



Universitat de Lleida

**DEGREE CURRICULUM
THERMODYNAMICS AND
CHEMICAL KINETICS**

Coordination: SALVADOR TUREGANO, JOSE

Academic year 2022-23

Subject's general information

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|--|---|--------|-------------|------------------|
| Subject name | THERMODYNAMICS AND CHEMICAL KINETICS | | | |
| Code | 101601 | | | |
| Semester | 2nd Q(SEMESTER) CONTINUED EVALUATION | | | |
| Typology | Degree | Course | Character | Modality |
| | Bachelor's Degree in Biotechnology | 1 | COMMON/CORE | Attendance-based |
| Course number of credits (ECTS) | 6 | | | |
| Type of activity, credits, and groups | Activity type | PRALAB | PRAULA | TEORIA |
| | Number of credits | 0.8 | 0.2 | 0.8 |
| | Number of groups | 6 | 2 | 1 |
| Coordination | SALVADOR TUREGANO, JOSE | | | |
| Department | CHEMISTRY | | | |
| Important information on data processing | Consult this link for more information. | | | |
| Language | Castellà | | | |

| Teaching staff | E-mail addresses | Credits taught by teacher | Office and hour of attention |
|-------------------------|---------------------------|---------------------------|------------------------------|
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| SALVADOR TUREGANO, JOSE | jose.salvador@udl.cat | 9 | |

Learning objectives

L'estudiant, al superar l'assignatura, ha de ser capaç de:

1. Conèixer i saber utilitzar el concepte de potencial químic
2. Conèixer i saber aplicar les condicions d'equilibri químic i de fases i les principals característiques de cada un d'ells
3. Conèixer els principals trets dels sistemes col·loidals
4. Conèixer les bases que regeixen el comportament dels sistemes de no equilibri: Fenòmens de transport i reactivitat química
5. Conèixer els conceptes i metodologies emprades en la determinació de la velocitat d'una reacció química així com les bases de les principals teories que permeten justificar la velocitat dels processos
6. Relacionar els conceptes químicofísics adquirits amb els de matemàtiques, física i biologia.
7. Resoldre quantitativament els problemes que es presenten a la pràctica en el laboratori amb les determinacions que involucren els conceptes esmentats en l'assignatura emprant si és el cas programes informàtics especialitzats

Competences

General competences

The following basic competencies will be guaranteed, as a minimum:

CB2 That students know how to apply their knowledge to their work or vocation in a professional way and possess the competencies that are usually demonstrated through the development and defense of arguments and problem solving within their area of study

CB3 That students have the ability to gather and interpret relevant data (usually within their study area) to make judgments that include reflection on relevant social, scientific or ethical issues

CB4 That students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences

CB5 That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy

In addition, the graduate must be able to:

CG1 Be able to selectively search and use sources of information necessary to achieve the training objectives.

CG2 Interpret scientific-technical information with a critical sense, and be able to make presentations based on this information.

CG3 Work as a team, with a multidisciplinary vision and with the ability to make a rational and efficient distribution of tasks among team members.

CG4 Know and properly use the scientific and technical vocabulary typical of the different areas of Biotechnology.

CG5 Work in the laboratory applying quality criteria and good practice.

CG11 Acquire criteria for choosing the most appropriate analytical techniques for each specific practical case.

Specific skills

CE3 Know how to handle the essential instruments of a chemical laboratory.

CE4 Know the principles of physics-chemistry and be able to solve problems related to the kinetics of chemical reactions.

CE7 Know the procedures for the acquisition and preparation of samples for instrumental chemical analysis.

CE8 Know the fundamentals, know how to apply and interpret the instrumental techniques of biotechnological application.

CE13 Know and understand the physical-mathematical foundations of biotechnological processes.

Subject contents

Unit 1.- Principles of Thermodynamics (4 T + 2 P)

Introduction. First Principle. Enthalpy Second principle of thermodynamics. Microscopic meaning of entropy.

Unit 2.- Material balance (5 T +2 P)

Gibbs and Helmholtz functions. Chemical potentials. Conditions of phase equilibrium and chemical equilibrium. Thermodynamic relationships. Calculation of variations in state functions for different processes.

Unit 3.- Solutions. (5 T +4 P + 4 L)

Partial molar magnitudes. Mixing quantities. Chemical potentials for gases. Ideal solutions. Ideal dilute solutions. Non-ideal solutions. Activity and activity coefficient. Ladders. Colligative properties. Electrolyte solutions. Debye-Hückel theory.

Unit 4.- Chemical equilibrium in non-ideal systems. (3T +3P)

The equilibrium constant. Dependencies Equilibrium displacements.

Unit 5.- Phase equilibrium. (3T +3P)

Phase balances in 1-component systems. Clapeyron equation. Two-component phase diagrams: Liquid-vapor, liquid-liquid and solid-liquid equilibrium. Structure of phase diagrams. Three-component systems.

Unit 6.- Colloidal systems. (3T + 2P)

Interface. Thermodynamics of surfaces. Superficial films. Adsorption. Colloids

Unit 7.- Batteries and electrochemical systems. (3T + 2P)

Redox reactions. Faraday's laws. Electrode potentials. Battery thermodynamics: Nernst equation. Concentration stacks. Applications.

Unit 8.- Reaction kinetics. (8 T + 8 P + 4 L)

Determination of the kinetic equations. Reaction mechanisms. Approximation of the limiting stage and the steady state. Influence of temperature on kinetic constants. Experimental techniques for the measurement of reaction

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rates. Reactions in solution. Catalysis. Enzyme catalysis. Inhibition. Heterogeneous catalysis. Photochemistry. Dynamic theories of chemical reactivity.

T = Theory. P = Problems (in class or computer room) L = Laboratory

Practical activities

Determination of the reaction order, rate constant, activation energy and pre-exponential factor in a reaction

Determination of the thermodynamic constant of acidity of a weak acid

Solving simultaneous equilibrium problems with Visual MINTEQ

Exercises with educational programs on the equilibrium of phases in systems of one and two components

Determination of the nanoparticle size distribution and optical properties of these systems

Methodology

| Tipus d'activitat | Descripció | Activitat presencial alumne | | Activitat no presencial alumne | | Avaluació | Temps total |
|---------------------|---|--|-------|---|-------|-----------|-------------|
| | | Objectius | Hores | Treball alumne | Hores | Hores | Hores |
| Lliçó magistral | Classe magistral (Aula. Grup gran) | Explicació dels principals conceptes | | Estudi: Conèixer, comprendre i sintetitzar coneixements | | | |
| Problemes i casos | Classe participativa (Aula. Grup gran) | Resolució de problemes i casos | | Aprendre a resoldre problemes i casos | | | |
| Seminari | Classe participativa (Grup mitjà) | Realització d'activitats de discussió o aplicació | | Resoldre problemes. Discutir | | | |
| Laboratori | Pràctica de Laboratori (Grup mitjà) | Execució de la pràctica: comprendre fenòmens, mesurar... | | Estudiar i Realitzar memòria | | | |
| Aula d' informàtica | Pràctica d'aula d'informàtica (Grup mitjà) | Execució de la pràctica: comprendre fenòmens, mesurar... | | Estudiar i Realitzar memòria | | | |
| Pràctiques de camp | Pràctica de camp (Grup mitjà) | Execució de la pràctica: comprendre fenòmens, mesurar... | | Estudiar i Realitzar memòria | | | |

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|-----------------------------|---|---|--|--|--|--|--|
| Visites | Visita a explotacions o industries | Realització de la visita | | Estudiar i Realitzar memòria | | | |
| Activitats dirigides | Treball de l'alumne (individual o grup) | Orientar a l'alumne en el treball (en horari de tutories) | | Realitzar un treball bibliogràfic, pràctic, etc. | | | |
| Altres | | | | | | | |
| Totals | | | | | | | |

Evaluation

| Tipus d'activitat | Activitat d'Avaluació | | Pes qualificació |
|-----------------------------|--|---|------------------|
| | Procediment | | |
| Lliçó magistral | Proves escrites sobre la teoria del programa de l'assignatura | 4 | 60 |
| Problemes | Proves escrites sobre problemes i participació en la resolució de problemes a classe | 2 | 40 |
| Laboratori | Lliurament de memòries, proves escrites o orals | | |
| Seminari | Proves escrites o orals | | |
| Aula informàtica | Lliurament de memòries. Proves escrites o orals. | | |
| Pràctiques de camp | Lliurament de memòries. Proves escrites o orals | | |
| Visites | Lliurament de memòries. Proves escrites o orals. | | |
| Activitats dirigides | Lliurament del treball | | |
| Altres | | | |
| Total | | | 100 |

Bibliography

Bibliografia bàsica

ATKINS, P.W . - 1999 (6^a Ed.) - Química Física - Edicions Omega.

ATKINS, P.W .-2000 (3^a Ed.) -The Elements of Physical Chemistry – Oxford University Press

CLARET, J., MAS, F., SAGUÉS, F..- Termodinàmica Química i Electroquímica. Llibres de l'Índex. Barcelona 1996.

EISENBERG, D.; COOTHERS, D. - 1979 - Physical Chemistry with applications to the life Sciences. - Pub. Comp. Inc., NY.

LEVINE, I.N. - 2003 - Físico-química. - McGraw-Hill. Quinta edición

Bibliografia complementària

AGUILAR, A, GÓMEZ, E i LUCAS, J. M. –1997- Cinètica Química –Llibres de l'Index. Universitat

HIEMENZ, P. C-1997 (3^a Ed) - Principles of Colloid and Surface Chemistry- Marcel Dekker, Inc