Universidad Rey Juan Carlos

TEACHING GUIDE

PHARMACOLOGY

GRADO EN INGENIERÍA BIOMÉDICA (INGLÉS) (3º y 4º curso) (2374)

ACADEMIC YEAR 2026-27

Q2803011B UNIVERSIDAD REY JUAN CARLOS
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I.-Subject Identification	
Type	OBLIGATORIA
Teaching period	3 course, 1Q semester
Nº of credits	3
Language in wich the subject is taught	English

II.-Presentation

PHARMACOLOGY is the study of drugs, their actions, mechanisms, use and adverse reactions on the body. The use of drugs is essential in the approach to any pathology. The number of currently available drugs is continuously increasing, and therapeutic possibilities have grown exponentially thanks largely to a better understanding of the pathophysiology of illness, which has in turn allowed the detection of new pharmacological targets. The interaction of PHARMACOLOGY with BIOMEDICAL ENGINEERING is playing an increasingly significant role particularly in the following aspects:

- Uncovering new pharmacological targets requires the use of new technologies for the development of selective drugs. Molecular modelling and 3D design approaches are of particular relevance in this sense.
- One of the main objectives of biomedical engineering should be the search for new systems of drug administration and application, through the development of systems addressed, to the extent possible, to increase the efficacy of drugs reducing the possibility of side effects at the same time.
- The use of drugs as diagnostic tools to determine the characteristics of the pathology in a specific patient requires the use of safer and more efficient methods.

Therefore, in this subject the different systems and routes of administration, the way drugs work and their interaction with the organism both in physiological and pathological situations, will be described. Additionally, some of the main different pharmacological groups will also be studied, including their pharmacological characteristics, their indications, side effects and contraindications. In order to adequately understand the contents of this subject, basic knowledge on human physiology is required. To optimize academic performance, it is advisable to rely on the contents learnt in other subjects, such as physiology and biochemistry.

Important note: *The lectures will be taught according to institutional guidelines/to whatever the institution dictates, as far as possible, in an on-site format, especially regarding practical sessions and exams. In any case, in the event that follow-up of theory classes, activities or exams should be required remotely via the eCampus (Aula Virtual) or Microsoft Teams, it is necessary for the student to have a computer equipped with camera, microphone and internet access.*

III.-Learning outcomes

CG01 . Analyze and synthesize problems related to biomedical engineering, solve them and communicate them efficiently.
CE29. Understand the principles of functioning of an organism from the cellular level through the tissue level to the biological system level.
CE30. Understand the of the molecular bases of genetics and proteins, the concepts of microbiology, pharmacology and proteomics and their applications in biomedicine.
CE35. Use basic concepts of biotechnology applied to pharmacy and medicine.

- Key for degrees not adapted to RD 822/21: **CB** - basic competences, **CG** - generic competences, **CE** - specific competences, **CT** - transversal competences.
- Key for degrees adapted to RD 822/21: **CON** - knowledge, **COM** - competences, **HAB** - skills.

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IV.-Contents

IV.A.-Syllabus

Thematic block	Topic
Pharmacokinetics and pharmacodynamics	1. Introduction to the course. 2. Drug transport across biological membranes. Drug absorption. Pharmaceutical forms and routes of administration. 3. Distribution. Drug metabolism and excretion. Pharmacokinetic parameters. 4. Drug-receptor interaction. Mechanisms of drug action.
Pharmacological approaches categorized by the organ or system they primarily affect	1. Peripheral nervous system. 2. Central nervous system. 3. Cardiovascular system. 4. Digestive system. 5. Genito-urinary system. 6. Respiratory system. 7. Endocrine system. 8. Locomotor system. 9. Blood.
Other pharmacological approaches	1. Anti-inflammatory drugs. 2. Antibiotics and antiviral drugs. 3. Cancer chemotherapy. 4. Immunomodulatory drugs.

IV.B.-Training activities

Type	Title
Group work	Analysis and synthesis of information (scientific articles and others) provided by the teaching staff or new information on a topic that the student will have to look for. Small groupworks (4-6 students) supervised by the teaching staff. Presentation to the class.
Resolution of exercises, problems, case studies	Problem-solving exercises or questionnaires provided by the teaching staff in regards to the laboratory practicals and seminars.
Test and/or exams	Multiple-choice tests as specified in the Assessment Method section.
Theoretical sessions	Lectures and master classes of theory.
Practical sessions	Practical sessions and demonstrations on the methods, equipment and systems used for preclinical evaluation of new drugs.

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Academic tutorials	Monitoring group works (group tutorials) to resolve any questions, at least two tutorials per group (one initial and one throughout the preparation of the work); individual tutorials as requested by each student.

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V.-Student workload	
Theoretical sessions	20
Resolution of exercises, problems, case studies, etc.	3
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	4
Tests and/or exams	3
Academic tutorials	14
Related activities: conferences, seminars, etc.	10
Preparation of theoretical sessions and self-study	10
Preparation of practical tasks, exercises, case studies, projects, etc.	6
Preparation for tests and/or exams	20
Total student workload	90

VI.-Methodology and academic programme		
Type	**Period**	**Content**
Active methodologies or innovative teaching	Week 1 to Week 14	Problem-based learning. The teaching staff will introduce students to pharmacology research through videos or simulators. Then, they will pose specific exercises for the students to solve.
Active methodologies or innovative teaching	Week 1 to Week 14	Cooperative and collaborative learning. Students will organize in teams according to the instructions provided by the teaching staff. Then, the teachers will communicate the drug class each team has to work on and multiple-choice questions with five possible options will be elaborated by each group (one question per group member). By the end of the course, questions will be shared through the eCampus (Aula Virtual) and the final exam will include up to 25% of these questions.

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Active methodologies or innovative teaching	Week 1 to Week 14	Flipped classroom. Each team will choose a recent article describing original research (for example, the technical development of a device or a strategy and its testing in clinical or preclinical context) showing how biomedical engineering has solved or is trying to solve a problem related with pharmacology (improve drug delivery, efficiency, or safety; facilitate disease diagnosis; improve understanding of pathophysiology¿). Once the article has been selected, the team representative will send it to the teachers to check its adequacy to the objectives of the activity. The team will prepare a PowerPoint presentation to explain the contents of the selected and approved article. The PowerPoint presentation will include a background, hypothesis, objectives, methods, results and discussion, and conclusion. Each team will present their teamwork orally in the classroom to all classmates and attending teachers.
Other activities	Week 1 to Week 14	Reading scientific articles for the production of the group works or any other supplementary material to the master class of theory, seminars or practical sessions provided by the teaching staff.
Theoretical sessions	Week 1 to Week 14	Face-to-face lectures or master classes. Given the extent of the syllabus, only the study of some of the planned topics will be undertaken, but in a more extensive way and trying to highlight their relation with biomedical engineering. Every year the topics in block 1 will be studied, whilst the topics corresponding to blocks 2 and 3 could change (they will serve as representative examples of the different drug families).
Academic tutorials	Week 1 to Week 14	Follow-up of group works; individual tutoring will be offered and schedule agreed with the teacher when demanded. In case of request of individual academic tutorials outside class hours, this will require students to have a computer equipped with camera, microphone and internet access.

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

Seminars	Week 3 to Week 8	Dosage forms and routes of administration. Seminar given on site and completion of exercises on site, via eCampus (Aula Virtual) or through specific software applications.
Tests and/or exams	Week 5 to Week 14	Pharmacology examination during regular schedule (first mid-course exam) or at the schedule time assigned by the Vice-Rector for Academic Affairs (second mid-course exam, ordinary call for exams).
Practical sessions	Week 10 to Week 14	Preclinical evaluation of the drugs. Presentation by the teaching staff and demostrations through videos or simulators and the completion of specific exercises (see Active Methodology: Problem-based learning).
Group work	Week 3 to Week 14	Reading and presentation of a research work on a drug topic and its relation with biomedical engineering. Works will be carried out in groups of 4-6 students (see Active Methodology: Flipped classroom). The teaching staff will provide previous information (outline, scientific articles) based on which the students will look for further updates and elaborate a multimedia presentation, which will be presented to the class. Every group will have to hand a dossier with a register of what has been done during the monitoring sessions (see Academic Tutorials), a memo summary and the audiovisual presentation on the topic (video and Microsoft PowerPoint slides in Handout/Notes Pages form), a full list of references used for the production of the topic and examination questions on the topic (one question per student; see Active Methodology: Cooperative and collaborative learning).

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

VII.-Assessment methods

The general assessment method is continuous as established in the *Regulation for the Assessment of Learning Outcomes* of Rey Juan Carlos University.

All the assessment systems established in the degree report must be employed, except for those that have a minimum weight of 0%, which can be used by professors in the academic years they consider relevant. Each assessment system may be applied through one or more assessment activities, consistent with the system. No assessment activity can exceed individually 60% of the overall grade for the subject.

The sum of non re-evaluable activities cannot exceed 40% of the overall grade for the subject and, in general, should not have an established minimum grade (except for practical activities in which, strictly speaking, the conditions of the ordinary call cannot be reproduced in the extraordinary call).

Those students who do not manage to pass the subject in the ordinary call, or do not attend this first call, may attend the extraordinary call only for failed re-evaluable assessment activities.

The distribution and characteristics of the assessment activities are described below.

VII.A.-Description and weight of the assessment activities

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

CONTINUOUS ORDINARY ASSESSMENT:

The course will be evaluated by continuous assessment according to the following distribution of activities:

Assessment system	Re-assessable in the extraordinary evaluation period	Weight	Assessment method	Cut-off score	Content	Date
SE2 - Writing exam on the course concepts	Yes (individual evaluation activity)	70% In the ordinary period divided in two tests: i) Midterm exam (20% of the final score of the course) and ii) final exam (50% of the final score of the course)	Test (20%)	No cut-off score (cumulative scoring)	Block I and theorical content of the seminars	Ordinary teaching period
			Test (50%)	The cut-off score to pass the exam is 5/10 (equal to 60% of the questions correctly answered)	All the syllabus	Official call for exams
SE 5 - Practical/Laboratory report and presentation	No (cumulative scoring)	30%	Audiovisual presentation (10%)	No (cumulative scoring)	Work group activity related to the contents of the syllabus (same score for all of the members of the group). This activity will be evaluated using a pre-established rubric. The final score for this activity will be the average of the scores awarded by the different professors using said rubric	At the end of the ordinary teaching period (on-site activity)
			Presentation of a dossier (10%)	No (cumulative scoring)	Work group activity related to the contents of the syllabus (same score for all of the members of the group)	At the end of the ordinary teaching period (delivered via e-Campus/Aula Virtual)

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

			Practicals (10%)	No (cumulative scoring)	Attendance (a mandatory requirement for assessment). Individual problem-solving exercises and questionnaires provided by the teaching staff in regards to the laboratory practicals and seminars. This includes two 2-hour practical sessions (one on in vitro pharmacology and one on in vivo pharmacology) and one 2-hour seminar (on dosage forms and their routes of administration), which will be assessed through the evaluation of exercises or via a test or questionnaire	Right after the practicals (on-site activity and/or delivered via e-Campus/Aula Virtual)

Briefly, two exams will be carried out during the course (the sum of both makes 70% of the overall score of the course):

- Test 1. Multiple-choice exam. Each question with 5 different options, only one option per question is correct. There is no penalty marking but 5/10 points correspond to 60% of the questions correctly answered. The exam represents 20% of the overall score of the course. NOT RE-ASSESSABLE EXAM: it is part of the continuous evaluation of the student. There is no cut-off score. The score obtained in this exam will be added to those obtained in test 2 and in the rest of activities. Questions will correspond to the contents taught by the teaching staff during the first half of the course: Block I and theorical content of the seminars. Passing this exam (with at least 5/10 points) does not imply the examined material to be excluded from entering in test 2.
- Test 2: multiple-choice exam (each question with 5 different options, only one option per question is correct; there is no penalty marking but the cut-off score needed to pass the exam is set at 60%, which corresponds to 5/10 points); the exam represents 50% of the overall score of the course; RE-ASSESSABLE EXAM during the re-assessable exam period; be aware that the CUT-OFF SCORE to pass the exam is 5/10 (equal to 60% of the questions correctly answered) so may the student not be able to obtain that minimum score, they will have to take a re-assessable exam during the re-assessable exam period; questions will correspond to the contents taught by the teachers during the first half of the course (content of test 1), during the second half of the course, and to the materials of the topics presented by the students during the second half of the course (up to 25% of these questions will correspond to questions provided by the students in their dossier, as long as they are properly formulated).

The remaining 30% of the overall score of the course will correspond to:

- Audiovisual presentation of the topic produced by each work group (same score for all of the members of the group): 10%. NOT RE-ASSESSABLE ACTIVITY, NO CUT-OFF SCORE, no minimum score required for inclusion in the final grade calculation

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

(cumulative grading).
•Presentation of a dossier by each work group (same score for all of the members of the group): 10%. NOT REASSESSABLE ACTIVITY, NO CUT-OFF SCORE, no minimum score required for inclusion in the final grade calculation (cumulative grading).
•Practicals (individual): 10% (problem-solving exercises and questionnaires provided by the teaching staff in regards to the laboratory practicals and seminars). NOT RE-ASSESSABLE ACTIVITY, NO CUT-OFF SCORE, no minimum score required for inclusion in the final grade calculation (cumulative grading). However, in order to be assessed and receive the corresponding scores, attendance at these activities is mandatory.

Calculation of the final score:

The final score corresponds to the sum of the scores of the different activities, upon achievement of the cut-off score needed to pass the activity with cut-off score.

In order to pass the course it is compulsory:

1. to pass test 2 during the ordinary or extraordinary call for exams;
2. to obtain 5 out of 10 points as the sum of the scores obtained in the different activities (tests 1 and 2, practical activities, etc.).

Active participation in lectures, monitoring sessions, practicals and seminars may be considered for the final grading of the subject.

EXTRAORDINARY ASSESSMENT:

In the extraordinary exam call, only the reassessable test will be taken, according to the table above (test 2). Students will only sit for this test in the extraordinary assessment period if they did not pass the test or did not sit for it in the ordinary assessment period. To calculate the final score in this period, the sum of the scores of the activities passed in the continuous ordinary assessment period and the score obtained for the re-assessed activity will be used, as indicated in the previous section. The reassessment will take place on the official date indicated for the extraordinary examination period.

SPECIAL ASSESSMENT ARRANGEMENTS: They will be ruled according to that stipulated on Article 19 of the Regulations for assessment of learning outcomes of Universidad Rey Juan Carlos, approved June 12, 2024. The assessment method to be applied in this call will be the same as that previously described for this course.

VII.B. Assessment of students with academic exemption from class attendance

Having Academic Exemption from Class Attendance (DAAC) does not imply that students are automatically exempt from participating in the continuous assessment activities or in the training activities of compulsory attendance as established in the teaching guide. Once the exemption has been granted, students must contact the subject's teaching staff, who will propose the adaptations he/she may consider relevant, as long as they guarantee the acquisition and adequate assessment of the learning goals established. Students must maintain adequate communication with the teaching staff so that they may provide information on the dates for training and assessment activities, if these are not established in the programme and available for students at the time of achieving the exemption.

Subject with possibility of academic exemption: Yes.

VII.C. Review of assessment activities

In accordance with the Regulation for the Assessment of Learning Outcomes of Rey Juan Carlos University.

VII.D.-Students with a disability or special educational needs

In order to guarantee equal opportunities, non-discrimination, universal accessibility and academic success, students with disabilities or especial education needs may request curricular adaptations to follow their studies. These adaptations will be provided by the Unit of Attention to People with Disabilities of Rey Juan Carlos University, in accordance with the regulation which regulates the service for the Attention of People with Disabilities at the University. This Unit will issue a report for curricular adaptations, so that students with disabilities or special education needs must contact the service (at e-mail discapacidad.programa@urjc.es) in order to provide relevant information for different educational alternatives.

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c55626f6708d029b46df954025f.

VII.E.-Academic behaviour, academic integrity and honesty

Rey Juan Carlos University is fully committed to the highest standards of academic integrity and honesty, so studying at the URJC means assuming and subscribing to the values of integrity and academic honesty set out in the University's Ethical Code. To support this process, the University has Rey Juan Carlos University's Academic Conduct Regulation as well as different tools (anti-plagiarism, supervision...) that offer a collective guarantee for the full development of these essential values.

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

VIII.-Teaching resources and materials

Basic bibliography

- Lorenzo Fernández P, Moreno González A, Leza Cerro JC, Lizasoain Hernández I, Moro Sánchez MÁ, Portolés Pérez A. "Velázquez. Farmacología Básica y Clínica" (19ª ed.). Madrid: Editorial Médica Panamericana; 2018. ISBN: 978-8411060585. *(Library on Alcorcón Campus*: 615 FAR BAS; 6 copies in Spanish. *Online access*).
- Flórez Beledo J, Armijo Simón JA, Mediavilla Martínez A. "Farmacología Humana" (6ª ed.). Madrid: Elsevier Masson; 2013. ISBN: 978-8445823163. *(Library on Alcorcón Campus*: 615 FAR HUM; 9 copies in Spanish. *Online access*).
- Ritter JM, Flower RJ, Henderson G, Loke YK, MacEwan D, Rang HP. “Rang y Dale. Farmacología” (9ª ed.). Madrid: Elsevier; 2020. ISBN: 978-8491135586. *(Library on Alcorcón Campus*: 615 RAN phar; 3 copies + 4 copies in Spanish).
- Brunton LL, Hilal-Dandan R, Knollmann BC. "Goodman &Gilman. Las bases farmacológicas de la terapéutica" (13ª ed.). Madrid: MacGraw Hill-Interamericana de España; 2019. ISBN: 978-1456263560. *(Library on Alcorcón Campus*: 615.01/.03 GOO BAS; 5 copies in Spanish. *Online access*).

Consultation bibliography

ONLINE RESOURCES:

- Agencia Española de Medicamentos y Productos Sanitarios: https://www.aemps.gob.es/
- Brithish Pharmacological Society:https://www.bps.ac.uk/
- Vidal Vademecum Spain: https://www.vademecum.es/
- Sociedad Española de Farmacología: https://www.socesfar.es/
- PubMed: https://pubmed.ncbi.nlm.nih.gov/

FILMS AND DOCUMENTARIES ON CLINICAL TRIALS:

- **Antiparkinsonian drugs**: *Director*: Marshall P. *Title*: Awakenings. *Year*: 1990. *Duration*: 121 min. *Type*: film. (*Library on Alcorcón Campus*: DVDO-23, DVDO-277, DVDO-280, DVDO-319; *Library on Fuenlabrada Campus*: DVD-10528)
- **Chemotherapy agents**: *Director*: Ireland D. *Title*: Living proof. *Year*: 2008. *Duration*: 128 min. *Type*: film. (*Library on Alcorcón Campus*: DVDO-369, DVDO-370, DVDO-371, DVDO-372, DVDO-373, DVDO-374).
- **Antidepressants**: *Director*: Wates M. *Title*: Magic Medicine. *Year*: 2018. *Duration*: 79 min. *Type*: documentary.
- **Antidiabetics**: *Director*: Hepner L, Mossman G. *Title*: The human trial. *Year*: 2022. *Duration*: 91 min. *Type*: documentary.

SUMMER READINGS:

- **Antiparkinsonian drugs**: Sacks O. Awakenings (Picador Collection). Pan MacMillan: London (UK): Pan MacMillan; 2023. ISBN: 1529087430. (*Library on Alcorcón Campus*: 616.831 SAC AWA).
- **Opioids**: Keefe PR. Empire of pain. London (UK): Palgrave MacMillan; 2021. ISBN: 1529063078. *(Library on Alcorcón Campus*: N KEEP IMP; 2 copies in Spanish).
- **Chemotherapy agents**: Bazell R. Her-2: The making of herceptin, a revolutionary treatment for breast cancer. New York (USA): Random House Publishing Group; 1998. ISBN: 0812991842.

IX.-Professors

Name and surname	ANA BAGÜES ARIAS
E-mail address	ana.bagues@urjc.es
Department	Ciencias Básicas de la Salud
Campus	Fuenlabrada
Category	Profesor/a Permanente Laboral
Academic degree	Doctor
Person responsible for the subject	No

Q2803011B UNIVERSIDAD REY JUAN CARLOS
Fecha firma: 14/11/2026 18:56 | Hash: 8947d0c5562f6708d029b46df954025f.

Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	1
Number of sexennia	1
No. of positive evaluations by Docentia	3
Name and surname	MIGUEL ÁNGEL MARTÍNEZ GARCÍA
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Department	Ciencias Básicas de la Salud
Campus	Fuenlabrada
Category	Profesor/a Ayudante Doctor/a
Academic degree	Doctor
Person responsible for the subject	Yes
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	2
Number of sexennia	1
No. of positive evaluations by Docentia	2
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Department	Ciencias Básicas de la Salud
Campus	Fuenlabrada
Category	Catedrático/a de Universidad
Academic degree	Doctor
Person responsible for the subject	No
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	5
Number of sexennia	4
No. of positive evaluations by Docentia	6

Q2803011B UNIVERSIDAD REY JUAN CARLOS
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