

BASIC DETAILS:

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| Subject: | GREEN AND SUSTAINABLE PHARMACY | | |
| Id.: | 30619 | | |
| Programme: | GRADUADO EN FARMACIA. PLAN 2008 (BOE 15/12/2008) | | |
| Module: | FARMACIA INDUSTRIAL Y BIOTECNOLOGÍA | | |
| Subject type: | OPTATIVA | | |
| Year: | 5 | Teaching period: | Primer Cuatrimestre |
| Credits: | 4 | Total hours: | 100 |
| Classroom activities: | 42 | Individual study: | 58 |
| Main teaching language: | Inglés | Secondary teaching language: | Castellano |
| Lecturer: | | Email: | |

PRESENTATION:

This subject deals with the environmental problem that pharmaceuticals and the industry generates. The student will learn to identify several environmental aspects and evaluate the impacts generated during the lifecycle of the pharmaceutical. Furthermore, the student will be able to provide actions that minimize the impacts. Being aware of the problem and being able to provide solutions is important, not only for the formation of the student as pharmacist but also due to the social concern.

PROFESSIONAL COMPETENCES ACQUIRED IN THE SUBJECT:

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| General programme competences | G01 | Capacidad de expresar opiniones y proponer argumentos con efectividad a nivel oral y escrito. Emplea eficazmente las destrezas lingüísticas para articular opiniones y formular argumentos eficazmente tanto oralmente como por escrito |
| | G03 | Capacidad el aprendizaje autónomo y el auto-crítica |
| | G05 | Capacidad de trabajo en equipo, contribuyendo activamente a los objetivos y a la organización de un equipo |
| | G06 | Capacidad de aplicar los conocimientos aprendidos a la práctica y en las destrezas que se pueden transferir al ámbito del trabajo |
| | G09 | Demostrar capacidad de innovación, creatividad e iniciativa |
| | G10 | Comprensión o conocimiento de los métodos generales de organización, gestión, administración planificación y dirección empresariales y su aplicación a los sector farmacéutico |
| Specific programme competences | E01 | Habilidades de utilización segura de medicamentos teniendo en cuenta sus propiedades físicas y químicas incluyendo cualquier riesgo asociado a su uso |
| | E03 | Habilidad para seleccionar las técnicas y procedimientos apropiados en el diseño, aplicación y evaluación de reactivos, métodos y técnicas analíticas |
| | E05 | Capacidad de estimar los riesgos asociados a la utilización de sustancias químicas y procesos de laboratorio |
| | E11 | Capacidad de estimar los riesgos biológicos asociados a la utilización de sustancias y procesos de laboratorios asociados a dicho uso |
| | E20 | Desarrollar análisis higiénico-sanitarios (bioquímico, bromatológico, microbiológicos, parasitológicos) relacionados con la salud en general y con los alimentos y medio ambiente en particular |
| | E21 | Evaluar los efectos de sustancias con actividad farmacológica |
| | E24 | Promover el uso racional del medicamento y productos sanitarios |
| | E31 | Actuar de acuerdo con los principios éticos y deontológicos y según disposiciones legislativas, reglamentarias y administrativas que rigen el ejercicio profesional |
| | E32 | Capacidad para reconocer y analizar problemas nuevos y planificar estrategias para resolverlos |
| | E36 | Capacidad para formular propuestas de transformación social desde un pensamiento crítico y constructivo |
| | E37 | Capacidad de actuación, decisión e iniciativa basada en las propias convicciones y en comportamientos éticos. |
| E70 | Conocimiento de la Relación existente entre medio ambiente y salud | |
| Learning outcomes | R1 | Ser consciente de la problemática medioambiental que los fármacos y su industria generan a lo largo del ciclo de vida del mismo, así como evaluar los impactos y proponer mejoras, desde distintos puntos de vista (industria, consumidor, sistema de salud). |
| | R2 | Evaluar experimentalmente la ecotoxicidad y biodegradabilidad de los fármacos, tratando |

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| | | matemáticamente los resultados e interpretándolos correctamente. |
| | R3 | Aplicar la metodología del análisis de ciclo de vida a un fármaco, utilizando las herramientas informáticas adecuadas e interpretando los resultados con rigurosidad, siendo consciente de la importancia de estas técnicas para la evaluación de los impactos medioambientales en la industria farmacéutica. |
| | R4 | Diseñar un proyecto de investigación y desarrollarlo en su totalidad, comunicando los resultados con rigurosidad. |
| | R5 | Aplicar los conocimientos adquiridos durante su formación como farmacéutico para idear, redactar y defender opiniones relacionadas con la presencia de los fármacos en el medio ambiente con coherencia. |

PRE-REQUISITES:

The activities of this course are based on the knowledge and skills acquired in previous courses. Students must ensure that executes and delivers the requested work and activities, including laboratory work, applying the skills acquired in previous courses.

SUBJECT PROGRAMME:

Subject contents:

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| 1 - What is Green and Sustainable Pharmacy |
| 1.1 - 1.Introduction |
| 1.2 - Environmental concern |
| 1.3 - Environmental problems caused by drugs and/or pharmaceutical |
| 1.4 - Environmental concepts |
| 1.5 - Green and Sustainable Pharmacy |
| 2 - Framework |
| 2.1 - Introduction |
| 2.2 - Environmental protection agency |
| 2.3 - Chemical regulation in Europe |
| 3 - Pharmaceuticals in the environment |
| 3.1 - Introduction |
| 3.2 - Environmental risk assesment |
| 3.3 - Ecotoxicology |
| 3.4 - Biodergadability |
| 4 - Greener Pharmacy |
| 4.1 - Traditional approach vs Green Pharmacy approach |
| 4.2 - Measuring "greenes" of a pharmaceutical process |
| 4.3 - Green Pharmacy toos |
| 4.4 - Green Chemistry Principles |
| 4.5 - Green Pharmacy in the industry |
| 5 - Life cycle of a pharmaceutical |
| 5.1 - Introduction |
| 5.2 - From public the health perspective |
| 5.3 - From the manufacturing industry perspective |
| 6 - Environmental Management System |
| 6.1 - Environmental Management System |
| 6.2 - Environmental management systems - Requirements with guidance for use (ISO 14001:2004) |

Subject planning could be modified due unforeseen circumstances (group performance, availability of resources, changes to academic calendar etc.) and should not, therefore, be considered to be definitive.

TEACHING AND LEARNING METHODOLOGIES AND ACTIVITIES:

Teaching and learning methodologies and activities applied:

Theoretical sessions

The theoretical sessions will be based on the active learning methodology. The lecturer will help students learning and progress by orally discussing some of the main theoretical content of the course, using ICTs and providing the needed resources. Collection of student exercises, problems and materials that must be carried out throughout the course as individual work, as well as guidelines and directions to execute them properly will be also provided. On the other hand, students will do a number of activities during the session that help to create a learning portfolio.

The methodology of the theoretical sessions will be the following:

- Learning outcome and evaluation criteria will be provided as well as subject content at the beginning of each session/ unit, including vocabulary and communicative language skills that will be practiced through the session/ unit.
- Some of the content will be lectured. However, the student will usually have to look for the information elsewhere through a number of projects or activities specifically designed for this aim.
- Finally, some activities, problems, cases or any other task will be completed by the student as the culmination of what he/ she has learned during the session/ unit.

Laboratory experiments

Students will have to design experiments, basing on the guidelines provided by the lecturer. Furthermore, the laboratory notebook will be written and results discussed. Student will have to demonstrate autonomy and self-confidence. After conducting experiments, students will perform the mathematical treatment of the results and set them out in a report that will include the discussion and interpretation.

Tutoring sessions

These sessions are designed for the student to solve any doubts that may arise in relation to the subject. In addition the student may request guidelines for learning in these sessions, as well as expanding literature. They may also be useful in performing the proposed activities and projects, since the teacher can monitor the progress of work and orient.

Student work load:

| Teaching mode | Teaching methods | Estimated hours |
|-----------------------------|-----------------------------------|-----------------|
| Classroom activities | Master classes | 14 |
| | Other theory activities | 10 |
| | Coursework presentations | 2 |
| | Laboratory practice | 16 |
| Individual study | Tutorials | 3 |
| | Individual coursework preparation | 7 |
| | Group coursework preparation | 14 |
| | Project work | 14 |
| | Portfolio | 20 |
| Total hours: | | 100 |

ASSESSMENT SCHEME:

Calculation of final mark:

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|------------------------|--------------|
| Written tests: | 30 % |
| Individual coursework: | 40 % |
| Trabajo experimental: | 30 % |
| TOTAL | 100 % |

*Las observaciones específicas sobre el sistema de evaluación serán comunicadas por escrito a los alumnos al inicio de la materia.

BIBLIOGRAPHY AND DOCUMENTATION:

Basic bibliography:

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| ANASTAS, Paul. WARNER, John. Green Chemistry. theory and practice. Oxford University Press, 2000 |
| SANGHI, Rashmi. SINGH, Vandana. Green Chemistry for Environmental Remediation. John Wiley |
| KÜMMERER, Klaus. HEMPEL Maximilian. Green and Sustainable Pharmacy. Springer, 2010 |
| WALKER, C.H. HOPKIN, S.P. Principles of ecotoxicology. Taylor Francis, 2012. |
| NEWMAN, Michael. UNGER, Michael. Fundamentals of ecotoxicology. Lewis Publisher. 3 rd Edition |

Recommended bibliography:

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| JORGENSEN, Sven Erik. Ecotoxicology: a derivative of encyclopedia of ecology. Elsevier Academic Press, 2010. |
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Recommended websites:

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| Norman network | http://www.norman-network.net/index_php.php |
| Institut Català de Recerca de l'Aigua Recerca i Innovació per a l'ús sostenible de l'aigua | http://www.icra.cat/ |
| Green Chemistry network | http://www.greenchemistrynetwork.org/ |
| Planta Pílogo de Química Fina. Universidad de Alcalá | http://www.ppqf.net/ |
| Center for Green Chemistry at Yale | http://www.greenchemistry.yale.edu/ |
| OECD Guidelines for the testing of Chemicals | http://www.oecd-ilibrary.org |

* Guía Docente sujeta a modificaciones