VNIVERSITAT DE VALÈNCIA

Course Guide
34101 Radiopharmacy

COURSE DATA

Data Subject	
Code	34101
Name	Radiopharmacy
Cycle	Grade
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1201 - Degree in Pharmacy	Faculty of Pharmacy and Food Sciences	5	First term

Subject-matter

Degree	Subject-matter	Character
1201 - Degree in Pharmacy	34 - Radiopharmacy	Optional

Coordination

Name	Department
PEREZ GIMENEZ, FACUNDO	315 - Physical Chemistry

SUMMARY

Radiopharmacy is a course dedicated to the study, preparation and control of radiopharmaceuticals and other radiopharmaceuticals products and performing analytical techniques that use radioactivity measurable quantity. It is legally recognized as a speciality pharmaceutical hospital.
We begin by describing the general concepts of nuclear stability, radioactive decays rates and kinetic parameters, later to the mechanisms of interaction with the material and analyze the methods of detection and protection.
We describe the methods of obtaining radionuclides used in hospitals and diagnostic applications and /or treatment, also including immunoanalitical methods.

In the development of the subject, the aim is to make the student aware of the proper treatment of radioactive waste generated in the hospital and industrial environment, as well as the optimization of the production methods of radioactive elements for health purposes, as an essential part of their adaptation to the sustainable development goals (SDGs).

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is very convenient for students demonstrating basic knowledge of chemistry, physics and instrumental techniques.

OUTCOMES

1201 - Degree in Pharmacy

- Reinforce the acquisition of the general competences of the Curriculum of Degree in Pharmacy.
- Obtain, analyze, control and produce drugs whose composition involved radioactive elements (radiopharmaceuticals), are of interest and health of human or veterinary use.
- Assess the toxicity and therapeutic radiopharmaceuticals, and their safe use, taking into account their physical, chemical and radioactive substances, including any risks associated with its use.
- Prepare and dispense radiopharmaceuticals in the hospital, ensuring quality.
- Develop clinical analysis using radiochemical techniques and given their opinions of the laboratory diagnosis.

LEARNING OUTCOMES

The skills acquired in this area must demonstrate that the student has acquired the knowledge, skills and abilities essential for the normal development of the activity of the Pharmacist in reference to the use of radioactive materials for therapeutic and /or diagnoses in both hospital setting and in industry:
• Obtain, analyze, control and produce drugs whose composition involved radioactive elements (radiopharmaceuticals), are of interest and health of human or veterinary use.
• Assess the toxicity and therapeutic radiopharmaceuticals, and their safe use, taking into account their physical, chemical and radioactive substances, including any risks associated with its use.
• Prepare and dispense radiopharmaceuticals in the hospital, ensuring quality.
• Develop clinical analysis using radiochemical techniques and given their opinions of the laboratory diagnosis.

DESCRIPTION OF CONTENTS

1. RADIOPHARMACY: Concept

RADIOPHARMACY: Concept. Pharmaceutical speciality.

2. RADIOACTIVITY: Nature. Classification of Radioactive decay. Kinetics of radioactive decay

RADIOACTIVITY: Nature and origin. Classification of Radioactive decay. Kinetics of radioactive decay. Absolute units and specific activity. Relationship between activity and mass

3. DECAY OF RADIONUCLIDES MIXTURE

DECAY OF RADIONUCLIDES MIXTURE: Not genetically related. Genetically related: Equilibrium secular and trasient.

4. INTERACTION OF PARTICLE-RADIATION WITH THE MATTER

INTERACTION OF PARTICLE-RADIATION WITH THE MATTER: Specific ionization. Penetrating power. Interaction of alpha particles. Interaction of beta particles. Interaction of gamma radiation.

5. RADIOACTIVITY DETECTORS

RADIOACTIVITY DETECTORS: Photo Detectors. Ionization chambers. Detectors of solid and liquid scintillation. Semiconductor detectors

6. PRODUCTION OF RADIONUCLIDES

PRODUCTION OF RADIONUCLIDES: Reactors: neutron activation and fission reaction. Cyclotron. Generators: Generator 99Mo / 99mTc. Quality control: physical, chemical, radiological and biological

7. RADIOTRACER OF CLINICAL APPLICATIONS

RADIOTRACER OF CLINICAL APPLICATIONS: Characteristics. Labeling techniques. Degradation and conservation of radioactive tracers.

8. RADIOPHARMACEUTICALS GENERAL CHARACTERISTICS

RADIOPHARMACEUTICALS: Ideal characteristics. Mechanism of action. Factors influencing the design of radiopharmaceuticals. ADME characteristics. Classification.

9. RADIOPHARMACEUTICALS CONTROL OF QUALITY

RADIOPHARMACEUTICALS CONTROL OF QUALITY:
- Physicochemical Controls: shape, size, and number of particles, pH, tonicity.
- Radiological Controls: radioactive concentration, purity radionuclidic, radiochemical purity, specific activity.
- Biological controls: sterility, non-pyrogenic and toxicity.

10. INTERACTIONS OF RADIOPHARMACEUTICALS

INTERACTIONS OF RADIOPHARMACEUTICALS: Positive and negative interactions. Contraindications

11. TECHNETIUM RADIOPHARMACEUTICALS

TECHNETIUM RADIOPHARMACEUTICALS: Collection and quality control. Applications.

12. IODINATED RADIOPHARMACEUTICALS

IODINATED RADIOPHARMACEUTICALS: Collection and quality control. Applications.

13. OTHER RADIOPHARMACEUTICALS OF INTEREST

OTHER RADIOPHARMACEUTICALS OF INTEREST: Radiopharmaceuticals of diagnostic use and therapeutic use.

14. POSITRON EMISSION RADIOPHARMACEUTICALS

POSITRON EMISSION RADIOPHARMACEUTICALS: Features, synthesis and applications. Description of the PET technique.

15. RADIOIMMUNOANALITICAL TECHNIQUES

RADIOIMMUNOANALITICAL TECHNIQUES: RIA. IRMA. Applications.

16. LAW AND REGULATIONS

LAW: Laws and recommendations applicable in Radiopharmacy. Radiological quantities and units. Dose limits. Biological effects. Protection Standard

17. PRACTICE

-Gamma spectrometry: Overview of instrumentation. Realization of spectra and identification of emission sources
-Statistics of Counting: measures of activity and mass estimate of radioactive elements.
-99Mo/99mTc Generator: Elution. Control. Variation-time activity.
-RIA-IRMA Analysis: calibration curves and determination of concentrations.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	14,00	100
Tutorials	3,00	100
Seminars	0,50	100
Attendance at events and external activities	5,00	0
Development of group work	3,00	0
Development of individual work	3,00	0
Study and independent work	20,00	0
Readings supplementary material	3,00	0
Preparation of evaluation activities	8,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	3,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The subject’s development is arranged around four types of activities: The theoretical classes, the laboratory practical classes, the tutorials and the work presentations.

Theoretical Classes. The students must acquire the basic knowledge according to the program outlined above mainly by their individual study as well as the master classes attendance. In such magisterial classes, the teacher will draw, during two hours per week, a global picture of the Program: He will emphasize the key concepts allowing the student a correct understanding of the matter and will respond any questions the students may pose. The students will have at their disposal a basic and complementary bibliography, web sites of interest and supporting computer material. They will also be trained so that they can use all this information in the most profitable way possible. Moreover, they will have available a virtual classroom with supplementary material in order to ease their study.

Laboratory Classes. First of all, the students must read and understand well the classes in advance, the fundamentals and development of each one and every experiment included in the practical notebook.

Once in the laboratory, the teacher will expose briefly the principal aspects of the experiment to carry out and will answer any question from the students.

After the experimental procedure is ended, the student will analyze the results achieved and will perform the corresponding calculations on the lab. computers.

Finally he will present a memory over all the results and features at the laboratory while he was in there. The student must not only explain the correct results but, whether necessary, will also explain the possible failures. Such a memory will be graded by the teacher who will also put an exam to fully evaluate the student's comprehension of the matter.

Tutorials. The students will attend the tutorials during 3 sessions of 1 hour each. Thereby the possible doubts and /or suggestions of the students will be answered. Furthermore, the teacher will also propose them additional or alternatives ways to reinforce knowledge acquired.

Seminars. The students, arranged in groups of six member each, may choose to elaborate and expose a work about any of the monographic themes proposed by the teacher.

EVALUATION

The students' evaluation will have into account all aspects mentioned in the previous items, particularly in the *Methodology*, and it will be realized by the teacher continuously.

A 15% of the global rating will come from continuous assessment (questionnaires, problems workshops, tutorials, preparation and exposition of works, assistance,...).

At the end of the semester a written exam consisting of theoretical and practical questions, will be put. The exam should be sufficient to evaluate the student's progress in assimilating the new concepts as well as his synthetic and expositive abilities. The theory mark will cover 60% of the global mark.

The laboratory practical sessions are obligatory and will account for 25% of the whole mark. The evaluation will take place through an exam over the actual details of the practical classes development as well as over conceptual issues. The obligatory memory made by the students will also be considered for the final lab's mark.

The passing mark is 5 points out of a maximum of 10. The final mark is obtained as the result of the application of the following algorithm:

FINAL MARK = THEORY x 0,60 + PRACTIQUES x 0,25 + EVALUATION CONT. x 0,15

Students who do not take the final exam of theory, will be qualified in the first convocatory record as "NOT FILED". In the second call, the score will be "FAILURE" if they had participated in any of the measurable academic activities outlined in this guide.

REFERENCES

Basic

- FUNDAMENTALS OF NUCLEAR PHARMACY. Gopal B. Saha. Ed. Springer.
- RADIOFARMACIA: TRAZADORES RADIACTIVOS DE USO CLÍNICO. Jesús Mallol. Ed. Interamericana Mc.Graw-Hill.
- THE HANDBOOK OF RADIOPHARMACEUTICALS. Azuwuike Owunwanne, Mohan Patel y Samy Sadek. Ed. Chapman & Hall Medical.
- MANUAL DE RADIOFARMACIA. Jesús Mallol. Ed. Díaz de Santos.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contents

All the contents programmed in the teaching guide for the theory sessions, practices, seminars, and tutorials are maintained.

2. Workload and schedule

All the aspects included in the teaching guide regarding the volume of work and are maintained.

3. Teaching methodology

All aspects cited in the guide are maintained. The teaching material necessary for the development of the activities will be uploaded to the virtual classroom: Powerpoint and complementary annexes, Recorded transparencies and Videoconference Tutorials.

4. Evaluation

The criteria included in the teaching guide are maintained.

5. Bibliography

The recommended references remain.