TEACHING GUIDE	2015/16		
Centre	310 - Faculty of Science and Technology	Cycle	Indiferente
Plan	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	Third year

SUBJECT

26735 - Mass Transfer	ECTS Credits:	6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

Mass transfer completes the description of the three transfer phenomena that may take place in a chemical process alongside momentum and energy transfer. The three of them complete one of the most important basic concepts of Chemical Engineering

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

CM01 - Analyze, using mass and energy balances, installations, equipment, and processes in which the matter undergoes changes in morphology, composition, state, energy, and reactivity.
CM03 - Analyze, model, and calculate operations of separation on the basis of applied thermodynamics and mass transfer.
CM09 - Compare theoretical models and simulated results with real results obtained in laboratory units and pilot plants.
CM11 - Skillfully manage the information and communication technologies applied to learning, the sources of information and the specific data bases of Chemical Engineering, as well as office software to support oral presentations.
CM12 - Communicate and transmit, efficiently in writing and basically in oral format, the knowledge, results, abilities, and skills adquired, in a pluridisciplinary and multilingual environment.
CM13 - Organize and plan activities, in work groups, with recognition of diversity and multiculturalism, critical thinking and constructive spirit, originating in group leadership.
CM14 - Development of leadership in work groups, with delegation of tasks, establishing structures with recognition of the diversity of the group.
CM15 - Solve problems of matters corresponding to Chemical Engineering, laid out with quality criteria, sensitivity towards the environment, sostainability, ethical criteria, and encouragement of peace.

THEORETICAL/PRACTICAL CONTENT

1.-Introduction. Introduction. Mechanisms of Mass Transfer. Concentration: Definitions and Units. Mass Transfer between Phases: Equilibrium and Transfer Rate; Requirements for Mass Transfer; Continuous Contact and Intermittent Contact between Phases.
2.-Thermodynamics of the Separation Processes. Introduction. Energy, Entropy, and Exergy Balances in Separation Processes. Equilibrium of phases. Ideal models for gas and liquid. Nonideal thermodynamic property models: State Equations, Activity-Coefficient Correlation Equations. Selection of the Appropriate Model. Binary Mixtures. Multi-Component Mixtures: Bubble Point, Dew Point. Flash Distillation.
3.-Molecular Diffusion in Fluids. Introduction. Molecular Diffusion in Steady-State. Coefficients of Diffusion. Molecular Diffusion in Laminar Flow. Molecular Diffusion in Turbulent Flow. Molecular Diffusion in Gases. Molecular Diffusion in Liquids. Applications of Molecular Diffusion.
4.-Coefficients of Mass Transfer. Introduction. Coefficients of Mass Transfer in Laminar Flow. Coefficients of Mass Transfer in Turbulent Flow. Models for Mass Transfer in the Interphase.
5.-Single-Stage Processes. Introduction. Equilibrium Criteria. Equilibrium Conditions. Rule for the Phases of Gibbs and Degrees of Freedom. Vapor-Liquid Binary Systems (Absorption, Distillation). Liquid-liquid Ternary Systems (Extraction with Solvents). Solid-Liquid Systems (Liquefaction, Crystallization, and Adsorption). Gas-solid systems (Adsorption). Introduction to Multi-Phase systems.
6.-Multi-Stage Processes. Introduction. Cascade of Stages in Contact: Configuration in Parallel Currents, Crossed Currents, and Countercurrents. Cascade of Specific Stages in Contact: Solid-Liquid Cascades, Liquid-Liquid Extraction Cascades; Multi-Component Vapor-Liquid Cascades, Membrane Cascades. Hybrid Systems. General Calculation Methods: General Method of Approximate Calculation; Rigorous Calculation and General Simplified Methods.
7.-Equipment for Mass Transfer Processes. Introduction. General Characteristics of the Equipment used in Mass Transfer. Stage Efficiency. Mixer-Settler Tank. Plate Columns. Packed Columns. Other Equipment used in Mass Transfer Operations.

METHODS

Theoretical information is presented during class hours and practical exercises are solved afterwards in increasing complexity. The use of computers is recommended due to the complexity of the calculations that have to be carried out. Thus, these exercises are solved by means of calculation sheets

TYPES OF TEACHING

Type of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Classroom hours	35	5	15		5				
Hours of study outside the classroom	52	8	22		8				

Legend: M: Lecture S: Seminario GA: Pract.Class.Work GL: Pract.Lab work GO: Pract.computer wo GCL: Clinical Practice TA: Workshop TI: Ind. workshop GCA: Field workshop

ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

- Extended written exam 60%
- Practical work (exercises, case studies & problems set) 15%
- Team work (problem solving, project design) 15%
- Exposition of work, readings, etc. 5%
- IRAKASGAIAREN JARRAIPENA ETA PARTE HARTZEA (FOROA) 5%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

-CONTINUOUS ASSESSMENT TESTS OR EXAMS: 50-60% OF THE TOTAL
-PROBLEM-SOLVING AND CASE STUDIES: 10-15% OF THE TOTAL
-REALIZATION OF ASSIGNMENTS AND WRITTEN REPORTS: 10-15% OF THE TOTAL
-COMPUTER SKILLS (EXAM, REPORT, ATTENDANCE, ETC.): 5-10% OF THE TOTAL
-ORAL PRESENTATION (ASSIGNMENTS, REPORTS, PROBLEMS, CASE STUDIES, ETC.): 5-10% OF THE TOTAL
-TUTOR REPORTS ABOUT THE STUDENT: 5% OF THE TOTAL (Graduate in Chemical Engineering)

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

-DURING THE SECOND CALL FOR EXAMS THE EVALUATION WILL BE BASED EXCLUSIVELY ON THE FINAL EXAM.

COMPULSORY MATERIALS

egela

BIBLIOGRAPHY

Basic bibliography

Costa, E., and cols. "Ingeniería Química. 5. Transferencia de materia". Ed. Alhambra,. Madrid (1986).
Coulson, J.M. Richardson, J.F. "Ingeniería Química". Ed. Reverté, Barcelona (10979-84).
Seader, J.D., Henley, E.J. "Separation Process Principles". Ed. John Wiley, Nueva York (2006).
Treybal, R.E. "Operaciones con transferencia de masa" H.A.S.A., Buenos Aires (1980).

In-depth bibliography

Kirk-Othermer Encyclopedia of Chemical Technology, 38 Ed. John Wiley (1978-84).
Perry, R.H. and cols. "Manual del Ingeniero Químico" 68 Ed. Ed. McGraw Hill, Mexico(1993).
Reid, R.C. and cols. "The properties of gases and liquids". Ed. McGraw Hill, Nueva York (1987).

Journals

Internationl Journal of Heat and Mass Transfer, ISSN- 0947-7411. editado por Elsevier.

Heat mass transfer, ISSN- 0947-7411, editado por Springer.

Useful websites

Mass Transfer:

eu.wiley.com/WileyCDA/WileyTitle/productCd-EHEP001650.html
www.onesmartclick.com/engineering/mass-transfer.html

Glossaries:

higheredbcs.wiley.com/legacy/college/henley/047064611X/glossary/sciences_glossary.pdf
www.chemspy.com

Termodynamic properties:

webbook.nist.gov/chemistry/
www.ddbst.com

REMARKS

TEACHING GUIDE	2015/16		
Centre	310 - Faculty of Science and Technology	Cycle	Indiferente
Plan	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	Third year

SUBJECT

26736 - Chemical Reactor Design	ECTS Credits:	6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

In this course we will learn how to design and scale biological and chemical reactors. The fundamentals target the calculation of reaction kinetics, mass balances and the reactor conditions (reactor type, volume, temperature, among others) assuming ideal systems; batch and continuous. We will set strategies for designing reactors and combination of them for simple reactions, including chemical and biological systems, setting the grounds for more complex heterogeneous systems, complex reactions, optimized temperature profiles and non-ideal flow reactors.
Although the fundamental concepts and methodology of the course will be developed assuming ideal systems, we will also study the design considering real and complex ones, with special emphasis on heterogeneous reactors and biochemical reactors using enzymes and microorganisms.
The course has a strong practical component and students learn to design reactors independently with the use of basic concepts, rather than memorizing formulas. Besides, the course requires a participatory attitude of each student for developing communication and teamwork skills. Thus, the subject requires solving personal and group assignments in a continuous evaluation fashion.
Basic knowledge of mathematics, physics and chemistry, as well as more advanced thermodynamics and kinetics, fluid mechanics, heat transfer and mass transfer are applied.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific skills to be developed throughout the course:
• Describing chemical and biochemical phenomena in the reactor through the use of mass and energy balances
• Analysis and design of ideal homogeneous reactors
• Optimization of process conditions from different perspectives, e.g. production, selectivity, economic, among others
• Identifying and quantifying ideal flows or mixings, and its implications in the design of reactors
• Simplified analysis of heterogeneous reactors used for chemical or biological processing
• Introduce concepts associated with the reactor design as safety, environment and sustainability
Transversal skills to be developed throughout the course:
• Manage information from different sources and databases
• Communicate and transmit the knowledge, abilities and skills acquired
• Planning group activities, including exercises and laboratory assignments
• Promoting diversity, critical thinking and innovation
• Develop leadership and management skills
• Solving problems with scientific and technological quality criteria, respect for the environment and aiming sustainability
• Focus concepts to the industrial production of goods

THEORETICAL/PRACTICAL CONTENT

1. Introduction. Basics of reactor design. Historical evolution. Reactor development. Homogeneous and heterogeneous reactors. Issues to consider in the design. Tools and design stages: micro and macrokinetic models. Current state of reactor design and future prospects.
Section A. Homogeneous Reactor
2. The batch reactor. Obtaining the kinetic equation using a batch reactor: integral and differential methods. Reactors for gas reactions with variable volume. Reactors for constant volume. Design equations in isothermal regime. The batch reactor with temperature profiles. Types of temperature regimes. Optimization criteria. Semicontinuous reactors.
3. Plug flow continuous reactor. Concept of space time. Ideal plug flow. Design for different temperature regimes. Recirculation.
4. Continuously stirred tank reactor. Concept of perfect mix. Design for different temperature regimes. Comparison with the ideal plugh flow reactor. Combination of reactors: analytical and graphic optimization. Comparison with isolated reactors.
Section B. Optimization of Process Conditions
5. Optimal design for simple reactions. Selecting the reactor design for simple reactions. Comparison of ideal reactors. Optimizing the process conditions.
6. Optimal design for complex reactions. Reactor selection and design for complex reactions. Yield and selectivity. Comparison of reactors for reactions in series and parallel. Optimal design based on the study of selectivity.
7. Optimal temperature regimes. Effect of temperature on the design in endothermic and exothermic reactions. Optimum temperature profile in tubular reactors. Practical approaches in industrial reactors.
8. Continuous autothermal reactors. Stable operating conditions in reactors perfect mix. Stability and steady states. Effect

of process variables. Autothermal operation in tubular reactors.
Section C. Real flow and transport in reactors Property
9. Not ideal flow reactors. Residence time distribution (RTD). Design for first-order reactions and other kinetics. Dispersion model. Tanks in series model.
10. Transport property considerations. Mass transfer and heat transfer. Mass transfer coefficients and heat characteristic. Design considerations. Scaling.
Section D. Heterogeneous reactors
11. Gas-solid reactors. Description and selection of the reactor. Fixed bed catalytic reactors: Design for different temperature regimes. Fluidized bed reactors and their application in catalytic and non-catalytic reactions. Design models.
12. Gas-liquid and gas-liquid-solid reactors. General concepts. Macroscopic models. Reactor types and criteria for reactor selection. Main applications.
Section E. Bioreactors
13. Bioreactors with microorganisms. Kinetics. Structured and unstructured models. Discontinuous and continuous reactor.
14. Biological reactors with enzymes. Kinetics. Immobilization of enzymes. Reactors with immobilized enzymes. Response strategies.
Section F. Security
15. Security, environmental and sustainability aspects. Boundary conditions for safety. Alternatives for a save design. Environmental conditions. Contribution of reactor design to sustainability. Design innovations.

METHODS

LLectures
Oriented to set the fundamentals of the subject, and with examples and exercises for applying these fundamentals plus getting skills of problem solving.
Seminars
Students alone or gathered in groups will solve exercises requiring the skills acquired in the course and additional communication skills with collages. Groups would be made according to the different background of the members (BioTech + ChemE + Basque + Spanish) for boosting cooperative interaction. The seminars target to expand concepts, answer questions and develop student initiatives.
Exercises
The exercises are designed to develop the key skills associated with this course, with a parallel learning of other capacities as analysis, synthesis and communication.
Laboratory
Several aspects of the subject would be performed in the laboratory, solving practical examples pre-visualized in the tutorials and seminars. These laboratory assignments will be performed in dedicated apparatus and facilities available for the students. After the work, the students need to upload a manuscript with the most relevant aspects and results of the work.

TYPES OF TEACHING

Type of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Classroom hours	25	9	20	6					
Hours of study outside the classroom	38	10	32	10					

Legend: M: Lecture S: Seminario GA: Pract.Class.Work GL: Pract.Lab work GO: Pract.computer wo
GCL: Clinical Practice TA: Workshop TI: Ind. workshop GCA: Field workshop

ASSESSMENT SYSTEMS

- Mixed assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

- Extended written exam 30%
- Multiple choice test 30%
- Practical work (exercises, case studies & problems set) 30%
- Team work (problem solving, project design) 10%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

For the final mark, tasks are weighted as follows:
• Continuous assessment 90%
• Group assignments and laboratory 10%
The continuous assessment consists in 3 exams perfumed throughout the semester; each passed exam "eliminates" the corresponding part of the subject.
If the student does not pass any of the continuous assessments, he/she will be examined in the final exam. Students have

the right to increase the mark of each of the continuous assessments in the final exam, performing the required assignments.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

El examen de la convocatoria extraordinaria consistirá en la respuesta a una pregunta teórica, varias cuestiones y un problema.

COMPULSORY MATERIALS

Temas redactados y problemas resueltos por el profesor.

BIBLIOGRAPHY

Basic bibliography

Levenspiel, O., Ingeniería de las Reacciones Químicas, Reverté, Barcelona, 2002.
Fogler, S.H., Essential of Chemical Reaction Engineering, 2nd Ed., Prentice Hall Int., Englewood Cliffs, New Jersey, 2011.
Cuevas-García, R., Introducción al Diseño de Reactores Homogéneos, Reactores Intermitentes, PFR y CSTR, Editorial Académica Española, Madrid, 2013.
Conesa,J.A., Diseño de Reactores Heterogéneos, Servicio de Publicaciones de la Universidad de Alicante, 2010
Hill, Ch. G., An Introduction to Chemical Reaction Engineering, John Wiley, Nueva York, 1977.

In-depth bibliography

Butt, J.B., Reaction Kinetics and Reactor Design, 2nd Edition, Marcel Dekker Inc., Nueva York,-Basel, 2000.
Coker, A.K., Kayode, C.A., Modeling of Chemical Kinetics and Reactor Design, Elsevier Inc., 2001.
Froment, G.F., Bischoff, K.B., Chemical Reactor Analysis and Design, 2nd Ed, John Wiley, Nueva York, 1990.
Jakobsen, H.A., Chemical Reactor Modeling, Springer Berlin Heilderberg, Berlin, 2008.
Rawlings, J.B., Ekerdt, J., Chemical Reactor Analysis and Design Fundamentals, Nob Hill Publishing, Madison. Wisconsin, 2002.

Journals

AIChE Journal
Chemical Engineering Journal
Chemical Engineering Science
Industrial Engineering Chemistry Research
Chemical Engineering Education

Useful websites

REMARKS

TEACHING GUIDE	2015/16

Centre	310 - Faculty of Science and Technology	**Cycle**	Indiferente
Plan	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Third year

SUBJECT

26762 - Processes of Separation	**ECTS Credits:**	6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

Separation processes of pure components, which have been developed for thousands of years, are nowadays vital components of chemical and biotechnological industries. Most of the elements of these plants deal with the purification of the raw materials, intermediates and final products. These processes are basically controlled by mass transfer and establish in most cases the profitability of the process.
This course requires the knowledge acquired in the subject "Mass Transfer", studied in the first semester of the third year of Chemical Engineering and Biotechnology degrees and provides the knowledge required for the subject "Experimental Methods in Chemical Engineering II", also studied during the third year of the Chemical Engineering degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Analyzing installations, equipments or processes where matter suffers composition changes, by means of mass and energy balances.
- Integrating basic and common concepts of engineering in Chemical Engineering, Biochemical Engineering and Biotechnology concepts.
- Analyzing, modelling and calculating separation operation based on applied thermodynamic and matter transfer fundamentals.
- Comparing theoretical models and simulation results with real units’ results.
- Managing information technologies.
- Communicating and transferring knowledge, results and ideas in a professional and multidisciplinary environment.
- Organizing and planning activities in working groups.
- Developing leadership in working groups, by means of assigning work taking into account the group diversity.
- Solving chemical Engineering and Biotechnology problems, considering quality and environmental safety.

In this course we will learn the general characteristics of separation processes and the development of the most important ones: absorption and stripping, binary distillation, extraction, drying, crystallization, adsorption, ion exchange, chromatography, membrane separations.

THEORETICAL/PRACTICAL CONTENT

1. Introduction to separation processes. Separation processes in the chemical industry. Separation mechanisms: separations by phase addition or creation, separations by barriers, separations by solid agents, separations by external field or gradient. Operation alternatives. Product recovery and purity factor. Energy for separation. Selection of separation processes.

2. Absorption and stripping of dilute mixtures. Liquid-gas equilibrium of dilute mixtures. Equipment. Operation in stages: Operation in trayed towers. Stage Efficiency. Graphical and algebraic methods for determining the theoretical number of stages. Operation in packed columns. Height of the filler. HETP.

3. Distillation of Binary Mixtures. Vapour-liquid equilibrium. Distillation types. Auxiliary equipment. Equipment and Design Considerations. Flash distillation. Approximate graphical methods (McCabe-Thiele): Number of rectifying stages. Number of stripping stages. Feed-stage location. Optimum reflux ratio. Use of Murphree vapour efficiency. Rigorous graphical method (Ponchon Savarit). Operation in packed columns. Distillation under non-steady state.

4. Liquid - liquid extraction with ternary systems. Liquid-liquid equilibrium. Design considerations. Single stage extraction. Number of steps in multi-stage systems. Solvent optimum amount. Simplification in non-miscible systems.

5. Liquid-solid extraction. Liquid-solid equilibrium. Design considerations. Single stage extraction. Number of steps in multi-stage systems. Solvent optimum amount. Leaching diffusional model.

6. Solids drying. Drying equilibrium. Industrial dryers. Air-water interactions: wet temperature and saturation temperature. Solid drying kinetics. Models for dryers. Drying time in discontinuous dryers. Continuous dryers’ dimensions. Improvement of the dryer’s efficiency.

7. Crystallization. Crystallization equilibrium. Crystal geometry and distribution. Crystallization kinetics: nucleation and crystal growing. Industrial equipments for crystallization. Mass and energy balances in crystallizers. Crystal-population balance.

8. Adsorption, Ion Exchange and Chromatography. Adsorbents and ion exchangers. Adsorption and ion exchange

equilibrium. Transfer processes in solid adsorbents. Discontinuous, semi-continuous and fixed bed adsorption and ion exchange processes design. Adsorption and ion exchange cycles. Chromatographic separations.

9. Introduction to membrane separations. Membrane materials. Modules and industrial units. Mass transfer in membranes. Dialysis and electrodialysis. Reverse osmosis. Microfiltration and ultrafiltration. Gas permeation. Pervaporation.

METHODS

Lectures (M): The theoretical background of each subject will be provided, pointing out the most relevant aspects. This information must be complemented with the specific bibliography that will be supplied at the end of each lesson.
Tutorials (GA): Students will have to resolve, previously guided by the teacher, several problems related to each lesson.
Computer Labs (GO): A general problem of a separation process will be solved, using the software Excel (or similar). This case-study will be developed in working groups of three students, being each of them responsible for each of the stages that make up the whole process:
- Presentation of the main sheet (proposal, diagram and summary of the solution) and mass and energy balances.
- Calculation of the contact height or length.
- Calculation of the section and optimization of the process by minimizing the contactor’s volume.

Seminars (S): These lessons will be focused on obtaining the needed information for solving the general design problem and its subsequent development in a spreadsheet. Attendance is compulsory.
On the other hand, with the aim of complementing the formation of the students in bibliographic research, autonomy and oral presentation skills, each group will have to carry out and present a theoretical work about membrane separations, as an example of an advanced separation process. This work involves defining the following aspects, being each of the members of the group responsible for one of them:
- Definition, historical development and contemporary equipment.
- Design methodology.
- Current and future applications.

TYPES OF TEACHING

Type of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Classroom hours	35	5	15		5				
Hours of study outside the classroom	52	8	22		8				

Legend: M: Lecture S: Seminario GA: Pract.Class.Work GL: Pract.Lab work GO: Pract.computer wo
GCL: Clinical Practice TA: Workshop TI: Ind. workshop GCA: Field workshop

ASSESSMENT SYSTEMS

- Mixed assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

- Extended written exam 70%
- Individual work 10%
- Team work (problem solving, project design) 10%
- Exposition of work, readings, etc. 10%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Midterms (2) and final exam: 70 % (40 % first mid-term, 30 % second mid-term).
Problems resolution and oral presentations at blackboard: 10 %
Carrying out and presenting a theoretical work on membrane separation: 10 % (5 % team mark, 5 % individual mark)
Computer skills (attendance, resolution and report of a case-study): 10 % (5 % team mark, 5 % individual mark)
A minimum score of 4 in the exams is required for counting the rest of tasks required for the final grade. A final exam and two midterms (lessons 1-5 (8th of April) and lessons 6-9 (13th of May)) will be carried out.
Passing the midterms will involve not having to do the final exam but both the theoretical and problems parts must be passed.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Final written exam (theory and problems): 70 %.
Marks of the works carried out during the course: 30 %
Optionally:
Theoretical questions about membrane separations (10 %), solving a practical case using the Excel software (10 %) and an oral presentation of the developed Excel program, explaining the performed calculations (10 %).
A minimum score of 4 in the exam is required for counting the rest of tasks required for the final grade.

COMPULSORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Coulson, J.M. Richardson, J.F. "Ingeniería Química". Ed. Reverté, Barcelona (10979-84).
Henley, e.J., Seader, J.D. "Operaciones de separación por etapas de equilibrio en Ingeniería Química". Ed. Reverté, Barcelona (1988).
King, C.J. "Procesos de separación", Ed. Reverté, Barcelona (1980).
Seader, J.D., Henley, E.J. "Separation Process Principles". Ed. John Wiley, Nueva York (1998).
Treybal, R.E. "Operaciones con transferencia de masa" H.A.S.A., Buenos Aires (1970).
Blumberg, R., "Liquid-Liquid Extraction", Ed. Academic Press, London (1988).
Haselden, G.G., y cols. "Distillation &Absorption". Ed. Hemisfere Publishing, Nueva York (1991).
Wallas S.M. "Phase equilibria in Chemical Engineering". Butterworth Publishers, Stoneham (1985).

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Kirk-Othermer Encyclopedia ofChemical Technology, 38 Ed. John Wiley (1978-84).
Perry, R.H. y cols. "Manual del Ingeniero Químico" 68 Ed. Ed. McGraw Hill, Mexico(1993).
Rouseau, R.W. "Handbook of Separation Process Technology". Ed. John Wiley, Nueva York (1987).
Reid, R.C. y cools. "The properties of gases and liquids". Ed. McGraw Hill, Nueva York (1987).

Journals

Separation and Purification Methods, ISSN-0360-2540, editado por Taylor & Francis inc.
Separation and purification reviews, ISSN-1542-2119. editado por Taylor & Francis inc.
Separation Science and Technology, ISSN-0149-6395, editada por Taylor & Francis inc.

Useful websites

Enlaces de interés http://iq.ua.es/links.html Herramienta interactiva del Método de Ponchon y Savarit http://iq.ua.es/McCabe-V2/index.htm
Herramienta interactiva del método de McCabe, http://iq.ua.es/Ponchon/index.html
Rectificación discontinua en columnas de relleno http://w3.ua.es/ite/proyectos/proyectoRDCR /index.html
Información del Physics Laboratory of NIST http://physics.nist.gov/cuu/Units/
IUPAC http://www.iupac.org/dhtml_home.html
http://lorien.ncl.ac.uk/ming/distil/distildes.htm
Destilacion http://www.brinstrument.com/fractional-distillation/links.html
Extracción líquido-líquido http://www.liquid-extraction.com/default.htm
Equipo para extracción sólido-líquido http://test-equipment.globalspec.com/Industrial-Directory/solid_liquid_extraction

REMARKS

TEACHING GUIDE	2015/16		
Centre	310 - Faculty of Science and Technology	Cycle	Indiferente
Plan	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	Third year

SUBJECT

27801 - Animal Physiology	ECTS Credits:	6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

La asignatura Fundamentos de Fisiología Animal aborda el estudio de las bases biológicas que permiten entender el funcionamiento de los diversos tipos de animales, así como sus relaciones con otros individuos y con su entorno. Para ello, resulta fundamental avanzar en el conocimiento y la comprensión de los procesos de integración y coordinación de las funciones de los tejidos y órganos que hacen posible un funcionamiento armónico de los seres vivos.
Se trata de una asignatura de 6C que se imparte con carácter obigatorio en el primer cuatrimestre del tercer curso del Grado de Biología, y que se integra en el módulo 05 denominado Integración Fisiológica y Aplicaciones de Bioquímica y Biología Molecular, que tiene como primer objetivo aplicar los conceptos moleculares a la comprensión de la organización y funcionamiento de los organismos y fundamentalmente del ser humano, e incluye una serie de asignaturas obligatorias entre las que se encuentra la Fisiología Animal, así como varias optativas, entre ellas la Fisiología Humana, que constituye una especialización de la Fisiología Animal.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific skills to be acquired:

1. Animals as functional units: students are trained to analyze organisms as a hierarchic organization of processes whose final goal is to maintain integrity and fitness.
2. Bases of regulation of animal functions are framed within the concepts of compensation and homeostasis.
3. Control and regulation systems are subject to detailed study: physical and chemical principles underlying mechanisms as well as structures at the different levels of organization (molecular, cellular and systemic) are explained.
4. Identifying the key role of the internal environment (milieu intérieur) in connecting organs and systems, describing the main elements of circulatory circuits and the physical laws explaining coordinated function.
5. Describing the main systems of homeostatic regulation in animals as models of functional integration.

Trasnversal skills:

1. Developing analysis, synthesis, organizational and planning abilities to allow decision making as well as elaborating and transmitting information.
2. Maintaining a positive attitude enabling the acquisition of skills for continuity self-learning, encouraging initiative and motivation for quality and consideration about the environment.
3. Developing abilities for interpersonal exchange to favour team-work and progress as regards to critical reasoning as well as an ethic compromise with society.

THEORETICAL/PRACTICAL CONTENT

Introduction:

1. Principles of cellular physiology. Matter and information exchanges with the internal environment.
2. Organisms as the integrated summation of exchange systems. Energy fluxes. The concept of functional unity and homeostasis.

Integrative and Control Systems

3. Electrical properties of membranes. The role of Ion channels. Resting and Action Potentials. Speed of propagation of action potentials.
4. Transmission of information between neurons. Structure and function of electrical and chemical synapses. Quantal release of neurotransmitters.
5. Integration at synapses. Excitatory and inhibitory synapses. Facilitation and potentiation.
6. Flow of information in the nervous system: Neuronal networks. Convergence and divergence.
7. General properties of sensory reception. Properties of receptor cells. Receptor and Generating Potentials. Encoding stimulus intensities.
8. Common mechanisms of sensory transduction. Chimioreception. Mechanoreception and Hearing: the hair cell. Light receptors, optic mechanisms and vision.
9. Effectors of the nervous system: glands, muscles and animal movement. Structure and function of skeletal muscle. The sliding-filament theory.
10. Mechanics of muscle contraction: isometric vs. isotonic contraction. Force production: Power-velocity curve. Classification of fiber types. Smooth muscle. Cardiac muscle.
11. Evolution of nervous systems. Organization of the vertebrate nervous system. Afferent and efferent pathways.

12. The autonomous nervous system: sympathetic and parasympathetic divisions.
13. Endocrine coordination. Functional classification of hormones and secretions. Cellular mechanisms of hormone actions. External and internal receptors. Second messengers.
14. Neuroendocrine systems. The Hypothalamus - hypophysis axis in vertebrates and related systems.
15. Physiological effects of hormones. Water & salt balances. Energy fluxes, repair, growth and reproduction.

Circulation

16. Function and general plan of the circulatory system: open and closed circulation. The peripheral circulation: structure of arteries, veins and capillaries.
17. Cardiac pumps. Vertebrate hearts: comparative functional morphology. Frequency and cardiac output.
18. Hemodynamics. Blood pressure, flow and resistance. Pressure Regulation. Regulation filtration pressure across capillary walls: counterbalance between hydrostatic and colloid osmotic pressures to preserve liquid within the circulatory vessels.
19. Control of central cardiovascular system. Control of microcirculation.

Integration of physiological systems: basic circuit of homeostatic regulation.

20. Nutrient cycling. Structures, organs and regulation of supplies of metabolic substrates.
21. Water and salt balances: regulation of osmotic concentration and ionic composition of the milieu intérieur.
22. Gas Exchange and acid-base balance: structures organs and regulation of gas transfer.

LABORATORY PRACTISES

-Computer programs simulating endocrine and nervous systems.
-Influence of the size of a solute on diffusion rate.
-Influence of temperature and concentration upon osmotic flux.
-Regulation of cardio respiratory function.
-Effect of activity on metabolic rate.

METHODS

Laboratory work and team work in seminars is compulsory.
Practical class work will deal with resolution of practical problems and discusión of selected topics.
Certain lessons will be undertaken by collective work in seminars and will be presented to the class for discusión.

TYPES OF TEACHING

Type of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Classroom hours	35	4	6	15					
Hours of study outside the classroom	53	10	12	15					

Legend: M: Lecture S: Seminario GA: Pract.Class.Work GL: Pract.Lab work GO: Pract.computer wo
GCL: Clinical Practice TA: Workshop TI: Ind. workshop GCA: Field workshop

ASSESSMENT SYSTEMS

- Mixed assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

- Extended written exam 80%
- Practical work (exercises, case studies & problems set) 10%
- Team work (problem solving, project design) 5%
- Exposition of work, readings, etc. 5%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Writen tests questioning about theoretical knowledge (70% of final marks) exercises (10% of final marks), and practical questions about laboratory work (10% of final marks) will be given. A written report for undertaken team work followed by individual oral presentation will represent 10% of final marks.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Results obtained for the Work Group Presentations (Seminars) as well as the Laboratory Practices and Exam will be maintained for the Extraordinary Exams in July. The written test will be retaken both as regards or theory and problems.

COMPULSORY MATERIALS

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PHYSIOLOGICAL AND BIOCHEMICAL ZOOLOGY
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ACTA-PHYSIOLOGICA-SCANDINAVICA.
PFLUGERS-ARCHIV-EUROPEAN-JOURNAL-OF-PHYSIOLOGY.
MARINE-AND-FRESHWATER-BEHAVIOUR-AND-PHYSIOLOGY.
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JOURNAL-OF-PHYSIOLOGY-LONDON.
JOURNAL-OF-APPLIED-PHYSIOLOGY.
JOURNAL OF EXPERIMENTAL ZOOLOGY
JOURNAL-OF-ANIMAL-PHYSIOLOGY-AND-ANIMAL-NUTRITION-ZEITSCHRIFT-FUR-TIERPHYSIOLOGIE-TIERERNAHRUNG-UND-FUTTERMITTELKUNDE.

Useful websites

www.whfreeman.com/animalphys5/
www.estrellamountain.edu/faculty/farabee/biobk/biobooktoc.html
http://private.nmr.ru/manuals/biophys/OLTB/index.html
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REMARKS