd semester - 30 ECTS

PARCOURS : Parcours Biochimie Biotechnologie / biochemistry and biotechnology track - 30 ECTS

UE : B3-3-S2-UE-COSHSLS - 5 ECTS

UE : Chimie 3BB S2 / Chemistry 3BB S2 - 8 ECTS

EC : Chimie organique 2 : Synthèse de molécules d'intérêt / Organic chemistry 2 : Synthesis of molecules of interest - 5 ECTS

EC : Chimie analytique : analyses physico-chimiques / Analytical chemistry : physico-chemical analyse - 3 ECTS

UE : Tronc commun scientifique 3BS S2 / Scientific Common Core 3BS S2 - 6 ECTS

EC : Projet de biologie de synthèse / Synthetic Biology Project - 3 ECTS

EC : Omiques 1 : NGS, Applications et Analyses / Omics 1 : NGS, Applications and Analysis - 2.00 ECTS

EC : Ethique 2 : Travailler l'éthique à partir des représentations et des imaginaires des biosciences / Ethic 2 - 1.00 ECTS

UE : Physiologie, Biologie 3BB S2 / Physiology, Biology 3BB S2 - 5 ECTS

EC : Biologie du developpement / Biology of development - 3 ECTS

EC : Physiologie 2 : Communications hormonales et nerveuses / Physiology 2 : Hormonal and nervous communications - 2.00 ECTS

UE : Biochimie 3BB S2 / Biochemistry 3BB S2 - 6 ECTS

EC : Biochimie analytique / Analytical biochemistry - 6 ECTS

PARCOURS : Parcours bioinformatique et modélisation / bioinformatic and modelisation track - 30 ECTS

UE : Mathématiques et Statistiques 3BIM S2 / Mathematics and statistics 3BIM S2 - 9 ECTS

EC : Biostatistiques 2 : Compléments mathématiques pour les statistiques / Biostatistics 2 : Mathematical Supplements for Statistic - 1 ECTS

EC : Biomathématiques 3 : Equations différentielles ordinaires avancées / Biomathematics 3 : Advanced Ordinary Differential Equations - 3.00 ECTS

EC : Biomathématiques 2 : Algèbre linéaire / Biomathematics 2 : Linear Algebra - 2.00 ECTS

EC : Biostatistiques 3 : Le modèle linéaire / Biostatistics 3 : The linear model - 3 ECTS

UE : B3-3-S2-UE-COSHSLS - 5 ECTS

UE : Tronc commun scientifique 3BS S2 / Scientific Common Core 3BS S2 - 6 ECTS

EC : Projet de biologie de synthèse / Synthetic Biology Project - 3 ECTS

EC : Omiques 1 : NGS, Applications et Analyses / Omics 1 : NGS, Applications and Analysis - 2.00 ECTS

EC : Ethique 2 : Travailler l'éthique à partir des représentations et des imaginaires des biosciences / Ethic 2 - 1.00 ECTS

UE : Informatique 3BIM S2 / Computing 3BIM S2 - 7 ECTS

EC : Informatique 2 : Linux local et distant / Computer 2 : Local and Remote Linux - 2 ECTS

EC : Informatique 4 : Bases de données / Computer 4 : Databases - 2 ECTS

EC : Informatique 3 : Algorithmique et Programmation / Computer 3 : Algorithmics and Programming - 3 ECTS

UE : Biologie / Biology 3BIM S2 - 3 ECTS

EC : Biologie cellulaire TP / Cell biology praticals - 1 ECTS

EC : Enzymologie / Enzymology - 1 ECTS

EC : Physiologie 2 : Récepteurs et voies de signalisation / Physiology 2 : Receptors and signaling pathways - 1 ECTS

ANNEE : 4ème année / 4th year - 60 ECTS

SEMESTRE : 1er semestre / 1st semester - 30 ECTS

PARCOURS : Parcours Bioinformatique et Modélisation / Bioinformatics and Modelling track - 30 ECTS

UE : SHS, Langues et Sport 4BS S1 / SHS, Languages and Sport 4BS S1 - 5 ECTS

EC : Conférences métiers / Industrial Communication - 1 ECTS

EC : Projet Personnel et Professionnel 1 / Personal and Professional Project 1 - 1 ECTS

UE : Informatique 4BIM S1 / Computing 4BIM S1 - 6 ECTS

EC : Informatique 5 : Programmation orientée-objet / Object-oriented programming - 3 ECTS

EC : Informatique 6 : Intelligence artificielle / Computer 6 : Artificial intelligence - 3 ECTS

UE : Mathématiques et Statistiques 4BIM S1 / Mathematics and statistics 4BIM S1 - 8 ECTS

EC : Biomathématiques 4 : Equations aux Différences et Equations aux Dérivées Partielles / Differences Equations and Partial differential equation - 4.00 ECTS

EC : Biostatistiques 5 : Modèles linéaires mixtes et statistiques non paramétriques / Biostatistics 5 : Mixed Linear Models - 2 ECTS

EC : Biostatistiques 4 : Analyses multivariées / Biostatistics 4 : Multivariate Analysis - 2 ECTS

UE : Biologie et Bioinformatique 4BIM S1 / Biology and Bioinformatic 4BIM S1 - 11 ECTS

EC : Omiques 2 : Génomique / Omics 2 : Genomics - 4.00 ECTS

EC : Génétique des eucaryotes / Genetics of the eukaryote cell - 4 ECTS

EC : Immunologie / Immunology - 3 ECTS

EC : Génétique et dynamique des populations / Population genetics and dynamics - 3 ECTS

PARCOURS : Parcours Biochimie et biotechnologies / Biochemistry and Biotechnology Track - 30 ECTS

UE : SHS, Langues et Sport 4BS S1 / SHS, Languages and Sport 4BS S1 - 5 ECTS

EC : Conférences métiers / Industrial Communication - 1 ECTS

EC : Projet Personnel et Professionnel 1 / Personal and Professional Project 1 - 1 ECTS

UE : Physiologie Microbiologie 4BB S1 / Physiology Microbiology 4BB S1 - 13 ECTS

EC : Physiologie 3 : Régulations grandes fonctions et pharmacologie / Physiology 3 : Regulation of major functions and pharmacology - 5 ECTS

EC : Microbiologie moléculaire / Molecular microbiology - 5 ECTS

EC : Immunologie / Immunology - 3 ECTS

EC : Génétique et dynamique des populations / Population genetics and dynamics - 3 ECTS

UE : Biochimie 4BB S1 / Biochemistry 4BB S1 - 12 ECTS

EC : TP Biochimie structurale et fonctionnelle / Practical : Structural and Functional Biochemistry - 3 ECTS

EC : Projet biochimie industrielle / Industrial Biochemistry Project - 5 ECTS

EC : Biochimie métabolique et fonctionnelle / Metabolic and functionnal biochemistry - 2 ECTS

EC : Biochimie de Signalisation et Enzymologie / Signaling Biochemistry and Enzymology - 2 ECTS

SEMESTRE : 2ème semestre / 2nd semester - 30 ECTS

PARCOURS : Parcours Biochimie et Biotechnologies / Biochemistry and Biotechnology Track - 30 ECTS

UE : Biologie 4BB S2 / Biology 4BB S2 - 6 ECTS

EC : Génétique : Génétique quantitative moléculaire et épigénétique / Genetics : Molecular and epigenetic quantitative genetics - 2 ECTS

EC : Biotechnologie et Imagerie Cellulaire / Biotechnology and Cell Imaging - 4 ECTS

UE : Physiologie Statistiques 4BB S2 / Physiology Statistics 4BB S2 - 5 ECTS

EC : Biostatistiques 2 : modèles linéaires et non paramétriques / Biostatistics 2 : linear and non- parametric models - 3 ECTS

EC : Pharmacologie 1 : ADMET et Modèles compartiments / Pharmacology 1 : ADMET and Compartmental Models - 2 ECTS

UE : SHS, Langues et Sport 4BS S2 / SHS, Languages and Sport 4BS S2 - 3 ECTS

EC : Options Sciences Humaines et Sociales, S2 Série 2 / Social and Human Sciences Options, S2 Series 2 - undefined ECTS

UE : Omiques, Procédés 4BB S2 / Omics, Processes 4BB S2 - 5 ECTS

EC : Génie des procédés : Biochimie et catalyse enzymatique / Process engineering : Biochemistry and enzymatic catalysis - 2 ECTS

EC : Bioinformatique / Bioinformatic - 3.00 ECTS

UE : Stage professionnel de 4ème année / Professional training (fourth year) - 11 ECTS

UE : Activités volontaires 4BS S2 - 0 ECTS

EC : Elu(e) étudiant(e) de 4eme année au conseil de département - ECTS

PARCOURS : Parcours Bioinformatique et Modélisation / Bioinformatics and Modelling Track - 30 ECTS

UE : SHS, Langues et Sport 4BS S2 / SHS, Languages and Sport 4BS S2 - 3 ECTS

EC : Options Sciences Humaines et Sociales, S2 Série 2 / Social and Human Sciences Options, S2 Series 2 - undefined ECTS

UE : Biologie et Bioinformatique 4BIM S2 / Biology and Bioinformatic 4BIM S2 - 7 ECTS

EC : RMN et cristallographie / NMR and crystallography - 2 ECTS

EC : Pharmacologie 1 : ADMET et Modèles compartiments / Pharmacology 1 : ADMET and Compartmental Models - 2 ECTS

EC : Omique 3 : Transcriptomic / Omics 3 : Transcriptomic - 3.00 ECTS

UE : Informatique 4BIM S2 / Computing 4BIM S2 - 5 ECTS

EC : Projet 4BIM : Développement logiciel / 4BIM Project : Software Development - 3 ECTS

EC : Informatique 7 : Programmation web / Computer 7 : Network programming and web programming - ECTS

UE : Mathématiques et Statistiques 4BIM S2 / Mathematics and statistics 4BIM S2 - 4 ECTS

EC : Biostatistiques pour l'épidémiologie, modèle linéaire général / Epidemiological Statistics, Generalized Linear Model - 2 ECTS

EC : Biomathématiques 5 : Processus stochastiques / Biomathematics 5 : Stochastic Processes - 2.0 ECTS

UE : Activités volontaires 4BS S2 - 0 ECTS

EC : Elu(e) étudiant(e) de 4eme année au conseil de département - ECTS

UE : Stage professionnel de 4ème année / Professional training (fourth year) - 11 ECTS

ANNEE : 5ème année / 5th year - 60 ECTS

SEMESTRE : 1er semestre / 1st semester - 30 ECTS

PARCOURS : Parcours standard BB - 30 ECTS

UE : Modules communs 5BS S1 / Common modules 5BS S1 - 10 ECTS

EC : Culture industrielle et Innovation / Industrial innovation - 2 ECTS

EC : Procédés des industries pharmaceutiques / Processes of the pharmaceutical industries - 2 ECTS

EC : Génomique médicale / Medical genomics - 2.00 ECTS

EC : Virologie structurale et antiviraux / Structural virology and antiviral strategies - 2 ECTS

EC : Planification expérimentale / Experimental planning - 2 ECTS

EC : Sciences et technologies des aliments / Food Science and Technology - 2 ECTS

EC : Traitement et analyse d'images biologiques / Signal and image analysis - 2 ECTS

EC : Métabolomique et biotechnologies médicales innovantes / Metabolomics and innovative medical biotechnologies - 2 ECTS

EC : Empreintes écologiques / Climate issues and environmental footprints - 2 ECTS

EC : Biochimie Industrielle et environnementale / Industrial and environmental biochemistry - 2 ECTS

EC : Pharmacologie 2 / Pharmacology 2 - 2.00 ECTS

EC : Biotechnologies Végétales : Défis Alimentaires et Environnementaux / Plant Biotechnologies : Food and Environmental Challenges - 2 ECTS

UE : SHS, Langues et Sport 5BS S1 / SHS, Languages and Sport 5BS S1 - 7 ECTS

EC : Projet personnel et professionnel 2 / Personal and Professional project - 1 ECTS

EC : Projet Personnel en Humanités / Personal Project in Humanities - undefined ECTS

EC : Options Sciences Humaines et Sociales, S1 Série 4 / Social and Human Sciences Options, S1 Series 4 - undefined ECTS

UE : Projet Biologie 5BB S1 / Biology Project 5BB S1 - 13 ECTS

EC : Projet de pharmacocinétique et modélisation / Pharmacokinetic and Modeling Project - 4.00 ECTS

EC : Projet Procédés Industriels / Industial Processes Project - 5 ECTS

EC : Projet 5BB / Project 5BB - 5 ECTS

EC : Bioingénierie des protéines / Bioengineering of proteins - 4 ECTS

PARCOURS : Parcours standard BIM - 30 ECTS

UE : Modules communs 5BS S1 / Common modules 5BS S1 - 10 ECTS

EC : Culture industrielle et Innovation / Industrial innovation - 2 ECTS

EC : Sciences et technologies des aliments / Food Science and Technology - 2 ECTS

EC : Génomique médicale / Medical genomics - 2.00 ECTS

EC : Pharmacologie 2 / Pharmacology 2 - 2.00 ECTS

EC : Traitement et analyse d'images biologiques / Signal and image analysis - 2 ECTS

EC : Planification expérimentale / Experimental planning - 2 ECTS

EC : Procédés des industries pharmaceutiques / Processes of the pharmaceutical industries - 2 ECTS

EC : Métabolomique et biotechnologies médicales innovantes / Metabolomics and innovative medical biotechnologies - 2 ECTS

EC : Empreintes écologiques / Climate issues and environmental footprints - 2 ECTS

EC : Virologie structurale et antiviraux / Structural virology and antiviral strategies - 2 ECTS

EC : Biochimie Industrielle et environnementale / Industrial and environmental biochemistry - 2 ECTS

EC : Biotechnologies Végétales : Défis Alimentaires et Environnementaux / Plant Biotechnologies : Food and Environmental Challenges - 2 ECTS

UE : Projet 5BIM S1 / Project 5BIM S1 - 5 ECTS

EC : Projet 5BIM / 5BIM Project - 5.00 ECTS

UE : SHS, Langues et Sport 5BS S1 / SHS, Languages and Sport 5BS S1 - 7 ECTS

EC : Projet Personnel en Humanités / Personal Project in Humanities - undefined ECTS

EC : Projet personnel et professionnel 2 / Personal and Professional project - 1 ECTS

EC : Options Sciences Humaines et Sociales, S1 Série 4 / Social and Human Sciences Options, S1 Series 4 - undefined ECTS

UE : Bioinformatique 5BIM S1/ Bioinformatics 5BIM S1 - 4 ECTS

EC : Omiques 5 : Protéomique / Omics 5 : Proteomics - 2.00 ECTS

EC : Omiques 4 : Bioinformatique structurale et Drug design / Omics 4 : Structural bioinformatics and Drug design - 2.00 ECTS

UE : Options 5BIM S1 / Options 5BIM S1 - 4 ECTS

EC : Calcul haute performance / High performance computing - 2 ECTS

EC : Biostatistiques 7 : Statistiques bayésiennes / Bayesian statistics - 2 ECTS

EC : Modélisation de réseaux biologiques / Modeling of biological networks - 2.00 ECTS

EC : Modélisation de systèmes biologiques de l'individu à l'écosystème / Modelling of biological systems from the individual to the ecosystem - 2 ECTS

SEMESTRE : 2ème semestre / 2nd semester - 30 ECTS

PARCOURS : Parcours standard / Standard track - 30 ECTS

UE : Stage professionnel de 5ème année / Professional training (5th year) - 30 ECTS

PARCOURS : Filière Etudiant Entreprendre (FEE) / Entrepreneur Student Track - 30 ECTS

UE : Vendre et communiquer son projet / Selling and communicating your project - 5 ECTS

EC : Vendre et communiquer son projet / Selling and communicating your project - ECTS

UE : Agir en tant qu'entrepreneur / Acting as an entrepreneur - 5 ECTS

EC : Agir en tant qu'entrepreneur / Acting as an entrepreneur - ECTS

UE : Mieux se connaitre pour entreprendre avec justesse / Know yourself better to do business right - 5 ECTS

EC : Mieux se connaitre pour entreprendre avec justesse / Know yourself better to do business right - ECTS

UE : Structurer son projet entrepreneurial / Structuring your business project - 5 ECTS

EC : Structurer son projet entrepreneurial / Structuring your business project - ECTS

UE : Faire émerger une opportunité d'entreprendre / Create an entrepreneurial opportunity - 5 ECTS

EC : Faire émerger une opportunité d'entreprendre / Create an entrepreneurial opportunity - ECTS

UE : Concevoir un produit innovant / Designing an innovative product - 5 ECTS

EC : Concevoir un produit innovant / Designing an innovative product - ECTS

IDENTIFICATION

CODE : BS-3-S1-EC-COECOEN
ECTS : 1.00

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	5h
Total :	25h

ASSESMENT METHOD

Oral presentation based on a slideshow of a group project on a product innovation related to biosciences

TEACHING AIDS

- Lecture slides
- Extensive case study on Gilead corporation and the antiviral drugs industry
- Articles

TEACHING LANGUAGE

French

CONTACT

M. BRETTE Olivier :
olivier.brette@insa-lyon.fr

AIMS

COMPETENCES
This course targets the following skills :
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level 2)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

This course is related to the following fields of knowledge :
Business economics
Industrial economics
Innovation economics

CONTENT

Introduction. Definitions and landmarks
1. The economic environment of business
2. The strategic management of business
3. Intellectual Property and its stakes
Presentation of group projects. 6 innovation case studies related to biosciences

BIBLIOGRAPHY

- Johnson, G., Whittington, R., Scholes, K., Angwin, D., Regnér, P., 2019, Exploring Strategy, 12e ed., Pearson
- Europresse
- https://www.xerficanal.com

PRE-REQUISITES

none

IDENTIFICATION

CODE : BS-3-S1-EC-COETHI1
ECTS : 1.00

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	5h
Total :	25h

ASSESMENT METHOD

A ‘long’ summary text, taking into account the ethical debates surrounding a medical device, which has also been studied in Olivier Brette's business economics course (S1)

TEACHING AIDS

On moodle

TEACHING LANGUAGE

French

CONTACT

MME CHOUTEAU Marianne :
marianne.chouteau@insa-lyon.fr

AIMS

By the end of the first semester of the 3rd year of BS, students will be able to :
1. identify the socio-political and economic context of a drug or phytosanitary device, formulating its technical culture and highlighting the 3 levels that make it up
2. Build an ethical deliberation tool, such as an ethical matrix, by identifying the stakeholders involved.
3. Identify an ethical issue and write a summary using elements from the course and documentation appropriate to the standards.
4. Evaluate and discuss own ethical positions

1. Act responsibly in a complex world
- Understand the complex issues (in business and society) facing engineers: grasp their social, societal, political, economic, environmental, ethical and philosophical dimensions, etc.
- Integrate a responsible dimension (deontology, ethics) into their actions, identify, evaluate and anticipate the consequences of their actions and decisions at different levels of scale.

2. Work, learn and develop independently

- Acquire new skills independently, by seeking out the necessary resources,
- Exercise critical thinking skills, think for yourself
- Construct and defend ethical and critical reasoning as part of a team,
- Understand the social implications of scientific issues
- Interact with others, work as part of a team
Communicate effectively

CONTENT

- Introduction to technological ethics: the question of "technical culture" as a basis for reflection
- Environmental ethics
- Animal ethics
- The engineers social responsibility

BIBLIOGRAPHY

Aristote (1994). Ethique à Nicomaque. Paris : Livre de poche.
Butler, J. (2007). Le Récit de soi, traduit de l'anglais par Bruno Ambroise et Valérie Aucouturier, Paris : Puf.
Beau, R. & Larrère, C. (2018). Penser l'Anthropocène. Paris: Presses de Sciences Po.
Revue française d'éthique appliquée
Gilligan C., (2024) "Une voix humaine. L'éthique du care revisitée, Flammarion
Jonas, H. (1995). Le principe responsabilité. Paris : Cerf.
Jonas, H. (1997). Pour une éthique du future. Paris : Rivages.
Simon, R. (1993). L'éthique de la responsabilité. Paris : Cerf.

PRE-REQUISITES

Be able to speak and write in French

Microbiology

IDENTIFICATION

CODE : BS-3-S1-EC-COMICRO
ECTS : 2

HOURS

Cours :	14h
TD :	0h
TP :	24h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	12h
Total :	52h

ASSESMENT METHOD

Lab class report. 30 mn
Written individual evaluation

TEACHING AIDS

Photocopies of the illustrations will be handed out before each lecture.
-slides
-videos

TEACHING LANGUAGE

English

CONTACT

MME HAICHAR Feteh-El-Zahare : feteh-el-zahare.haichar@insa-lyon.fr

AIMS

To learn the fundamentals of handling and culture of microrganisms.
To acquire a global view of the microbial world, in nature, wastewater treatment plants, and as pathogenic agents and biotechnological tools.
To learn the essential concepts of genetics and understand the interest of some of them in bacterium identification and industrial microbiology.
To present the fundamentals of ecology, microbiology and genetic engineering.
To present a complete view of bacterial genetics, from the origins until now.

CONTENT

The roots of microbiology, genetics and ecology.
Archae- and Eubacteria; viruses.
The components of the bacterial cell
1. Cell envelope and secretion.
2. Internal structures: nucleide, plasmids, tubulin, actin.
Bacterial chromosome replication and bacterial division, cell cycle
3. External structures: capsule, fimbriae, flagelle. Assembly

Micro-organism diversity, role in ecosystems, bioremediation, food industry

Way of life of microorganisms: free life, biofilm, interactions with higher organism (symbiosis-pathogenesis) Notion of Microbiome. Some examples of pathogenic bacteria.

Basic notions of genetics: genes, alleles, adaptation and mutation.
Exchange of genetic material in bacteria: conjugation, transduction, transformation.

Evolution of microorganisms, short generation time + high selection pressure, high frequency of mutations, emergence of new strains, increased biodiversity. Case study: the emergence of antibiotic resistance and societal impact. The major mechanisms of resistance

BIBLIOGRAPHY

Atlas R. M. and Bartha R. 1997. Microbial ecology: fundamentals and applications (4th edition). Benjamin Cummings.
Griffiths A. J. F., Miller J. H., Suzuki D. T., Lewontin R. C. and Gelbart W. M. 2000. An introduction to genetic analysis. W. H. Freeman.
Hart T. et Shears P. 1997. Atlas de poche de microbiologie. Médecine-Sciences Flammarion.
Lewin B. 2003. Genes VIII. Benjamin Cummings.
Prescott L. M., Harley J. P. and Klein D. A. 2004. Microbiology (6th edition). McGraw-Hill Science.

PRE-REQUISITES

French general high school biology curriculum up to 11th grade.

Biology

IDENTIFICATION

CODE : BS-3-S1-EC-COBIOGE
ECTS : 2

HOURS

Cours :	22h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

1 x 1.3h Written evaluation

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. CHARLES Hubert :
hubert.charles@insa-lyon.fr

AIMS

The educational objectives of the lecture part are:
- to Familiarize the students with the vocabulary and the main notions of the biology (origin and nature of the life, evolution, biodiversity, organization of the human beings and ecosystems, work in sterile conditions),
- to bring to light the main tendencies (association, exchanges, complexification) by leaning on the main biological model, this to illustrate the big fundamental problems of the biology and the applications in agronomy and health notably.

At the conclusion of this module the student will have to be capable of becoming integrated into a research programm or development in biology (discussion with the specialists) and also of implementing and\or of participating in experiments.

CONTENT

1. Definition and origin of life (1h) - HC
2. Basis of evolution (2h) - HC :
3. Introduction to ecology (2h) - HC
4. Organism complexity, life cycles and focus on the main model organisms of biology.
4.1. Prions, viruses and bacteria (1h) - HC
4.2. Symbiosis in the living (2h) - AH
4.3 Protists and the unicellular multicellular passage (3h) - AH
4.3. Organization of metazoans and implementation of organization plans (from diplobastics to tribloblastics) (3h) - AH
4.4. Biology of arthropods (focus on the insect) (2h) - AH
4.5. Biology and complexification of chordates (focus on zebra fish, xenopus, chicken, mammals (murine, human) (4h) - HC
5. Introduction to plant biology (2h) - AH
7. Final exam (2h) - AH/HC

BIBLIOGRAPHY

1. Le monde du vivant, traité de biologie - W.K. Purves, G. H. Orians et H.C. Heller
2. Biology 1 and 2 - K. Arms, P.C. Camp - Edit. Etudes Vivantes

PRE-REQUISITES

French general high school biology curriculum up to 11th grade.

Cell Biology

IDENTIFICATION

CODE : BS-3-S1-EC-COBIOCE
ECTS : 2

HOURS

Cours :	22h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

2 hours

TEACHING AIDS

Powerpoint document

TEACHING LANGUAGE

French

CONTACT

M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

'This CE contributes to the competences :
A1. Analyse a system (real or virtual) (level 1)
A3. Implement an experimental approach (level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)

CONTENT

1 Animal and plant cells .
2 Study methods.
3 Structure, ultrastructure, chemical composition and functioning of different cell compartments.
4 Mitosis and cell cycle, regulation, oncogenesis .
5 Cell differentiation, apoptosis .
6 Living cell dynamics: the main methods of exploration, examples of particular processes (cell migration, modelling and analysis of endocytosis processes, calcium signalling, cell deformations...).
7 New techniques for the study of cellular dynamics: use of GFP, techniques of FRAP and FLIP, FRET and BRET, TIRFM, FCS.

BIBLIOGRAPHY

Biologie moléculaire de la cellule, B. Alberts et al. Médecine Sciences, Flammarion Paris
Molecular Cell Biology, J. Darnell et al., Scientific American Books, Freeman and Company, NY
La Recherche
Scientific American
Cell
Biofutur

PRE-REQUISITES

French general high school biology curriculum up to 11th grade.

Physiology Pharmacology

IDENTIFICATION

CODE : BS-3-S1-EC-COPHYS1
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

1 x 1h30
True/False Questions
Multiple Choice Questions
Targeted Questions
Concept Application Exercises
Document Analysis

TEACHING AIDS

duplicate course material

TEACHING LANGUAGE

French

CONTACT

MME DELTON Isabelle :
isabelle.delton@insa-lyon.fr

AIMS

This EC contributes to the following skills:
A1. Analyze a real or virtual system (or problem) (Level 1)
- Decompose a system into a subset of interacting sub-parts
A3. Implement an experimental approach (Level 1)
A6. Communicate an analysis or a scientific approach using scenarios appropriate to their specialty (Level M)
- Interpret experimental results and integrate them into a biological problem
C7. Manipulate cell cultures, microorganisms, or laboratory animals (Level 1)
- Choose the most appropriate experimental model
C8. Use the main techniques for exploring biological functions (Level 1)
The knowledge associated with this EC is:
General and cellular physiology
Anatomy and physiology of laboratory animals
Experimental surgery
Ethics

OBJECTIVES:
Acquire basic knowledge of the different levels of organization of a living organism, understand its structural and thermodynamic complexity, and approach the study of the mechanisms responsible for the homeostasis of the internal environment using a cybernetic approach.
Introduce the fundamental concepts and basic techniques in animal experimentation.

CONTENT

Knowledge of the organizational levels of a living organism and the mechanisms responsible for homeostasis of the inner environment.
- Liquid compartments
- Membrane water and solute transport (passive, active)
- Ion exchange and membrane potential
- Acido-basic regulation
- Blood cells and their functions
- Renal regulation of the inner environment

BIBLIOGRAPHY

Physiologie des régulations - E. Schoffeniels and G. Mooner - Masson - 1993
Review of Medical Physiology. 20th Edition - W.F. Ganong - Mc Graw-Hill Professional Publishing - 2001
Introduction à la physiologie - Cybernétique et régulations - Bernard Calvino - Belin - 2003
The laboratory mouse - Hedrich H, Bullock GR - Academic press - 2004
The laboratory rat - Krinke GJ, Bullock GR - Academic press - 2000
Current techniques in small animal surgery - Bojrab MJ, Ellison GW, Slocum B - Lippincott, Williams et Wilkins - 1997
Experimental and surgical techniques in the rat - Waynforth HB, Flecknell PA - Academic press - 1992
Laboratory animal anesthesia: a practical introduction for research workers and technicians - Flecknell PA - Academic press - 1996

PRE-REQUISITES

French general high school biology curriculum up to 11th grade.

Mathematics

IDENTIFICATION

CODE : BS-3-S1-EC-CORNMAT
ECTS :

HOURS

Cours :	0h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	16h
Travail personnel :	0h
Total :	16h

ASSESMENT METHOD

Self-assessment on Wooclap

TEACHING AIDS

https://moodle.insa-lyon.fr/course/view.php?id=7502

TEACHING LANGUAGE

French

CONTACT

M. BERNARD Samuel :
bernard@math.univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyse a system (real or virtual) (level 1)
A2. Use a model of a real or virtual system (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 1)

CONTENT

1 Functions, maps
1.1 Some usual maps
1.2 Exercises on functions
2 Derivatives
2.1 List of common derivatives
2.2 Exercises on derivatives
3 Taylor series and truncated expansions
3.1 Expansion of a function of two variables
3.2 Expansion of a function from R2 → R2
4 Integrals and primitives
4.1 Primitives
4.2 Integrals
5 Differential equations in 1D
5.1 Finding solutions of differential equations
6 Complex numbers
6.1 Roots of a complex number
6.2 Exercises on complex numbers
7 Matrices in dimension 2
7.1 Eigenvalues of a 2 × 2 matrix
7.1.1 Exercises on eigenvalues
7.2 Matrix-vector operations
7.2.1 Exercises on Matrix-vector and matrix-matrix operations
8 Eigenvalue decomposition
8.1 Eigenvectors
8.2 Exercises on eigenvalues decomposition
9 Linearisation of functions R2 → R2
9.1 Exercises on linearisation
10 Solution of systems of linear differential equations in dimension 2

BIBLIOGRAPHY

PRE-REQUISITES

High school mathematics level

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S1-EC-COSTAT1
ECTS : 3

HOURS

Cours :	12h
TD :	23h
TP :	0h
Projet :	0h
Evaluation :	1h
Face à face pédagogique :	36h
Travail personnel :	40h
Total :	76h

ASSESMENT METHOD

2 x 1h written exam (with documents)

TEACHING AIDS

Photocopies of documents. On line PDF et PPT documents. Specialized softwares and web sites

TEACHING LANGUAGE

French

CONTACT

M. MEYER Sam :
sam.meyer@insa-lyon.fr
MME AUBIN Samuela :
samuela.leoni@insa-lyon.fr

AIMS

Being capable of analyzing data resulting from different types of experiments and to model experimental situations to propose effective strategies. Be capable of adapting itself to situations and varied domains and of taking into account the constraints of quality and control.
This course has to supply the statistical indispensable basic tools to structure, analyze and model simple data. He also has to allow to conceive experimental plans and to acquire the concepts and the general methods allowing to adapt itself to the diverse situations met in Life Sciences and in the industry. Simulations on microcomputer allow to show the laws of the statistics. The lesson leans on the consultation of web sites and specific softwares.

CONTENT

- Probabilities (elementary, conditional, ..).
- Random variables and vectors: definitions, properties, moments, micro-computer simulations.
- The main discreet and continuous laws and their inter-relations
- Law of large numbers and central limit theorem.
- Populations and samples. Sampling laws.
- Estimation, estimators and methods: point and confidence interval estimation.
- General information on hypothesis tests, likelihood of hypothesis.
- Main usual parametric tests. Comparison of variances, means, proportions. Contingency tables. Normality tests. Testing of outliers.
- Power of a simple experiment and determination of the number of measurements to be carried out. - Introduction to the linear model.
- Introduction to R software for statistics

BIBLIOGRAPHY

1 - Statistique théorique et appliquée (vol. 1 et 2) - P. Dagnelie - De Boeck Université - 1998
2 - Statistical theory and methodology - K.A. Brownlee - Wiley and Sons. New York - 1967
3 - Biostatistical analysis - J.H. ZAR - Prentice-Hall - 1998

PRE-REQUISITES

Bac + 2 level in mathematics

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Computer Sciences 1 : Introduction to data processing automation

IDENTIFICATION

CODE : BS-3-S1-EC-COINFO1
ECTS : 2.50

HOURS

Cours :	0h
TD :	32h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	32h
Travail personnel :	30h
Total :	62h

ASSESMENT METHOD

Formative assessment: the second session of the module ends with a 15-minute self-assessment MCQ.

Summative assessment by continuous assessment: from the third session onwards, each session ends with a 15-minute MCQ on the session's content.

TEACHING AIDS

Resources are available to the registered students on the course's Moodle space: https://moodle.insa-lyon.fr/course/view.php?id=6534

TEACHING LANGUAGE

French

CONTACT

M. BESLON Guillaume :
guillaume.beslon@insa-lyon.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 1)
A2. Use a model of a real or virtual system (level 1)
A5. Process data (level 1)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 1)
C4. Implement analysis tools for high-throughput biology (level 1)
C12. Automate the processing and extraction of knowledge from biological data. (level 1)
B2. Work, learn and develop independently (level M)
B5. Act responsibly in a complex world (level 1)

CONTENT

8 sessions of 4h
8 sessions of 4 hours
- What is “good” data?
- Process a data file using a Jupyter notebook; visualize data
- Simulation of a dynamical system (SIR system)
- Data visualization and dimension reduction
- Data visualization and clustering
- Introduction to medical image processing
- Digital environmental issues
- Societal issues of digital technology

Associated skills :
- Organize secure, reliable file storage and sharing
- Use Python interactively (as a super-calculator)
- Predict the evolution of variable values in a given algorithm
- Design an algorithm to solve a simple problem and implement it in Python
- Automate the processing of text or Excel files with a Python script
- Understand the societal and environmental challenges of the digital world

Associated knowledge :
- Notion of file, directory, access rights
- File sharing and collaborative working solutions
- Notion of algorithm
- Notion of variable
- Control structures
- Notion of function
- Python functions for manipulating text and Excel files

BIBLIOGRAPHY

PRE-REQUISITES

Rudiments d'algorithmique et programmation, idéalement en Python.

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S1-EC-COMATH1
ECTS : 2.50

HOURS

Cours :	10h
TD :	12h
TP :	7h
Projet :	0h
Evaluation :	1h
Face à face pédagogique :	30h
Travail personnel :	33h
Total :	63h

ASSESMENT METHOD

Final exam

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

M. Bernard Samuel :
bernard@math.univ-lyon1.fr

Mme Charles Sandrine :
sandrine.charles@univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 1)
A2. Use a model of a real or virtual system (level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 1)
C15. Contribute to environmental studies with biological and evolutionary components (level 1)
B2. Work, learn and develop independently (level M)

CONTENT

- Introduction to dynamic systems (1D and 2D)
- Applications in population dynamics: logistical, Gompertz and fishing models. Prey-predator model of Lotka-Volterra, competitive/mutualism models, SI and SIR models.
- TP with R software (deSolve, phaseR).

BIBLIOGRAPHY

PRE-REQUISITES

BS-3-S1-EC-COMATH1 or equivalent: functions, derivatives, integrals, differential equations in 1D, coplex numbers, 2D matrices

Biochemistry

IDENTIFICATION

CODE : BS-3-S1-EC-COBIOCH
ECTS : 2.0

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

Written exam and homework

TEACHING AIDS

Courses slides
Biochemistry - Berg, Tymoczko, Dtryer, Freeman, New York - ciples of Biochemistry - Nelson et Cox, Freeman, New York

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie : nathalie.bernoud-hubac@insa-lyon.fr

Mme Lazar Adina : adina-nicoleta.lazar@insa-lyon.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 1)
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)
B2. Work, learn and develop independently (level 2)

CONTENT

Knowledge of molecules and their physico-chemical characteristics. Structure-activity relationships of molecules of the living.
1. proteins: properties of amino acids; protein structure - Ramachandran diagram, folding mechanism and folding pathologies (example of Alzheimer¿s disease); structure-function relationship, structure-cell location; 3D Structure Analysis; Using the Uniprotkb Database; Protein Study Methods.
2. Nucleotides and nucleic acids: nucleic acid chemistry; nucleotide structure - double helix of nucleic acids; transcription and translation; DNA replication; DNA mutations and repair.
3. Lipids: structure and properties, lipid classes, biological roles; structure-function relationship; biological membrane structure; lipid analysis methods.
4. Carbohydrates: structure and properties of simple carbohydrates and polyosides, glycoconjugues.

BIBLIOGRAPHY

Biochemistry - Berg, Tymoczko, Dtryer, Freeman, New York
Lehninger Principles of Biochemistry - Nelson et Cox, Freeman, New York

PRE-REQUISITES

French general high school biology curriculum up to 11th grade.
Chemistry syllabus from the preparatory classes for engineering schools.

Chemistry

IDENTIFICATION

CODE : BS-3-S1-EC-COCHPHY
ECTS : 2

HOURS

Cours :	0h
TD :	42h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	44h
Travail personnel :	8h
Total :	52h

ASSESMENT METHOD

An individual written assessment in person lasting 1h30 in total.

For practical work:
Summative assessment of three practical work reports: writing skills, knowing how to present and discuss results with a critical scientific approach.

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. SOULERE Laurent :
laurent.soulere@insa-lyon.fr

AIMS

At the conclusion of this module the student will have acquired a good expertise concerning the analytical methods used for identifying organic compounds. He will have to be able to interpret simple spectra and will have to be capable of having a dialogue with specialists of each technique.
This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 1)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)

The educational objectives of this module are:
-Introduction to nuclear magnetic resonance (NMR)
-Introduction to mass spectrometry
-Introduction to fluorescence spectrometry
-Introduction to infrared spectroscopy
-Introduction to UV-visible spectrometry
-Introduction to molecular modeling

The student will be able to characterize new synthetic commpounds with potential biological interest and application.

CONTENT

Nuclear Magnetic Resonance (NMR)
Mass spectroscopy
Infrared spectroscopy
UV-visible spectroscopy
Fluorescence spectroscopy
Molecular modelling

BIBLIOGRAPHY

Mass Spectrometry in Drug Discovery D.T. Rossi, M. W. Sinz M. Dekker, Inc. 2002.
Interpreting Protein Mass spectra. A Comprehensive Resource A. P. Snyder Oxford Unversity Press 2000.

PRE-REQUISITES

General organic chemistry and structural biochemistry basis

Organic Chemistry

IDENTIFICATION

CODE : BS-3-S1-EC-COCHORG
ECTS : 3

HOURS

Cours :	0h
TD :	26h
TP :	24h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	52h
Travail personnel :	25h
Total :	77h

ASSESMENT METHOD

Continuous monitoring in Practical work (3 short written interrogations and 3 reports)
1 exam at the end of the period

TEACHING AIDS

3 handouts (TP, TD and CM) + specific supports downloadable on moodle
A kit of molecular models

TEACHING LANGUAGE

French

CONTACT

MME POPOWYCZ Florence :
florence.popowycz@insa-lyon.fr

AIMS

"This course targets the following skills :
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 1)
B3. Interact with others, work as part of a team (level M)
"

CONTENT

- Nomenclature
- Chemical bonds and Lewis structure
- How to write and read a reaction mechanism?
- Stereochemistry and asymmetric carbon

TP: Experimentation of the concepts developed in regular classroom: Specific applications to fine chemistry and separation techniques

BIBLIOGRAPHY

Invitation to Organic Chemistry- A.W. Johnson- Johns and Bartlett. Ed

PRE-REQUISITES

Chemistry syllabus from the preparatory classes for engineering schools. Electronic structure of atoms

Chemistry

IDENTIFICATION

CODE : BS-3-S2-EC-BBCHIM2
ECTS : 5

HOURS

Cours :	22h
TD :	0h
TP :	46h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	70h
Travail personnel :	57h
Total :	127h

ASSESMENT METHOD

Experimental Project Note
Written exam (1h30)

TEACHING AIDS

An handout
A molecular modelling kit

TEACHING LANGUAGE

French

CONTACT

MME POPOWYCZ Florence :
florence.popowycz@insa-lyon.fr

AIMS

"This course targets the following skills :
A2. Use a model of a real or virtual system (level 1)
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level M)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level M)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 1)
B1. Know oneself, manage oneself physically and mentally (level M)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level 1)
"

CONTENT

Development and application of chemical tools to the synthesis or biosynthesis of molecules of interest.
The theoretical concepts are constructed according to the logic of the mechanistic approach.
The presentation of the different families of organic compounds concerned and their involvement in the preparation of molecules of interest is discussed.

BIBLIOGRAPHY

Invitation to Organic Chemistry- A.W. Johnson- Johns and Bartlett. Ed

PRE-REQUISITES

A good knowledge of the three-dimensional structure of organic compounds

Chemistry

IDENTIFICATION

CODE : BS-3-S2-EC-BBCHIM3
ECTS : 3

HOURS

Cours :	0h
TD :	16h
TP :	20h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	38h
Travail personnel :	36h
Total :	74h

ASSESMENT METHOD

One written exam in classroom for a maximum overall duration 1h30

For practical sessions.
Formative direct oral evaluation (know how to collect experimental data according to a given procedure and with respect of safety procedures),
Formative low-stake assignment for the three first lab-days : correction and feedback on synthetic reports (know how to present and discuss results with a critical and argumented view).
Sommative individual evaluation for one of the two last synthetic reports.

TEACHING AIDS

Books list suggested to help understanding or supplementing the course available (Moodle).

Classroom pedagogical supports available on line (Moodle) to complete the individual notes
Optional self-tests (Moodle quizzes) are proposed to check personal learning outcomes.

Practical sessions guided through technical notes given in advance or proposed during single session.

TEACHING LANGUAGE

French

CONTACT

Soulère Laurent :
laurent.soulere@insa-lyon.fr

AIMS

This analytical chemistry module aims to teach the theoretical and practical bases necessary for understanding and applying the main simple and instrumental analysis methods. The fundamental concepts and principles developed by the methods and techniques (separative, spectral, electrochemical) illustrated in the five practical work sessions are presented. Classical analytical techniques are implemented to consolidate the basic gestures and techniques of solution chemistry learned during their first cycle while familiarizing themselves with the formulas of the most common chemical products and acquiring mastery of laboratory equipment. The elementary concepts of chemometrics for the argumentation on the validity of the results obtained (precision, possible statistical exploitation) are also covered. Hygiene, safety and environmental protection are associated as soon as possible. Training in writing an exploitable results report is also targeted.

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)

Learning objective 1: Describe an exploitable protocol by justifying its principle by the concepts of solution chemistry.

Learning objective 2: Master the use of appropriate measuring instruments to prepare a solution of given concentration, measure a physicochemical property, by colorimetry, pHmetry or by NMR or UV-VIS spectrophotometry.

Learning objective 3: Give a result with the associated measurement uncertainties by the exploitation of experimental measurements in analytical chemistry.

Learning objective 4: Produce a summary report of analytical chemistry results that can be used by a person skilled in the art and presenting an explicit argumentation of the protocol carried out and the results obtained.

CONTENT

8 sessions of 2 hours of Directed Work during the semester and 5 sessions of 4 hours of Practical Work.
The contents will be presented through the study of the dosages carried out in particular in practical work.

BIBLIOGRAPHY

Skoog, West, Holler, ed De Boeck, Chimie Analytique, 8ème édition
Mahé, Stéphane, Chimie des Solutions, Sciences Sup, Dunod
Charlot G., ed Masson et Cie, Chimie Analytique Générale
Delcourt M-O, ed De Boeck, Equilibres chimiques en solution
Zumdahl S. , ed De Boeck, Chimie des Solutions
Chang, R., University Science Books, Physical Chemistry for the Biosciences
Brissett, J-L et coll, ed TEC&DOC, Chimie Analytique en solution
Clayden, Greeves, Warren and Wothers, ed Oxford, Organic Chemistry
Mendham et coll, ed De Boeck, Analyse chimique quantitative de Vogel
Burgot, J-L., Chimie Analytique et Equilibres ioniques, ed Lavoisier
Jerome Rosenberg, Lawrence Epstein, Peter Krieger, College Chemistry (Schaum's outlines)

PRE-REQUISITES

Undergraduate Level in General Chemistry (usual parameters, equilibria in solution)

BS-3-COCHPHY-S1 Physical Chemistry (UV, NMR spectroscopies)
BS-3-COSTAT1-S1 Biostatistiques (confident intervals, standard deviation, basic statistical tests)

Microbiology

IDENTIFICATION

CODE : BS-3-S2-EC-COBISYN
ECTS : 3

HOURS

Cours :	12h
TD :	0h
TP :	24h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	38h
Travail personnel :	39h
Total :	77h

ASSESMENT METHOD

written evaluation on lectures 1 x 1,5 h
practical sessions report

TEACHING AIDS

ckeck on Moodle
-slides
-videos
-situational exercises

TEACHING LANGUAGE

French

CONTACT

MME Agnes : RODRIGUE-PLANCHE
agnes.rodrigue@insa-lyon.fr

AIMS

Objective
acquire basic knowledge of the "Synthetic biology" approach (assembly of Biobricks in silico, adaptation to the cell chassis, outsourcing of syntheses, quality control of received DNA constructions.)

"This course targets the following skills :
A3. Implement an experimental approach (level 1)
A5. Process data (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C7. Handle cell cultures, microorganisms or laboratory animals (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C14. Develop and validate biotechnology manufacturing processes (level 1)
C15. Contribute to environmental studies with biological and evolutionary components (level 2)
B2. Work, learn and develop independently (level 2)
"

CONTENT

Lectures:
1 - Introduction to synthetic biology
2 - Basic concepts in molecular biology
3- Genetic engineering
4 - Synthesis of genes and genetic circuits
5 - Applications
6- Ethics and safety

Practical sessions:
1) Check the quality of a DNA component produced to drawing by an external service provider:

. use methods for DNA preparation, separation and revelation . use techniques for DNA characterization by restriction enzyme digestion

. perform plasmid transformation techniques in E. coli

. be able to compare the sequence delivered with the sequence plan provided.

2) Plan tests of the functionality of a “part”/“device”/DNA system, integrating the various levels influencing function (transcription, translation, product stability) . use the principles and application of methods for measuring the luminescence of the Lux reporter by spectroscopy.

3)Apply knowledge of DNA composition and the notion of BiobrickTM

. identify the various signals on a DNA sequence using SnapGene and BLAST software, and manipulate the BiobrickTM standard

. master the assembly of genetic regulation and routing signals (address signals) 4) Be autonomous and safe in basic molecular biology manipulations, limiting the impact of these activities on the environment as much as possible (personal protection systems in the face of biological and chemical risks).

BIBLIOGRAPHY

http://parts.igem.org/Help:An_Introduction_to_BioBricks
http://parts.igem.org/Catalog
http://biologie-synthese.cnam.fr/qu-est-ce-que-la-biologie-de-synthese--518724.kjsp?RH=1331550349786

IDENTIFICATION

CODE : BS-3-S2-EC-COOMIQ1
ECTS : 2.00

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

1 final exam

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)

SKILLS
- Analyzing high throughput sequencing data (quality control, de novo genome assembly, detection of mutations, RNA-seq, ChIP-seq, 16S diversity study)

OBJECTIVES
At the end of this course, students will be able to work on high throughput sequencing data analysis projects.

The learning outcomes of this course module are :
- Know the main DNA sequencing methods
- Know the main types of sequencing projects and the methodology for analyzing the corresponding data.
- Know how to analyze high-throughput sequencing data with Galaxy

CONTENT

Theoretical part:
Introductory course to sequencing methods (Sanger, Illumina, Ion Torrent, Pacbio, Nanopore), various sequencing projects and associated analytical methods (de novo assembly, re-sequencing/mapping, RNA-seq, 16S diversity studies)

Practical part:
Analysis of NGS data in Galaxy: i) Genome Assembly, ii) Detection of mutations, iii) RNA-seq, iv) ChIP-seq, v) 16S Diversity studies

BIBLIOGRAPHY

-

PRE-REQUISITES

-

IDENTIFICATION

CODE : BS-3-S2-EC-COETHI2
ECTS : 1.00

HOURS

Cours :	6h
TD :	8h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	16h
Travail personnel :	11h
Total :	27h

ASSESMENT METHOD

A collective and public conference in the humanities and social sciences (20 minutes of speaking time / 20 minutes of questions)

TEACHING AIDS

On moodle

TEACHING LANGUAGE

French

CONTACT

MME CHOUTEAU Marianne :
marianne.chouteau@insa-lyon.fr

AIMS

By the end of the second semester of the 3rd year of Biosciences, BB and BIM students will be able to :
1. identify an ethical issue linked to the life sciences and taken from a film/series
2. Develop an ethical argument and
3. Evaluate and discuss their own ethical positions (compare them with those of others: work in sub-groups).

This CE contributes to the following skills (level) with associated abilities:
B1. Knowing oneself, managing oneself physically and mentally (level M)
B2. Working, learning and developing independently (level 1)
- Acquire new skills on their own by seeking out the necessary resources
- Exercise critical thinking, think for yourself
B3. Interacting with others, working in a team (level 1)
- Communicate appropriately: pass on a message, listen, show empathy, assert one's point of view, debate in a reasoned manner, etc.
- situate his/her original discourse using explicit references
- Integrate into a group, position yourself, build a dynamic relationship with the group, integrate new members
- Managing conflict and balancing individual and collective interests
- Work in sub-groups of 6 students from formulating the ethical issue to presenting it to the class, researching the ethical and social issue independently
- Present this reflection in the form of a lecture/debate and a written summary by sub-group.

B5. Acting responsibly in a complex world (level 2)
- Understand the complex issues (in the company and in society) facing the engineer: grasp the social, societal, political, economic, environmental, ethical and philosophical dimensions.
- Integrate a responsible dimension (deontology, ethics) into its actions
- Identify, evaluate and anticipate the consequences of their actions and decisions at different scales
- Deal with ethical and social issues relating to the life sciences

CONTENT

- Introduction to the concepts of representations and imaginary
- Understand the links between scientific and technical questions and the imaginary and the representations
- Exploration of ethical themes related to biosciences

BIBLIOGRAPHY

L. Boia (1998), Pour une histoire de l¿imaginaire, Paris, Les Belles Lettres
P. Charaudeau, Les stéréotypes, c¿est bien. Les imaginaires, c¿est mieux in Boyer H. (dir.), Stéréotypage, stéréotypes : fonctionnements ordinaires et mises en scène, L¿Harmattan, Paris.
M. Chouteau & C. Nguyen (2019), La science-fiction pour former des ingénieurs aux liens technique et société. L'imaginaire technologique comme élément de la culture technique. http://www.openscience.fr/La-science-fiction-pour-former-des-ingenieurs-aux-liens-technique-et-societe-L
M. Chouteau et C. Nguyen (2017), "De l'imaginaire dans les objets ou comment les élèves-ingénieurs investissent leur culture technique", Rencontres Pédagogie et formation, INSA Lyon
A.-F. Garçon (2005), « Les techniques et l¿imaginaire : une question incontournable pour l¿historien », Hypothèses, p. 221-228
P. Flichy (2001), « La place de l¿imaginaire dans l¿action technique », Réseaux, 109, p. 51-73
M. Godelier, (2006), « Imaginaire et symbolique » in Le dictionnaire des sciences humaines , Paris, PUF, p. 598-600
D. Janicaud, (1985), La puissance du rationnel, Paris, Gallimard
P. Musso, L. Ponthou, E. Seulliet (2005), Fabriquer le futur. L¿imaginaire au service de l¿innovation, Paris, Village mondial.
P. Musso, S. Coiffier, J.-F. Lucas, (2014), Innover avec et par les imaginaires. Paris. Editions du Manicius.
M. H. Parizeau (2010), Biotechnologie, nanotechnologie, écologie. Entre science et idéologie, Quae éditions.
Picon (2001), « Imaginaires de l¿efficacité, pensée technique et rationalisation», Réseaux, 109, p.17-50.
V. Scardigli (1992), Le sens de la technique, Paris, PUF
L. Vievard, (2013), Dix imaginaires des sciences. Pour la Direction de la Prospective et du Dialogue Public. Grand Lyon.
L. Vievard (2014), La mise en représentations et ses registres. Le cas des

Biotechnologies. Pour la Direction de la Prospective et du Dialogue Public. Grand Lyon.
J.-J. Wunenburger (2003), L¿imaginaire, Paris, PUF (coll. QSJ)

PRE-REQUISITES

Savoir s'exprimer à l'écrit et à l'oral en français
Cours d'économie d'entreprise d'Olivier Brette du semestre 1 et cours d'éthique de Marianne Chouteau du semestre 1 (Éthique 1)

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

Biology

IDENTIFICATION

CODE : BS-3-S2-EC-BBBIODE
ECTS : 3

HOURS

Cours :	24h
TD :	0h
TP :	16h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	42h
Travail personnel :	31h
Total :	73h

ASSESMENT METHOD

- student presentations
- practical work reports

TEACHING AIDS

Lecture note, articles, reviews

TEACHING LANGUAGE

French

CONTACT

MME ZAIDMAN Anna :
anna.zaidman@insa-lyon.fr

AIMS

This CE contributes to skills :
A3. Implement an experimental approach (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico, including massive data (big data) (level 1)
C7. Handle cell cultures, micro-organisms or laboratory animals (level 2)
C8. Use the main techniques for exploring biological functions (level 2)
C15. Contribute to environmental studies by adding biological and evolutionary components (level 1)
B3. Interact with others, work in a team (level M)

CONTENT

BJECTIVES :
- To understand the major stages and processes in animal development: how do we obtain the organisational plan of an animal from a single egg cell? To understand how the molecular and cellular mechanisms of development are revealed and to know a certain number of these fundamental mechanisms.
- be able to argue the main advantages and disadvantages of model organisms in genetics and developmental biology in relation to the study of a given biological problem (fundamental or applied).
- Be able to apply experimental designs to these models in order to answer a biological question and analyse the data obtained.
- Use the concepts of developmental biology to formulate functional and evolutionary hypotheses, know a few environmental toxicology models (example of the gammare, a sentinel organism in ecotoxicology).

KNOWLEDGE:
The knowledge associated with this CE is:
Developmental biology. Molecular and cellular mechanisms underlying animal development.
The main model organisms in genetics and developmental biology will be seen in relation to the contributions they have made to developmental biology.
The course is organised interactively in the form of a reversed course.

Practical work (4 x 4h):
- Drosophila model: from a developmental model organism to the study of the microbiota
- Zebrafish model: example of the study of a teratogen
- Nematode model: C. elegans as a model for studying muscular dystrophy
(Fluorescent labelling and observation using an epifluorescence microscope)
- Gammarids model: sentinel model in ecotoxicology

BIBLIOGRAPHY

Developmental Biology, Twelfth Edition, by Michael J. F. Barresi and Scott F. Gilbert

PRE-REQUISITES

Cell and molecular biology, basic knowledge in genetics

Physiology Pharmacology

IDENTIFICATION

CODE : BS-3-S2-EC-BBPHYS2
ECTS : 2.00

HOURS

Cours :	22h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

1 X 1h30
Short exercises
Document Analysis
Authorized Course Materials

TEACHING AIDS

duplicated course material

TEACHING LANGUAGE

French

CONTACT

MME DELTON Isabelle :
isabelle.delton@insa-lyon.fr

AIMS

This EC contributes to the following skills:
A1. Analyze a real or virtual system (or problem) (Level 2)
A3. Implement an experimental approach (Level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (Level 1)
C2. Design, adapt, and optimize experimental designs in Biosciences (Level 1)
C7. Manipulate cell cultures, microorganisms, or laboratory animals (Level 1)
B2. Work, learn, and develop independently (Level M)

The knowledge associated with this EC is:
General and cellular physiology
Experimental approach
Scientific communication and analysis of scientific articles

OBJECTIVES:
Study the structural and functional organization of the two main communication systems in the body: the hormonal system and the nervous system. Understand the molecular mechanisms involved in the transmission of nervous and hormonal information. Understand the principle, interest and limitations of the "in vivo" and "in vitro" techniques most used in this field.

CONTENT

Hormonal and nervous communications.
- Hormones and neurotransmitters
- Membrane receptors
- Nuclear receptors
- Signalling routes
- Adaptation mechanisms
- Study techniques for the characterization of receptors and neuronal activity

BIBLIOGRAPHY

Endocrinologie et communications cellulaires - Simon Idelman et Jean Verdetti - EDP Sciences - 2000
Communications et signalisations cellulaires - Yves Combarnous - Editions TEC et DOC - Lavoisier - 2004
Neurobiologie cellulaire - Constance Hammond et Danièle Tritsch - Doin - 1997
Introduction à la physiologie - Cybernétique et régulations - Bernard Calvino - Belin - 2003

PRE-REQUISITES

BS-3-S1-EC-COPHYS1
Basic knowledge in cellular biology and biochemistry

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Biochemistry

IDENTIFICATION

CODE : BS-3-S2-EC-BBBIOC1
ECTS : 6

HOURS

Cours :	22h
TD :	0h
TP :	56h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	80h
Travail personnel :	72h
Total :	152h

ASSESMENT METHOD

Written questioning / TP report

TEACHING AIDS

handout practical classes

TEACHING LANGUAGE

French

CONTACT

Mme LETISSE Marion :
marion.letisse@insa-lyon.fr
Mme COSTAZ Celine :
celine.costaz@insa-lyon.fr

AIMS

The educational objectives are to allow the students to acquire knowledge in the various biochemical techniques used for the investigation of biological compounds and in the understanding of their principle; to master these techniques to isolate, purify, assay the molecules of interest; to study their structures and properties; to acquire an operational know-how in biochemical experimentation.

At the conclusion of this module the student will be be able to:
present and to describe the main available analytical tools and their limits,
choose and to use the most efficient analytical tools,
choose the most suitable devices,
master the main techniques and the tools used in analytical biochemistry in the respect for the good practices of laboratory,
implement and perform experimental protocols of biochemistry,
know how to analyze and criticize the results,
know how to interpret them in their biological context,
adapt himself/herself to more complex situations and to propose improvements of experimental protocols.

CONTENT

Liquid-liquid extraction (single, repeated, opposite flow)
Accelerated solvent extraction system (ASE)
Supercritical fluid extraction
Solid phase extraction (SPE)
Filtration and ultrafiltration
Centrifugation
Electrophoresis
Ion exchange; thin layer, exclusion, affinity, chromatography,
Hhigh performance liquid chromatography, supercritical fluid and gas chromatography
Derivatization technics of molécules
GC and LC-mass spectrometry: different ionization modes
Quantitative analysis

Labs: Cartonenoid fractionation, exclusion chromatography, egg yolk cholesterol assay and separation, buffers/pHetry, protein assay, precipitation, protein purification, ion exchange chromatography

BIBLIOGRAPHY

Abrégé de chimie analytique, Tome 1 : Chimie des solutions - M. GUERNEK et M. HAMON - Masson Paris - 1986
Abrégé de chimie analytique, Tome 2 : Méthode de séparation - G. MAHUZIER et M. HAMON - Masson Paris - 1986
Analyse chimique - Méthode et techniques instrumentales modernes - F. ROUESSAC et A. ROUESSAC - Masson Paris - 1994
Electrophoresis in practice (fourth edition) - Westermeier R. - Eds, Wiley-VCH Verlag GmbH et Co. KGaA, 2005.
Liquid chromatography column theory - R.P.W. Scott and C.F. Simpson - Eds, John Wiley et Sons Publishers, NY - 1992
Preprative chromatography-Prof. Dr. Ing Henner Smidt-Traub-Eds, Wiley-VCH Verlag GmbH et Co. KGaA, Weinheim, 2005.
LC-MS- Mc Master-Eds, John Wiley et Sons, Inc., 2005

PRE-REQUISITES

First cycle: mathematics, physics, chemistry. Basic knowledge in organic, analytical, physical chemistry and in structural biochemistry.

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S2-EC-BMSTAT2
ECTS : 1

HOURS

Cours :	8h
TD :	4h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	14h
Travail personnel :	13h
Total :	27h

ASSESMENT METHOD

1h30 final exam

TEACHING AIDS

see Moodle

TEACHING LANGUAGE

French

CONTACT

MME AUBIN Samuela :
samuela.leoni@insa-lyon.fr
M. MEYER Sam :
sam.meyer@insa-lyon.fr
M. CHARLES Hubert :
hubert.charles@insa-lyon.fr

AIMS

The educational objectives of this modules are:
- to present the main concepts on mathematical statistics needed to data analysis and experimental design,
- probability and mathematical statistics

At the conclusion of this lesson the student will have to be capable of starting a lesson of statistics applied to the biological data.

CONTENT

Mathematical complements for statistics: probabilistic calculation (main theorems), properties and interrelations of the main statistical laws

BIBLIOGRAPHY

1. Statistique théorique et appliquée. Statistique descriptive et bases de l'interférence statistique (tome 1) - P. Dagnélie - De Boeck Université - 1998
2. Probabilités, analyse des données et statistique - G. Saporta - Editions Technip - 1990
3. Initiation aux probabilités - S.M. Ross - Presses Polytechniuqes et Universitaires Romandes - 1996
4. Biostatistical analysis - J.H. Zar - Prentice-Hall - 1998
5. Biometry : the principles and pratice of statistics in biological research - R.R. Sokal et J. Rohlf - Freeman and Co. - 1994

PRE-REQUISITES

good knoledge in mathematics (matricial analysis and linear algebra)

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S2-EC-BMMATH3
ECTS : 3.00

HOURS

Cours :	14h
TD :	24h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	37h
Total :	77h

ASSESMENT METHOD

Final exam

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

MME CHARLES Sandrine :
sandrine.charles@univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level 1)
B2. Work, learn and develop independently (level M)
B5. Act responsibly in a complex world (level 1)

The educational objective of this module is to learn the qualitative study of dynamical systems and their applications in population dynamics.

At the conclusion of this module the student will have to be capable of:
- solving systems of ordinary differential equations (analytic and numerical) by analytical or numerical methods,
- to put in equation (to model) a particular biological problem.

CONTENT

- Bifurcations in R.
- First integrals, functions of Lyapunov, limit cycle and theorem of Poincaré-Bendixson.
- Bifurcations in R 2 (Poincaré-Andronov-Hopf theorem).
- EDO digital integration schemes.
- TP under R.

BIBLIOGRAPHY

1. Mathemical Models in Biology - Edelstein-Keshet, L - McGrawHill - 1988
2. Mathematical Biology - Murray, JD - Springer Verlag - 1993
3. Modélisation en Biologie et Ecologie - Pavé, A. - Aléas - 1994
4. Equations différentielles - M. Crouzeix, M. Mignot - Masson Editeur - 1983
5. Analyse numérique et équations différentielles - J.P. Demailly - Masson Editeur - 1989
6. Solving Ordinary differntial equations - H. Hairer, G. Wanner - Springer Verlag Editeur - 1983

PRE-REQUISITES

Solving simple ordinary differential equations.

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S2-EC-BMMATH2
ECTS : 2.00

HOURS

Cours :	12h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Delivrable
Final exam

TEACHING AIDS

https://moodle.insa-lyon.fr/course/view.php?id=6401

TEACHING LANGUAGE

English

CONTACT

M. BERNARD Samuel :
bernard@math.univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
A5. Process data (level M)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C4. Implement analysis tools for high-throughput biology (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)

This course aims at providing solid ground knowldege of linear algbra and widely used numerical methods for solving large dimensional linear problems. At the end of the class, the student will be able to:
- Code and use numerical algorithms for matrix factorization for solving linear problems
- Use eigenvalue decompostion to compute powers of matrices, matrix exponentials
- Write down and solve a least-square problem from real world datasets
- Use singular-value decomposition perform principal component analsysis
- Interpret as linear problems and solve ranking problems, recommendation problem, dimension reduction problems (low-rank approximation, diffusion-maps) form large-dimension datasets
- Understand the advantages and limitations of the different factorization methods and algorithms
- Compute the condition number of a problem and a matrix, and choose appropriate tools for that problem

CONTENT

- Basics and Introduction: vector spaces and subspaces, linear maps, range, kernel, independent sets, generating sets, basis, dimension, incomplete basis theorem, rank of linear maps, rank-nullity theorem, matrices and vectors
- Matrices and Vectors: orthogonal vectors and matrices, matrix times a vector, eigenvalues and eigenvectors, eigenvalue decomposition, geometric multiplicity, characteristic polynomial, algebraic multiplicity, Jordan normal form
- Singular value decompostion: existence, uniqueness, applications to dimension reduction
- Principal component analysis
- Least-squares and linear regression: interpolation and polynomial fitting, least-square problem, pseudo-inverse of rectangular matrices, projections and projectors, algorithms for least-square problems, linear regression
- QR decomposition: Gram-Schmidt orthogonalization, Householder triangularization, solving linear problems, linear regression
- Algorithms for eigenvalues: understanding iterative methods, power iteration, Rayleigh quotient, inverse iteration, Rayleigh quotient iteration, Schur factorization, QR algorithm for eigenvalues
- Condition number of a problem or matrix

BIBLIOGRAPHY

- J Fresnel, Algèbre des matrices, Hermann, 2013.
- LN Trefethen et D Bau III, Numerical linear algebra, volume 50. Siam, 1997

PRE-REQUISITES

- Basic linear algebra useful but not required
- Basic Python programming

Mathematics and Modeling

IDENTIFICATION

CODE : BS-3-S2-EC-BMSTAT3
ECTS : 3

HOURS

Cours :	14h
TD :	24h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	37h
Total :	77h

ASSESMENT METHOD

QCM + 1h30 final exam

TEACHING AIDS

see Moodle for course handouts, video lessons, tutorials and marked subjects.

TEACHING LANGUAGE

French

CONTACT

M. CHARLES Hubert :
hubert.charles@insa-lyon.fr
M. SUBTIL Fabien :
fabien.subtil@chu-lyon.fr

AIMS

At the conclusion of this module the student will have to be capable of analyzing biological data by using linear statistics.
The educational objectives of this module are to present the main concepts on statistical inference and their use to linear analysis of biological data.

CONTENT

Linear model: introduction to simple linear model (matrix and geometric approach)
- analysis of the 1 and 2 factors variance:
* Least square parameter estimates (assumptions and adjustment criteria)
* notion of contrast
* notion of interaction
- linear regression
* Least square parameter estimates (assumptions and adjustment criteria)
* trusted intervalues
* decomposition of variance
* linearity test (embossed models)
- Multiple regression and covariance analysis;
- Use of R for analyses and simulations
- nonlinear regression

BIBLIOGRAPHY

- Statistique théorique et appliquée. Inférence statistique à une et à deux dimensions, tome 2 - P. Dagnélie - De Boeck Université - 1998
- Biostatistical analysis - J.H. Zar - Prentice-Hall - 1998
- http://members.aol.com/johnp71/javastat.html

PRE-REQUISITES

Biostatistics (1)

Microbiology

IDENTIFICATION

CODE : BS-3-S2-EC-COBISYN
ECTS : 3

HOURS

Cours :	12h
TD :	0h
TP :	24h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	38h
Travail personnel :	39h
Total :	77h

ASSESMENT METHOD

written evaluation on lectures 1 x 1,5 h
practical sessions report

TEACHING AIDS

ckeck on Moodle
-slides
-videos
-situational exercises

TEACHING LANGUAGE

French

CONTACT

MME Agnes : RODRIGUE-PLANCHE
agnes.rodrigue@insa-lyon.fr

AIMS

Objective
acquire basic knowledge of the "Synthetic biology" approach (assembly of Biobricks in silico, adaptation to the cell chassis, outsourcing of syntheses, quality control of received DNA constructions.)

"This course targets the following skills :
A3. Implement an experimental approach (level 1)
A5. Process data (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C7. Handle cell cultures, microorganisms or laboratory animals (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C14. Develop and validate biotechnology manufacturing processes (level 1)
C15. Contribute to environmental studies with biological and evolutionary components (level 2)
B2. Work, learn and develop independently (level 2)
"

CONTENT

Lectures:
1 - Introduction to synthetic biology
2 - Basic concepts in molecular biology
3- Genetic engineering
4 - Synthesis of genes and genetic circuits
5 - Applications
6- Ethics and safety

Practical sessions:
1) Check the quality of a DNA component produced to drawing by an external service provider:

. use methods for DNA preparation, separation and revelation . use techniques for DNA characterization by restriction enzyme digestion

. perform plasmid transformation techniques in E. coli

. be able to compare the sequence delivered with the sequence plan provided.

2) Plan tests of the functionality of a “part”/“device”/DNA system, integrating the various levels influencing function (transcription, translation, product stability) . use the principles and application of methods for measuring the luminescence of the Lux reporter by spectroscopy.

3)Apply knowledge of DNA composition and the notion of BiobrickTM

. identify the various signals on a DNA sequence using SnapGene and BLAST software, and manipulate the BiobrickTM standard

. master the assembly of genetic regulation and routing signals (address signals) 4) Be autonomous and safe in basic molecular biology manipulations, limiting the impact of these activities on the environment as much as possible (personal protection systems in the face of biological and chemical risks).

BIBLIOGRAPHY

http://parts.igem.org/Help:An_Introduction_to_BioBricks
http://parts.igem.org/Catalog
http://biologie-synthese.cnam.fr/qu-est-ce-que-la-biologie-de-synthese--518724.kjsp?RH=1331550349786

IDENTIFICATION

CODE : BS-3-S2-EC-COOMIQ1
ECTS : 2.00

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

1 final exam

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)

SKILLS
- Analyzing high throughput sequencing data (quality control, de novo genome assembly, detection of mutations, RNA-seq, ChIP-seq, 16S diversity study)

OBJECTIVES
At the end of this course, students will be able to work on high throughput sequencing data analysis projects.

The learning outcomes of this course module are :
- Know the main DNA sequencing methods
- Know the main types of sequencing projects and the methodology for analyzing the corresponding data.
- Know how to analyze high-throughput sequencing data with Galaxy

CONTENT

Theoretical part:
Introductory course to sequencing methods (Sanger, Illumina, Ion Torrent, Pacbio, Nanopore), various sequencing projects and associated analytical methods (de novo assembly, re-sequencing/mapping, RNA-seq, 16S diversity studies)

Practical part:
Analysis of NGS data in Galaxy: i) Genome Assembly, ii) Detection of mutations, iii) RNA-seq, iv) ChIP-seq, v) 16S Diversity studies

BIBLIOGRAPHY

-

PRE-REQUISITES

-

IDENTIFICATION

CODE : BS-3-S2-EC-COETHI2
ECTS : 1.00

HOURS

Cours :	6h
TD :	8h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	16h
Travail personnel :	11h
Total :	27h

ASSESMENT METHOD

A collective and public conference in the humanities and social sciences (20 minutes of speaking time / 20 minutes of questions)

TEACHING AIDS

On moodle

TEACHING LANGUAGE

French

CONTACT

MME CHOUTEAU Marianne :
marianne.chouteau@insa-lyon.fr

AIMS

By the end of the second semester of the 3rd year of Biosciences, BB and BIM students will be able to :
1. identify an ethical issue linked to the life sciences and taken from a film/series
2. Develop an ethical argument and
3. Evaluate and discuss their own ethical positions (compare them with those of others: work in sub-groups).

This CE contributes to the following skills (level) with associated abilities:
B1. Knowing oneself, managing oneself physically and mentally (level M)
B2. Working, learning and developing independently (level 1)
- Acquire new skills on their own by seeking out the necessary resources
- Exercise critical thinking, think for yourself
B3. Interacting with others, working in a team (level 1)
- Communicate appropriately: pass on a message, listen, show empathy, assert one's point of view, debate in a reasoned manner, etc.
- situate his/her original discourse using explicit references
- Integrate into a group, position yourself, build a dynamic relationship with the group, integrate new members
- Managing conflict and balancing individual and collective interests
- Work in sub-groups of 6 students from formulating the ethical issue to presenting it to the class, researching the ethical and social issue independently
- Present this reflection in the form of a lecture/debate and a written summary by sub-group.

B5. Acting responsibly in a complex world (level 2)
- Understand the complex issues (in the company and in society) facing the engineer: grasp the social, societal, political, economic, environmental, ethical and philosophical dimensions.
- Integrate a responsible dimension (deontology, ethics) into its actions
- Identify, evaluate and anticipate the consequences of their actions and decisions at different scales
- Deal with ethical and social issues relating to the life sciences

CONTENT

- Introduction to the concepts of representations and imaginary
- Understand the links between scientific and technical questions and the imaginary and the representations
- Exploration of ethical themes related to biosciences

BIBLIOGRAPHY

L. Boia (1998), Pour une histoire de l¿imaginaire, Paris, Les Belles Lettres
P. Charaudeau, Les stéréotypes, c¿est bien. Les imaginaires, c¿est mieux in Boyer H. (dir.), Stéréotypage, stéréotypes : fonctionnements ordinaires et mises en scène, L¿Harmattan, Paris.
M. Chouteau & C. Nguyen (2019), La science-fiction pour former des ingénieurs aux liens technique et société. L'imaginaire technologique comme élément de la culture technique. http://www.openscience.fr/La-science-fiction-pour-former-des-ingenieurs-aux-liens-technique-et-societe-L
M. Chouteau et C. Nguyen (2017), "De l'imaginaire dans les objets ou comment les élèves-ingénieurs investissent leur culture technique", Rencontres Pédagogie et formation, INSA Lyon
A.-F. Garçon (2005), « Les techniques et l¿imaginaire : une question incontournable pour l¿historien », Hypothèses, p. 221-228
P. Flichy (2001), « La place de l¿imaginaire dans l¿action technique », Réseaux, 109, p. 51-73
M. Godelier, (2006), « Imaginaire et symbolique » in Le dictionnaire des sciences humaines , Paris, PUF, p. 598-600
D. Janicaud, (1985), La puissance du rationnel, Paris, Gallimard
P. Musso, L. Ponthou, E. Seulliet (2005), Fabriquer le futur. L¿imaginaire au service de l¿innovation, Paris, Village mondial.
P. Musso, S. Coiffier, J.-F. Lucas, (2014), Innover avec et par les imaginaires. Paris. Editions du Manicius.
M. H. Parizeau (2010), Biotechnologie, nanotechnologie, écologie. Entre science et idéologie, Quae éditions.
Picon (2001), « Imaginaires de l¿efficacité, pensée technique et rationalisation», Réseaux, 109, p.17-50.
V. Scardigli (1992), Le sens de la technique, Paris, PUF
L. Vievard, (2013), Dix imaginaires des sciences. Pour la Direction de la Prospective et du Dialogue Public. Grand Lyon.
L. Vievard (2014), La mise en représentations et ses registres. Le cas des

Biotechnologies. Pour la Direction de la Prospective et du Dialogue Public. Grand Lyon.
J.-J. Wunenburger (2003), L¿imaginaire, Paris, PUF (coll. QSJ)

PRE-REQUISITES

Savoir s'exprimer à l'écrit et à l'oral en français
Cours d'économie d'entreprise d'Olivier Brette du semestre 1 et cours d'éthique de Marianne Chouteau du semestre 1 (Éthique 1)

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

CS2: Local and Remote Linux

IDENTIFICATION

CODE : BS-3-S2-EC-BMINFO2
ECTS : 2

HOURS

Cours :	6h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

Individual practical work report on the final lab session.

TEACHING AIDS

Teaching resources are accessible to registered students via the course's Moodle space: https://moodle.insa-lyon.fr/course/view.php?id=6589

TEACHING LANGUAGE

English

CONTACT

MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

This course targets the following skills :
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)

CONTENT

Skills:
- Use Linux efficiently on command line
- Automate a task with a simple shell script
- Connect in ssh to a remote server by typing its password and transferring files via scp
- Connect in ssh to a remote server using a public key and transfer files via scp

Knowledge:
- Notion of file system, example of Linux file system
- Notion of absolute path and relative path
- Concept of owner, group, access rights
- Concept of process
- Notion of remote server
- ssh protocol bases
- Key authentication, notion of public/private key

BIBLIOGRAPHY

William Shotts. The Linux Command Line.

PRE-REQUISITES

Being able to autonomously use a operating system via the graphical interface. Basic knowledge of file systems.

CS4: Databases

IDENTIFICATION

CODE : BS-3-S2-EC-BMINFO4
ECTS : 2

HOURS

Cours :	10h
TD :	14h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

- 3 written tests of 9 minutes each: questions on the concepts studied in the course based on realistic situations, short application exercises, etc.
- A deliverable of code (implementation of a database, SQL queries, questions on the implementation asked during rendering)

TEACHING AIDS

Teaching aids available at: https://sergiopeignier.github.io/Databases.html

TEACHING LANGUAGE

English

CONTACT

M. PEIGNIER Sergio :
sergio.peignier@insa-lyon.fr

AIMS

This course targets the following skills :
A4. Design a system to meet specifications (level 1)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)

CONTENT

Skills:
- Choose between a relational model and a non relational model for a database
- Design a database using a relational model
- Implement and administer a Database Management System such as Mysql
- Writing SQL queries to exploit a relational database
- Perform basic operations on a non relational database

Knowledge:
- Entities-associations scheme
- Relational database concepts, tables, tuples, keys
- Normal forms
- Relational algebra
- SQL queries
- DBMS Administration (Mysql)
- Types of non relational databases

BIBLIOGRAPHY

Silberschatz, A., Korth, H. F., & Sudarshan, S. (2010). Database system concepts (6th ed.). McGraw-Hill.

Sadalage, P. J., & Fowler, M. (2012). NoSQL distilled: A brief guide to the emerging world of polyglot persistence. Addison-Wesley.

PRE-REQUISITES

Programming concepts

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

CS 3: Algorithmics and Python programming

IDENTIFICATION

CODE : BS-3-S2-EC-BMINFO3
ECTS : 3

HOURS

Cours :	16h
TD :	22h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	37h
Total :	77h

ASSESMENT METHOD

Formative assessment:
- Wooclap quizzes at each lecture session
- self-assessment on past exam papers

Summative assessment :
Final individual exam. Duration : 90 minutes, partly pen-and-paper, partly on computers. All documents allowed but AI tools like ChatGPT or Copilot forbidden. Students may need to use the code produced the project for some of the questions. The exam includes an exercise on the impact of food consumption on the planet. Students can either use the classroom computers or their own computer (but should be able to use them for Python programming without help). Only plain Python scripts are accepted (.py), not Jupyter notebooks (.ipynb).

TEACHING AIDS

Resources are available to the registered students on the course's Moodle space: https://moodle.insa-lyon.fr/course/view.php?id=6582

TEACHING LANGUAGE

English

CONTACT

MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

This course targets the following skills :
A2. Use a model of a real or virtual system (level 2)
A4. Design a system to meet specifications (level 2)
A5. Process data (level M)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level M)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 1)
B4. Creativity, innovation, entrepreneurship (level 1)
B5. Act responsibly in a complex world (level 2)

CONTENT

Skills:
- Predict the evolution of the memory footprint of a given algorithm
- Read data from a file, write data to a file
- Assessing the complexity of an algorithm
- Design an algorithm to solve a problem
- Implement an algorithm in Python in the imperative style
- Choose a data representation adapted to the problem
- Judiciously select data structures and algorithms to minimize algorithmic complexity
- Reusing existing code (modules, libraries)
- Versioning a program with git
- Exploit life cycle analysis data

Knowledge:
- Data encoding
- Limits of number representation
- Main algorithmic data structures (static tables, dynamic tables, stacks, files, associative tables, trees, graphs)
- Implementation of these abstract data types in Python (tuple, list, collections.deque, dict, set...)
- Tree and graph path algorithms;
- Notion of algorithmic complexity;
- Concept of modularity
- Code version concept and basic git commands
- Environmental impacts of food production depending on food type, diet as a lever of action.

"Lecture" sessions use the flipped classroom strategy. Students work at home on the provided resources, then the lecture sessions are devoted to their questions on the concepts studied at home, and to actively solving algorithmic exercises.

Lab sessions are devoted to a Python programming project applied to an ecological transition question. Students will work in pairs to progressively conceive and implement a program that generates eco-responsible meals, based on real nutritional and ecological data.

BIBLIOGRAPHY

Peter Wentworth, et al. How to Think Like a Computer Scientist: Learning with Python 3 Documentation.

PRE-REQUISITES

Students should be already familiar with the basic Python syntax, and know how to use conditionals, loops, lists, functions and external libraries.

IDENTIFICATION

CODE : BS-3-S2-EC-BMTPCEL
ECTS : 1

HOURS

Cours :	0h
TD :	0h
TP :	16h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	16h
Travail personnel :	9h
Total :	25h

ASSESMENT METHOD

TP report in scientific poster format

TEACHING AIDS

TP handout
PPT files

TEACHING LANGUAGE

French

CONTACT

MME RIBEIRO LOPES :
melanie.ribeiro-lopes@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 1)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 1)
C7. Handle cell cultures, microorganisms or laboratory animals (level 2)
C8. Use the main techniques for exploring biological functions (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)
B3. Interact with others, work as part of a team (level M)
B7.Work in an international and intercultural context (level M)

OBJECTIVES :
At the end of this module the student should be able to:
- understand the technical difficulties associated with experimentation on cell models
- implement a cell culture protocol in accordance with Good Laboratory Practice
- implement various methods of analysis and observation on cell models (viability test, fluorescence imaging)
- draw up an experimental protocol
- analyse simple experimental results in cell biology
- interpret microscopic observations and identify cellular structures
- develop scientific reasoning and formulate hypotheses based on experimental results
- explain a cell biology concept clearly and concisely

CONTENT

Practical work on the study of the deleterious effects of oxidising molecules on cells of the mammalian immune system, using the example of the effect of hydrogen peroxide on murine macrophages.
The practical classes are divided into 4 phases:
1- Basics of cell culture: handling in sterile conditions, culture conditions and cell passage; preparation of media for all sessions.
2- Viability test: study of the cytotoxic effect of hydrogen peroxide (dose/response effect, toxicity threshold)
3- Demonstration of the induction of apoptosis/necrosis according to nuclear morphological characteristics (labelling of nucleic acids and observation by fluorescence microscopy)
4 - Demonstration of the impact of hydrogen peroxide on cell morphology (labelling of the actin cytoskeleton and observation by fluorescence microscopy).

In the final phase, the students implement a protocol they have produced themselves.

BIBLIOGRAPHY

PRE-REQUISITES

To follow this EC, students must be able to:
- Describe the structure and organisation of eukaryotic cells
- Explain the functions of the main cell organelles
- Explain the principles of cell division and cell death

Biochemistry

IDENTIFICATION

CODE : BS-3-S2-EC-BMENZYM
ECTS : 1

HOURS

Cours :	4h
TD :	0h
TP :	16h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	5h
Total :	25h

ASSESMENT METHOD

Continuous evaluation of lab work and reports

TEACHING AIDS

TP handout and lecture notes.

TEACHING LANGUAGE

French

CONTACT

MME COSTAZ Celine :
celine.costaz@insa-lyon.fr

AIMS

At the conclusion of this module the student will have to be capable of understanding the functioning dress rehearsal of an enzyme to insert it into a step of modelling.
The educational objectives of this module are to provide the basis in dynamic biochemistry and enzymology necessary to understand and analyse the catalytic properties of enzymes.

CONTENT

- The structure of enzymes and active sites,
- Enzyme kinetics: single- and multi-substrate kinetics, catalytic parameters,
- Types of enzyme inhibition. Allosteric regulation and control of enzymatic activity.

Laboratory work, statistical and computer analysis of enzyme kinetic data: single-substrate kinetics (acetylcholinesterase); substrate specificity, enzyme inhibition, determination of the catalytic parameters. Two-substrate kinetics with the GOT from heart, cofactor requirement for activity, analysis of the reaction mechanism.

BIBLIOGRAPHY

- Travaux pratiques et dirigés d'Enzymologie : cinétique enzymatique - INSA - 2001
- Biochimie - R. Garrett et C. Grisham - De Boeck Université - 2000
- Enzymes - J. Pelmont - PUG - 1995

PRE-REQUISITES

Basic attainments in structural biochemistry.

Physiology Pharmacology

IDENTIFICATION

CODE : BS-3-S2-EC-BMPHYS2
ECTS : 1

HOURS

Cours :	14h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	16h
Travail personnel :	11h
Total :	27h

ASSESMENT METHOD

1 x 2h

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. GUILLOT Nicolas :
nicolas.guillot@insa-lyon.fr

AIMS

SKILLS: This CE contributes to the following competencies (levels) and associated skills: A1. Analyze a real or virtual system (or problem) (level 1) A3. Implement an experimental approach (level 2) A5. Process data (level 2) The knowledge associated with this CE is General physiology of the central nervous and endocrine systems OBJECTIVES :
At the end of this module, students should be able to understand the main principles of nervous and endocrine physiology.
Students should be able to describe the organization of the central nervous system, including schematic drawings. This includes the major anatomical structures of the brain, the different nuclei and fascicles.
-Be able to describe and explain the function of the sympathetic, parasympathetic and endocrine nervous systems.
He/she should be able to compare the hormonal regulation mechanisms of the various endocrine glands and predict the effects of altering these mechanisms.
-The student should be able to study the interactions between the endocrine system and other systems (nervous and cardiovascular) to predict their role in homeostasis.
-Critique pharmacological and therapeutic approaches targeting the autonomic nervous system, assessing their relevance and side effects.
-Evaluate the respective influence of the sympathetic and parasympathetic nervous systems on physiological functions in order to predict their effects under stress and at rest.

CONTENT

Hormonal and nervous communication
- Anatomy of the central nervous and endocrine systems
- Hormones and neurotransmitters
- Membrane receptors
- Signaling pathways
- Neuronal networks
- Techniques for studying and modulating neuronal activity

BIBLIOGRAPHY

- Physiologie des régulations - E. Schoffeniels et G. Mooner - Masson - 1993
- Introduction à la physiologie - Cybernétique et régulations - B. Calvino - Belin - 2003
- Endocrinologie et communications cellulaires - S. Idelman et J. Verdetti - EDP Sciences - 2000
- Communications et signalisations cellulaires - Y. Combarnous - Editions TEC et DOC, Lavoisier - 2004
- Neurobiologie cellulaire - C. Hammond et D. Tritsch - Doin - 1997
- Immunobiologie - Janeway C.A.et Travers P. - Ed.DeBoeck Université - 1997
- Immunologie - Bach J.F. - Ed. Flammarion - 1999
- Immunochemistry in practice - Johnstone A et Thorpe R - Ed.Blackwell Science - 1996
- Immunologie, 4° edition - Revillard J.P. - Ed. DeBoeck Université - 2001
- Immunologie fondamentale et appliquée - Roitt I. et al. - Medsi , Paris - 1993

PRE-REQUISITES

Basic knowledge of cell biology and physiology

Professional Conferences

IDENTIFICATION

CODE : BS-4-S1-EC-COCONFM
ECTS : 1

HOURS

Cours :	16h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	16h
Travail personnel :	0h
Total :	16h

ASSESMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie :
nathalie.bernoud-hubac@insa-lyon.fr
MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

This course targets the following skills :
B6. Situate oneself, work and develop within a company or socio-productive organization (level 1)

The educational objectives of this module are to give an overview of the different jobs in biotechnologies, data science and bioinformatics.

At the conclusion of this module the student will have a more clear view of the job possibilities in order to create is own career plan.

CONTENT

External speakers (former students sometimes) from the industrial or academic world come to present their professional activities, their role as an executive in their company and their training curriculum.

BIBLIOGRAPHY

PRE-REQUISITES

IDENTIFICATION

CODE : BS-4-S1-EC-COPPP01
ECTS : 1

HOURS

Cours :	8h
TD :	6h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	14h
Travail personnel :	4h
Total :	18h

ASSESMENT METHOD

Deliverable: end-of-semester astonishment report on all proposed activities.

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level M)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

Educational workshops on a variety of themes: thinking about career plans, active job search methodology, exploring self-knowledge and knowledge of others, understanding the levers and obstacles of interpersonal communication, discovering possible career opportunities by presenting a variety of post-graduation career paths in the form of trade conferences, understanding the work environment, discussing work-related psycho-social risks. Workshops feature role-playing exercises to enable students to experiment with professional situations. They also take part in a simulated interview with professionals during the company forum.

BIBLIOGRAPHY

l'orientation éducative des adultes - S. BOURSIER - Acteurs de la Formation, éditions entente, Paris - 1989
Les enquêtes Sociologiques - R. GHIGLIONE ; B. MATALOND - A. Colin, Paris - 1991
Le bilan personnel - S. MICHEL ; M-C.MALLEN - Les éditions d'organisation, Paris - 1990
Les cahiers d'orientation - découvrir l'entreprise, Idécom éditeur, orientation service, Paris - 1997

PRE-REQUISITES

IDENTIFICATION

CODE : BS-4-S1-EC-BMINFO5
ECTS : 3

HOURS

Cours :	8h
TD :	32h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	40h
Travail personnel :	35h
Total :	75h

ASSESMENT METHOD

Collective deliverable + individual final exam

TEACHING AIDS

The resources are made available to registered students via the course's Moodle space: https://moodle.insa-lyon.fr/course/view.php?id=6501

TEACHING LANGUAGE

English

CONTACT

M. PARSONS David :
david.parsons@insa-lyon.fr

M. Valette Sébastien :
sebastien.valette@insa-lyon.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
A4. Design a system to meet specifications (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level 1)
B3. Interact with others, work as part of a team (level 2)

CONTENT

- C++ syntax and semantics
- Compilation chain
- Declaration, definition
- Scope and lifetime
- Pointers and references, passing parameters
- Structure and management of memory
- Tools of the programmer (make, git, gdb, valgrind)
- Data structures and classes, attributes, methods
- Encapsulation
- Construction, destruction
- Inheritance and polymorphism
- Standard library (STL)

BIBLIOGRAPHY

1. Le langage C++ - Stroustrup B - Campus Press
2. C++ la synthèse (concepts objets, standard ISO et modélisation UML) - Editions Dunod - 2000

PRE-REQUISITES

Students should be able to
* design and implement an algorithm, including complex ones, in the language of their choice
* use a terminal (shell) effectively
* use git in a basic but systematic way

Machine Learning

IDENTIFICATION

CODE : BS-4-S1-EC-BMINFO6
ECTS : 3

HOURS

Cours :	8h
TD :	32h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	40h
Travail personnel :	35h
Total :	75h

ASSESMENT METHOD

CC1: Machine questionnaire (45 minutes). This questionnaire will cover the teaching program and will include, in particular, the following aspects: parameter tuning, data formats, pre-processing, validity and variability of models in machine learning.

CC2: Group oral presentation and oral questions (30 minutes). This presentation will demonstrate the appropriation of the elements of the teaching program. It will require the involvement of all group members and will include, in particular, the analysis of a performance comparison.

TEACHING AIDS

Course materials in electronic version in English.

TEACHING LANGUAGE

English

CONTACT

M. RIGOTTI Christophe :
christophe.rigotti@insa-lyon.fr

AIMS

A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level 2)

CONTENT

Machine Learning and Data Mining:
- Supervised and unsupervised approaches (e.g., decision trees, K-nearest neighbors, SVM, neural networks, K-means, hierarchical clustering, density-based clustering).
- Evaluation of results (e.g., cluster compactness, cross-validation).
- Elements of methods for implementation (pre-processing, combinations of techniques).
- Implementation on a machine.

Optimizations used in Machine Learning and Data Mining:
- Understanding what an optimization problem is and its modeling.
- Simple local optimization methods (e.g., gradient descent, Newton's method).

Practical modalities: Most of this course will be based on problem-solving learning (optimization problem, unsupervised learning problem, and supervised learning problem).

BIBLIOGRAPHY

Data Mining and Machine Learning: Fundamental Concepts and Algorithms (2020 - Second Edition) by Mohammed J. Zaki and Wagner Meira, Jr.

Introduction to Data Mining (2018 - Second Edition) by Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar.

PRE-REQUISITES

General scientific level of L3. Python programming fundamentals

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S1-EC-BMMATH4
ECTS : 4.00

HOURS

Cours :	18h
TD :	32h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	52h
Travail personnel :	50h
Total :	102h

ASSESMENT METHOD

1 Report
1 Delivrable
1 Written exam
1 Hands-on experience

TEACHING AIDS

https://moodle.insa-lyon.fr/course/view.php?id=6527

TEACHING LANGUAGE

English

CONTACT

MME CHARLES Sandrine :
sandrine.charles@univ-lyon1.fr

M. Bernard Samuel :
bernard@math.univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A2. Use a model of a real or virtual system (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level 1)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level M)
B5. Act responsibly in a complex world (level 1)

At the conclusion of this module the student will have to be capable of fitting into a team of mathematical modelling using dynamical systems in biology.
The educational objectives of this module are to learn the qualitative study of dynamical systems and of the applications in population dynamics, neurosciences and in the field of human health.

CONTENT

- Difference equations for biologie and ecology
- Reaction-diffusion equations for biology and ecology: travelling waves, Turing patterns
- Numerical methods: discretization, boundary conditions

BIBLIOGRAPHY

- Mathemical Models in Biology - Edelstein-Keshet, L - McGrawHill - 1988
- Mathematical Biology - Murray, JD - Springer Verlag - 1993
- Modélisation en Biologie et Ecologie - Pavé, A. - Aléas - 1994

PRE-REQUISITES

Solving simple ordinary differential equations.

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S1-EC-BMSTAT5
ECTS : 2

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

1h30 final exam

TEACHING AIDS

On Moodle: course material (ppt and pdf), tutorials and corrected subjects.

TEACHING LANGUAGE

French

CONTACT

M. MEYER Sam :
sam.meyer@insa-lyon.fr
M. CHARLES Hubert :
hubert.charles@insa-lyon.fr

AIMS

This CE contributes to the following competencies (level) with associated capabilities:
A1 Analyze a real or virtual system (or problem) (level 3)
A2 Operate a model of a real or virtual system (level 3)
- Analyzing data by linear modeling with a Gaussian error model and fixed and random effects
- Analyzing data by non-parametric modeling
A3 Implement an experimental approach (level 3)
C1 Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2 Design, adapt and optimize experimental designs in Biosciences (level 2)
C9 Choose and implement statistical tools adapted to and for a biological problem (level 3)
C10 Assess the limits of a model's validity and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (Level 3)

The knowledge associated with the CE course is :
Linear statistics (regression, ANOVA 1 and 2, multiple regression), least squares and likelihood, mixed model, Nonparametric test construction, Rank statistics, resampling.

OBJECTIVES :
The pedagogical objectives of this module are:
- the theoretical and applied presentation of the main methods and models used for linear data analysis,
- The examples, applications and simulations will be carried out with the R software.

At the end of this module, the student should be able to analyse his/her own biological data and/or to join a group of biostatisticians in a research laboratory or in a company.

CONTENT

Mixed linear model (variance analysis models)
1. Analysis of Variance
1.1. Positioning the problem
1.2. Possible models
1.3. Study of the fixed model
1.4. Random model study (only 1 variable)
2. 2-Factor Variance Analysis
2.1. Fixed model
2.2. Random Model
2.3. Mixed model (A random, B fixed)
2.4. Hierarchical models

Non parametric statistics
1. Definition and Context
2. Rank Sum Test (a general approach from an example)
2.1. Different experimental situations
2.2. Enumeration approach
2.3. Approximation approach
2.4. Determining the Correct Law
2.5. Simulation approach
3. Population Identity Testing
4. Comparisons of Central Trends
5. Dispersion Comparisons
6. Correlation analysis
7. Independence tests
8. Countless tests

BIBLIOGRAPHY

Pratique de la modélisation Statistique PHILIPPE BESSE

PRE-REQUISITES

An equivalent of the BS-3-S2-EC-BMSTAT3 course is required to access this course.

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S1-EC-BMSTAT4
ECTS : 2

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Skills are assessed by a 1.5-hour final exam during which the students must be able to justify the choice of a method to answer a thematic question, implement the analyses in R and interpret the results obtained.

TEACHING AIDS

pdf version of courses available

TEACHING LANGUAGE

French

CONTACT

M. MEYER Sam :
sam.meyer@insa-lyon.fr
M. CHARLES Hubert :
hubert.charles@insa-lyon.fr
M. DRAY Stéphane :
stephane.dray@univ-lyon1.fr

AIMS

SKILLS:
This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A2. Use a model of a real or virtual system (level 3)
A3. Implement an experimental approach (level 3)
A5. Process data (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 3)

The knowledge associate to this course includes:
Multivariate analysis - PCA, COA, MCA, PCAIV, Co-Inertia, PCoA - , Implementation of permutation tests

OBJECTIVES:
The educational objectives of this module are:
- to give an applied and a theoretical presentation of the main models and methods for linear analysis of data.
- Examples, applications and simulations will be performed using the R software.

At the conclusion of this module the student will have to be capable of analyzing these own biological data and\or of fitting into a group of biostatisticians in a research laboratory as in company.

CONTENT

Multivariate analysis
- Introduction to categorical and mixed numerical multivariate measurements: graphs and statistics
- French Multivariate Factor Analysis: PCA, MCA, Mixed Analysis and COA
- Two-table methods: PCAIV and Co-Inertia
- Distance matrices and PCoA

BIBLIOGRAPHY

1. Multivariate Analysis of Ecological Data with ade4 - J. Thioulouse et al. - Springer ISBN 978-1-4939-8848-8 - 2018
2. Using Multivariate Analysis (4th eition) - B.G. Tabachnick & L.S. Fidell - Allyn and Bacon ISBN 0-3210-5677-9 - 2001
3. Numerical Ecology - Legendre & Legendre - Elsevier ISBN 9780444538680 – 2012

PRE-REQUISITES

BIM-3-BISTAT1, BIM-3-BISTA2 or equivalent

IDENTIFICATION

CODE : BS-4-S1-EC-BMOMIQ2
ECTS : 4.00

HOURS

Cours :	18h
TD :	20h
TP :	12h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	52h
Travail personnel :	50h
Total :	102h

ASSESMENT METHOD

2 written exams
1 Deliverable "Projet Mapping"

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas : nicolas.parisot@insa-lyon.fr
M. PEIGNIER Sergio : sergio.peignier@insa-lyon.fr

AIMS

"This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 3)
C4. Implement analysis tools for high-throughput biology (level 3)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level 3)
"

SKILLS:
- Assembling genomic sequences
- Annotating genomic sequences
- Searching and comparing sequences
- Using mapping tools
- Analyzing 16S rRNA gene diversity studies

OBJECTIVES:
At the end of this course the student will be able to join a research or development program in bioinformatics for the analysis of genomic and metagenomic data with complete autonomy of work
The learning outcomes of this course are:
- To bring the fundamental biological, mathematical and computing concepts in bioinformatics to analyse genomes and metagenomes.

CONTENT

Introduction to genomics
Theoretical part: Definitions and applications; Sequence databases; Genome diversity and content; Gene annotation; Evolution of genome size; Searching for similarities in a database; Phylogeny
Practical part: TD Annotation of genomic sequences; TD BLAST; TD Phylogeny

Sequence bioinformatics
Theoretical part: Introduction; Data structures; Distances; Alignment with SW and NW)
Practical part: TD Levenshtein + alignment; TD BWT; TD DC3

AI for genomics
Theoretical part: Main AI method families; Encoding; Metrics and good testing practices
Practical part: TD Using AI for genome annotation

Mapping project: from scratch development of a genomic read mapping solution.

Speakers from industry on applied metagenomics

BIBLIOGRAPHY

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PRE-REQUISITES

- fundamentals in algorithmics
- fundamentals in molecular biology

IDENTIFICATION

CODE : BS-4-S1-EC-BMGENEU
ECTS : 4

HOURS

Cours :	22h
TD :	0h
TP :	28h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	52h
Travail personnel :	50h
Total :	102h

ASSESMENT METHOD

1 oral presentation (group)
1 report in article format (group)
1 intermediate exam in the form of a wooclap quiz (individual)
1 final exam (individual)

TEACHING AIDS

Course, TD and TP handouts
Online PPT files
specific documents and publications

TEACHING LANGUAGE

French
English

CONTACT

Mme ZAIDMAN Anna :
anna.zaidman@insa-lyon.fr

Mme RIBEIRO LOPES Mélanie :
melanie.ribeiro-lopes@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C7. Handle cell cultures, microorganisms or laboratory animals (level 2)
C8. Use the main techniques for exploring biological functions (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level 1)
B7.Work in an international and intercultural context (level M)

OBJECTIVES :
At the end of this module, students should have a good theoretical and practical knowledge of the basic methods of molecular biology and the main concepts of molecular genetics, enabling them to work as bioinformaticians in research or development laboratories specialising in this field.

CONTENT

This EC is divided into three parts:

Part 1. CM - Regulation of gene expression in eukaryotes
- Regulation of gene transcription (RNA polymerases, cis-regulatory sequences, transactivators, coactivators)
- Epigenetic regulation (DNA methylation, histone modifications, chromatin remodelling, microRNA)
- Maturation and addressing of mRNAs (cap, polyA tail, splicing, mRNA addressing and transport)
- Post-transcriptional and post-translational modifications
- Protein degradation

Part 2. TD - Methods in molecular biology of eukaryotes
- Techniques for analysing gene expression (e.g. (q)RT-PCR, RNA-seq, microarrays, reporter genes)
- Techniques for analysing interactions between nucleic acids and/or proteins (e.g. ChIP-seq, EMSA, pull-down assay, yeast two-hybrid assay)
- Genome editing and manipulation techniques (e.g. mutagenesis, CRISPR-cas9, RNA interference, GAL4-UAS system).

Each method is discussed from a theoretical point of view, then illustrated through a study of documents and/or an analysis of scientific articles that have used it.
This part concludes with a workshop, during which the students are presented with a concrete situation and must, in groups, define a set of biological questions generated by this situation and propose a methodology to answer them, justifying their choice.

Part 3. Practical work - Study of the molecular basis of a human disease
Applications to the case of aniridia using Drosophila as a model. The students explore the regulatory link between two transcription factors involved in this disease using some of the functional analysis approaches seen in the previous sections (mutants, qRT-PCR, reporter genes). One session is devoted to the study of gene conservation in the course of evolution, to initiate a discussion on the relevance of model organisms.

BIBLIOGRAPHY

PRE-REQUISITES

Biology

IDENTIFICATION

CODE : BS-4-S1-EC-COIMMUN
ECTS : 3

HOURS

Cours :	22h
TD :	2h
TP :	8h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	34h
Travail personnel :	37h
Total :	71h

ASSESMENT METHOD

Intermediate exam
Final exam
Summary work on an application (group oral presentation)
Practical work report (group)

TEACHING AIDS

Pdf of the lecture, reviews on various topics, textbook in English available at INSA's librairy

TEACHING LANGUAGE

English

CONTACT

MME ZAIDMAN Anna :
anna.zaidman@insa-lyon.fr
MME RIBEIRO LOPES :
melanie.ribeiro-lopes@insa-lyon.fr
M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

This CE contributes to competences :
A1. Analyse a system (real or virtual) (level 2)
A3. Implement an experimental approach (level 2)
A6. Communicate an analysis or a scientific approach using situations appropriate to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C2. Design, adapt and optimise experimental plans in the Biosciences (level 2)
C8. Use the main techniques for exploring biological functions (level 1)
B2. Work, learn and develop independently (level M)
B3. Interacting with others, working in a team (level M)
B7. Working in an international and intercultural context (level M)

CONTENT

The module is designed to be interactive with participative lessons, thanks to the integration of :
- Wooclap quiz
- a gamified session on the generation of antibody diversity (game 'in the shoes of a B lymphocyte')
- a virtual reality session on the activation of dendritic cells and the formation of the immunological synapse between the dendritic cell and the T lymphocyte
- a session in which students present different immunotherapy techniques (in groups).

Learning programme:
1. Introduction to immunology: Presentation of the immune system. General concepts: recognition, specificity and memory, innate immunity, acquired immunity.
2. Mechanisms of innate immunity (recognition and effector mechanisms).
3. Molecules at the heart of adaptive immunity: TCR BCR Antibodies CMH CD4 and CD8; 8; Antigens (concepts of antigenicity, immunogenicity, haptens)
4. Generation of antibody diversity and LB selection
5. Generation of TCR diversity and LT learning
6. LTs in action (diversity of functions)
7. LB activation and antibody effector mechanisms
8. Unconventional lymphocytes, mucosal immunity,
9. The immune system in action: a) against extracellular bacteria; b) against intracellular bacteria; c) against viruses; d) against cancers.
10. immunotherapies: vaccination, serotherapy, immunosupression

TP - immunological and immunochemical techniques: use of antibodies, immunodiffusion, immunoelectrophoresis

BIBLIOGRAPHY

Basic Immunology: Functions and Disorders of the Immune System - A. K. Abbas - ELSEVIER
Cellular and molecular immunology - Abbas - 9th edition - ELSEVIER- 2018

PRE-REQUISITES

Good bases in molecular biology and cellular biology.

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Biology

IDENTIFICATION

CODE : BS-4-S1-EC-COGENDP
ECTS : 3

HOURS

Cours :	22h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	37h
Total :	77h

ASSESMENT METHOD

Final exam 50%. Pratical work 50%.

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

Mme Zaidman Anna :
anna.zaidman@insa-lyon.fr

AIMS

'This CE contributes to the competences :
A2. Use a model of a real or virtual system (level 2)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico including massive (big data) (level 2)
C4. Implement analysis tools for high throughput biology (level 1)
C9. Choose and implement statistical tools adapted to biological problems (level 3)
C10. Assess the limits of validity of a model and identify the sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand the underlying processes (level 3)
C15. Contribute to environmental studies by adding biological and evolutionary components (level 3)

CONTENT

Population and quantitative genetics:
Basic models of the transmission of genetic information in eukaryotes at the population level, as well as its evolution (inbreeding, selection, drift, mutation) are introduced. Applications in the fields of health (epidemiology of genetic diseases, evolution of resistance), as well as genetic mechanisms of response of organisms to variations in their environment (evolution, adaptation) are presented. An introduction to the Wright-Fisher model will be made to introduce indicators of population structuring. The genetic determinism and environmental complex of so-called "quantitative" traits (such as size) is presented. Concepts, tools and methods for decomposing the variability of these traits and their transmission through generations are described. The lectures are accompanied by TDs throughout the semester.

Population Dynamics:
The course will address the major concepts of population dynamics, based on current ecological problems. It will develop the basic dynamic and statistical modeling approaches to estimate the parameters from which population management and conservation decisions can be made. Population conservation issues will be developed, focusing in particular on the example of invasive species. Practical work will focus on the population dynamics of pathogens in their host population and how dynamic models can be used to understand and help manage infectious diseases.

BIBLIOGRAPHY

1. Principles of Population Genetics, 2nd edition - Hartl D. et Clark A. - Sinauer Associates, inc. - 1989
2. Quantitative genetics, 4th edition - Falconer et Mackay - Longman - 1996
3. Evolution in health and disease - Stearns S. - Oxford University Pres - 1998

PRE-REQUISITES

Mendel genetics, statistics.

Professional Conferences

IDENTIFICATION

CODE : BS-4-S1-EC-COCONFM
ECTS : 1

HOURS

Cours :	16h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	16h
Travail personnel :	0h
Total :	16h

ASSESMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie :
nathalie.bernoud-hubac@insa-lyon.fr
MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

This course targets the following skills :
B6. Situate oneself, work and develop within a company or socio-productive organization (level 1)

The educational objectives of this module are to give an overview of the different jobs in biotechnologies, data science and bioinformatics.

At the conclusion of this module the student will have a more clear view of the job possibilities in order to create is own career plan.

CONTENT

External speakers (former students sometimes) from the industrial or academic world come to present their professional activities, their role as an executive in their company and their training curriculum.

BIBLIOGRAPHY

PRE-REQUISITES

IDENTIFICATION

CODE : BS-4-S1-EC-COPPP01
ECTS : 1

HOURS

Cours :	8h
TD :	6h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	14h
Travail personnel :	4h
Total :	18h

ASSESMENT METHOD

Deliverable: end-of-semester astonishment report on all proposed activities.

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level M)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

Educational workshops on a variety of themes: thinking about career plans, active job search methodology, exploring self-knowledge and knowledge of others, understanding the levers and obstacles of interpersonal communication, discovering possible career opportunities by presenting a variety of post-graduation career paths in the form of trade conferences, understanding the work environment, discussing work-related psycho-social risks. Workshops feature role-playing exercises to enable students to experiment with professional situations. They also take part in a simulated interview with professionals during the company forum.

BIBLIOGRAPHY

l'orientation éducative des adultes - S. BOURSIER - Acteurs de la Formation, éditions entente, Paris - 1989
Les enquêtes Sociologiques - R. GHIGLIONE ; B. MATALOND - A. Colin, Paris - 1991
Le bilan personnel - S. MICHEL ; M-C.MALLEN - Les éditions d'organisation, Paris - 1990
Les cahiers d'orientation - découvrir l'entreprise, Idécom éditeur, orientation service, Paris - 1997

PRE-REQUISITES

Physiology Pharmacology

IDENTIFICATION

CODE : BS-4-S1-EC-BBPHYS3
ECTS : 5

HOURS

Cours :	24h
TD :	16h
TP :	24h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	64h
Travail personnel :	63h
Total :	127h

ASSESMENT METHOD

Final exam and report

TEACHING AIDS

Handout text book

TEACHING LANGUAGE

French

CONTACT

M. GUILLOT Nicolas :
nicolas.guillot@insa-lyon.fr

AIMS

SKILLS :
This CE contributes to the competences below (level) with the associated abilities:
A1. Analyse a system (real or virtual) (level 2)
A2. Use a model of a real or virtual system (M)
A3. Use an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate an analysis or a scientific approach using situations appropriate to their speciality (M)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
- Integrate knowledge of biology to formulate hypotheses.
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico, including massive data (big data) (level 2)
- Interpret experimental results and integrate them into a biological problem.
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 2)
C7. Handle cell cultures, micro-organisms or laboratory animals (level 2)
C8. Use the main techniques for exploring biological functions (level 2)
C9. Choose and use statistical tools adapted to biological problems (1)
C10. Appreciate the limits of validity of a model and identify the sources of variability and uncertainty (1)
B2 Work, learn and develop independently (1)
B3 Interact with others (1)
The knowledge associated with this CE is :
Integrated functioning of the major physiological systems (cardiovascular system, respiration, digestion, endocrine regulation)
Main methods of functional exploration in rodents, neuropharmacology, methods of modelling pharmacodynamic responses.

OBJECTIVES :
- To describe the mechanisms that control and regulate the functioning of a complex biological system on the basis of its constituent parameters, their hierarchy, their spatial and temporal relationships and the communication pathways involved.
- Understand the potential and limitations of animal experimentation.
- Know how to choose an experimental model, design and implement an experimental protocol in physiology or pharmacology.
- Know how to implement an animal experimentation protocol.
- Be familiar with restraint techniques and master techniques for injecting substances and taking samples of biological fluids from rodents.
- Know how to induce and manage anaesthesia and master basic rodent surgery techniques.
- be able to carry out physiological or pharmacological studies on isolated organs.

CONTENT

Integrated functioning of large physiological systems (cardiovascular system, kidney, endocrine regulations...)

OBJECTIVES: Describe the mechanisms that control and regulate the functioning of a complex biological system based on its constituent parameters, their hierarchization, their articulation in space and time, and the channels of communication involved.

PROGRAMME
-Cardiovascular system and blood pressure regulation
-The renal system and water regulation
-Neurophysiology

Labs:
- heart function session: heart rate, arrhythmia and pharmacological regulations, end diastolic volume. in silico
- blood pressure session: regulations, sympathetic nervous system and parasympathetic. in silico
- Session on behavioural neurophysiology: habituation test in vivo
- session on enteric nervous system regulation: preparation of Finkleman and intestinal motility. in silico
- renal physiology, in silico
- Session on animal experimentation: regulatory framework and ethical aspects in public and private R&D

BIBLIOGRAPHY

- Physiologie des régulations - E. Schoffeniels and G. Mooner - Masson - 1993
Review of Medical Physiology. 20th Edition - W.F. Ganong - Mc Graw-Hill Professional Publishing - 2001

- Introduction à la physiologie - Cybernétique et régulations - Bernard Calvino - Belin - 2003
- Drug discovery and evaluation: Pharmacological assays - Vogel HG, - Springer - 2002
- Experimental animal physiology: a contemporary system approach - Ottis K, Pritchett JF, Wit LC - Kendall Hunt Pub co - 2000
- Current techniques in small animal surgery - Bojrab MJ, Ellison GW, Slocum B - Lippincott, Williams et Wilkins - 1997
-Diehl KH, Hull R, Morton D, Pfister R, Rabemampianina Y, Smith D, Vidal JM, van de Vorstenbosch C. 2001. A good practice guide to the administration of substances and removal of blood, including routes and volumes. J Appl Toxicol. 21(1):15-23.
-Perel P, Roberts I, Sena E, Wheble P, Briscoe C, Sandercock P, Macleod M, Mignini LE, Jayaram P, Khan KS. 2007.
Comparison of treatment effects between animal experiments and clinical trials: systematic review. BMJ. 27;334(7586):197.

PRE-REQUISITES

Basic knowledge in animal physiology

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Molecular Microbiology

IDENTIFICATION

CODE : BS-4-S1-EC-BBMICRO
ECTS : 5

HOURS

Cours :	18h
TD :	4h
TP :	36h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	60h
Travail personnel :	67h
Total :	127h

ASSESMENT METHOD

Practical work report.
Written exam.

TEACHING AIDS

Course slide show (available in pdf).
Practical work booklet.

TEACHING LANGUAGE

French

CONTACT

HAICHAR Feteh-El-Zahare : feteh-el-zahare.haichar@insa-lyon.fr
M. SIMON Victor : victor.simon@insa-lyon.fr

AIMS

SKILLS :
A1. Analyse a real or virtual system (or problem) (level 1)
A3. Implement an experimental approach (level 2)
- Propose an experimental approach to validate or refute a hypothesis
- Define a strategy for studying the expression of a gene
A5. Process data (level 2)
A6. Communicate an analysis or a scientific approach using situations appropriate to their speciality (level 2)
- Analyse and interpret experimental data from the scientific literature, structuring their discourse around a line of reasoning.
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
- Integrate knowledge of microbiology and genetics to formulate hypotheses about the mechanisms regulating gene expression.
C2. Design, adapt and optimise experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterise and purify biomolecules (level 1)
C7. Handle cell cultures, micro-organisms or laboratory animals (level 2)
- Modify a bacterial genome to order
C8. Use the main techniques for exploring biological functions (level 2)
B3. Interact with others, work in a team (level 2)

OBJECTIVES :
- To describe the molecular processes and players that orchestrate gene expression in bacteria.
- Interpret figures from scientific publications by explaining the experimental approach used, summarising the results obtained and formulating a critical analysis.
- Plan and carry out molecular microbiology experiments as part of a laboratory team in order to produce reliable scientific results.
- Write a report on practical work in precise scientific language, choosing the relevant elements to describe their results and generating figures that are legible and interpretable.

CONTENT

The course presents the organisation and regulation of gene expression in bacteria. It begins with the bacterial chromosome and its replication, followed by transcription and its key players. Transcriptional and post-transcriptional regulation is addressed through transcription factors, ribregulators and non-coding RNAs. Finally, global responses to stress and environmental signals, such as quorum sensing, are presented.
The practical sessions, designed as a mini-course, aim to edit a bacterial genome using a system based on Cas9 technology.

BIBLIOGRAPHY

Snyder, L., Henkin, T.M., Peters, J.E., and Champness, W. (2013) Molecular Genetics of Bacteria, 4th Edition. American Society of Microbiology.

PRE-REQUISITES

Notions of general microbiology (bacterial growth, gene transfer, etc.), molecular biology (replication, transcription, translation, etc.) and genetics (gene structure, etc.).

Biology

IDENTIFICATION

CODE : BS-4-S1-EC-COIMMUN
ECTS : 3

HOURS

Cours :	22h
TD :	2h
TP :	8h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	34h
Travail personnel :	37h
Total :	71h

ASSESMENT METHOD

Intermediate exam
Final exam
Summary work on an application (group oral presentation)
Practical work report (group)

TEACHING AIDS

Pdf of the lecture, reviews on various topics, textbook in English available at INSA's librairy

TEACHING LANGUAGE

English

CONTACT

MME ZAIDMAN Anna :
anna.zaidman@insa-lyon.fr
MME RIBEIRO LOPES :
melanie.ribeiro-lopes@insa-lyon.fr
M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

This CE contributes to competences :
A1. Analyse a system (real or virtual) (level 2)
A3. Implement an experimental approach (level 2)
A6. Communicate an analysis or a scientific approach using situations appropriate to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C2. Design, adapt and optimise experimental plans in the Biosciences (level 2)
C8. Use the main techniques for exploring biological functions (level 1)
B2. Work, learn and develop independently (level M)
B3. Interacting with others, working in a team (level M)
B7. Working in an international and intercultural context (level M)

CONTENT

The module is designed to be interactive with participative lessons, thanks to the integration of :
- Wooclap quiz
- a gamified session on the generation of antibody diversity (game 'in the shoes of a B lymphocyte')
- a virtual reality session on the activation of dendritic cells and the formation of the immunological synapse between the dendritic cell and the T lymphocyte
- a session in which students present different immunotherapy techniques (in groups).

Learning programme:
1. Introduction to immunology: Presentation of the immune system. General concepts: recognition, specificity and memory, innate immunity, acquired immunity.
2. Mechanisms of innate immunity (recognition and effector mechanisms).
3. Molecules at the heart of adaptive immunity: TCR BCR Antibodies CMH CD4 and CD8; 8; Antigens (concepts of antigenicity, immunogenicity, haptens)
4. Generation of antibody diversity and LB selection
5. Generation of TCR diversity and LT learning
6. LTs in action (diversity of functions)
7. LB activation and antibody effector mechanisms
8. Unconventional lymphocytes, mucosal immunity,
9. The immune system in action: a) against extracellular bacteria; b) against intracellular bacteria; c) against viruses; d) against cancers.
10. immunotherapies: vaccination, serotherapy, immunosupression

TP - immunological and immunochemical techniques: use of antibodies, immunodiffusion, immunoelectrophoresis

BIBLIOGRAPHY

Basic Immunology: Functions and Disorders of the Immune System - A. K. Abbas - ELSEVIER
Cellular and molecular immunology - Abbas - 9th edition - ELSEVIER- 2018

PRE-REQUISITES

Good bases in molecular biology and cellular biology.

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Biology

IDENTIFICATION

CODE : BS-4-S1-EC-COGENDP
ECTS : 3

HOURS

Cours :	22h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	40h
Travail personnel :	37h
Total :	77h

ASSESMENT METHOD

Final exam 50%. Pratical work 50%.

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

Mme Zaidman Anna :
anna.zaidman@insa-lyon.fr

AIMS

'This CE contributes to the competences :
A2. Use a model of a real or virtual system (level 2)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico including massive (big data) (level 2)
C4. Implement analysis tools for high throughput biology (level 1)
C9. Choose and implement statistical tools adapted to biological problems (level 3)
C10. Assess the limits of validity of a model and identify the sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand the underlying processes (level 3)
C15. Contribute to environmental studies by adding biological and evolutionary components (level 3)

CONTENT

Population and quantitative genetics:
Basic models of the transmission of genetic information in eukaryotes at the population level, as well as its evolution (inbreeding, selection, drift, mutation) are introduced. Applications in the fields of health (epidemiology of genetic diseases, evolution of resistance), as well as genetic mechanisms of response of organisms to variations in their environment (evolution, adaptation) are presented. An introduction to the Wright-Fisher model will be made to introduce indicators of population structuring. The genetic determinism and environmental complex of so-called "quantitative" traits (such as size) is presented. Concepts, tools and methods for decomposing the variability of these traits and their transmission through generations are described. The lectures are accompanied by TDs throughout the semester.

Population Dynamics:
The course will address the major concepts of population dynamics, based on current ecological problems. It will develop the basic dynamic and statistical modeling approaches to estimate the parameters from which population management and conservation decisions can be made. Population conservation issues will be developed, focusing in particular on the example of invasive species. Practical work will focus on the population dynamics of pathogens in their host population and how dynamic models can be used to understand and help manage infectious diseases.

BIBLIOGRAPHY

1. Principles of Population Genetics, 2nd edition - Hartl D. et Clark A. - Sinauer Associates, inc. - 1989
2. Quantitative genetics, 4th edition - Falconer et Mackay - Longman - 1996
3. Evolution in health and disease - Stearns S. - Oxford University Pres - 1998

PRE-REQUISITES

Mendel genetics, statistics.

Biochemistry

IDENTIFICATION

CODE : BS-4-S1-EC-BBBIOC4
ECTS : 3

HOURS

Cours :	0h
TD :	0h
TP :	48h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	48h
Travail personnel :	27h
Total :	75h

ASSESMENT METHOD

Continuous evaluation of laboratory work; final report. 1 written exam of 2 hours.

TEACHING AIDS

duplicated lecture notes.

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr
MME COSTAZ Celine :
celine.costaz@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 1)
B1. Know oneself, manage oneself physically and mentally (level 2)
B2. Work, learn and develop independently (level 1)
B3. Interact with others, work as part of a team (level 1)
B5. Act responsibly in a complex world (level 1)

At the conclusion of this module the student will have to be capable of mastering the main technologies and the tools of dynamic and analytical biochemistry in the respect for the good practices of laboratory, to implement and realize experimental protocols of biochemistry, to know how to analyze and criticize the results, know how to interpret them in their biological context, to adapt himself to more complex situations and to build new experimental protocols.
The educational objectives are to allow the students to acquire knowledge in the various technologies of dynamic and analytical biochemistry for the investigation of biological compounds and in the understanding of their principle; to master these techniques to isolate, purify, assay the molecules of interest, to study the structures and the properties of lipids and proteins and to understand the catalytic properties of enzymes, in fact to acquire an operational know-how in biochemical experimentation.

CONTENT

1 lipid cycle (5 half days) and 1 protein/enzymo cycle (6 half days):
proteins/ligands, enzyme purification and enzyme assay, enzyme effectors (substrates, inhibitors); structure and lipid composition of different biological samples (example: egg yolk phospholipids)

BIBLIOGRAPHY

duplicated lecture note: Practical Works of Biochemistry, Structural ane dynamic biochemistry - 4th year 1st semester - INSA

PRE-REQUISITES

Basic knowledge in analytical and structural biochemistry and in enzymology.

Biochemistry

IDENTIFICATION

CODE : BS-4-S1-EC-BBBIOC5
ECTS : 5

HOURS

Cours :	0h
TD :	0h
TP :	64h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	64h
Travail personnel :	61h
Total :	125h

ASSESMENT METHOD

Continuous evaluation of laboratory work. Overview of the project as a poster presentation or brochure. The innovative nature of the proposed development will also be assessed.

TEACHING AIDS

Duplicated lecture notes, scientific articles and reviews

TEACHING LANGUAGE

French

CONTACT

MME LAZAR Adina :
adina-nicoleta.lazar@insa-lyon.fr
MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 2)
A4. Design a system to meet specifications (level 1)
A5. Process data (level 2)
A6. Communicate scientific analysis or approaches (level 2)
C1. Apply a scientific approach (hypothetico-deductive) (level 2)
C2. Design, adapt and optimize experimental plans in Biosciences (level 2)
C5. Quantify, structurally characterize and purify biomolecules (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 2)
C8. Use the appropriate techniques for exploring biological functions (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 2)
C14. Develop and validate biotechnology manufacturing processes (level 1)
B1. Know oneself, manage oneself physically and mentally (level 2)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 2)
B4. Creativity, innovation, entrepreneurship (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 1)

The student will manage a project of biotechnology in team, define a strategy of production of molecules of industrial interest, specify a manufacturing charge specification, implement and realize experimental protocols of biochemistry or enzymology.
The educational objectives are to allow the students to acquire knowledge in technologies in the domains of biochemistry or enzymology, to master these technologies, to learn about the management of project since its conception until its realization, to learn to organize a teamwork.

CONTENT

3 industrial biochemistry projects proposed in parallel, that the students will choose upstream. 3 teachers each propose their project. For example, industrial production of fructose syrup, enzymatic bioconversion of sugars of nutritional interest; pharmaceutical biotechnologies - nano-systems for theranostic. One of the projects is in collaboration with Applexion, a Lyon-based company.

BIBLIOGRAPHY

Several scientific articles and reviews will be proposed for each project. Students will be encouraged to delve deeper into this documentary research (guided by teachers) and adapt the protocols to their project.Other document will also be proposed: Documents for the practical works of biochemistry, 4th year, part Amidon-Sucres; Practical Works of biochemistry, 4th year Enzymology II - INSA

PRE-REQUISITES

Analytical, structural, dynamic biochemistry, enzymology, biophysics.

Biochemistry

IDENTIFICATION

CODE : BS-4-S1-EC-BBBIOC6
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

1x2h

TEACHING AIDS

handouts, scientific articles, slides

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie :
nathalie.bernoud-hubac@insa-lyon.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level M)
B5. Act responsibly in a complex world (level 1)

CONTENT

Have an integrated view of metabolism for applications in pharmaceutical and agro-food fields. Be able to understand and design metabolic patterns. Acquire a good knowledge of carbohydrate and lipid metabolism from a bioenergetic perspective.

Biosignalization - Signal transduction; Glucose metabolism (Glycolysis and neoglucogenesis); Pentose-phosphates pathway; Metabolism glycogen (glycogenesis, glycogenesis, glycogenesis, regulations metabolic); mitochondrial pyruvate metabolism and cycle tricarboxylic; Lipid digestion, absorption and transport; Metabolism lipids (beta-oxidation of fatty acids; ketones; biosynthesis of fatty acids, complex lipids, cholesterol); Regulation metabolism and metabolic abnormalities.

BIBLIOGRAPHY

Textbook of biochemistry - Thomas M. Devlin, Wiley et Sons publishers, New York
Biochemistry - Berg, Tymoczko, Dtryer, Freeman, New York -
Lehninger Principles of Biochemistry - Nelson et Cox, Freeman, New York

PRE-REQUISITES

Structural biochemistry.

Biochemistry

IDENTIFICATION

CODE : BS-4-S1-EC-BBBIOC3
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

2x1h

TEACHING AIDS

Slides
Scientific film

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie :
nathalie.bernoud-hubac@insa-lyon.fr
MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

C1. Apply a scientific approach to translate and solve a biological problem (level 2)
- Controlling the structure-activity relationships of living molecules
- Know the principles of metabolism (lipids) and cell signalling

The knowledge associated are :
Knowledge of enzymes (kinetics and industrial applications)
Molecular structure and activity
Knowledge of molecules and their physico-chemical characteristics.

OBJECTIVES :
To be able to interpret enzymatic catalytic reactions: kinetic measurement, to identify inhibition mechanisms, to determine enzymatic parameters...
To be able to use enzymes in bioengeeniring in collaboration with specialist.
To know theretical and pratical aspects of enzymology which concernphysiological machanisms or applications in pharmacology, medicine, agronomy or engeeniring.
To understand lipid signalling within eukaryotes and to propose mechanisms
action for cellular response to specific stimuli.

CONTENT

General enzymology
definitions, classification/nomenclature of enzymes, enzymatic reactions to a substrate (Michaelian kinetics/fast equilibrium model/parameters/fast equilibrium model and near-steady state model), pH and temperature influence and case of immobilized enzymes, inhibitions, enzymatic reactions to two substrates (sequential (ordered or random) or substituted mechanisms, mechanism determination, ligand/protein bonds (saturation, Scatchard), nonmichaelian kinetics, heterogeneous catalysis

Lipid mediators; Metabolic pathways in the synthesis and degradation of these lipids; Lipid mediator receptors; Signalisation of bioactive lipids.
Mechanisms of action.
Physiological and pathophysiological case studies.

BIBLIOGRAPHY

Biochimie dynamique - J.P. Borel - Maloine, Paris
Enzyme engineering - I. Chibata - Plenum Press, NY
Les biocapteurs - Tran Minh Canh - Masson, Paris
Biotechnologie - R. Schriban, coordonateur - Techniques et Documentation Lavoisier
Biochemistry - Harper's
Biochemistry - Zubay G.
Textbook of Biochemistry - Devlin T.M.

PRE-REQUISITES

Structural Biochemistry. Metabolic and Functionnal Biochemistry. Analytical Biochemistry. Organic chemistry and physical chemistry

Biology

IDENTIFICATION

CODE : BS-4-S2-EC-BBGENET
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

2h

TEACHING AIDS

Powerpoint document

TEACHING LANGUAGE

French

CONTACT

M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

This CE contributes to skills :
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 1)
C15. Contribute to environmental studies by including biological and evolutionary components (level 1)

CONTENT

The knowledge associated with this CE is :
genetics and epigenetics
Basic knowledge of distributional genetics, quantitative genetics, molecular genetics and epigenetics.
Present how genetic information is transferred in individuals and populations.

1. Mendel's laws. Quantitative genetics. Hardy's and Weinberg's laws; cytoplasmic transmission (mitochondria, plastids, symbionts).
2. Molecular genetics and epigenetics in eukaryotes:
21. Regulation of gene transcription in eukaryotes (RNA polymerases, cis-regulatory sequences, transactivators, coactivators, chromatin structure and transcription, methylation).
22. Maturation of eukaryotic mRNAs (capping, polyadenylation, standard and alternative splicing and auto-splicing)
23. The coding of information by mature cytoplasmic messenger RNAs (message translation and protein synthesis, messenger quality control, mRNA stability factors, mRNA addressing).
24. Role of microRNAs.

BIBLIOGRAPHY

Génétique - J.L. Rossignol - Masson - 1990
Introduction à l'analyse génétique - D.T. Suzuki et al. - De Boeck - 1991
Genes VII - B. Lewin - Oxford Univ. Press - 1999
L'organisme en développement - J. Signoret et A. Collenot - Hermann - 1991
Biologie Cellulaire - T.D. Pollard, W.C. Earnshaw - Elsevier - 2004

PRE-REQUISITES

Knowledge in cell and molecular biology.

IDENTIFICATION

CODE : BS-4-S2-EC-BBBICTP
ECTS : 4

HOURS

Cours :	0h
TD :	0h
TP :	64h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	66h
Travail personnel :	36h
Total :	102h

ASSESMENT METHOD

1 oral presentation (group)
1 report in article format (as a group)
1 poster (group)
1 exam (individual)

TEACHING AIDS

Practical work handouts
PPT files
Specific documents and publications

TEACHING LANGUAGE

French

CONTACT

MME ZAIDMAN Anna :
anna.zaidman@insa-lyon.fr

Mme Ribeiro-Lopes Mélanie :
melanie.ribeiro-lopes@insa-lyon.fr

AIMS

This CE contributes to the competences :
A3. Implement an experimental approach (level 3)
A5. Process data (level 2)
A6. Communicate an analysis or a scientific approach using situations appropriate to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C2. Design, adapt and optimise experimental plans in the Biosciences (level 2)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico, including massive data (big data) (level 2)
C5. Quantify, structurally characterise and purify biomolecules (level 1)
C7. Handle cell cultures, micro-organisms or laboratory animals (level 3)
C8. Use the main techniques for exploring biological functions (level 2)
C9. Choose and implement statistical tools adapted to biological problems (level M)
C11. Model and interpret biological data to understand the underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
C14. Develop and validate biotechnology manufacturing processes (level 1)
C15. Contribute to environmental studies by adding biological and evolutionary components (level 2)
B2. Working, learning and developing independently (level M)
B3. Interacting with others, working in a team (level M)
B4. Demonstrating creativity, innovation and entrepreneurship (level M)

CONTENT

Module entirely in TP-project format

Part 1.
Theme: Research model of the weevil and its obligatory symbiosis as a target for future alternatives to pesticides.
Techniques:
- FISH / imaging / image analysis
- DNA extraction and quantitative PCR
- Flow cytometry
- Analysis of articles

Part 2.
Theme: Eukaryotic cell models (insects, mammals) for the study of antioxidant molecules
Techniques:
- eukaryotic cell cultures
- immunohistochemistry methods, microscopic methods (fluorescence, confocal)
- study of apoptosis and other types of cell death, cytotoxicity analyses (H202)
- RNA extraction, qRT-PCR, sample preparation RNAseq analyses

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S2-EC-BBBIOST
ECTS : 3

HOURS

Cours :	12h
TD :	22h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	36h
Travail personnel :	41h
Total :	77h

ASSESMENT METHOD

2 x 1h 2 h

TEACHING AIDS

Photocopies of documents
On line PDF et PPT documents
Specialized softwares and web sites

TEACHING LANGUAGE

French

CONTACT

M. MEYER Sam :
sam.meyer@insa-lyon.fr

AIMS

Being capable of analyzing data resulting from experiments in various domains and to model experimental situations to propose effective strategies of study. Be capable of adapting itself to more complex situations and of being able to work with experts.
The course presented in 3rd year is completed by an education realized in the form of steered works. He has to supply to the student the main methodological tools which will allow him(her) to treat the varied experimental results obtained in the diverse disciplines of life sciences . An introduction to the experimental design is also realized.

CONTENT

1) Introduction to the linear model 1: Linear regression to one or more variables.
Estimation of model parameters.
Forecasting, comparison of models.
2) Introduction to Linear Model 2: Analysis of Variance at One or More Controlled Factors
Fixed and random cross models. Notion of interaction. Multiple comparisons of means. Simple experimental designs. Power of an analysis of variance. Introduction to the analysis of correlated data.
3) Introduction to non-parametric methods
Global comparison of distributions.
Test of homogeneous sequencing, of the median.
Rank tests (Wilcoxon) applied to averages
4) An introduction to the methodology of the plans of experiments (Taguchi method) will be discussed through a session of practical work and will be illustrated by the use of a catapult: choice of factors to reach a target with a given precision.

BIBLIOGRAPHY

1 - Statistique théorique et appliquée, vol. 1 et 2 - Dagnelie P. - De Boeck Université - 1998
2 - Pratique des statistiques non paramétriques - Sprent P. - INRA Editions - 1992
3 - Non parametric statistics - Conover W.J. - J. Wiley and Sons. N.Y. - 1980
4 - Méthodes statistiques en Sciences Humaines - Howell D.C. - De Boeck Université - 1998

PRE-REQUISITES

Module 32-BB-APPST or equivalent.

Physiology Pharmacology

IDENTIFICATION

CODE : BS-4-S2-EC-COPHAR1
ECTS : 2

HOURS

Cours :	8h
TD :	14h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

Final exam

TEACHING AIDS

duplicate course material

TEACHING LANGUAGE

French

CONTACT

M. GUILLOT Nicolas :
nicolas.guillot@insa-lyon.fr

AIMS

SKILLS :
This CE contributes to the following competencies (level) with associated capabilities:
A1. Analyze a real or virtual system (or problem) (M)
A2. Use a model of a real or virtual system (level 2)
A5. Process data (M)
C6. Measure and evaluate the impact of new healthcare products or diagnostic methods (level 2)
C10. Assess the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 1)
B5. Act responsibly in a complex world (M)

The knowledge associated with this CE course is
Drug life cycle. Notion of medico-economics. Pharmacokinetic models and xenobiotic metabolism.

OBJECTIVES :
Course:
Introduce the pharmaceutical industry and describe the various stages in the design of a drug (players, duration, regulatory requirements, costs, etc.).
Describe, analyze and model the fate of a drug in the body (ADME).
Provide the fundamental basis for studying drug metabolism and mechanisms of action.
Practical exercises: on PK models

CONTENT

CM: Teaching on two aspects of pharmacology: 1, Becoming a drug in the body: absorption, distribution, metabolism and elimination (ADME). and 2, Pharmacokinetics: 1 and 2-compartment models.

ADME: Variations in drug sensitivity. Models and methods of study, interests and limitations. Metabolism of xenobiotics. Main biotransformation pathways and stages, mono-oxygenates. The main conjugation reactions and their targets. Modulating factors of biotransformation: physiological and behavioural factors, induction, polymorphism.
pharmacokinetics. Fundamental concepts and goals. Compartmental and non compartmental pharmacokinetics. Modelling of a simple two-compartment system and simulations. Estimation of model parameters and forecasts. Infusion models, oral intake and bioavailability. General principles of toxicology.

BIBLIOGRAPHY

Goodman and Gilman's The Pharmacological Basis of Therapeutics - L.S. Goodman - McGraw-Hill, P 2006
Modern Pharmacology with clinical applications - C.R. Craig and R.E.Stitzel - Little Brown and Co - 1997
Conjugaison reactions in Drug Metabolism - G.J. Mulder - Taylor et Francis, London - 1990
Biotransformations - D.R. Hawkins - The Royal Society of Chemistry, London - 1994
Pharmacokinetics - M. Gibaldi, D. Perrier - Marcel Dekker Publisher - 1993

PRE-REQUISITES

Good background in chemistry, biochemistry and physiology.

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE
Humanities and social sciences

IDENTIFICATION

CODE : HU-0-S2-EC-S-SERIE2
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Assessment will be conducted through continuous evaluation. The assessment methods will be presented at the beginning of the semester by the teaching team.

TEACHING AIDS

Materials are chosen by the instructor based on the module:
• Didactic documents related to the module
• Audiovisual materials
• Recommended readings

TEACHING LANGUAGE

French

CONTACT

Mme JOUISHOMME Delphine :
delphine.jouishomme@insa-lyon.fr
Mme GOUTALAND Carine :
carine.goutaland@insa-lyon.fr

AIMS

A series of elective courses in Humanities and Social Sciences (HSS) offers several options for students to choose from, allowing them to develop and deepen specific skills. This course aims to develop one or more transversal skills among the following:
• CT1: Self-awareness and self-management
• CT2: Working, learning, and evolving independently
• CT3: Interacting with others, working in a team
• CT4: Demonstrating creativity
• CT5: Acting responsibly in a complex world
• CT6: Navigating and evolving within an organization
• CT7: Working in an international and intercultural context
The list of options available in Series 1 and the specific competencies for each option are detailed in the catalog on the IntranetHumas:
https://intranethumas.insa-lyon.fr/sciences-humaines-sociales/offre-de-formation/cours-la-carte-0

CONTENT

Each module is designed to encourage interaction and active student participation. The content is structured around the following key aspects:
• Theoretical deepening related to the theme
• Reflection on the topic
• Practical exercises and activities
• Assessments and presentation of work

BIBLIOGRAPHY

The bibliography is selected by the instructor based on the module.

PRE-REQUISITES

French

IDENTIFICATION

CODE : BS-4-S2-EC-BBGENPR
ECTS : 2

HOURS

Cours :	14h
TD :	0h
TP :	8h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

1x2h

TEACHING AIDS

Course handouts, personal documentation for practical innovation projects

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

Present the various processes of biotechnology implemented in the pharmaceutical industry.
Present the main parameters of driving of processes.

CONTENT

Courses and exercises: Theoretical bases of process engineering: introduction, fluid mechanics and hydrodynamics, transfer phenomena, agitation and reactors, scale-up

Process engineering: biochemical engineering and enzymatic catalysis, industrial microbiology

Innovation/creation project: Fermentation of biomass by Saccaharomyces cerevisiae for beer production: creation of a free and original formulation, implementation of production in compliance with good manufacturing practices, production monitoring (batch record), quality monitoring, regulations (label and associated standards), marketing (sales name and slogan, sales target), quality control: implementation of the HACCP plan, analysis of finished products in collaboration with bioMérieux, biowaste reclamation for food use.

BIBLIOGRAPHY

1. Biotechnologie, 5ème édition - R. Soriban - Technique et Documentation - 1999
2. Biotechnology, vol 2 Bioprocessin - H.J. Rahm, G. Reed - Verlag Chemie - 1994

PRE-REQUISITES

Good knowledge in analytical Biochemistry and in Biotechnologies.

IDENTIFICATION

CODE : BS-4-S2-EC-BBOMIQE
ECTS : 3.00

HOURS

Cours :	10h
TD :	16h
TP :	8h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	34h
Travail personnel :	41h
Total :	75h

ASSESMENT METHOD

2 practical reports

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr
M. PEIGNIER Sergio :
sergio.peignier@insa-lyon.fr

AIMS

"This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 1)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 3)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
"

SKILLS:
- Working on a UNIX environment
- Sequence databases
- Sequence similarity searches
- Annotation of genomic sequences

OBJECTIVES:
At the end of this course the student will have to be capable of beginning a research activity in the bioinformatics field for the analysis of genomes.
The learning outcomes of this course are :
- To bring the fundamental biological, mathematical and computing concepts in bioinformatics to lead the students to master the tools and concepts to analyse genomes.

CONTENT

Theoretical part:
Introductory course in bioinformatics (Sequence databases, Genome annotation, similarity search, alignment, phylogeny)

Practical part:
- Working on a UNIX environment
- Installing and using BLAST
- Annotating a genomic sequence
- Alignment and Phylogeny
- AI for genomics

BIBLIOGRAPHY

-

PRE-REQUISITES

- fundamentals in molecular biology

IDENTIFICATION

CODE : BS-4-S2-EC-COELUCD
ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

ASSESMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

CONTENT

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE
Humanities and social sciences

IDENTIFICATION

CODE : HU-0-S2-EC-S-SERIE2
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Assessment will be conducted through continuous evaluation. The assessment methods will be presented at the beginning of the semester by the teaching team.

TEACHING AIDS

Materials are chosen by the instructor based on the module:
• Didactic documents related to the module
• Audiovisual materials
• Recommended readings

TEACHING LANGUAGE

French

CONTACT

Mme JOUISHOMME Delphine :
delphine.jouishomme@insa-lyon.fr
Mme GOUTALAND Carine :
carine.goutaland@insa-lyon.fr

AIMS

A series of elective courses in Humanities and Social Sciences (HSS) offers several options for students to choose from, allowing them to develop and deepen specific skills. This course aims to develop one or more transversal skills among the following:
• CT1: Self-awareness and self-management
• CT2: Working, learning, and evolving independently
• CT3: Interacting with others, working in a team
• CT4: Demonstrating creativity
• CT5: Acting responsibly in a complex world
• CT6: Navigating and evolving within an organization
• CT7: Working in an international and intercultural context
The list of options available in Series 1 and the specific competencies for each option are detailed in the catalog on the IntranetHumas:
https://intranethumas.insa-lyon.fr/sciences-humaines-sociales/offre-de-formation/cours-la-carte-0

CONTENT

Each module is designed to encourage interaction and active student participation. The content is structured around the following key aspects:
• Theoretical deepening related to the theme
• Reflection on the topic
• Practical exercises and activities
• Assessments and presentation of work

BIBLIOGRAPHY

The bibliography is selected by the instructor based on the module.

PRE-REQUISITES

French

Chemistry

IDENTIFICATION

CODE : BS-4-S2-EC-BMRMNCR
ECTS : 2

HOURS

Cours :	16h
TD :	0h
TP :	8h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

1 x 2h written exam and practical report

TEACHING AIDS

Powerpoint

TEACHING LANGUAGE

French

CONTACT

M. DA SILVA :
pedro.da-silva@insa-lyon.fr
M. GOUET Patrice :
patrice.gouet@ibcp.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 2)
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 2)
A5. Process data (level 1)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 2)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C8. Use the main techniques for exploring biological functions (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 1)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 2)

CONTENT

- Crystallogenesis,
- Crystallographic symmetry,
- X-ray diffraction,
- Electron density
- Fourier transforms, electron density maps,
- Building of x-ray structures,
- Structure analysis.

BIBLIOGRAPHY

1. Principles of protein X-ray crystallography - Jan Drenth - Springer (2nd edition) - 1999
2. Protein Crystallography - T.L. Blundell et L. Johnson - Academmic Press - 1976

PRE-REQUISITES

Knowledge on protein structures

Physiology Pharmacology

IDENTIFICATION

CODE : BS-4-S2-EC-COPHAR1
ECTS : 2

HOURS

Cours :	8h
TD :	14h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	24h
Travail personnel :	28h
Total :	52h

ASSESMENT METHOD

Final exam

TEACHING AIDS

duplicate course material

TEACHING LANGUAGE

French

CONTACT

M. GUILLOT Nicolas :
nicolas.guillot@insa-lyon.fr

AIMS

SKILLS :
This CE contributes to the following competencies (level) with associated capabilities:
A1. Analyze a real or virtual system (or problem) (M)
A2. Use a model of a real or virtual system (level 2)
A5. Process data (M)
C6. Measure and evaluate the impact of new healthcare products or diagnostic methods (level 2)
C10. Assess the limits of validity of a model and identify sources of variability and uncertainty (level 1)
C11. Model and interpret biological data to understand underlying processes (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 1)
B5. Act responsibly in a complex world (M)

The knowledge associated with this CE course is
Drug life cycle. Notion of medico-economics. Pharmacokinetic models and xenobiotic metabolism.

OBJECTIVES :
Course:
Introduce the pharmaceutical industry and describe the various stages in the design of a drug (players, duration, regulatory requirements, costs, etc.).
Describe, analyze and model the fate of a drug in the body (ADME).
Provide the fundamental basis for studying drug metabolism and mechanisms of action.
Practical exercises: on PK models

CONTENT

CM: Teaching on two aspects of pharmacology: 1, Becoming a drug in the body: absorption, distribution, metabolism and elimination (ADME). and 2, Pharmacokinetics: 1 and 2-compartment models.

ADME: Variations in drug sensitivity. Models and methods of study, interests and limitations. Metabolism of xenobiotics. Main biotransformation pathways and stages, mono-oxygenates. The main conjugation reactions and their targets. Modulating factors of biotransformation: physiological and behavioural factors, induction, polymorphism.
pharmacokinetics. Fundamental concepts and goals. Compartmental and non compartmental pharmacokinetics. Modelling of a simple two-compartment system and simulations. Estimation of model parameters and forecasts. Infusion models, oral intake and bioavailability. General principles of toxicology.

BIBLIOGRAPHY

Goodman and Gilman's The Pharmacological Basis of Therapeutics - L.S. Goodman - McGraw-Hill, P 2006
Modern Pharmacology with clinical applications - C.R. Craig and R.E.Stitzel - Little Brown and Co - 1997
Conjugaison reactions in Drug Metabolism - G.J. Mulder - Taylor et Francis, London - 1990
Biotransformations - D.R. Hawkins - The Royal Society of Chemistry, London - 1994
Pharmacokinetics - M. Gibaldi, D. Perrier - Marcel Dekker Publisher - 1993

PRE-REQUISITES

Good background in chemistry, biochemistry and physiology.

IDENTIFICATION

CODE : BS-4-S2-EC-BMOMIQ3
ECTS : 3.00

HOURS

Cours :	14h
TD :	26h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	40h
Travail personnel :	35h
Total :	75h

ASSESMENT METHOD

1 practical report "TP RNA-seq"
1 Poster

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

"This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 3)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
"

SKILLS:
- Development of bioinformatics and statistical analysis protocols for transcriptomic data analysis
- Analysis conventional RNA-seq sequencing data
- Identification of splice variants
- Reconstruction of gene regulatory networks
- Analysis of ChIP-seq data

OBJECTIVES:
At the end of this course, the student should be able to join a research or development program in bioinformatics for the analysis of transcriptomic data with complete autonomy of work.
The learning outcomes of this course module are :
- to provide the fundamental biological, mathematical and computational concepts in bioinformatics for transcriptome and gene expression regulation study.

CONTENT

Introduction to Transcriptomics
Theoretical part: Introductory course on transcriptomics (methods for transcriptome analysis, RNA-seq, microarray, single cell)

Conventional RNA-seq
Practical Part: QC, Mapping, Counting, Differential Expression, GSEA

Inference of regulation networks
Theoretical Part: Introduction to Gene network Inference
Practical part: clustering of co-expressed genes, gene network inference

ChIP-seq
Theoretical part: Introduction to the biophysics of DNA-protein interactions and ChIP-seq
Practical Part: ChIP-seq analysis

Advanced RNA-seq
Theoretical part: Introduction to Predicting Splicing Variants
Practical part: Prediction of splicing variants, contribution of de novo approaches

scRNA-seq & Spatial Transcriptomics
Theoretical part: Introduction to new approaches in transcriptomics (single cell RNA-seq and spatial transcriptomics)
Practical part: Analysis of scRNA-seq data

BIBLIOGRAPHY

-

PRE-REQUISITES

Software development

IDENTIFICATION

CODE : BS-4-S2-EC-BMPRDEV
ECTS : 3

HOURS

Cours :	12h
TD :	8h
TP :	0h
Projet :	3h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	52h
Total :	75h

ASSESMENT METHOD

- Assessment of project management by the group tutor, including assessment of the writing of a backlog report (specifications and schedule of tasks to be completed during the first sprint of the project).
- Deliverable (code + deployment).
- Presentation (return of the code, installation, execution and answers to the jury's questions).

TEACHING AIDS

https://sergiopeignier.github.io/software_development.html
https://sergiopeignier.github.io/software_deployment.html

TEACHING LANGUAGE

English

CONTACT

M. PEIGNIER Sergio :
sergio.peignier@insa-lyon.fr

AIMS

This course targets the following skills :
A4. Design a system to meet specifications (level 3)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 2)
B4. Creativity, innovation, entrepreneurship (level 2)

CONTENT

- Presentation of the main software development and deployment tools (including test automation tools and the Agile organisation) through a few hours of lessons, with a presentation by industrialists on the validation of automated systems.
- Software development and deployment project (in Python), carried out in groups of around four students on a pre-defined subject.

BIBLIOGRAPHY

Scrum: The Art of Doing Twice the Work in Half the Time" by Jeff Sutherland
Sutherland, J. (2014). Scrum: The art of doing twice the work in half the time. Crown Business

Cassell, L., & Gauld, A. (2021). Python projects: A practical guide to building and deploying Python applications. Apress.

Python Packaging User Guide. (n.d.). Packaging Python projects. Python Packaging Authority. Retrieved April 7, 2025, from https://packaging.python.org/en/latest/tutorials/packaging-projects/

PRE-REQUISITES

- Good programming skills
- Python
- Notions in Machine Learning
- GIT

IDENTIFICATION

CODE : BS-4-S2-EC-BMINFO7
ECTS :

HOURS

Cours :	6h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	28h
Travail personnel :	24h
Total :	52h

ASSESMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. LAUNAY Guillaume :
guillaume.launay@univ-lyon1.fr

AIMS

At the end of this course, the student will be able to:
- program in Python a simple RESTful web service
- program in Javascript a web application able to interact with a server with AJAX

CONTENT

Capacities:
- programming a simple REST web service in Python
- programming a client-side web application in Javascript, with a server query in Ajax

Knowledge:
- Server-side web programming in Python;
- REST web service;
- Client-side web programming in Javascript;
- AJAX

BIBLIOGRAPHY

PRE-REQUISITES

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S2-EC-BMSTAT6
ECTS : 2

HOURS

Cours :	10h
TD :	14h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

First session : written terminal exam (1h30)
Second session : written terminal exam (1h30)

TEACHING AIDS

Course slides; tutorials;

TEACHING LANGUAGE

French

CONTACT

M. SUBTIL Fabien :
fabien.subtil@chu-lyon.fr

AIMS

COMPETENCIES:
This CE contributes to the following competencies (level) with associated abilities:
A1. Analyze a real or virtual system (or problem) (level 3)
- Reduce a system or problem using hypotheses
- Model a system or problem using quantities and related objects
A2. Operate a model of a real or virtual system (level 3)
- Estimate the errors induced by the implementation of the model
- Implement strategies for verifying the results of modeling
A5. Process data (level 3)
- Analyze a set of data to extract trends and anomalies
- Interpret data within the framework of a model
A6. Communicate a scientific analysis or approach in situations appropriate to their speciality (level 2)
- Structure their discourse around logical, reasoned reasoning, targeting clearly identified objectives
- Express themselves with a satisfactory level of language, seeking a balance between everyday language and symbolic language
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 2)
C9. Select and implement statistical tools adapted to a biological problem (level 3)
- Calculate the power of an experiment and control the various risks of error
- Fit a linear and non-linear model and validate the quality of the fit
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand the underlying processes (level 3)
- Propose, evaluate and implement appropriate modeling solutions (software for formal calculations and statistics, programming languages)

CONTENT

Indicators used in epidemiology
Relative risk, odds ratio, incidence ratio. Classical epidemiologic study designs: cohort, case control, cross sectional.

Introduction to generalized linear models:
- logistic regression
- Poisson regression
- general features of generalized linear models and extensions.

The module comprises lectures and worked sessions with data examples analyzed with R.

BIBLIOGRAPHY

1. An introduction to generalized linear models (2nd edition) - A.J. Dobson - Chapman and Hall ISBN 1-5848-8165-8 -2001
2. Comprendre et utiliser les statistiques dans les sciences de la vie - B Falissard - Masson - 2005.

PRE-REQUISITES

Good knowledge in statistical inference and linear regression, and in R.

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-4-S2-EC-BMMATH5
ECTS : 2.0

HOURS

Cours :	12h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

Two delivrables

TEACHING AIDS

https://moodle.insa-lyon.fr/course/view.php?id=6560

TEACHING LANGUAGE

English

CONTACT

M. BERNARD Samuel :
bernard@math.univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A2. Use a model of a real or virtual system (level 3)
A3. Implement an experimental approach (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 3)

This is a introduction course in stochastic processes and calculus with applications in biology. The course is divided into two main parts. Part I will cover stochastic processes in discrete time or state, while Part II will focus stochastic processes in contiunous time.
A the end of the class, the student will be able to characterize and perform numerical simulations of stochastic processes in discrete and continuous time and state, and build adapted models biological problems.

Apply hidden Markov chains for comparison, identification, aligment, and prediction of genomic sequences; Use Moran processes to infer development stages of cancers; Build and run simulations of biochemical networks with appropriate numerical algorithm for stochastic simulations; Analyze and characterize noisy time series; Run simulations of dynamical systems with noise

CONTENT

Part I - Stochastic Processes
Essentials of random variables, and application to chance and bad luck in cancer; Stochastic processes: definitions, applications in biology, stationarity, branching processes; Markov processes: properties, Chapman-Kolmogorov equations, Markov chains, Moran processes and application to cancer; Hidden Markov chains: applications in genomics; Biochemical Networks: birth/death processes, Stochastic Simulation Algorithm (SSA), tau-leaping algorithm

Part II - Stochastic Calculus
Brownian Motion (Wiener process): definition, construction, properties, distribution, first return times; Time series: auto-correlation, spectrum, Ruelle plot; Stochastic integral equations: white noise, solutions, Ornstein-Uhlenbeck process, colored noise; Stochastic differential equations: Langevin equations, Euler-Maruyama and Milstein numerical schemes, comparison with ODEs, applications to ecology and neurosciences; Stochastic integral : Itô integral, definition, lemma, use; Fokker-Plank equations : Master equations (Chapman-Kolmogorov), derivation, link between Fokker-Plank and Langevin equations, numerical simulations

BIBLIOGRAPHY

NG van Kampen, Stochastic Processes in Physics and Chemistry (2006) Elsevier

PRE-REQUISITES

Basic notions of probability, random variables ; usual distributions ; Calculus and ordinary differential equations

IDENTIFICATION

CODE : BS-4-S2-EC-COELUCD
ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

ASSESMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr

AIMS

CONTENT

BIBLIOGRAPHY

PRE-REQUISITES

Engineering methods

IDENTIFICATION

CODE : BS-5-S1-EC-COCULTI
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Quiz on Moodle

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 2)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level 1)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

Organization management: regulation, project management tools (6sigma, lean management, agile methods), interpersonal communication
Basic knowledge of employment law
Innovation and Emerging Issues: Data Science and Industry 4.0, Environmental Issues (Green Vaccine)
Intellectual property, patents, software licenses
Case study and examples of industrial projects (biopharma, environment, agri-food)

BIBLIOGRAPHY

All courses are taught by industrial collaborators

PRE-REQUISITES

IDENTIFICATION

CODE : BS-5-S1-EC-COPROCP
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

Cases Study Written Report Oral Exam

TEACHING AIDS

Written Documents

TEACHING LANGUAGE

French

CONTACT

M. GRIVEL Sylvain :
sylvain.grivel@sanofi.com
MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A4. Design a system to meet specifications (level 3)
A5. Process data (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 3)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level M)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level M)

CONTENT

Validation methodology :
Introduction : quality, authorities and regulatory references (AFSAP, EMEA, FDA, BPF, GMP, Normes ISO...), qualification and validation.
Control of validation :
Scope
Principle
Methodology :
Qualifications : design qualification, installation qualification, operational qualification, performance qualification.
Validation : process mapping, criticality analysis (critical and operational parameter), reproducibility and robustness, process validation.
Actors of validation
Documentation
Exercises.
Marketing authorization dossier :
Aims
Composition
Summary of product characteristics (SPC)
Pharmaceutical dossier
Pre-clinical dossier
Clinical dossier
The Common Technical Document (CTD)

BIBLIOGRAPHY

PRE-REQUISITES

Industrial Processes I

IDENTIFICATION

CODE : BS-5-S1-EC-COGEMED
ECTS : 2.00

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

A final project restitution and debriefing will be held at the end of the module.

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French
English

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

"This course targets the following skills :
A2. Use a model of a real or virtual system (level M)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 1)
C9. Select and apply statistical tools adapted to biological problems (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B1. Know oneself, manage oneself physically and mentally (level M)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)
B7.Work in an international and intercultural context (level 3)
"

OBJECTIVES:
At the end of this course the student will be able to join a research or development program in medical genomics
The learning outcomes of this course are:
- To bring the fundamental biological and computing concepts in bioinformatics to analyse medical genomics data.

CONTENT

Theoretical part:
1) Genomics
- concepts: genotype-phenotype association, Mendelian and complex diseases, rare diseases, germline and somatic alterations, cell-free DNA
- methods: calling germline and somatic variants, genotype imputation, GWAS
2) Transcriptomics, multi-omics and beyond
- concepts: inter- and intra-tissue heterogeneity, cancer and microenvironment; complementarity of different 'omic' layers; clinical data and digital pathology
- methods: calling somatic variants, deconvolution and quantifying the tumor microenvironment; multi-omic integration and classification, deep learning and integration with image analysis
3) Epigenomics
- concepts: chromatin and histone modification, methylation, cell-type signatures, effect of environmental factors
- methods: mapping, methylation quantification, peak calling, differentially methylated positions and regions, deconvolution and identification of cell types, inference of environmental risk factors
4) Metabolomics
- concepts: experimental design, metabolites and disease, biomarkers
- methods: peak detection, metabolite identification; clustering and regression, metabolic pathway and network analysis; identifying biomarkers

Practical part:
1) Developing and deploying a medical genomic bioinformatic workflow
- using Nextflow to run parallel, scalable analyses on HPC and cloud computing facilities
- efficient use of github for open-source development and Continuous Integration automated tests
- reliance on conda and docker/singularity containers for reproducibility
2) Performing a multi-omic analysis of cancer data
- accessing public cancer resources from the R environment
- performing uni-omic and multi-omic molecular classifications
- interpreting the results and finding clinical implications

Projects will be proposed to process and analyze cancer data, related to the interests of IARC-WHO. Students will work in groups of 4 people.

BIBLIOGRAPHY

-

PRE-REQUISITES

- Basic knowledge of bioinformatics (NGS sequence analysis)
- Basic knowledge of molecular biology

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

Microbiology

IDENTIFICATION

CODE : BS-5-S1-EC-COVIROL
ECTS : 2

HOURS

Cours :	20h
TD :	0h
TP :	4h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

written exam
practicals

TEACHING AIDS

power-point documents

TEACHING LANGUAGE

English

CONTACT

M. GOUET Patrice :
patrice.gouet@ibcp.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A3. Implement an experimental approach (level 2)
A5. Process data (level 1)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 1)

CONTENT

Viruses are omnipresent in our environment. They play an essential role both in terms of health and in evolutionary processes.
This teaching unit will cover both the basics of virology, with the study of replication cycles, and the most modern structural techniques with high-resolution cryo-electron microscopy and virtual reality observation of viral assemblies.
It will show how these results enable the rational development of drugs against major human pathogens, such as the influenza virus or the human immunodeficiency virus.

- Part 1: Introduction to virology, viral replication and the infective power of viruses
- Part 2: Molecular and structural virology, helical and icosahedral assemblies
- Part 3: Use of cryo-electron microscopy and virtual reality in structural virology
- Part 4: Applications with study of rhinovirus, influenza virus and human immunodeficiency virus
- Part 5: Rational development of antiviral drugs and vaccines

BIBLIOGRAPHY

- Biochemistry by Donald Voet (Author) and Judith G. Voet (Author)
- Introduction to protein structure by Carl Branden (Author) and John Tooze (Author)

PRE-REQUISITES

molecular biology, structural biochemistry

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-5-S1-EC-COPLAEX
ECTS : 2

HOURS

Cours :	16h
TD :	8h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

written exam
Compte rendu de TP et projet

TEACHING AIDS

see Moodle

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

The educational objective is to bring a control of the methodology of experimental fine-tuning applied to the industrial contexts. It is thus a question of presenting this methodology by showing that it is applicable to all the industrial domains and to all the stages: of the R*D in the production. We suggest to the students living an experiment of deployment of this methodology in the contact of an industrial speaker.

CONTENT

BIBLIOGRAPHY

contact industriel : Sandrine RIBEIRO

PRE-REQUISITES

Skills in linear modelling (ANOVA) are preferable, but the course is open to a fairly wide audience.

IDENTIFICATION

CODE : BS-5-S1-EC-COALIME
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Report of the group project: written report and oral presentation

TEACHING AIDS

teacher's handout, personal documentation for the food innovation project

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
A4. Design a system to meet specifications (level 2)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 1)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 2)
C14. Develop and validate biotechnology manufacturing processes (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level M)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level 2)
B4. Creativity, innovation, entrepreneurship (level 2)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level M)

CONTENT

Group work: implementation of general knowledge in food science and technology to create a new food product : design of the specifications, the pilot manufacturing process, the industrialization process, and the HACCP plan. The realization of a prototype can be proposed by the students.

To ensure students' acquisition of knowledge, the following chapters may be covered according to the needs of the project :

Water and food conservation, chemical and enzymatic modifications of food, milk and dairy products, egg-derived products, fruit and vegetables, meat, treatment of food commodities, bread and cereals, industrial production of sugar

Industrial intervention: introduction of cheese classes/technologies, fabrication diagrams, diagram describing the jobs involved in the different steps of cheese production, brewing and beer fabrication

BIBLIOGRAPHY

The engineer's technical papers
Science des aliments, tome 1 et tome 2, éd. Lavoisier Tec et Doc
Génie Industriel Alimentaire, tome 1 et tome 2, éd. Lavoisier Tec et Doc
Biochimie alimentaire, éd. Dunod
Textbook of food science and technology, A. Sharma
Food processing : principles and applications, Ramaswamy, Marcotte.

PRE-REQUISITES

Structural biochemistry, general microbiology

Signal and image analysis

IDENTIFICATION

CODE : BS-5-S1-EC-COIMAGE
ECTS : 2

HOURS

Cours :	14h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Week 3: written report on a case study in low / medium level,
Week 6: written report on a case study in high-level,
Week 7: oral presentation of a finalized quantitative analysis of images.

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

M. PEIGNIER Sergio :
sergio.peignier@insa-lyon.fr

AIMS

This CE contributes to the competences :
A4. Design a system to meet specifications (level M)
A5. Process data (level 3)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico, including massive data (big data) (level 3)
C9. Choose and implement statistical tools adapted to biological problems (level 2)
C10. Assess the limits of validity of a model and identify the sources of variability and uncertainty (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)

OBJECTIVES :
At the end of this module, the student will be able to:
- Explain how digital images are represented and manipulated in a computer.
- Write a program that implements fundamental image processing algorithms.
- Master the description of image processing techniques and know how to use known image processing libraries.

CONTENT

Digital Image Fundamentals
- Elements of Visual Perception.
- Light and the Electromagnetic Spectrum.
- Image Sensing and Acquisition.
- Image Sampling and Quantization.
- Some Basic Relationships between Pixels.
- Linear and Nonlinear Operations.

Image Enhancement in the Spatial Domain
- Basic Gray Level Transformations.
- Histogram Processing.
- Basics of Spatial Filtering.
- Smoothing Spatial Filters.
- Sharpening Spatial Filters.

Image Segmentation
- Detection of Discontinuities.
- Edge Linking and Boundary Detection.
- Thresholding.
- Region-Based Segmentation.
- Segmentation by Morphological Watersheds.

Morphological Image Processing
- Dilation and Erosion.
- Opening and Closing.
- Extensions to Gray-Scale Images.

BIBLIOGRAPHY

1. Murat Kunt, Techniques modernes de traitement numérique des signaux (Masson)
2. Jean-Noël Martin, Débuter en traitement numérique du signal - Applications au filtrage et au traitement des sons (Collection TechnoSup, éditions Ellipses)
3. Image J : freeware for image treatment and analysis (official website :http://rsbweb.nih.gov/ij/index.html, description : http://fr.wikipedia.org/wiki/ImageJ)
4. Diane Lingrand, Introduction au Traitement d'Images (Vuibert)
5. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (Addison-Wesley)
6. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach (Prentice Hall)

PRE-REQUISITES

- Algorithms
- Python programming

Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-COMETAB
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

In groups, written report (5p max) and presentation of a topic of your choice on innovative biotechnologies.

TEACHING AIDS

Slides
Internet searches
Videos

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie : nathalie.bernoud-hubac@insa-lyon.fr
MME LAZAR Adina : adina-nicoleta.lazar@insa-lyon.fr

AIMS

CONTENT

BIBLIOGRAPHY

PRE-REQUISITES

Structural biochemistry, Functional metabolic biochemistry, Signaling biochemistry, Analytical biochemistry, Industrial biotechnologies

IDENTIFICATION

CODE : BS-5-S1-EC-COCLIMA
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Presentations or other deliverables (to be seen in session)

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. CHARLES Hubert :
hubert.charles@insa-lyon.fr

AIMS

A4. Designing a system to meet a set of specifications
- Integrating ecological footprints (cost) into production
C3. Collecting, storing and organising biological data obtained in vivo, in vitro and in silico including big data
- design, use or optimise digital systems to limit their ecological footprint
C6. Measuring and evaluating the impact of new health products or diagnostic methods
- Assessing the environmental impact of a product or prototype (life cycle assessment)
C13. Understand the quality assurance and regulatory framework in the field of biotechnology
- Integrating ecological (cost) footprints into a biotechnology process
C14. Developing and validating manufacturing processes in biotechnologies
- Integrating ecological (cost) footprints into a biotechnology process
C15. Contribute to environmental studies with biological and evolutionary components
B4. Be creative, innovative, enterprising
- develop processes and products that are more respectful of overall health
B5. Acting responsibly in a complex world

OBJECTIVES
The pedagogical objective of this course is to make engineering students aware of the need to integrate ecological costs (footprints) into healthy industrial production and to give them some evaluation tools to do so in a concrete way in their immediate environment (the department, the campus or the town).

CONTENT

This program is subject to change as the course is being edited. In the first year this course will be relatively experimental and its content will also be defined with the students. An important part will be devoted to applied work (10 to 12 hours) on concrete and local issues (in the department, on campus or in the urban area).

S1: Introduction and reminder of the basics of ecology (HC)
S2: IPCC Reports (HC)
S3: IPBES reports (HC)
S4: Ecosystem Services and Ecological Footprints (HC)
S5: Digital fingerprints (LL)
S6: Life cycle and responsible production: Sanofi's vision
S7: Responsible Lifecycle and Production: bioMérieux's vision
S8 to S11: TP concrete project (calculation of carbon footprint or ecological footprint associated with an activity on campus)
S12 and S13: restitution in the form of presentations (or other deliverables)

Translated with www.DeepL.com/Translator (free version)

BIBLIOGRAPHY

PRE-REQUISITES

None

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-COBIENV
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Group project presenting an innovative and ecological product or biotechnology
Individual work presenting the technique or product

TEACHING AIDS

Slides
Internet search
Film

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie : nathalie.bernoud-hubac@insa-lyon.fr
Mme LO VAN Amanda : amanda.lo-van@insa-lyon.fr

AIMS

This course targets the following skills :
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level M)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level M)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3)
B5. Act responsibly in a complex world (level 3)

At the industrial stage, biochemistry helps to create alternative sources of supply capable of lowering the environmental footprint. Producing differently and producing better are today's fundamental challenges. Biochemistry provides high-performance technological solutions.

The educational objective is to train future engineers in the basic principles of development, scaling, optimization and valorization of bioprocesses.

This option proposes to present the essential elements of the engineering approach, particularly in the environmental and pharmaceutical fields, as well as the main concepts derived from them.

CONTENT

1) Metabolic Engineering - Description and elements of development, scale-up, optimization and valorization of bioprocess.

2) Alternative sources of supply to reduce the environmental footprint.

3) Real case studies (illustrations by examples such as microalgae and biofuels or alicaments).
Interventions/discussions with Green Tech industrial actors could be scheduled.

1) Metabolic Engineering - Description and elements of development, scale-up, optimization and valorization of bioprocesses in the environmental, energy, food, cosmetic and pharmaceutical fields.

2) Alternative sources of supply to reduce the environmental footprint.

3) Real case studies. Illustrations by examples such as: biofuels (oil and derivatives from lipids, alcohol from sugars; algae fuels from micro-algae; biomasses used, biotechnologies implemented and environmental impact); alicaments (production, which industrial biotechnologies of transformation, biomass resources, nutrition and health).
Interventions and discussions with Green Tech industrial actors could be scheduled.

BIBLIOGRAPHY

PRE-REQUISITES

Structural biochemistry, Functional metabolic biochemistry, Signaling biochemistry, Analytical biochemistry, Industrial biotechnologies

Physiology Pharmacology

IDENTIFICATION

CODE : BS-5-S1-EC-COPHAR2
ECTS : 2.00

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

oral presentation by group
Free-form written submission (poster, report, brochure, etc.)

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME DELTON Isabelle :
isabelle.delton@insa-lyon.fr

AIMS

This EC contributes to the following skills:
A1. Analyze a real or virtual system (or problem) (Level 3)
A3. Implement an experimental approach (Level 3)
A6. Communicate an analysis or a scientific approach using scenarios adapted to their specialty (Level 2)
C6. Measure and evaluate the impact of new health products or diagnostic methods (Level 2)
B2. Work, learn, and develop independently (Level 3)
- Conduct a literature review of a molecule of therapeutic interest
B3. Interact with others, work in a team (Level 2)
- Collective bibliographic project B4. Demonstrate creativity, innovation, and entrepreneurship - Use original presentation methods (role-playing, posters, flyers, videos)

The knowledge associated with this EC is:
General Physiology and Pharmacology
Experimental Pharmacology

CONTENT

Targets and modes of action of drugs (receptor agonist / antagonist, enzyme or gene expression inhibitors / activators, etc.); Efficiency and specificity criteria

Pharmaceutical engineering: formulation and vectorization of active ingredients for pharmaceutical and cosmetic applications

Cosmetology: skin penetration, study models

Neuropharmacology: study models and practical cases

Group project: bibliographic research (scientific and economic aspects) on a molecule of therapeutic interest

BIBLIOGRAPHY

PRE-REQUISITES

General pharmacology: notions of receptors, affinity, signaling pathways
Pharmacokinetics: ADME

Plant Biotechnologies

IDENTIFICATION

CODE : BS-5-S1-EC-COPHVEG
ECTS : 2

HOURS

Cours :	14h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Written knowledge test

TEACHING AIDS

Powerpoint slides

TEACHING LANGUAGE

French

CONTACT

M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

"This course targets the following skills :
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B7.Work in an international and intercultural context (level M)
"

CONTENT

The knowledge associated with this CE is :
Plant biology

To acquire the biological and evolutionary bases of the plant kingdom and to know the physiology of flowering plants (Angiosperms) in order to be able to handle and use them in Biotechnology.
To present the fundamental concepts of the plant kingdom and the physiology of the development and reproduction of flowering plants.
To integrate the specific features of plant biology for work in the field of agronomy.
Raise students' awareness of sustainable development issues related to plant biotechnology and sustainable agriculture.

This training includes a lecture, and sessions of TD intended for collective exchanges on the biotechnologies developed on the plant

The course consists of :
- An introduction to the general organization of the plant world (Cormophytes and Thallophytes)
- Study of plant tissues in spermaphytes
- Vegetative and reproductive systems of angiosperms: physiological and evolutionary aspects
- The 5 phytohormones and their roles in the development of angiosperms
- Physiology of reproduction
- Introduction to transgenesis in plants

The course is based on thematic group work on current developments in plant biotechnology (e.g. genetic manipulation of plants, optimization of mycorrhizal symbiosis), sustainable development issues (e.g. emission and capture of CO2; limitation of input use...), societal/ethical choices (e.g. scientific and ethical aspects of GMOs).

BIBLIOGRAPHY

Ecologie générale - Barbault - Abrégés Masson - 1990
Plant physiology - Taiz and Zeiger - Benjamin / Cummings - 1991
Molecular embryology of flowering plants - V. Raghavan
Plant biochemistry and Molecular biology - Hans Walter Helott
4ème édition : Biologie végétale, plantes supérieures : appareil reproducteur - Robert Gorenflot
6 ème édition : Biologie végétale, plantes supérieures : appériel végétatif - Robert Gorenflot

PRE-REQUISITES

No

IDENTIFICATION

CODE : BS-5-S1-EC-COPPP02
ECTS : 1

HOURS

Cours :	8h
TD :	2h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	10h
Travail personnel :	15h
Total :	25h

ASSESMENT METHOD

Attendance at all sessions, compulsory enrolment in at least 1 simulated interview with a company, and in-house work on a free, in-depth reflection on my career plan.

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level M)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

- Reminders about the professional project, recruitment tools
- Sources of information and contacts to companies
- Recruitment interview
- Briefing on the business / sector survey
- Selection of themes and Constitution of subgroups
- Oral presentation of subgroups
- Maintenance simulation

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE : HU-0-S1-EC-S-PPH
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Written report (10 pages minimum) and oral defence (in presence of tutor and guest).

TEACHING AIDS

Présentation du PPH sur Moodle : http://moodle.insa-lyon.fr

TEACHING LANGUAGE

French

CONTACT

AIMS

The PPH is an individual exercise where the student carries out an investigation or some research into a subjet of particular interest to them in the aim of developing some form of critical analysis of the subject. The PPH is a means by which the student can show their ability to build an analysis based on a rigorously developed thesis. The analysis is based on a personal approach to the subject (openness to the wider world), the way the subject is dealt with (for example the use of a personal experience as a way of seeing the world or the chosen subject), or in certain cases the creative approach used (for example, for an artistic experience).
The PPH requires the ability to work autonomously.

The PPH contributes primarily to the development of competencies CT2.1-4 and CT3.1 ; other competencies can be developed depending on the choice of project.

CONTENT

Work on a particular theme with a tutor chosen by the student.
Filling in of a project sheet (elaboration of the question, definition of the personal approach, bibliography, etc),
Step by step meetings with the tutor (plan, analysis, etc),
Report writing and oral presentation.

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE
Humanities and social sciences

IDENTIFICATION

CODE : HU-0-S1-EC-S-SERIE4
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Assessment will be conducted through continuous evaluation. The assessment methods will be presented at the beginning of the semester by the teaching team.

TEACHING AIDS

Materials are chosen by the instructor based on the module:
• Didactic documents related to the module
• Audiovisual materials
• Recommended readings

TEACHING LANGUAGE

French

CONTACT

Mme JOUISHOMME Delphine :
delphine.jouishomme@insa-lyon.fr
Mme GOUTALAND Carine :
carine.goutaland@insa-lyon.fr

AIMS

A series of elective courses in Humanities and Social Sciences (HSS) offers several options for students to choose from, allowing them to develop and deepen specific skills. This course aims to develop one or more transversal skills among the following:
• CT1: Self-awareness and self-management
• CT2: Working, learning, and evolving independently
• CT3: Interacting with others, working in a team
• CT4: Demonstrating creativity
• CT5: Acting responsibly in a complex world
• CT6: Navigating and evolving within an organization
• CT7: Working in an international and intercultural context
The list of options available in Series 1 and the specific competencies for each option are detailed in the catalog on the IntranetHumas:
https://intranethumas.insa-lyon.fr/sciences-humaines-sociales/offre-de-formation/cours-la-carte-0

CONTENT

Each module is designed to encourage interaction and active student participation. The content is structured around the following key aspects:
• Theoretical deepening related to the theme
• Reflection on the topic
• Practical exercises and activities
• Assessments and presentation of work

BIBLIOGRAPHY

The bibliography is selected by the instructor based on the module.

PRE-REQUISITES

French

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Physiology Pharmacology

IDENTIFICATION

CODE : BS-5-S1-EC-BBPHAPK
ECTS : 4.00

HOURS

Cours :	4h
TD :	4h
TP :	44h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	52h
Travail personnel :	48h
Total :	100h

ASSESMENT METHOD

Continuous evaluation of laboratory work Written and oral report

TEACHING AIDS

Duplicated course material
Specific publications
Mlwin et JMP softwares

TEACHING LANGUAGE

French

CONTACT

MME DELTON Isabelle :
isabelle.delton@insa-lyon.fr
M. GUILLOT Nicolas :
nicolas.guillot@insa-lyon.fr

AIMS

SKILLS:
Block #1: Experimental know-how skills

A2. Exploit a model of a real or virtual system (M)
A3. Implement an experimental approach (level 3)
A4. Design a system that meets specifications (level 3)
A5. Process data (level 3)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico including massive (big data) (level 2)
- Interpret experimental results and integrate them into a biological problem
- Validate an analytical (pharmacology) or experimental method
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 3)
C7. Manipulate cell cultures, microorganisms or laboratory animals (level M)
C8 Use the main techniques for exploring biological functions (level 3)
C11. Model and interpret biological data to understand the underlying processes (level 3)

block #2 project management skills
A6. Communicate an analysis or a scientific approach with scenarios adapted to their specialty (M)
B3 Interact with others, work in a team (level M)
C10 Appreciate the limits of validity of a model and identify the sources of variability and uncertainty (level 2)
C9 Choose and implement statistical tools adapted to and for a biological problem (level M)
C13. Understand the quality assurance and regulatory framework in the field of biotechnologies (level M)

block #3 entrepreneurship/innovation skills
The student should be able to choose a dosage method based on quality criteria (extraction yield....
C2. Design, adapt and optimize experimental plans in Biosciences (level 3)
B2 Work, learn, evolve independently (level M)

B4. Demonstrate creativity, innovate, undertake (M).

CONTENT

OBJECTIVES : To design and conduct the pharmacokinetic study of a drug. Acquire new analytical and modelling techniques and apply them to the experimental results obtained.

CURRICULUM Course and TP : PK, PD, population pharmacokinetics models. Presentation and use of compartmental and non compartmental pharmacokinetic software. Project: pharmacokinetic study of a drug. Simulation on rabbit model. HPLC dosage, quality control of dosages: limit of quantification, linearity...

BIBLIOGRAPHY

- Pharmacokinetic and Pharmacodynamic data Analysis : concepts and applications. J. Gabrielsson and D. Weiner. 2000 (third edition); Swedish Pharmaceutical Press, Stockholm.
- Pharmacokinetic-Pharmacodynamic Modeling and Simulation. P. Bonate. ; Springer

PRE-REQUISITES

2 years of study in the department Biosciences or equivalent theoritical and practical knowledges.

Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-BBBIOC7
ECTS : 5

HOURS

Cours :	0h
TD :	0h
TP :	62h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	62h
Travail personnel :	63h
Total :	125h

ASSESMENT METHOD

Drafting of an industrial production protocol. Writing a research report processes

TEACHING AIDS

scientific publications, patent texts, processes of production and analysis, supplier's web sites of industrial equipment.

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie :
nathalie.bernoud-hubac@insa-lyon.fr

AIMS

COMPETENCES: At the end of this course the students will be able to make a change of scale between a phase of development in laboratory and a production unit.

This course targets the following skills :
A3. Implement an experimental approach (level 3)
A4. Design a system to meet specifications (level 3)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 3)
C5. Quantify, structurally characterize and purify biomolecules (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 3)
B1. Know oneself, manage oneself physically and mentally (level 3)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3?)
B5. Act responsibly in a complex world (level 2)

OBJECTIVES:
Provide additional training on methods of preparatory biochemistry by introducing concepts of mass and continuous production. Confront students to solve practical theoretical and practical problems of production, purification and analysis of natural substances and to bring them into line with the requirements of quality, cost and safety.

CONTENT

Implementation of a pre-pilot scale extraction and purification process collagen for medical use; This project will enable students to implement technologies in the field of production, in
BPI conditions (good industrial practices). These technologies than continuous grinding, vacuum mixing and mixing, tangential filtration or freeze-drying will be implemented with semi-industrial equipment. This project will also allow students to become familiar with the quality and health safety of products and reflect on the costs of production related to materials, reagents and personnel. Finally, they will design the transposition of the study to the industrial scale.

BIBLIOGRAPHY

PRE-REQUISITES

Analytic Chemical and Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-BBPROJE
ECTS : 5

HOURS

Cours :	0h
TD :	10h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	10h
Travail personnel :	90h
Total :	100h

ASSESMENT METHOD

1 requirements specification
1 deliverable
1 oral presentation

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

M. CHARLES Hubert :
hubert.charles@insa-lyon.fr
M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr
MME BERNARD KNIBBE :
carole.knibbe@insa-lyon.fr
RODRIGUE-PLANCHE Agnes :
agnes.rodrigue@insa-lyon.fr

AIMS

This course targets:
- all skills of block A (level 3),
- several skills from block C (level 3), depending on the topic of the project,
- and the following skills from block B:

At the end of this module, students should be able to work in a team to design and implement an innovative experimental approach applied to a biological problem proposed by a company, NGO or laboratory in the human health and ecosystem health sectors.

CONTENT

- Project in groups of 4 based on subjects proposed by companies or laboratories.

This project is divided into 5 phases to develop students' project management skills:
- Analyze the company's functional requirements
- Define technical specifications and design relevant solutions
- Produce a functional solution
- Test and validate the solution produced
- Deliver the solution to the company (including documentation and/or user training)

Depending on the project, these 5 phases can be carried out iteratively using the AGILE methodology.

BIBLIOGRAPHY

PRE-REQUISITES

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Protein engineering

IDENTIFICATION

CODE : BS-5-S1-EC-BBMICR3
ECTS : 4

HOURS

Cours :	16h
TD :	4h
TP :	40h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	60h
Travail personnel :	40h
Total :	100h

ASSESMENT METHOD

written examination
oral presentation

TEACHING AIDS

ppt files
printed laboratory book
videos
scientific litterature

TEACHING LANGUAGE

French

CONTACT

MME Agnes : RODRIGUE-PLANCHE
agnes.rodrigue@insa-lyon.fr

AIMS

"This course targets the following skills :
A3. Implement an experimental approach (level 3)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 3)
C5. Quantify, structurally characterize and purify biomolecules (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 2)
C7. Handle cell cultures, microorganisms or laboratory animals (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 3)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 1)

“The knowledge associated with this CE is:
Structure-function relationships, rational design and directed mutagenesis
Recombinant protein production and applications in biotechnology, particularly in healthcare

Protein engineering, genetic and metabolic engineering
Cell reprogramming

CONTENT

-Genetic engineering products
-Protein production (enzymes, recombinant antibodies, miniaturized antibodies, gene therapies).
-Applications in the fight against pathogenic microorganisms, vaccines, therapeutic antibodies, in vivo diagnostics, etc.
-Expression systems (microbial, plant, insect, cell cultures).
- Modification and improvement of production strains.

-cellular cultures in a bioreactor

BIBLIOGRAPHY

PRE-REQUISITES

-from gene to RNA and protein
-control of gene expression
-3D protein structure
- genetic engineering

Engineering methods

IDENTIFICATION

CODE : BS-5-S1-EC-COCULTI
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Quiz on Moodle

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 2)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level 1)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

Organization management: regulation, project management tools (6sigma, lean management, agile methods), interpersonal communication
Basic knowledge of employment law
Innovation and Emerging Issues: Data Science and Industry 4.0, Environmental Issues (Green Vaccine)
Intellectual property, patents, software licenses
Case study and examples of industrial projects (biopharma, environment, agri-food)

BIBLIOGRAPHY

All courses are taught by industrial collaborators

PRE-REQUISITES

IDENTIFICATION

CODE : BS-5-S1-EC-COALIME
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Report of the group project: written report and oral presentation

TEACHING AIDS

teacher's handout, personal documentation for the food innovation project

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
A4. Design a system to meet specifications (level 2)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 1)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 2)
C14. Develop and validate biotechnology manufacturing processes (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level M)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level 2)
B4. Creativity, innovation, entrepreneurship (level 2)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level M)

CONTENT

Group work: implementation of general knowledge in food science and technology to create a new food product : design of the specifications, the pilot manufacturing process, the industrialization process, and the HACCP plan. The realization of a prototype can be proposed by the students.

To ensure students' acquisition of knowledge, the following chapters may be covered according to the needs of the project :

Water and food conservation, chemical and enzymatic modifications of food, milk and dairy products, egg-derived products, fruit and vegetables, meat, treatment of food commodities, bread and cereals, industrial production of sugar

Industrial intervention: introduction of cheese classes/technologies, fabrication diagrams, diagram describing the jobs involved in the different steps of cheese production, brewing and beer fabrication

BIBLIOGRAPHY

The engineer's technical papers
Science des aliments, tome 1 et tome 2, éd. Lavoisier Tec et Doc
Génie Industriel Alimentaire, tome 1 et tome 2, éd. Lavoisier Tec et Doc
Biochimie alimentaire, éd. Dunod
Textbook of food science and technology, A. Sharma
Food processing : principles and applications, Ramaswamy, Marcotte.

PRE-REQUISITES

Structural biochemistry, general microbiology

IDENTIFICATION

CODE : BS-5-S1-EC-COGEMED
ECTS : 2.00

HOURS

Cours :	8h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

A final project restitution and debriefing will be held at the end of the module.

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French
English

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

"This course targets the following skills :
A2. Use a model of a real or virtual system (level M)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C4. Implement analysis tools for high-throughput biology (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 1)
C9. Select and apply statistical tools adapted to biological problems (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 2)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B1. Know oneself, manage oneself physically and mentally (level M)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)
B7.Work in an international and intercultural context (level 3)
"

OBJECTIVES:
At the end of this course the student will be able to join a research or development program in medical genomics
The learning outcomes of this course are:
- To bring the fundamental biological and computing concepts in bioinformatics to analyse medical genomics data.

CONTENT

Theoretical part:
1) Genomics
- concepts: genotype-phenotype association, Mendelian and complex diseases, rare diseases, germline and somatic alterations, cell-free DNA
- methods: calling germline and somatic variants, genotype imputation, GWAS
2) Transcriptomics, multi-omics and beyond
- concepts: inter- and intra-tissue heterogeneity, cancer and microenvironment; complementarity of different 'omic' layers; clinical data and digital pathology
- methods: calling somatic variants, deconvolution and quantifying the tumor microenvironment; multi-omic integration and classification, deep learning and integration with image analysis
3) Epigenomics
- concepts: chromatin and histone modification, methylation, cell-type signatures, effect of environmental factors
- methods: mapping, methylation quantification, peak calling, differentially methylated positions and regions, deconvolution and identification of cell types, inference of environmental risk factors
4) Metabolomics
- concepts: experimental design, metabolites and disease, biomarkers
- methods: peak detection, metabolite identification; clustering and regression, metabolic pathway and network analysis; identifying biomarkers

Practical part:
1) Developing and deploying a medical genomic bioinformatic workflow
- using Nextflow to run parallel, scalable analyses on HPC and cloud computing facilities
- efficient use of github for open-source development and Continuous Integration automated tests
- reliance on conda and docker/singularity containers for reproducibility
2) Performing a multi-omic analysis of cancer data
- accessing public cancer resources from the R environment
- performing uni-omic and multi-omic molecular classifications
- interpreting the results and finding clinical implications

Projects will be proposed to process and analyze cancer data, related to the interests of IARC-WHO. Students will work in groups of 4 people.

BIBLIOGRAPHY

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PRE-REQUISITES

- Basic knowledge of bioinformatics (NGS sequence analysis)
- Basic knowledge of molecular biology

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

Physiology Pharmacology

IDENTIFICATION

CODE : BS-5-S1-EC-COPHAR2
ECTS : 2.00

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

oral presentation by group
Free-form written submission (poster, report, brochure, etc.)

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME DELTON Isabelle :
isabelle.delton@insa-lyon.fr

AIMS

This EC contributes to the following skills:
A1. Analyze a real or virtual system (or problem) (Level 3)
A3. Implement an experimental approach (Level 3)
A6. Communicate an analysis or a scientific approach using scenarios adapted to their specialty (Level 2)
C6. Measure and evaluate the impact of new health products or diagnostic methods (Level 2)
B2. Work, learn, and develop independently (Level 3)
- Conduct a literature review of a molecule of therapeutic interest
B3. Interact with others, work in a team (Level 2)
- Collective bibliographic project B4. Demonstrate creativity, innovation, and entrepreneurship - Use original presentation methods (role-playing, posters, flyers, videos)

The knowledge associated with this EC is:
General Physiology and Pharmacology
Experimental Pharmacology

CONTENT

Targets and modes of action of drugs (receptor agonist / antagonist, enzyme or gene expression inhibitors / activators, etc.); Efficiency and specificity criteria

Pharmaceutical engineering: formulation and vectorization of active ingredients for pharmaceutical and cosmetic applications

Cosmetology: skin penetration, study models

Neuropharmacology: study models and practical cases

Group project: bibliographic research (scientific and economic aspects) on a molecule of therapeutic interest

BIBLIOGRAPHY

PRE-REQUISITES

General pharmacology: notions of receptors, affinity, signaling pathways
Pharmacokinetics: ADME

Signal and image analysis

IDENTIFICATION

CODE : BS-5-S1-EC-COIMAGE
ECTS : 2

HOURS

Cours :	14h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Week 3: written report on a case study in low / medium level,
Week 6: written report on a case study in high-level,
Week 7: oral presentation of a finalized quantitative analysis of images.

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

M. PEIGNIER Sergio :
sergio.peignier@insa-lyon.fr

AIMS

This CE contributes to the competences :
A4. Design a system to meet specifications (level M)
A5. Process data (level 3)
C3. Collect, store and organise biological data obtained in vivo, in vitro and in silico, including massive data (big data) (level 3)
C9. Choose and implement statistical tools adapted to biological problems (level 2)
C10. Assess the limits of validity of a model and identify the sources of variability and uncertainty (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)

OBJECTIVES :
At the end of this module, the student will be able to:
- Explain how digital images are represented and manipulated in a computer.
- Write a program that implements fundamental image processing algorithms.
- Master the description of image processing techniques and know how to use known image processing libraries.

CONTENT

Digital Image Fundamentals
- Elements of Visual Perception.
- Light and the Electromagnetic Spectrum.
- Image Sensing and Acquisition.
- Image Sampling and Quantization.
- Some Basic Relationships between Pixels.
- Linear and Nonlinear Operations.

Image Enhancement in the Spatial Domain
- Basic Gray Level Transformations.
- Histogram Processing.
- Basics of Spatial Filtering.
- Smoothing Spatial Filters.
- Sharpening Spatial Filters.

Image Segmentation
- Detection of Discontinuities.
- Edge Linking and Boundary Detection.
- Thresholding.
- Region-Based Segmentation.
- Segmentation by Morphological Watersheds.

Morphological Image Processing
- Dilation and Erosion.
- Opening and Closing.
- Extensions to Gray-Scale Images.

BIBLIOGRAPHY

1. Murat Kunt, Techniques modernes de traitement numérique des signaux (Masson)
2. Jean-Noël Martin, Débuter en traitement numérique du signal - Applications au filtrage et au traitement des sons (Collection TechnoSup, éditions Ellipses)
3. Image J : freeware for image treatment and analysis (official website :http://rsbweb.nih.gov/ij/index.html, description : http://fr.wikipedia.org/wiki/ImageJ)
4. Diane Lingrand, Introduction au Traitement d'Images (Vuibert)
5. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing (Addison-Wesley)
6. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach (Prentice Hall)

PRE-REQUISITES

- Algorithms
- Python programming

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematics and Modeling

IDENTIFICATION

CODE : BS-5-S1-EC-COPLAEX
ECTS : 2

HOURS

Cours :	16h
TD :	8h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

written exam
Compte rendu de TP et projet

TEACHING AIDS

see Moodle

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

The educational objective is to bring a control of the methodology of experimental fine-tuning applied to the industrial contexts. It is thus a question of presenting this methodology by showing that it is applicable to all the industrial domains and to all the stages: of the R*D in the production. We suggest to the students living an experiment of deployment of this methodology in the contact of an industrial speaker.

CONTENT

BIBLIOGRAPHY

contact industriel : Sandrine RIBEIRO

PRE-REQUISITES

Skills in linear modelling (ANOVA) are preferable, but the course is open to a fairly wide audience.

IDENTIFICATION

CODE : BS-5-S1-EC-COPROCP
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	24h
Travail personnel :	26h
Total :	50h

ASSESMENT METHOD

Cases Study Written Report Oral Exam

TEACHING AIDS

Written Documents

TEACHING LANGUAGE

French

CONTACT

M. GRIVEL Sylvain :
sylvain.grivel@sanofi.com
MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
A3. Implement an experimental approach (level 2)
A4. Design a system to meet specifications (level 3)
A5. Process data (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 3)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level M)
B5. Act responsibly in a complex world (level M)
B6. Situate oneself, work and develop within a company or socio-productive organization (level M)

CONTENT

Validation methodology :
Introduction : quality, authorities and regulatory references (AFSAP, EMEA, FDA, BPF, GMP, Normes ISO...), qualification and validation.
Control of validation :
Scope
Principle
Methodology :
Qualifications : design qualification, installation qualification, operational qualification, performance qualification.
Validation : process mapping, criticality analysis (critical and operational parameter), reproducibility and robustness, process validation.
Actors of validation
Documentation
Exercises.
Marketing authorization dossier :
Aims
Composition
Summary of product characteristics (SPC)
Pharmaceutical dossier
Pre-clinical dossier
Clinical dossier
The Common Technical Document (CTD)

BIBLIOGRAPHY

PRE-REQUISITES

Industrial Processes I

Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-COMETAB
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

In groups, written report (5p max) and presentation of a topic of your choice on innovative biotechnologies.

TEACHING AIDS

Slides
Internet searches
Videos

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie : nathalie.bernoud-hubac@insa-lyon.fr
MME LAZAR Adina : adina-nicoleta.lazar@insa-lyon.fr

AIMS

CONTENT

BIBLIOGRAPHY

PRE-REQUISITES

Structural biochemistry, Functional metabolic biochemistry, Signaling biochemistry, Analytical biochemistry, Industrial biotechnologies

IDENTIFICATION

CODE : BS-5-S1-EC-COCLIMA
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Presentations or other deliverables (to be seen in session)

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. CHARLES Hubert :
hubert.charles@insa-lyon.fr

AIMS

A4. Designing a system to meet a set of specifications
- Integrating ecological footprints (cost) into production
C3. Collecting, storing and organising biological data obtained in vivo, in vitro and in silico including big data
- design, use or optimise digital systems to limit their ecological footprint
C6. Measuring and evaluating the impact of new health products or diagnostic methods
- Assessing the environmental impact of a product or prototype (life cycle assessment)
C13. Understand the quality assurance and regulatory framework in the field of biotechnology
- Integrating ecological (cost) footprints into a biotechnology process
C14. Developing and validating manufacturing processes in biotechnologies
- Integrating ecological (cost) footprints into a biotechnology process
C15. Contribute to environmental studies with biological and evolutionary components
B4. Be creative, innovative, enterprising
- develop processes and products that are more respectful of overall health
B5. Acting responsibly in a complex world

OBJECTIVES
The pedagogical objective of this course is to make engineering students aware of the need to integrate ecological costs (footprints) into healthy industrial production and to give them some evaluation tools to do so in a concrete way in their immediate environment (the department, the campus or the town).

CONTENT

This program is subject to change as the course is being edited. In the first year this course will be relatively experimental and its content will also be defined with the students. An important part will be devoted to applied work (10 to 12 hours) on concrete and local issues (in the department, on campus or in the urban area).

S1: Introduction and reminder of the basics of ecology (HC)
S2: IPCC Reports (HC)
S3: IPBES reports (HC)
S4: Ecosystem Services and Ecological Footprints (HC)
S5: Digital fingerprints (LL)
S6: Life cycle and responsible production: Sanofi's vision
S7: Responsible Lifecycle and Production: bioMérieux's vision
S8 to S11: TP concrete project (calculation of carbon footprint or ecological footprint associated with an activity on campus)
S12 and S13: restitution in the form of presentations (or other deliverables)

Translated with www.DeepL.com/Translator (free version)

BIBLIOGRAPHY

PRE-REQUISITES

None

Microbiology

IDENTIFICATION

CODE : BS-5-S1-EC-COVIROL
ECTS : 2

HOURS

Cours :	20h
TD :	0h
TP :	4h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

written exam
practicals

TEACHING AIDS

power-point documents

TEACHING LANGUAGE

English

CONTACT

M. GOUET Patrice :
patrice.gouet@ibcp.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A3. Implement an experimental approach (level 2)
A5. Process data (level 1)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C5. Quantify, structurally characterize and purify biomolecules (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level 1)

CONTENT

Viruses are omnipresent in our environment. They play an essential role both in terms of health and in evolutionary processes.
This teaching unit will cover both the basics of virology, with the study of replication cycles, and the most modern structural techniques with high-resolution cryo-electron microscopy and virtual reality observation of viral assemblies.
It will show how these results enable the rational development of drugs against major human pathogens, such as the influenza virus or the human immunodeficiency virus.

- Part 1: Introduction to virology, viral replication and the infective power of viruses
- Part 2: Molecular and structural virology, helical and icosahedral assemblies
- Part 3: Use of cryo-electron microscopy and virtual reality in structural virology
- Part 4: Applications with study of rhinovirus, influenza virus and human immunodeficiency virus
- Part 5: Rational development of antiviral drugs and vaccines

BIBLIOGRAPHY

- Biochemistry by Donald Voet (Author) and Judith G. Voet (Author)
- Introduction to protein structure by Carl Branden (Author) and John Tooze (Author)

PRE-REQUISITES

molecular biology, structural biochemistry

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Biochemistry

IDENTIFICATION

CODE : BS-5-S1-EC-COBIENV
ECTS : 2

HOURS

Cours :	24h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	26h
Travail personnel :	26h
Total :	52h

ASSESMENT METHOD

Group project presenting an innovative and ecological product or biotechnology
Individual work presenting the technique or product

TEACHING AIDS

Slides
Internet search
Film

TEACHING LANGUAGE

French

CONTACT

MME HUBAC Nathalie : nathalie.bernoud-hubac@insa-lyon.fr
Mme LO VAN Amanda : amanda.lo-van@insa-lyon.fr

AIMS

This course targets the following skills :
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level M)
C13. Understand quality assurance and regulatory standards in the field of biotechnology (level M)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3)
B5. Act responsibly in a complex world (level 3)

At the industrial stage, biochemistry helps to create alternative sources of supply capable of lowering the environmental footprint. Producing differently and producing better are today's fundamental challenges. Biochemistry provides high-performance technological solutions.

The educational objective is to train future engineers in the basic principles of development, scaling, optimization and valorization of bioprocesses.

This option proposes to present the essential elements of the engineering approach, particularly in the environmental and pharmaceutical fields, as well as the main concepts derived from them.

CONTENT

1) Metabolic Engineering - Description and elements of development, scale-up, optimization and valorization of bioprocess.

2) Alternative sources of supply to reduce the environmental footprint.

3) Real case studies (illustrations by examples such as microalgae and biofuels or alicaments).
Interventions/discussions with Green Tech industrial actors could be scheduled.

1) Metabolic Engineering - Description and elements of development, scale-up, optimization and valorization of bioprocesses in the environmental, energy, food, cosmetic and pharmaceutical fields.

2) Alternative sources of supply to reduce the environmental footprint.

3) Real case studies. Illustrations by examples such as: biofuels (oil and derivatives from lipids, alcohol from sugars; algae fuels from micro-algae; biomasses used, biotechnologies implemented and environmental impact); alicaments (production, which industrial biotechnologies of transformation, biomass resources, nutrition and health).
Interventions and discussions with Green Tech industrial actors could be scheduled.

BIBLIOGRAPHY

PRE-REQUISITES

Structural biochemistry, Functional metabolic biochemistry, Signaling biochemistry, Analytical biochemistry, Industrial biotechnologies

Plant Biotechnologies

IDENTIFICATION

CODE : BS-5-S1-EC-COPHVEG
ECTS : 2

HOURS

Cours :	14h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	26h
Travail personnel :	24h
Total :	50h

ASSESMENT METHOD

Written knowledge test

TEACHING AIDS

Powerpoint slides

TEACHING LANGUAGE

French

CONTACT

M. HEDDI Abdelaziz :
abdelaziz.heddi@insa-lyon.fr

AIMS

"This course targets the following skills :
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C15. Contribute to environmental studies with biological and evolutionary components (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B7.Work in an international and intercultural context (level M)
"

CONTENT

The knowledge associated with this CE is :
Plant biology

To acquire the biological and evolutionary bases of the plant kingdom and to know the physiology of flowering plants (Angiosperms) in order to be able to handle and use them in Biotechnology.
To present the fundamental concepts of the plant kingdom and the physiology of the development and reproduction of flowering plants.
To integrate the specific features of plant biology for work in the field of agronomy.
Raise students' awareness of sustainable development issues related to plant biotechnology and sustainable agriculture.

This training includes a lecture, and sessions of TD intended for collective exchanges on the biotechnologies developed on the plant

The course consists of :
- An introduction to the general organization of the plant world (Cormophytes and Thallophytes)
- Study of plant tissues in spermaphytes
- Vegetative and reproductive systems of angiosperms: physiological and evolutionary aspects
- The 5 phytohormones and their roles in the development of angiosperms
- Physiology of reproduction
- Introduction to transgenesis in plants

The course is based on thematic group work on current developments in plant biotechnology (e.g. genetic manipulation of plants, optimization of mycorrhizal symbiosis), sustainable development issues (e.g. emission and capture of CO2; limitation of input use...), societal/ethical choices (e.g. scientific and ethical aspects of GMOs).

BIBLIOGRAPHY

Ecologie générale - Barbault - Abrégés Masson - 1990
Plant physiology - Taiz and Zeiger - Benjamin / Cummings - 1991
Molecular embryology of flowering plants - V. Raghavan
Plant biochemistry and Molecular biology - Hans Walter Helott
4ème édition : Biologie végétale, plantes supérieures : appareil reproducteur - Robert Gorenflot
6 ème édition : Biologie végétale, plantes supérieures : appériel végétatif - Robert Gorenflot

PRE-REQUISITES

No

Projects

IDENTIFICATION

CODE : BS-5-S1-EC-BMPROJE
ECTS : 5.00

HOURS

Cours :	0h
TD :	10h
TP :	0h
Projet :	0h
Evaluation :	4h
Face à face pédagogique :	14h
Travail personnel :	115h
Total :	129h

ASSESMENT METHOD

1 requirements specification
1 deliverable
1 oral presentation

TEACHING AIDS

-

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

This course targets:
- all skills of block A (level 3),
- several skills from block C (level 3), depending on the topic of the project,
- and the following skills from block B:
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 3)
B3. Interact with others, work as part of a team (level 3)
B4. Creativity, innovation, entrepreneurship (level 3)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)
B7.Work in an international and intercultural context (level 2)

At the end of this module, students should be able to work in a team to propose an innovative solution to a data science or modelling problem proposed by a company, NGO or laboratory in the human health and ecosystem health sectors.

CONTENT

- Project in groups of 4 in AI or data science or machine learning, based on subjects proposed by companies or laboratories.

This project is divided into 5 phases to develop students' project management skills:
- Analyze the company's functional requirements
- Define technical specifications and design relevant solutions
- Produce a functional solution
- Test and validate the solution produced
- Deliver the solution to the company (including documentation and/or user training)
Depending on the project, these 5 phases can be carried out iteratively using the AGILE methodology.

BIBLIOGRAPHY

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PRE-REQUISITES

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INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE : HU-0-S1-EC-S-PPH
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Written report (10 pages minimum) and oral defence (in presence of tutor and guest).

TEACHING AIDS

Présentation du PPH sur Moodle : http://moodle.insa-lyon.fr

TEACHING LANGUAGE

French

CONTACT

AIMS

The PPH is an individual exercise where the student carries out an investigation or some research into a subjet of particular interest to them in the aim of developing some form of critical analysis of the subject. The PPH is a means by which the student can show their ability to build an analysis based on a rigorously developed thesis. The analysis is based on a personal approach to the subject (openness to the wider world), the way the subject is dealt with (for example the use of a personal experience as a way of seeing the world or the chosen subject), or in certain cases the creative approach used (for example, for an artistic experience).
The PPH requires the ability to work autonomously.

The PPH contributes primarily to the development of competencies CT2.1-4 and CT3.1 ; other competencies can be developed depending on the choice of project.

CONTENT

Work on a particular theme with a tutor chosen by the student.
Filling in of a project sheet (elaboration of the question, definition of the personal approach, bibliography, etc),
Step by step meetings with the tutor (plan, analysis, etc),
Report writing and oral presentation.

BIBLIOGRAPHY

PRE-REQUISITES

IDENTIFICATION

CODE : BS-5-S1-EC-COPPP02
ECTS : 1

HOURS

Cours :	8h
TD :	2h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	10h
Travail personnel :	15h
Total :	25h

ASSESMENT METHOD

Attendance at all sessions, compulsory enrolment in at least 1 simulated interview with a company, and in-house work on a free, in-depth reflection on my career plan.

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

MME LETISSE Marion :
marion.letisse@insa-lyon.fr

AIMS

This course targets the following skills :
B1. Know oneself, manage oneself physically and mentally (level M)
B2. Work, learn and develop independently (level 2)
B3. Interact with others, work as part of a team (level M)
B5. Act responsibly in a complex world (level 2)
B6. Situate oneself, work and develop within a company or socio-productive organization (level 2)

CONTENT

- Reminders about the professional project, recruitment tools
- Sources of information and contacts to companies
- Recruitment interview
- Briefing on the business / sector survey
- Selection of themes and Constitution of subgroups
- Oral presentation of subgroups
- Maintenance simulation

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Centre des Humanités
Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE
Humanities and social sciences

IDENTIFICATION

CODE : HU-0-S1-EC-S-SERIE4
ECTS : undefined

HOURS

Cours :	0h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	20h
Travail personnel :	0h
Total :	20h

ASSESMENT METHOD

Assessment will be conducted through continuous evaluation. The assessment methods will be presented at the beginning of the semester by the teaching team.

TEACHING AIDS

Materials are chosen by the instructor based on the module:
• Didactic documents related to the module
• Audiovisual materials
• Recommended readings

TEACHING LANGUAGE

French

CONTACT

Mme JOUISHOMME Delphine :
delphine.jouishomme@insa-lyon.fr
Mme GOUTALAND Carine :
carine.goutaland@insa-lyon.fr

AIMS

A series of elective courses in Humanities and Social Sciences (HSS) offers several options for students to choose from, allowing them to develop and deepen specific skills. This course aims to develop one or more transversal skills among the following:
• CT1: Self-awareness and self-management
• CT2: Working, learning, and evolving independently
• CT3: Interacting with others, working in a team
• CT4: Demonstrating creativity
• CT5: Acting responsibly in a complex world
• CT6: Navigating and evolving within an organization
• CT7: Working in an international and intercultural context
The list of options available in Series 1 and the specific competencies for each option are detailed in the catalog on the IntranetHumas:
https://intranethumas.insa-lyon.fr/sciences-humaines-sociales/offre-de-formation/cours-la-carte-0

CONTENT

Each module is designed to encourage interaction and active student participation. The content is structured around the following key aspects:
• Theoretical deepening related to the theme
• Reflection on the topic
• Practical exercises and activities
• Assessments and presentation of work

BIBLIOGRAPHY

The bibliography is selected by the instructor based on the module.

PRE-REQUISITES

French

IDENTIFICATION

CODE : BS-5-S1-EC-BMOMIQ5
ECTS : 2.00

HOURS

Cours :	10h
TD :	12h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	22h
Travail personnel :	28h
Total :	50h

ASSESMENT METHOD

2 practical reports

TEACHING AIDS

Learning materials will be available on the Moodle page dedicated to this course.

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

"This course targets the following skills :
A3. Implement an experimental approach (level 2)
A5. Process data (level 3)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 3)
C4. Implement analysis tools for high-throughput biology (level 3)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 3)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
"

SKILLS:
- Development of bioinformatics and statistical analysis protocols for proteomics and interactomics data analysis

OBJECTIVES:
At the end of this course, the student should be able to join a research or development program in bioinformatics for the analysis of proteomics and interactomics data with complete autonomy of work.
The learning outcomes of this course module are :
- to provide the fundamental biological, mathematical and computational concepts in bioinformatics for proteomics and interactomics.

CONTENT

1/ High throughput proteomics
Method: Mass Spectrometry
Spectrometers
Preparation and Design of experiments
Quantifications and Labelling
Advantages and limitations of the techniques
Bioinformatics analysis:
Spectrum processing
Enrichment and statistical processing

2/ High flow interactomics
Experimental techniques

Bioinformatics Analysis
Standard of description and exchange
Properties of interactomes
Network reconstruction and functional predictions

BIBLIOGRAPHY

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PRE-REQUISITES

- Basic knowledge of biochemistry
- Basic knowledge of sequence analysis
- Basic knowledge of statistics

IDENTIFICATION

CODE : BS-5-S1-EC-BMOMIQ4
ECTS : 2.00

HOURS

Cours :	10h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	30h
Travail personnel :	20h
Total :	50h

ASSESMENT METHOD

2 practical reports

TEACHING AIDS

TEACHING LANGUAGE

French

CONTACT

M. PARISOT Nicolas :
nicolas.parisot@insa-lyon.fr

AIMS

"This course targets the following skills :
A2. Use a model of a real or virtual system (level 2)
A3. Implement an experimental approach (level 2)
A5. Process data (level 2)
A6. Communicate a scientific analysis or approach, using situations adapted to their speciality (level 2)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 2)
C5. Quantify, structurally characterize and purify biomolecules (level 3)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 2)
C11. Model and interpret biological data to understand underlying processes (level 3)
C12. Automate the processing and extraction of knowledge from biological data. (level 2)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
"

At the conclusion of this module the student will have to be capable of becoming integrated into a workgroup (laboratory or industry) specialized in proteomics and in structural analysis (mastery of concepts and main tools).
The educational objective of this module is to form the future engineers in the methods and specific tools of analyses of sequences (search for similarity, detection of signatures, binary and multiple alignments) and of structures of proteins (prediction of structure, molecular modeling, optimization of the models by molecular mechanics, minimization of energy and simulated annealing).

CONTENT

Structural databases
- PDB, SCOP2, CATH2...
Prediction of secondary, tertiary structures
- Algorithms for predicting secondary structures;
- Modelling by homology, threading, ab initio
Methods and Analysis of Protein Structures
- Validation of 3D structures (addition of atoms, energy minimization, etc.)
Molecular dynamics and coarse grain
Docking and Drug design

BIBLIOGRAPHY

PRE-REQUISITES

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE : BS-5-S1-EC-BMHPCOM
ECTS : 2

HOURS

Cours :	12h
TD :	20h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	32h
Travail personnel :	18h
Total :	50h

ASSESMENT METHOD

- Practical session report

TEACHING AIDS

- Course Slide
- Practical session handbook

TEACHING LANGUAGE

French
English

CONTACT

M. ROUZAUD Jonathan : jonathan.rouzaud-cornabas@insa-lyon.fr

AIMS

SKILLS:
The knowledge associated with this EC is:
I. HIGH PERFORMANCE COMPUTING
- Parallelism: definition and usefulness
- Advantages and disadvantages of different parallel architectures: shared memory, distributed, vector machines and SIMD, multi-core and NUMA machines, many-cores (KNL), NVidia GPU, supercomputers
- Introduction to parallel programming with OpenMP and MPI
- Introduction to CUDA (Grids, Warps) and NVidia tool suites (profiling, debugging) and alternative to CUDA: OpenMP GPU and OpenACC
- Specificities of GPUs and how to implement large algorithmic models on GPU: Memories (Tiling), Computational performance (Warps, Divergence), Memory access performance (DRAM, coalescence), practical application via computational models (Histogram, Stencil, Reduction, Scan)
- Performance and parallel programming in Python

OBJECTIVES:
At the end of This course, the student will be able to:
- port a model of a system to a parallel implementation (A1 and A2) by applying parallelization and optimization skills (C2, C3)
- choose the most appropriate parallel architecture (A3) to parallelize the execution of a program (C3)
- implement the main families of algorithms used in scientific computing programs in the context of parallel programming (A1/A2)

CONTENT

I. HIGH PERFORMANCE COMPUTING

- Parallelism: definition and utility
- Pros and cons of existing parallel architectures : shared memory, distributed memory, vector and SIMD machines, multi-core machines and NUMA, many-cores (KNL), NVidia GPU, supercomputers
- Introduction to parallel programming with OpenMP and MPI
- Introduction to CUDA (Grids, Warps) and NVidia tool suites (profiling, debugging) and alternative to CUDA: OpenMP GPU and OpenACC
- Specificities of GPUs and how to implement classical algorithmic models on GPU: Memory (Tiling), Performance computing (Warps, Divergence), Performance access memories (DRAM, coalescence), put into practice via computational models (Histogram, Stencil, Reduction, Scan)
- Performance and parallel programming in Python

BIBLIOGRAPHY

I. HIGH PERFORMANCE COMPUTING

- Parallel Programming For Multicore and Cluster System (T. Rauber, G. Rünger)
- Sourcebook of Parallel Computing (J.J. Dongarra, I. Foster, G. Fox, W. Gropp, K. Kennedy,L. Torczon, A. White)
- Parallel Algorithms (H. Casanova, A. Legrand, Y. Robert)
- Parallel Computer Architecture (D.E. Culler, J. Pal Singh)
- Advanced Parallel Architecture - Parallelism, Scalability, Programmability (K. Hwang)
- Super-ordinateurs -- Aux extrêmes du calcul (Numéro spécial de la recherche, Nov. 2011)
- Programming Massively Parallel Processors, Third Edition: A Hands-on Approach 3rd Edition (David B. Kirk, Wen-mei W. Hwu)
- Using OpenMP : Portable Shared Memory Parallel Programming (Barbara Chapman, Gabriele Jost and Ruud van der Pas)
- Using OpenMP -- The Next Step : Affinity, Accelerators, Tasking, and SIMD (Ruud van der Pas, Eric Stotzer and Christian Terboven)

II. DEPLOYMENT

- Turnbull, J. (2014). The Docker Book: Containerization is the new virtualization.
- Goasguen, S. (2015). Docker Cookbook: Solutions and Examples for Building Distributed Applications. "O'Reilly Media, Inc."
- How To Package Your Python Code - Python Packaging Tutorial https://python-packaging.readthedocs.io/en/latest/
- Farcic, V. (2016). The DevOps 2.0 Toolkit. Packt Publishing Ltd.
- Leisch, F. (2008). Creating R packages: A tutorial

PRE-REQUISITES

- C++, Python
- Computer architecture

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

Mathematics and Modeling

IDENTIFICATION

CODE : BS-5-S1-EC-BMSTBAY
ECTS : 2

HOURS

Cours :	14h
TD :	0h
TP :	16h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	32h
Travail personnel :	18h
Total :	50h

ASSESMENT METHOD

First session : written terminal exam (1h30)
Second session : written terminal exam (1h30)

TEACHING AIDS

Course slides; tutorials; reference guides for using JAGS.

TEACHING LANGUAGE

French

CONTACT

M. SUBTIL Fabien :
fabien.subtil@chu-lyon.fr

AIMS

Introduce students to Bayesian inference and to technical tools to implement it. At the end of this course, the student will be able to understand and clarify differences between Bayesian and frequentist inference, as well as their own strengths and limitations. He will also be able to design, implement, validate a Bayesian model, as well as to interpret its results.

CONTENT

Theory of Bayesian inference:
- Principles of Bayesian inference
- Bayesian inference tools: explicit solutions, MCMC algorithms (Metropolis-Hastings et Gibbs sampling)
- Choice of prior distributions
- Parameter estimation
- Validation of results, and comparison of models

Each of these parts will be illustrated with concrete applications.

Implementation with "BUGS"-type tools :
- Formalization of a model in a directed acyclic graph
- Introduction to "BUGS"-type tools
- Handling of the JAGS software from simple examples

BIBLIOGRAPHY

Parent, E. and Bernier, J., 2007. Le raisonnement bayésien : Modélisation et inférence. Springer Verlag, 364 p.

PRE-REQUISITES

Solid bases in statistics and R programming (classical distribution laws, call to functions, for-loop, vector, matrix and data frame manipulation).

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Ingénieur, spécialité biotechnologies et bioinformatique

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

Mathematical modeling of biological networks

IDENTIFICATION

CODE : BS-5-S1-EC-BMRESEA
ECTS : 2.00

HOURS

Cours :	18h
TD :	14h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	32h
Travail personnel :	18h
Total :	50h

ASSESMENT METHOD

Final (written) exam

TEACHING AIDS

Slides, articles, models and code for practical exercises

TEACHING LANGUAGE

English

CONTACT

M. DE JONG :
hidde.de-jong@inria.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A2. Use a model of a real or virtual system (level 3)
A3. Implement an experimental approach (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C3. Collect, store and organize biological data obtained in vivo, in vitro and in silico, including big data (level 1)
C8. Use the main techniques for exploring biological functions (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 1)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 3)
C14. Develop and validate biotechnology manufacturing processes (level 1)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B4. Creativity, innovation, entrepreneurship (level M)
B7.Work in an international and intercultural context (level M)

CONTENT

Courses:
- Introduction : systems biology and biological networks
- Modeling of metabolic networks: flux balance analysis, kinetic modeling, metabolic control analysis
- Modeling of gene regulatory networks: kinetic modeling, qualitative modeling, stochastic modeling

Practical exercises:
- Flux balance analysis (COBRA)
- Integrated modeling of metabolism, gene expression and growth using ODE models (Matlab)

BIBLIOGRAPHY

A. Cornish-Bowden, Fundamentals of Enzyme Kinetics, Portland Press, London, 1995
Z. Szallasi, V. Periwal, J. Stelling (eds), System Modeling in Cellular Biology: From Concepts to Nuts and Bolts, MIT Press, Cambridge, MA, 2006
D. Fell, Understanding the Control of Metabolism, Portland Press, London, 1997
U. Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall, New York, 2006
R. Heinrich & S. Schuster, The Regulation of Cellular Systems, Chapman & Hall, New York, 1996
S.H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, Perseus Books, Reading, MA, 1994
H. Bolouri, Computational Modeling of Gene Regulatory Networks, Imperial College Press, London, 2008

Contacts
Carole.Knibbe@insa-lyon.fr
Hidde.de-Jong@inria.fr

PRE-REQUISITES

Basic knowledge in molecular biology and biochemistry
Basic knowledge in linear algebra, ordinary differential equations, and dynamical systems

Modelling of biological systems from the individual to the ecosystem

IDENTIFICATION

CODE : BS-5-S1-EC-BMECOSY
ECTS : 2

HOURS

Cours :	14h
TD :	16h
TP :	0h
Projet :	0h
Evaluation :	2h
Face à face pédagogique :	32h
Travail personnel :	20h
Total :	52h

ASSESMENT METHOD

Final exam in the form of a practical assignment to be completed in the R software, consisting of analysing a dataset from A to Z;

TEACHING AIDS

http://bmm.univ-lyon1.fr/bmm/index.php

https://sites.google.com/view/preditox/home

TEACHING LANGUAGE

French

CONTACT

MME CHARLES Sandrine : sandrine.charles@univ-lyon1.fr

Mme LOPES Christelle : sandrine.charles@univ-lyon1.fr

AIMS

This course targets the following skills :
A1. Analyze a system (real or virtual) (niveau 3)
A2. Use a model of a real or virtual system (level 3)
A5. Process data (level 3)
C1. Apply a scientific approach (hypothetico-deductive) to translate and solve a biological problem (level 3)
C2. Design, adapt and optimize experimental plans in the Biosciences (level 1)
C6. Measure and evaluate the impact of new health products or diagnostic methods (level 2)
C9. Select and apply statistical tools adapted to biological problems (level 2)
C10. Appreciate the limits of validity of a model and identify sources of variability and uncertainty (level 3)
C11. Model and interpret biological data to understand underlying processes (level 3)
B2. Work, learn and develop independently (level M)
B3. Interact with others, work as part of a team (level M)
B7.Work in an international and intercultural context (level M)

CONTENT

Two parts:
1. Game theory and evolutionarily stable strategies (ESS)
2. Predictive modelling in ecotoxicology (see here for more details: https://sites.google.com/view/preditox/programme

BIBLIOGRAPHY

Karl Sigmund Joseph Hofbauer. Evolutionary Games and Population Dynamics. Cambridge
University Press, 1998.

J. Von Neumann, Oskar Morgenstern, Theory of Games and Economic Behavior.

Strogatz, S. H. NONLINEAR DYNAMICS AND CHAOS With Applications to Physics, Biology, Chemistry, and Engineering; Strogatz, S. H., Ed.; CRC Press, Taylor & Francis Group: Boca Raton, FL, 2018.

Edelstein-Keshet, L. Mathematical Models in Biology; 2005.

PRE-REQUISITES

* Fluent in R programming
* Upgrading course in mathematics (BS-3-S1-EC-CORNMAT)
* Biomathematics 1: Modelling of biological dynamics by ordinary differential equations (BS-3-S1-EC-COMATH1)
* Biomathematics 3: Advanced ordinary differential equations (BS-3-S2-EC-BMMATH3)

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE : FEE-5-S2-EC-VENDRE
ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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BIBLIOGRAPHY

PRE-REQUISITES

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

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Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE : FEE-5-S2-EC-AGIR
ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE FEE-5-S2-EC-SECONNAITRE

ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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www.insa-lyon.fr

IDENTIFICATION

CODE FEE-5-S2-EC-STRUCTURER

ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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IDENTIFICATION

CODE : FEE-5-S2-EC-ENTREPRENDRE

ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél.+ 33 (0)4 72 43 83 83 - Fax + 33 (0)4 72 43 85 00
www.insa-lyon.fr

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Domaine Scientifique de la DOUA
20 Avenue Albert Einstein - 69100 VILLEURBANNE

IDENTIFICATION

CODE :FEE-5-S2-EC-CONCEVOIR

ECTS :

HOURS

Cours :	0h
TD :	0h
TP :	0h
Projet :	0h
Evaluation :	0h
Face à face pédagogique :	0h
Travail personnel :	0h
Total :	0h

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