Please note that only the following courses are available in the English language

**COURSE DESCRIPTION FORM**

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | GENETICS & BIOLOGY OF PERENNIAL PLANTS |  | Check |
|  |  | *Compulsory* |  |
| *ECTS Credits:* | 5 | *Elective* | **X** |
| *Course Code:* | 2 | *Semester* | **3** |
| *Lecturer:* | Marianna Hagidimitriou | *Autumn Term* | **X** |
| *Contact Details:* | marianna@aua.gr | *Spring Term* |  |

|  |  |  |
| --- | --- | --- |
| *PREREQUISITES* *(if any)* |  | *Course Code* |
| 1. |  |  |
| 2. |  |  |
| 3. |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **COURSE GOALS** | | | |
| **Upon successful completion of the course the student will:**   * Understand the biological cycle and secondary growth of perennial plants * Knowledge of how perennial plants adapt in different environments and their survival mechanisms * Have perceived the water movement through the xylem of perennial woody plan * Acquire knowledge of the evolution and genetic relationships of perennial plants * Independent work * Teamwork * Work in an interdisciplinary environment * Generating new research ideas | | | |
|  | | | |
| **COURSE CONTENTS** | |  | *Total Hrs* |
| 1. | Biological cycle of perennial woody plants |  | 8 |
| 2. | Secondary growth -Secondary tissues: cork, cork skin, secondary phloem, secondary xylem, reaction wood |  | 8 |
| 3. | Responsiveness, adaptability, survival mechanisms of perennial plants |  | 8 |
| 4. | Water Movement through the xylem of perennial plants |  | 7.5 |
| 5. | Biodiversity, evolutionary changes and phylogenetic analysis of perennial plants |  | 7.5 |
| 6. | Study and examination of external features and characteristics of the structure of perennial woody branches |  | 6,5 |
| 7. | Study and observation of bark and secondary xylem |  | 6,5 |
| 8. | Study and observation of transverse and radial sections of perennial woody plant executives |  | 6,5 |
| 9. | Study and observation of various details and growth layers of perennial woody plants |  | 6,5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TEACHING METHOD** | | | | **EXAMINATION** | |
| *Hours* | | | |  | *Weight* |
| Class | 39 |  |  | Written exam | 60% |
| Seminar | .. |  |  | Orals | ..% |
|  |  |  |  |  |  |
| Collaboration with lecturer | 60 |  |  | Personal assignments | 40% |
| Laboratory | 26 |  |  | Group assignments | ..% |
| TOTAL Hours: | 125 |  |  | TOTAL: | 100% |

|  |  |
| --- | --- |
| **SUGGESTED BIBLIOGRAPHY** | Biology of Plants**-**Raven, Evert, Eichorn-2015, Utopia Publishers |
|  | Plant Physiology -Taiz, Zeiger 2013, Utopia Publishers |
| **NOTES** | E-class/courses/ BIOTECH161 |

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Nikolaos Labrou, Evangelia Chronopoulou

5

3350

ENZYME BIOTECHNOLOGY

[lambrou@aua.gr](mailto:lambrou@aua.gr)

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| yes |
|  |
|  |
| yes  - |

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

This course aims at acquiring knowledge on:

1. Methods, techniques and instrumentation on enzyme purification at laboratory and large-scale.
2. Methods and techniques on enzyme immobilization and the application of immobilized enzymes
3. Methods and techniques on the application of enzymes in food industry.
4. Methods and techniques on the application of enzymes in chemical and pharmaceutical industry.
5. Analysis, evaluation and decision making on biocatalysis
6. Enzyme bioreactors

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Applied enzyme kinetics. |
| 2. | Downstream processing / enzyme purification technology (classification of enzymes and enzyme sources, the purification protocol, solid-liquid separation, cell disintegration, low purification stage  / fractionation, high purification stage / chromatographic techniques, enzyme formulation and quality control, examples on enzyme purification). |
| 3. | Immobilized enzymes (methods and techniques, influence of immobilization on the enzyme’s  molecular and kinetic features). |
| 4. | Enzyme applications in the food industry (starch, bakery, beer, wine, fruit juices, vegetable oils,  cheese, lactose). |
| 5. | Large-scale enzyme applications (paper, textiles, leather, home laundry detergents, animal food). |
| 6. | Enzyme applications in the chemical industry (aminoacids, pesticides, oligosaccharides, chemicals,  food supplements). |
| 7. | Enzyme applications in the pharmaceutical industry (antibiotics, steroids, drugs against hyper  cholesterolhaimia, HIV, hypertension, etc). |
| 8. | Enzyme applications in the analysis (the enzymes as reagents and as markers, enzyme-lined  immunosorbent assays, enzyme biosensors). |
| 9. | Enzyme catalysis in organic solvents (applications in water-miscible and water-immiscible  solvents, aromatic products, pesticides, triglycerides, peptides, insulin, aspartame, etc). |
| 10. | Discovery of new enzymes. |
| 11 | Enzyme bioreactors |

|  |
| --- |
| 2  5 |
| 4 |
| 5 |
| 4 |
| 4 |
| 4 |
| 2 |
| 2 |
| 2 |
| 2 |

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  | **EXAMINATION** |  |
| **Hours** |  |  | *Weight* |
| Class | 20 | Written exam | 50 % |
| Seminar | 6 | Orals | 0 % |
| Collaboration with lecturer | 4 | Personal assignments | 50 % |
| Laboratory | 6 | Group assignments | 0 % |
| TOTAL Hours: | 36 | TOTAL: | 100 % |

**SUGGESTED BIBLIOGRAPHY**

1. Y.D. Clonis, Enzyme Biotechnology, Crete University Press, Heraklion, Crete, Greece, 3rd

revised edition, 2013.

1. K. Buchholz, V. Kasche, U.T. Bornscheuer, Biocatalysis and Enzyme Technology, Wiley-

VCH Verlag GmbH, Germany, 2005.

1. Pandey, A., Webb, C., FERNANDES, M., Larroche, C., Enzyme Technology, Springer-

Verlag New York, 2006.

**NOTES**

…………………………………………………………………………………………………………..

………………………………………………………………………………………………………….

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Associate Professor Anna Kourti

5

3625

Molecular Ecology and Adaptation

[akourti@aua.gr](mailto:akourti@aua.gr)

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| **X** |
|  |
| **1** |
| **X** |
| **..** |

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

The aim of the “Gene and the Environment” course is the understanding of environmental (external) cues and the response of organisms through dynamic changes in expression, e.g. induction or/and repression, of various genes. Special emphasis is given on the interaction between genes and the environment which affects the

growth of organisms.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Genetics of animal behaviour. Genetic analysis of behaviour. Genetics of human  behaviour. |
| 2. | Adaptation behaviour-insect diapause. Genetic and molecular approach of  diapause. Regulation of diapause and types of gene expression. |
| 3. | Stress proteins and their role in diapause. Gene responses of plant organisms in  light and mechanical stimuli. Molecular response mechanisms in abiotic stresses. Molecular adaptation. |
| 4. | Biological clocks. Biological rhythms and adaptation. Circadian rhythms. Clock genes in Drosophila. Circadian clocks of insects. Molecular study of circadian  systems in various organisms. Circadian and photoperiodic clocks. |
| 5. | Environmental pollution and response of organisms. Molecular mechanisms of interaction between plants and microorganisms. |

|  |
| --- |
| 9 |
| 6 |
| 6 |
| 9 |
| 6 |

**LABORATORY EXERCISES** (Number of credits**:** 2)

COURSE GOALS**:** The aim of the laboratory exercises is the methodology of analysis and strategy of molecular responses of organisms in various environmental signals.

# COURSE CONTENTS:

1. Observation of the biological cycle of the insect *Sesamia nonagrioides* (Lepidoptera: Noctuidae) in the lab.
2. RNA isolation from *Sesamia nonagrioides*.
3. cDNA construction.
4. Directions for the design of degenerated promoters for gene isolation.
5. Familiarization with bioinformatics (via the Internet) for the analysis of genes and proteins.
6. The National Centre of Biotechnology Information (NCBI). GenBank file structure [‘the CDS characteristic’ (CDS future)].
7. Basic Local Alignment Search Tool, BLAST, as a method of discovery of sequence similarity. Prediction methods using DNA sequences.
8. Prediction methods using protein sequences. Protein identity using the ExPASy server of the Swiss Institute of Bioinformatics.
9. Physical properties of proteins based on sequence [(Compute pI/MW & ProtParam (ExPASy)]. Motifs and patterns.
10. Environmental effect on the developmental pattern of model plant *Arabidopsis thaliana*. Methods for plant RNA isolation.
11. Reverse transcription reaction and tracking of gene expression dynamics using semi-quantitative PCR.

**TEACHING METHOD EXAMINATION**

## Hours

36

..

*Weight*

Class Seminar

Written exam

Orals

25..%

75..%

Collaboration with lecturer

24

..

Laboratory

TOTAL Hours: 60

Personal assignments Group assignments

TOTAL:

..%

..%

100%

**SUGGESTED BIBLIOGRAPHY**

From genes to animal behaviour

Principles of animal behaviour

**NOTES**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Professor Polydefkis Hatzopoulos, Associate Professor Dimitra Milioni

*Compulsory*

*Elective Semester Autumn Term*

5

275

Molecular Biology

*Spring Term*

[phat@aua.gr](mailto:phat@aua.gr)[, dmilioni@aua.gr](mailto:%2Cdmilioni@aua.gr)

Check

|  |
| --- |
| **X** |
|  |
|  |
| **X** |
|  |

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

The aim of the course is to provide the student in-depth knowledge of the molecular basis of

information flow from DNA to proteins and help them understand how the genes are regulated.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | DNA replication |
| 2. | RNA synthesis and gene regulation |
| 3. | mRNA translation and processing |
| 4. | Structure of B-DNA. DNA is a double helix. Nucleic acids hybridize by base pairing.  Supercoiling affects the structure of DNA |
| 5. |  |

6

10

10

4

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  | **EXAMINATION** |  |
| **Hours** |  |  | *Weight* |
| Class | 30 | Written exam | 20% |
| Seminar | 6 | Orals | 40% |
|  |  |  |  |
| Collaboration with lecturer |  | Personal assignments | 40% |
| Laboratory | 40 | Group assignments |  |
| TOTAL Hours: | 76 | TOTAL: | 100% |

**SUGGESTED BIBLIOGRAPHY**

Principles of Molecular Biology: Genes to Proteins (Burton E.Tropp)

GENES VIII

The Cell: Α Molecular Approach

**NOTES**

…………………………………………………………………………………………………………..

………………………………………………………………………………………………………….

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact*

Professor Polydefkis Hatzopoulos, Associate Professor Anna Kourti, Associate Professor Manolis Flemetakis, Associate Professor Dimitra Milioni

akourti @aua.gr; [dmilioni@aua.gr](mailto:dmilioni@aua.gr); mflem@αua.gr; [phat@aua.gr.](mailto:phat@aua.gr)

*Compulsory*

*Elective Semester Autumn Term*

5

3200

Recombinant DNA Technology

*Spring Term*

Check

*Details:*

|  |
| --- |
| **X** |
|  |
|  |
|  |
| **X** |

*PREREQUISITES* ***(if any)*** *Course Code*

1. Molecular Biology

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

*The aim of the course is to provide a thorough understanding of theoretical and practical understanding of*

*basic and advanced molecular biology tools*

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Restriction endonucleases, cloning and vectors , nucleic acids isolation |
| 2. | Blotting methods and applications, genomic and cDNA libraries |
| 3. | Polymerase chain reaction |
| 4. | Gene transfer methods to animal cells, Animal genetic engineering |
| 5. |  |

5

5

10

10

**TEACHING METHOD EXAMINATION**

## Hours

*Weight*

Class

Written exam 20%

40%

Seminar Orals

30

7

Collaboration with lecturer Personal assignments

40%

TOTAL Hours:

Laboratory

76

40

Group assignments

TOTAL:

100%

**SUGGESTED BIBLIOGRAPHY**

From Genes to Genomes: Concepts and Applications of DNA Technology

Principles of Gene Manipulation and Genomics

**NOTES**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Associate Professor Eleni Douni

5

175

ANIMAL BIOTECHNOLOGY

[douni@aua.gr](mailto:douni@aua.gr) Tel: 210 5294372

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| **YES** |
| **NO** |
| **9th** |
| **YES** |
| **NO** |

*PREREQUISITES* ***(if any)*** *Course Code*

1. None

**COURSE GOALS**

The course is a basic introductory course on concepts of animal biotechnology, genetic engineering technologies in animal organisms and the applications arising in the agricultural and biomedical field.

This course aims to introduce students to the basic technologies of animal biotechnology for the understanding and application of genetic engineering technologies related to the creation of transgenic animals, gene targeting for gene inactivation, modification and conditional gene expression, as well as to the identification of mutations by genetic analysis.

It also refers to basic concepts and methodologies for the generation of biotechnological products such as monoclonal antibodies, recombinant proteins, vaccines and latest technologies related to animal cloning, stem cell biology, regenerative medicine, gene therapy, animal cell culturing, cryopreservation, assisted reproduction, genotypic analysis and diagnosis of diseases in order for the student to obtain a comprehensive insight into the applications of Biotechnology in Animal husbandry and biomedicine.

Finally, the aim of the course is the understanding of the importance of biotechnological technologies based on the use of animal organisms for the identification of gene function and the development of innovative

approaches and biotechnological products with applications in diagnosis and treatment.

**COURSE CONTENTS** *Total Hrs*

|  |  |  |  |
| --- | --- | --- | --- |
| 1. | Introduction to Functional Genomics and Animal Biotechnology technologies - Physiology  of Reproduction in Mammals |  | 3 |
| 2. | Genetic engineering technologies for the generation of transgenic animals - Biopharming |  | 3 |
|  | – Applications of transgenic technologies |  |
| 3. | Site-directed mutagenesis by gene targeting technologies– Creation of knockout animals | 3 |
| 4. | Modifications of the eukaryotic genome with the Cre / loxP system – Zinc finger | 3 |
|  | nucleases |  |
| 5. | Conditional genetic modifications – Spatial and temporal control of inducible gene | 3 |
|  | expression and modifications |  |
| 6. | Forward Genetics : From phenotype to gene identification by genetic analysis – Random | 3 |
|  | mutagenesis and Genetic Mapping |  |
| 7. | Animal Cloning Methods - Applications in farming and biotechnology - Bioethics | 3 |
| 8. | Stem Cells and their applications - Gene Therapy - Vectors – Applications | 3 |
| 9. | Review of the Immune System of Mammals | 3 |
| 10. | Monoclonal Antibodies - Vaccines | 3 |
| 11. | Methods for the production of recombinant proteins - Animal Cell Culturing | 3 |
| 12. | Techniques for Genotypic Analysis and Diagnosis of Diseases | 3 |
| 13. | Cryopreservation – Assisted Reproduction Technologies - Bioethics in Animal | 3 |
|  | Biotechnology |  |

**TEACHING METHOD EXAMINATION**

## Hours

3

*Weight*

Class Seminar

Written exam

Orals

100%

Collaboration with lecturer Personal assignments

2

TOTAL Hours:

Laboratory

5

Group assignments

TOTAL:

100%

**SUGGESTED BIBLIOGRAPHY**

ANIMAL BIOTECHNOLOGY “MODELS IN DISCOVERY AND TRANSLATION”. VERMA A.S.,

SINGH A. 2014. ISBN:978-0-12-416002-6

**NOTES**

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Assistant Professor Trias Thireou

5

3040

Bioinformatics

[thireou@aua.gr](mailto:%20thireou@aua.gr%09)

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| .. |
| X |
| 7 |
| X |
| .. |

*PREREQUISITES* ***(if any)*** *Course Code*

1. Computer Programming

2. Biochemistry

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

Understanding and practical application of basic principles, methodology and computer programs in bioinformatics. On completion the student will be able to follow advancements in the field as well as becoming

fluent with every day research computer tools in Biotechnology.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Biological Databases and database searching |
| 2. | Simple and Multiple Sequence alignment |
| 3. | Phylogenetic Analysis and HMM |
| 4. | Molecular Visualisation and Modelling |
| 5. | Genome handling and microarrays |

20

20

12

12

12

**TEACHING METHOD EXAMINATION**

## Hours

*Weight*

|  |  |  |  |
| --- | --- | --- | --- |
| Class | 39 | Written exam | 60% |
| Seminar | 6 | Orals | ..% |
|  |  |  |  |
| Collaboration with lecturer | 10 | Personal assignments | 40% |
| Laboratory | 21 | Group assignments | 0% |
| TOTAL Hours: | 76 | TOTAL: | 100% |

**SUGGESTED BIBLIOGRAPHY**

**David Mount, "Bioinformatics: Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press; 2nd edition (March 12, 2013)**

**Jonathan Pevsner, "Bioinformatics and Functional Genomics", Wiley-Blackwell; 2nd edition (May 4, 2009)**

**Jenny Gu, Philip E. Bourne, "Structural Bioinformatics", Wiley-Blackwell; 2nd edition**

**(March 16, 2009)**

**NOTES**

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Compulsory*

*Elective*

5

Physics for Life Sciences

*Semester*

Check

*Lecturer:* Associate Professor Michael Karpouzas, Assistant Professor Kostas Bethanis, Assistant Professor Nikolaos Alvertos

[+30210 5294221, mkarp@aua.gr](mailto:%2B302105294221%2Cmkarp@aua.gr)

*Contact Details:*

*Autumn Term Spring Term*

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

|  |
| --- |
| **X** |
| **..** |
| **1** |
| **X** |
| **..** |

**COURSE GOALS**

The course is the basic introduction in Physics. The course material aims to introduce students to the principles of Physics that constitute necessary background for the study of more advanced subjects such as Physical Chemistry, Biophysics, Biochemistry and generally Science and its applications, It focuses on areas of Physics that are related to Biotechnology. It also teaches basic methods of experimental measurements and statistical

analyses of experimental data that are necessary for scientific study.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Fluid Mechanics (fluid statics; intermolecular interactions, surface tension, capillary  action, fluid dynamics, viscosity, real fluids) |
| 2. | Thermodynamics (temperature, thermal equilibrium, calorimetry, heat transfer, kinetic model of an ideal gas, heat capacities, phases of matter, 1st law of thermodynamics, thermodynamics processes, internal energy, enthalpy, the 2nd law  of thermodynamics, entropy, Gibbs free energy) |
| 3. | Optics (geometric optics and optical instruments, reflection, refraction, polarization,  diffraction) |
| 4. | Atomic – Nuclear physics (atomic line spectra and energy levels, continuous spectra, wave-particle duality, introduction to quantum mechanics, atomic structure, properties of nuclei, nuclear structure, radiation, radiochronology, biological effects  of radiation) |
| 5. | Laboratory exercises |

|  |
| --- |
| 9 |
| 10 |
| 10 |
| 10 |
| 28 |

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  |  | **EXAMINATION** |
| **Hours** |  |  | *Weight* |
| Class | 39 | Written exam | 70% |
| Seminar | 10 | Orals | 10% |
|  |  |  |  |
| Collaboration with lecturer | 48 | Personal assignments |  |
| Laboratory | 28 | Group assignments | 20% |
| TOTAL Hours: | 125 | TOTAL: | 100% |

**SUGGESTED Y BIBLIOGRAPH NOTES**

J. Newman, Physics of the Life Sciences, Springer 2008

*H. Young, University Physics, Addison-Wesley 1992*

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Nikolaos Labrou, Evangelia Chronopoulou

5

2905

MOLECULAR ENZYMOLOGY

[lambrou@aua.gr](mailto:lambrou@aua.gr)

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| **YES** |
| **..** |
| **..** |
| **..** |
| **X** |

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

*This course aims at acquiring knowledge on:*

1. *The main class of enzymes and on prediction of their catalytic activity.*
2. *The basic principles and key mechanisms of enzymatic catalysis.*
3. *The basic principles of kinetics of enzymatic reactions and the factors affecting the catalytic activity of the enzymes.*
4. *On the structural features of the enzymes and structure-catalysis relationships.*
5. *The analysis of kinetic data.*
6. *The principles of enzyme inhibition and the concepts of allosteric activator or inhibitor.*
7. *Enzymes that are molecular targets for drug design.*
8. *Detoxifying enzymes and enzymes that recognize and modify nucleic acids.*
9. *The principles of enzyme engineering and the modification of the enzyme molecule.*
10. *The principles of designing structural modifications on the enzyme molecule by applying biocomputing methods and recombinant DNA technology.*
11. *The principles of designing new forms of enzymes with desired catalytic and structural properties by applying evolutionary methods.*
12. *The development, through teamwork, of a scientific plan/presentation/essay by exploiting the gained knowledge and multidisciplinary scientific literature.*

*13. Designing research on molecular enzymology.*

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | *Module 1: Principles of enzymology*   1. Historical background. Nomenclature and classification of enzymes. Determination of enzyme activity. Enzyme function, active sites, cofactors, specificity 2. The basic principles and key mechanisms of enzymatic catalysis 3. Thermodynamics and structure-catalysis relationships |
| 2. | *Module2: Enzyme kinetics*   1. The principles of enzyme kinetics and the factors affecting the catalytic activity. 2. Kinetic parameters and reaction equilibrium 3. The analysis of kinetic data, Michaelis-Menten equation and methods of plotting enzyme kinetics data 4. Effect of pH and temperature on enzyme stability and activity. 5. The principles of enzyme inhibition, types of inhibition and the concepts of allosteric activators or inhibitors. Reversible and irreversible inhibition (inactivation). Inhibition constants. Interaction of enzymes and xenobiotic compounds (drugs, insecticides, herbicides, etc.) 6. Multi-substrate enzyme reactions 7. Isotopes in enzyme reaction rate determination |

10

6

|  |  |
| --- | --- |
| 3. | *Module 3. Enzyme engineering*   1. Molecular dynamics and mechanics, structural rearrangements and fluctuations of the enzyme molecule 2. The principles of designing structural modifications on the enzyme molecule by applying biocomputing methods and recombinant DNA technology   8) Paleoenzymology and reconstruction of ancient enzymes. Methods for high throughput screening of mutant enzymes   1. Molecular methods for *in vitro* directed and random mutagenesis. Principles and methods of *in vitro* molecular evolution 2. The principles of designing new forms of enzymes with desired catalytic and structural properties by applying evolutionary methods 3. High-throughput screening methods for enzyme selection 4. *De novo* design of new functional enzymes 5. Chemical modification of enzyme structure 6. Applications of engineered enzymes in agriculture, medicine, industry and environmental technologies. Enzymes for molecular biology (structure, mechanism, applications) 7. Hybrid enzymes, semisynthetic enzymes, artificial enzymes, catalytic antibodies and ribozymes 8. Enzyme nanomachines and multi-complex enzymes |
| 4. | *Module 4: Enzyme applications*   1. Εnzymes that recognize and modify nucleic acids 2. Enzymes as molecular targets for drug design 3. Enzymes as body’s defense systems against xenobiotic compounds (oxygenases, transferases,   hydrolases, etc.) |

8

12

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  | **EXAMINATION** |  |
| **Hours** |  |  | *Weight* |
| Class | 20 | Written exam | 50% |
| Seminar | 6 | Orals | 0% |
|  |  |  |  |
| Collaboration with lecturer | 4 | Personal assignments | 50% |
| Laboratory | 6 | Group assignments | ..% |
| TOTAL Hours: | 36 | TOTAL: | 100% |

**SUGGESTED BIBLIOGRAPHY**

Yon-Kahn, Jeannine, Hervé, G. (2010) Molecular and Cellular Enzymology. Springer USA.

Hans Bisswanger (2011) Practical Enzymology, 2nd Edition, Wiley-Blackwell.

**NOTES**

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code:*

*Lecturer:*

*Contact Details:*

Professor Polydefkis Hatzopoulos

5

205

PLANT BIOTECHNOLOGY

[phat@aua.gr](mailto:phat@aua.gr), +30 210 5294321

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| **X** |
| **..** |
| **8** |
| **..** |
| **X** |

*PREREQUISITES* ***(if any)*** *Course Code*

1.

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

Upon successful completion of this course the students will acquire new knowledge and specific skills on the following subjects:

* Will gain knowledge on the major fields concerning the modification, transfer, expression and phenotypic appearance of the genetic information. The process of DNA transfer from any organism into plants.
* Creating new and novel traits in plants, or even features that are not found in plants.
* Using transgenic plants as bioreactors to produce substances with high added value.
* Creating transgenes in order to produce human proteins and vaccines.
* Using transgenics to provide service.
* Molecular agriculture and in production pluralism through plants, in general.
* Creation of transgenic plants as biofuels and remediation of polluted environments
* Will gain knowledge on genetic information transfer techniques and methods and on DNA analysis.
* Will have knowledge of procedures and practices of DNA and RNA analysis.
* Will learn to use techniques and methodologies for the certification and identification of genetically modified organisms (GMO).
* Will have knowledge of the processes and methods for applications of molecular analysis of transgenic plants.
* Will be capable to analyze, evaluate and decide on the applicability of techniques and methods for creating transgenic plants with molecular tools in any case scenario.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Principles of Gene manipulation |
| 2. | Agrobacterium DNA transfer. |
| 3. | DNA vectors and transgenic plants |
| 4. | Tissue – Cell culture for DNA transfer |
| 5. | Abiotic transformation methods – Electroporation |
| 6. | Particle Bombardment and Gene-Biomolecules Transfer. |
| 7. | Chemical and mechanical gene transfer in plants |
| 8. | Gene Targeting and Mutagenesis |
| 9. | Molecular improvement |
| 10. | Transgene applications in Production and Services |
| 11. | Transgenic plants resistant to herbicides, viruses, insects, bacteria, fungi. |
| 12. | Modification of transgenic plants physiology |
| 13. | Bioethics, Patent and Regulations |

|  |
| --- |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |
| 3 |

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  | **EXAMINATION** |  |
| **Hours** |  |  | *Weight* |
| Class | 39 | Written exam | 65% |
| Seminar | .. | Orals | ..% |
|  |  |  |  |
| Collaboration with lecturer | 60 | Personal assignments | 20% |
| Laboratory | 26 | Group assignments | 15% |
| TOTAL Hours: | 125 | TOTAL: | 100% |

**SUGGESTED BIBLIOGRAPHY**

Biotechnology J. Plant Biotechnology J

Nature Biotechnology

**NOTES**

Pdf files of presentation

**COURSE DESCRIPTION FORM**

*Title:*

*ECTS Credits: Course Code*

*Lecturer:*

*Contact Details:*

Professor Spyros Kintzios

5

3600

Bionanotechnology and Biosensors

[+30210 5294292, skin@aua.gr](mailto:%2B302105294292%2Cskin@aua.gr)

*Compulsory*

*Elective Semester Autumn Term Spring Term*

Check

|  |
| --- |
| **X** |
| **..** |
| **5** |
| **X** |
| **..** |

*PREREQUISITES* ***(if any)*** *Course Code*

1. …………………………………………

2.

3.

|  |
| --- |
|  |
|  |
|  |

**COURSE GOALS**

The course is the basic introduction to the scientific field of biosensors and nanotechnology and their applications in life sciences, as well as all affiliated techniques and methods used for the development, study and application of biosensors and nanotechnologies in modern analytical and diagnostic science, food safety and environmental monitoring..

The educational context aims to introducing students to the principles of nanotechnology, Biosensors, Electrochemistry and Microengineering, covering wide area of supplementary knowledge, including in-depth elements of microfluidics, photonics, biomolecular processes, molecular recognition, analytical chemistry and quality control.

It also refers to introductory principles and methodologies for designing and standardizing mircoelectromechanical systems (MEMS) and biosensors, carrying out analyses with high throughput systems, the use of expert systems, knowledge of materials used in MEMS and basic microengineering techniques (lithography, etching etc).

Finally, the course aims to provide to students a comprehensive review of the importance of biosensors and nanotechnology on modern analytical and diagnostic science and their contribution to the industry and service sectors. In parallel, it fosters the perspective career opportunities with specialization in analytical science with advanced methods.

## Following the completion of the course, students will be able to:

* **Understand the principles of biosensors and nanotechnology, their affiliated technologies and fields of application.**
* Know the tools and techniques of microengineering and analysis based on different biosensor systems.
* Design basic MEMS.
* Carry out laboratory analyses using at least two different biosensor types.
* Apply skills and knowledge for seeking new technologies and utilize research results for designing novel biosensor-based analytical systems.
* Collaborate with other students in order to prepare and publicly present a plan of natotechnological and biosensor-based approaches to a real application/analytical need, having in parallel acquired oral and written presentation skills.

**COURSE CONTENTS** *Total Hrs*

|  |  |
| --- | --- |
| 1. | Biosensors: A historical review. Principles of nanotechnology. |
| 2. | Elements of electrochemistry. Cyclic voltammetry, voltammetry and  chronoampeormetry. Electrochemical impedance spectrometry. |
| 3. | Optical biosensors. Cell-based biosensors. Methods for immobilizing/entrapping  biomolecules. |
| 4. | Basic Microengineering technologies: lithography, imprinting, surface microenginnering, volume microengineering. Microelectromechanic Systems (MEMS) – Introduction to Microenginnering. Commercial applications. Microfludics for biological applications,  protein separation and direct screening for disease agents. |
| 5. | Artificial intelligence systems in biosensors. |
| 6. | Application of MEMs in life sciences. DNA analysis. Application of microelectrode arrays. Application of biosensors in food safety and environmental monitoring. Application of  biosensors in medicine and life sciences.Other applications of biosensors |

|  |
| --- |
| 3  6 |
| 6 |
| 6 |
| 3  6 |

|  |  |  |  |
| --- | --- | --- | --- |
| **TEACHING METHOD** |  | **EXAMINATION** |  |
| **Hours** |  |  | *Weight* |
| Class | 26 | Written exam | 50% |
| Seminar | .. | Orals | ..% |
|  |  |  |  |
| Collaboration with lecturer | 73 | Personal assignments | ..% |
| Laboratory | 26 | Group assignments | 50% |
| TOTAL Hours: | 125 | TOTAL: | 100% |

**SUGGESTED BIBLIOGRAPHY**

*J.Y.Yoon*, Introduction to Biosensors: From Electric Circuits to Immunosensors, Springer 2012

*F.S. Ligler,* Optical Biosensors: Present & Future, Elsevier 2002

**NOTES**