

## SEPARATION PROCESSES

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Learning complements	Separation processes	3º	2º	6	Optional
<b>LECTURER(S)</b>			<b>Postal address, telephone nº, e-mail address</b> Department of Physical Chemistry. Faculty of Pharmacy. University of Granada Campus Universitario de Cartuja. 18071 -Granada (Spain)  <a href="mailto:emilioqf@ugr.es">emilioqf@ugr.es</a> , Room 194 Telf.:+ 958243826  <a href="mailto:dmalvarez@ugr.es">dmalvarez@ugr.es</a> , Room 202 Telf.:+ 958244274		
<b>Emilio García Fernández</b> <b>Delia Miguel Álvarez</b>			<b>TUTORING HOURS</b> <i>Second term:</i> Tuesday, Wednesday and Thursday from 09:30 to 11:30h (Emilio García Fernández, Room 194)  Tuesday and Thursday from 09:30 to 12:30h (Delia Miguel Álvarez, Room 202)		
<b>DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT</b>					
Pharmacy Degree					
<b>PREREQUISITES and/or RECOMMENDATIONS (if necessary)</b>					
Proper knowledge about: - Instrumentals Techniques - General Chemistry - Basic Physics and Physical Chemistry - Organic Chemistry - Inorganic Chemistry - Biochemistry					



## BRIEF ACCOUNT OF THE SUBJECT PROGRAMME (ACCORDING TO THE DEGREE)

Extraction. Thin layer chromatographic. Gas chromatographic. Liquid chromatographic  
Electrophoresis. Centrifugation. Sedimentation

## DETAILED SUBJECT SYLLABUS

### THEORETICAL SYLLABUS

**UNIT 1.** INTRODUCTION TO CHROMATOGRAPHY. HISTORY. CONCEPT OF CHROMATOGRAPHY. CLASSIFICATION. EQUILIBRIUM DISTRIBUTION. LINEAR ISOTHERMS. DISTRIBUTION PARAMETERS. LINEAR ELUTION CHROMATOGRAPHY. RETENTION PARAMETERS. MIGRATION.

**UNIT 2.** THEORIES OF CHROMATOGRAPHY. THEORY OF PLATES. COLUMN EFFICIENCY. KINETIC THEORY. GENERAL EQUATION. DIFFERENCES BETWEEN C. G. AND C. L. RESOLUTION. RETENTION TIME. OPTIMUM EFFICIENCY CONDITIONS OF THE COLUMN. GRADIENT ELUTION AND TEMPERATURE PROGRAMMING. APPLICATIONS. THE CALIBRATION METHOD USING STANDARDS. STANDARDIZATION AREAS. INTERNAL STANDARD.

**UNIT 3.** PLANE CHROMATOGRAPHY. CP AND CCF. HOW THE SEPARATION IS PERFORMED. PERFORMANCE CHARACTERISTICS. VARIABLES AFFECTING THE RF. QUALITATIVE AND QUANTITATIVE DETERMINATIONS.

**UNIT 4.** GAS CHROMATOGRAPHY. GC RETENTION VOLUME, SPECIFIC VOLUME. PHARMACEUTICAL APPLICATIONS. QUALITATIVE INTERPRETATION OF A CHROMATOGRAM. RELATIVE RETENTION. OSTER RELATIONSHIP. KOVATS RETENTION INDEX.

**UNIT 5.** GAS CHROMATOGRAPHY INSTRUMENTATION. CARRIER GAS. SAMPLE INJECTION. COLUMNS. STATIONARY PHASES. THERMAL CONDUCTIVITY DETECTORS, FLAME IONIZATION, ELECTRON CAPTURE, ATOMIC EMISSION. ATTACHMENT WITH MASS SPECTROMETRY.

**UNIT 6.** HPLC INSTRUMENTATION. MOBILE PHASE. PRESSURE SYSTEM. COLUMNS. COLUMN FILLING. DETECTORS: UV-V ABSORBANCE, FLUORESCENCE, ELECTROCHEMICAL, REFRACTIVE INDEX, DISPERSION.

**UNIT 7.** LIQUID CHROMATOGRAPHY. CLASSIFICATION. ADSORPTION CHROMATOGRAPHY. STATIONARY PHASES. SEPARATION MECHANISM. MOBILE PHASE, ELUENT FORTÉ (0B).

**UNIT 8.** LIQUID-LIQUID OR DISTRIBUTION CHROMATOGRAPHY. NORMAL PHASE CHROMATOGRAPHY. REVERSE PHASE CHROMATOGRAPHY. MOBILE PHASE POLARITY INDEX. MECHANISM. APPLICATIONS. ION PAIR CHROMATOGRAPHY.

**UNIT 9.** ION EXCHANGE CHROMATOGRAPHY. TYPES OF EXCHANGE RESINS. ION EXCHANGE MECHANISM. SUPPRESSOR COLUMN CHROMATOGRAPHY.

**UNIT 10.** EXCLUSION CHROMATOGRAPHY. MECHANISM. PARAMETERS. APPLICATIONS.

**UNIT 11.** OTHER CHROMATOGRAPHS. AFFINITY CHROMATOGRAPHY. MATRIXES AND LIGANDS. BIOSPECIFIC AND NONSPECIFIC CIRCUMVENTION. SUPERCRITICAL FLUID CHROMATOGRAPHY.



PROPERTIES OF SUPERCRITICAL FLUIDS. INSTRUMENTATION. STATIONARY AND MOBILE PHASES. PRESSURE EFFECT. DETECTORS. COMPARISON WITH OTHER METHODS. ATTACHMENT TO MASS SPECTROMETRY: CHEMICAL IONIZATION UNDER ATMOSPHERIC PRESSURE. ELECTRO-SPRAY.

**UNIT 12.** ELECTROPHORESIS. ELECTROKINETIC PHENOMENA. ZONE ELECTROPHORESIS. FACTORS AFFECTING ELECTROPHORESIS. IMMUNOELECTROPHORESIS.

**UNIT 13.** POLYACRYLAMIDE GEL ELECTROPHORESIS. APPLICATION TO THE SEPARATION OF PROTEINS. NON-DENATURING CONDITIONS. FERGUSON REPRESENTATION. DENATURING CONDITIONS. P.A.G.E.-SDS. ESTIMATION OF MOLECULAR MASSES. TRANSFER MEMBRANES. ELECTROFOCUSING. TWO-DIMENSIONAL ELECTROPHORESIS.

**UNIT 14.** AGAROSE GEL ELECTROPHORESIS. APPLICATION TO THE SEPARATION OF NUCLEIC ACIDS. PULSED-FIELD ELECTROPHORESIS.

**UNIT 15.** CAPILLARY ELECTROPHORESIS. INSTRUMENTATION. MIGRATION AND PLATE HEIGHT IN E.C. ELECTROSMOTIC FLOW CHARACTERISTICS. E.C DETECTION ZONE. CAPILLARY ISOELECTRIC FOCUSING. CAPILLARY ELECTROCHROMATOGRAPHY. CAPILLARY CHROMATOGRAPHY. MICELLAR ELECTROKINETIC.

**UNIT 16.** SEDIMENTATION. SEDIMENTATION AND ULTRACENTRIFUGATION. TRANSPORT UNDER CENTRIFUGAL FORCES. LAMM EQUATION. SOLUTIONS TO THE LAMM EQUATION. SVEDBERG EQUATIONS. DETERMINATION OF MOLECULAR PARAMETERS. MULTICOMPONENT SYSTEMS. SEDIMENTATION EQUILIBRIUM. DENSITY GRADIENT EQUILIBRIUM.

## **PRACTICAL SYLLABUS**

**PRACTICE 1.** SEPARATION OF DNA FRAGMENTS BY ELECTROPHORESIS.

**PRACTICE 2.** HPLC

**PRACTICE 3.** POTENTIOMETRIC DETERMINATION OF PHOSPHATE IN A YEAST EXTRACT POWDER BY ION EXCHANGE CHROMATOGRAPHY.

**PRACTICE 4.** LIQUID GEL EXCLUSION CHROMATOGRAPHY.

## **READING**

- "Principios de Análisis Instrumental." (6ª Edición) Skoog-Holler. S.A. Ediciones Paraninfo, 2009.
- "Fundamentos de Química Analítica". Douglas A. Skoog, Donald M. West y F. James Holler. Editorial Reverté. 1997 (4ª Edición)
- "Técnicas de separación en Química Analítica". R. Cela, R.A. Lorenzo y M.C. Casais. Editorial Síntesis. 2002. (1ª Edición)
- "Técnicas Analíticas de Separación" M. Valcarcel, Ed. Reverte.
- "Técnicas de separación en química analítica". Rafael Cela, Rosa Antonia Lorenzo, Ma del Carmen Casais Ed. Síntesis, 2003
- "Análisis instrumental" Kenneth A. Rubinson, Judith F. Rubinson - 2001 Pearson Educación

