**COURSE OUTLINE**

1. **GENERAL**

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| **SCHOOL** | HEALTH SCIENCES | | | | |
| **ACADEMIC UNIT** | BIOLOGICAL APPLICATIONS AND TECHNOLOGY | | | | |
| **LEVEL OF STUDIES** | UNDERGRADUATE | | | | |
| **COURSE CODE** | ΒΕΥ603 | **SEMESTER** | | 7th | |
| **COURSE TITLE** | BIOCHEMICAL ENGINEERING | | | | |
| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | | | **WEEKLY TEACHING HOURS** | | **CREDITS** |
|  | | | 6 | | 7 |
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| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |  | |  |
| **COURSE TYPE**  *general background,  special background, specialised general knowledge, skills development* | SPECIAL BACKGROUND | | | | |
| **PREREQUISITE COURSES:** |  | | | | |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | GREEK | | | | |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | Yes | | | | |
| **COURSE WEBSITE (URL)** | <http://ecourse.uoi.gr/enrol/index.php?id=385> | | | | |

1. **LEARNING OUTCOMES**

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| **Learning outcomes** | |
| *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*  *Consult Appendix A*   * *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* * *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* * *Guidelines for writing Learning Outcomes* | |
| The course is a basic introductory lesson in the concepts of Biochemical Engineering. The aim of the course is to understand the basic principles of Biochemical Engineering and especially the fields of application of enzymes and microorganisms in the processes of production of high value-added biotechnology products (drugs, nutritional additives, specialized chemicals, biofuels, .a), as well as the development of improved services in the fields of health, food production, environmental protection and agriculture. The course presents the basic techniques and methodologies used by Biochemical Engineering, such as techniques for cultivation of microbial, animal and plant cells for the production of biotechnological products, techniques of DNA engineering, methods of immobilization of enzymes and proteins in general as well as cells , the techniques of protein (enzyme) engineering, bio-transformations and bio-separations. Emphasis is given to the students' training in methods of improving the properties of enzymes and the function of cells as cell factories for the production of biotechnological products.  By the end of the course, the students will be able to understand the contribution of Biochemical Engineering applications to the production of improved products and goods (such as food, pharmaceuticals, specialized biomolecules and high added value products, biofuels, etc.) the environment, and more generally the improvement of the quality of human life. Additionally, students will be trained in basic techniques of cell growth in bioreactors, isolation and characterization of biotechnological products, immobilization of enzymes, development of bio-catalytic processes as well as analysis of function and structure of genes and proteins with bioinformatics tools. At the same time, the student will be able to collaborate with his / her students to create and present an integrated work on cutting edge applications of Biochemical Engineering applications. | |
| **General Competences** | |
| *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* | |
| *Search for, analysis and synthesis of data and information, with the use of the necessary technology*  *Adapting to new situations*  *Decision-making*  *Working independently*  *Team work*  *Working in an international environment*  *Working in an interdisciplinary environment*  *Production of new research ideas* | *Project planning and management*  *Respect for difference and multiculturalism*  *Respect for the natural environment*  *Showing social, professional and ethical responsibility and sensitivity to gender issues*  *Criticism and self-criticism*  *Production of free, creative and inductive thinking*  *……*  *Others…*  *…….* |
| Working independently  Working in a team  Search, analyse, and synthesize data and information using new ones  Technologies | |

1. **SYLLABUS**

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| Theory  • Introduction to Biochemical / Metabolic Engineering  • Basic consideration of metabolism  • Control of metabolic pathways  • Summary of enzymatic kinetics - enzyme inhibition  • Regulation of enzyme activity  • Allosteric enzymes - Synergistic engagement  • Experimental methods for the study and control of metabolism  • Fermenting metabolic pathways and metabolic products  • Kinetic models for the production of metabolic products  • Metabolic flow analysis  • Analysis of metabolic control  • Mass transport phenomena in bioprocesses  • Transfer of O2 to cell cultures  • Factors that affect cell growth  • Growth limited by the substrate  • Mass balances during cell growth in closed and open systems Development of cells in closed and open systems  • Applications of Biochemical / Metabolic Engineering  Laboratory Exercises  1. Experimental determination of kinetic constants of metabolic enzyme activity - Data analysis by applying alternative computational and graphical methods for the determination of kinetic enzyme activity constants  2. Regulation of enzyme activity by inhibitors - Identification and determination of kinetic constants describing different inhibition types.  3. Metabolic regulation of enzyme production during yeast cell growth - Induction and suppression of Saccharomyces cerevisiae? -galactosidase  4. Simulation and control of metabolic pathways - Implementation of the Gepasi program  5. Implementation of the Gepasi computational program in coordinated regulation of metabolic pathways  6. Regulation of bacterial metabolism with a view to overproduction of amino acids - Induction and suppression of lysine produced by *Corynebacterium glutamicum*  7. Simulation of bioprocesses of intermittent and continuous work |

1. **TEACHING and LEARNING METHODS - EVALUATION**

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| **DELIVERY** *Face-to-face, Distance learning, etc.* | Face to face |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** *Use of ICT in teaching, laboratory education, communication with students* | Use of ICT in teaching,  Use of ICT in laboratory education,  Use of ICT in communication with students. |
| **TEACHING METHODS**  *The manner and methods of teaching are described in detail.*  *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*  *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS* | |  |  | | --- | --- | | ***Activity*** | ***Semester workload*** | | Lectures | 35 | | Laboratory practice | 35 | | Reports-Essays | 40 | | Exercises | 20 | | Self-study | 80 | |  |  | | Course total | ***210*** | |
| **STUDENT PERFORMANCE EVALUATION**  *Description of the evaluation procedure*  *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*  *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | I. Written final exam (70%) including: Short answer and problem solving questions  II Written examination in the theory of laboratory exercises including short answer questions (10%)  III Evaluation of written reports of works in the context of laboratory exercises (15%)  IV. Public presentation of group work  (5%) |

1. **ATTACHED BIBLIOGRAPHY**

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| *- Suggested bibliography:*  Εισαγωγή στη Βιοχημική Μηχανική Γ. Λυμπεράτος, Σ. Παύλου, Εκδόσεις Τζιόλα.  Στοιχεία Βιοχημικής και Μεταβολικής Μηχανικής Χ. Σταμάτη Πανεπιστήμιο Ιωαννίνων 2015  Εργαστηριακός Οδηγός Βιοχημικής Μηχανικής Χ. Σταμάτη Πανεπιστήμιο Ιωαννίνων  *- Related academic journals:*  Applied Biochemistry and Biotechnology,  Journal of Chemical Technology and Biotechnology,  Enzyme and Microbial Technology  Biotechnology Progress  Process Biochemistry  Biotechnology and Βioengineering  Food Biotechnology  Journal of Biochemical Engineering  Bioresource Technology  International Journal of Biological Macromolecules  Microbial Cell Factories  Biochemical Engineering Journal  Trends in Biotechnology |