SUBJECT: ADVANCED DRUG DELIVERY

MATTER: Optional
MODULE: Module of Optional Subjects
STUDIES: Master in Pharmaceutical Chemistry

GENERAL FEATURES *
Type: ☐ Basic Training ☑ Compulsory ☑ Elective
☐ Master's thesis work, ☐ Outside practical

Duration: Semester Semester / s: 2
Number of ECTS credits: 5
Language / s: English

DESCRIPTION

BRIEF DESCRIPTION AND JUSTIFICATION (The meaning of the subject in relation to the studies. Between 100 and 200 words.)

This course aims to deepen the technological aspects of advanced drug delivery systems, with particular emphasis on understanding the transport of a drug and how this is affected by their physicochemical properties and the physiological barriers in the human body. At this point, the student is required to have some knowledge of chemistry and basic biology. After completing the course of Advanced Drug Delivery, it is intended that the student has knowledge of how to modify the administration of a drug by using different delivery systems and how this change affects their bioavailability and therefore their therapeutic properties.

The focus of the course will be eminently practical, where examples have a fundamental importance. In this sense, the course will be complemented by case studies to be discussed in class.

SKILLS (Of course you put in relation to the skills pre-assigned in the field.)

- To possess and understand knowledge to provide a basis or opportunity to be original in developing and / or applying ideas, often within a research context (CB6).
- That students can apply their acquired knowledge and capability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study (CB7).
- That the students are able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments (CB8).
- That students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences in a clear and unambiguous manner (CB9).
- That students have the learning skills to enable them to continue studying in a manner that may be largely self-directed or autonomous (CB10)
- Possess complementary skills useful for the practice of pharmaceutical chemistry (E20)
- Ability to recognize or related in some way with the practice of pharmaceutical chemistry that will be useful for the development of professional practice related disciplines (E21)

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- Ability to communicate in English and use English as a working language (T1)
- Ability to assess the impact of the use of chemistry in the sustainable development of society (T3)

PREREQUISITES * (Modules, materials, disciplines or expertise needed to track the subject. Contain subjects that must have been completed can be made.)

The corresponding to access master studies.

CONTENTS (Sections that make up the syllabus, to a second level of detail.)

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1. The reason for the Drug Delivery Systems
2. Fundamentals of Controlled Release Drug:
   2.1. Fundamentals of drug delivery
   2.2. Historical perspective and current needs
   2.3. Controlled release systems
   2.4. Nanomedicine
3. Pharmaceutical Applications:
   3.1. Administration, effectiveness and bioavailability: conventional vs controlled release
   3.2. Key factors for controlled drug delivery
   3.3. Aspects of pharmaceutical delivery systems
4. Drug Delivery Technologies
   4.1. Systems controlled by solvents
   4.2. Diffusion controlled systems
   4.3. Dissolution controlled systems
   4.4. Transdermal systems
5. Manufacturing Technologies of Advanced Delivery Systems
   5.1. Liposomes and lipid particles
   5.2. Nanoparticles, nanotubes and nanocomplexes
   5.3. Polymer-drug conjugates
   5.4. Matrix systems and drug eluting devices
6. Routes of Administration, Physiological Barriers and Rational Design of Advanced Delivery Systems
   6.1. parenteral
   6.2. Oral
   6.3. topical
   6.4. Pulmonary
   6.5. Others
7. Advanced Delivery Systems of Proteins and Nucleic acids
   7.1. Physiochemical properties of the therapeutic agent and its influence on the design
        of delivery systems
   7.2. Controlled release mechanisms
   7.3. Targeted delivery mechanisms
   7.4. Dosage forms
   7.5. Pharmacokinetics of advanced delivery systems

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8. Case Studies of Advanced Delivery Systems
   8.1. Study of a controlled release system in systemic therapy against cancer
   8.2. Study of a drug-eluting medical device: pharmacoactive stents

9. Regulatory Aspects of Advanced Delivery Systems
   9.1. Regulatory considerations
   9.2. Nanomedicines currently approved
   9.3. Nanomedicines in advanced clinical stages

**EXPLANATION OF TEACHING METHODOLOGY** (Justifying the teaching methods used in relation to the skills and contents of the subject. Between 100 and 200 words.)

The course consists of about 40-45 hours of lectures. All the material used during the lectures is delivered to the student. The presentation of the themes is complemented by discussion and resolution of problems and case studies.

At the end of Chapter 5, there will be a multiple choice exam. Students complete a group project on an advanced drug delivery system. At the end of the course, seminars about the presentation and discussion of the work done by students will be held. Finally, a final test will be performed.

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Optionally, there is the possibility of performing laboratory practices specific to this subject, especially in regard to the concepts described in Chapter 6, Manufacturing Technologies of Advanced Release Systems. Such practices shall be conducted in coordination with the other subjects. In the case of carrying out such practices, they will be presented publicly and the different results will be discussed.

- **Sessions of exposition of concepts**: Exposition of contents through presentation or explanation (possibly including demonstrations) by a professor.
- **Sessions solving exercises, problems and cases**: Solving exercises, approach / problem solving and presentation / discussion of cases by a professor with the active participation of students.
- **Seminars**: Statement made by a teacher in order to review, discuss and answer questions about materials and topics presented in the sessions of exposure sessions concepts and solving exercises, problems and cases.
- **Presentations**: Oral presentation to a teacher and possibly other students by a student. It can be a paper prepared by the student by searching the published literature or a summary of a practical or project undertaken by the student.
- **Activities of personal study by students**: Personal work required of the student to acquire the skills of each subject and assimilate the knowledge presented in the sessions of exposure sessions concepts and solving exercises, problems and cases, using, when necessary, the consultation recommended material.
- **Evaluation activities (testing, monitoring controls ...)**: Oral and / or written statements made during the course of a semester or after it.

### EVALUATION

**ASSESSMENT METHODS** * (Complete the table relating assessment methods, skills and weight in the course grade.)

<table>
<thead>
<tr>
<th>Evaluation Methods</th>
<th>%</th>
<th>Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Exam</td>
<td>50</td>
<td>E20, E21, T1, T3 / CB6, CB7</td>
</tr>
<tr>
<td>Follow-up exams</td>
<td>25</td>
<td>E20, E21, T1, T3 / CB6, CB7</td>
</tr>
<tr>
<td>Project and presentation</td>
<td>20</td>
<td>E20, E21, T1, T3 / CB8, CB9, CB10</td>
</tr>
<tr>
<td>Participation</td>
<td>5</td>
<td>T1, T3, CB8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td></td>
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</tbody>
</table>

**LEARNING OUTCOMES** *(Explanation of the embodiments that allow the student skills assessment, relating them to the skills and methods of assessment.)*

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• To demonstrate knowledge of the main types of drug delivery systems.
• Ability to associate the design of the various transport systems of drugs with their mechanism of action and therapeutic activity.
• To have knowledge of different release profiles and pharmacokinetics of different delivery systems.
• To be able to suggest designs of advanced drugs aimed at optimizing the pharmacokinetic properties of a drug and its biological activity.
• To demonstrate knowledge of the main approved products based on advanced drug delivery systems.

QUALIFICATION (Explanation of the computer system of the course grade.)

The grade of this course is obtained:

<table>
<thead>
<tr>
<th>Component</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Final Exam</td>
<td>50%</td>
</tr>
<tr>
<td>Follow-up exams</td>
<td>25%</td>
</tr>
<tr>
<td>Papers and presentations</td>
<td>20%</td>
</tr>
<tr>
<td>Participation</td>
<td>5%</td>
</tr>
</tbody>
</table>

Final exam (EF)
Follow-up exams (AS)
Project and presentation (T)
Participation (P)

The final grade is calculated using the results of the final examination (EF), the average test scores tracking (AS), the student’s work and its presentation (T) and class participation (P):

Grade = 50% EF + 25% AS + 20% T + 5% P

ASSESSMENT OF THE SKILLS (Define Calculation Expressions for each competency based assessment activities relevant.)

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Evaluation Methods</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context (CB6).</td>
<td>Final Exam Follow-up</td>
<td>EF 50% + 50% AS</td>
</tr>
<tr>
<td>Students can apply their broader (or multidisciplinary) acquired knowledge and ability to solve problems in new or unfamiliar environments within contexts related to their field of study (CB7).</td>
<td>Final Exam Follow-up</td>
<td>EF 50% + 50% AS</td>
</tr>
<tr>
<td>That the students are able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, includes reflections on social and ethical</td>
<td>Follow-up Project and presentation</td>
<td>75% T + 25% P</td>
</tr>
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<tr>
<th>Competencies</th>
<th>Evaluation Methods</th>
<th>Observations</th>
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<tbody>
<tr>
<td>responsibilities linked to the application of their knowledge and judgments (CB8).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences in a clear and unambiguous (CB9).</td>
<td>Project and presentation</td>
<td>T</td>
</tr>
<tr>
<td>Students should possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous (CB10)</td>
<td>Project and presentation</td>
<td>T</td>
</tr>
<tr>
<td>Possess complementary skills useful for the practice of pharmaceutical chemistry (E20) (E21)</td>
<td>Follow-up Project and presentation</td>
<td>50% AS + 50% T</td>
</tr>
<tr>
<td>Ability to communicate in English and use English as a working language (T1)</td>
<td>Project and presentation Participation</td>
<td>95% T + 5% P</td>
</tr>
<tr>
<td>Ability to assess the impact of the use of chemistry in the sustainable development of society (T3)</td>
<td>Project and presentation</td>
<td>T</td>
</tr>
</tbody>
</table>

**BIBLIOGRAPHY** *(Recommended and accessible to the student.)*

- Rebecca A. Bader, David A. Putnam, Engineering Polymer Systems for Improved Drug Delivery, Wiley 2014.
- Teacher Notes (available on the Blackboard platform, [http://iqs.blackboard.com](http://iqs.blackboard.com))

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HISTORICAL DOCUMENT

PREVIOUS CHANGES (Will display date and autor/s, the most recent first)
April 2015, Dr Salvador Borrós Gómez, Dr Víctor Ramos
September 2016, Dr Víctor Ramos

UPDATED (Indicated date and autor/s.)
October 2017, Dr Víctor Ramos

HISTORICAL DOCUMENT

PREVIOUS CHANGES (Will display date and author / s, the most recent first)
September 4, 2014, José I. Borrell
February 2, 2013, José I. Borrell

UPDATED (Indicate date and the author / s.)
September 26, 2016, José I. Borrell

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