Universidad Zaragoza

Academic Year/course: 2021/22

66861 - Advanced tools for diagnosis and prevention

Syllabus Information

Academic Year: 2021/22
Subject: 66861 - Advanced tools for diagnosis and prevention
Faculty / School: 105 - Facultad de Veterinaria
Degree: 617 - Master's in Global Health: Integration of Environmental, Human and Animal Health
ECTS: 6.0
Year: 1
Semester: Annual
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The subject and its expected results respond to the following approaches and objectives:

The main goal of the course is the handling and integration of diverse molecular, microbiological, anatomopathological and imaging techniques for their application to the diagnosis and prevention of diseases. The theory sessions will introduce the student to the basics of the tools and their applications. The theory will be interspersed with practice sessions, where this knowledge will be applied to the design of new diagnostics or vaccines and to the interpretation of results.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the subject learning goals provides training and competence to contribute to some extent to its achievement:

- Goal 3: Good Health and Well-being

- Goal 4: Quality Education

- Goal 9: Industry, innovation and infrastructures

1.2. Context and importance of this course in the degree

This course is part of the University Master in One Health: Integration of Environmental, Human and Animal Health. This master contemplates an interdisciplinary approach to the study of health. This approach seeks to integrate epidemiological, environmental and molecular tools to understand the dynamics of diseases. It is an elective subject within the specialty of Translational Research that provides basic and indispensable knowledge to use, interpret and design the current tools of diagnosis and prevention. It complements other subjects in the specialty such as "Omics tools in the study of health" or "Experimental models of disease", and also provides knowledge of the bases and interpretation of diagnostic and prevention results to students seeking a more general training in health.

1.3. Recommendations to take this course

It is recommended that the student has previous knowledge of Genetics, Biochemistry and Microbiology.

2. Learning goals

2.1. Competences

By taking this course the student will achieve the following specific skills:

- Understand and know how to apply different methods of microbiological, molecular and anatomopathological diagnosis of the disease.
- Apply standards and good laboratory practice to different diagnostic methods.
- Apply advanced imaging techniques in research and their applications in human and animal health.
- Understand the basis of personalised medicine.
- Understand the processes involved in the development and production of vaccines.

2.2. Learning goals

If students complete the course, they should be able to:

- Know how to apply the usual and advanced microbiological identification methods, reference methods and ISO and good practice standards to make a proper diagnosis.
- Understand the new diagnostic tools based on image or molecular analysis.
- Understand the process of designing and producing vaccines.
- Identify new non-vaccine preventive methods.
- Understand the application of pharmacogenomics in personalized treatment.

2.3. Importance of learning goals

The course contemplates the learning of the bases, design and interpretation of the results of the most advanced diagnostic and prevention tools. This learning is key for a health professional, both in its more clinical aspect for the interpretation of results, and in its research aspect for the development of new diagnostics or vaccines. In addition, the tools learned can be applied to other more basic aspects of health research such as the study of the molecular mechanisms underlying pathologies, the development of new treatments or specialized medicine.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that he/she has achieved the intended learning outcomes through the following assessment activities:

ACTIVITY 1: WRITTEN TEST FOR THE THEORETICAL EVALUATION

A final written test will be undertaken based on the answer to 20 multiple choice questions. It will evaluate the acquisition of basic theoretical knowledge of the subject.

The grade of this final written test will be between 0 and 10 and will represent 30% of the final grade of the course.

ACTIVITY 2: WRITTEN TEST FOR THE PRACTICE EVALUATION

At the end of each practice session, the student will have to fill out a questionnaire to assess whether he or she has acquired the skills wanted.

The evaluation of the set of practices, will be between 0 and 10, will be 20% of the final mark. This evaluation can be carried out via telematics using tools available at the University of Zaragoza (Moodle, etc.).

ACTIVITY 3: WORK ON PROBLEM SOLVING AND CASES

By groups, students will have to demonstrate their ability to interpret results from different diagnostic tests by solving a given clinical case. They will have to present the resolution of the case in a written report or using educational ICT tools.

The grade for this activity will be between 0 and 10 and will represent 20% of the final grade of the course.

ACTIVITY 4: THEORETICAL WORK AND WRITTEN PROJECTS

This activity supposes the continuation of the resolution of problems and cases. The same group that performs the diagnosis of activity 3 has to present, at the end of the course, a work in which they make a bibliographic review of the different tools used in the diagnosis and prevention of the disease diagnosed in the clinical case (activity 3).

This theoretical work has to be presented in a written report and in the classroom in a session reserved for it.

The grade for this activity will be between 0 and 10 and will represent 30% of the final grade of the course. This grade will take into account the following aspects:

Proven knowledge and understanding of the methodologies described (30%)

Bibliographic review: search, understanding and interpretation of preventive measures (30%).

Oral and written presentation quality (40%)

The tools available in the ADD of the University of Zaragoza (Moodle, etc.) may be used for the presentation of written reports. The coordination of the subject will set the dates for the delivery of the different tasks and the presentation of the cases / works. These dates will be available at the beginning of the course.

Summary table of the evaluation activities and their reflection in the student's final grade:

Assessment activities	Assessed contents	% Final grade

Written test 1	Theory session	30 %
Written test 2	Practice session	20 %
Theoretical work	Autonomous search for information and report writing	30 %
Case resolution	Group work for the resolution of practical cases.	20%

Global assessment: Students who have not chosen the continuous assessment or who have not passed the subject by this procedure will have the right to sit for a global assessment that will consist of a written test that assesses the theoretical and practical contents of the subject. This test will have a score between 0 and 10 points. Assessment criteria: the written test will suppose 100% of the final grade. The test will take place in the official exam period of the University of Zaragoza.

Grading system: in accordance with the Regulation of Learning Assessment Standards of the University of Zaragoza (Agreement of the Governing Council of 22 December 2010), the results obtained by the student will be graded according to the following numerical scale from 0 to 10, with the expression of one decimal place, to which the corresponding qualitative grade may be added:

0-4.9: FAIL.

5.0-6.9: PASS

7.0-8.9: GOOD (NT).

9.0-10: EXCELLENT (SB).

Students with a grade over 9.0 might be awarded with honours and it could be given to more than the 5% of the enrolled students during the academic year.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this subject is based on:

The course is structured in 7 thematic sections that include 15 theoretical topics and 8 practice sessions. As a result, a total of 42 hours of theory will be taught, including, as far as possible, practical examples. In a face-to-face session, the coordinator will explain the systematics for the resolution of cases applying the theoretical / practical knowledge. It has been calculated that, for the preparation of the theoretical exam and the resolution of the cases, 58 hours of the student's autonomous work will be required.

The student will take 16 hours of face-to-face practice sessions. These hours have been divided into 8 practice sessions with a variable duration depending on the subject matter. The student will have to answer a questionnaire at the end in which it will be reflected if he/she has acquired the skills wanted.

Finally, students will have 2 hours to present the resolution of clinical cases and the theoretical work and the associated group task will involve 30 hours of autonomous work.

Summary table of the time distribution in the different learning tasks

Activity	**Face-to-face(h)**	**Off-site (h)**
Lecture	42	0
Solving case assignment	2	28
Practice sessions	16	0
Theoretical work assignment	0	30
Autonomous work	0	30
Assessment test	2	0

4.2. Learning tasks

The syllabus offered to the student to help him/her achieve the expected results includes the following activities:

The participatory lectures will be given in the classroom, although some of them, because of the contents they address or because they are closely related to practical sessions, will be held in the computer room. Before the beginning of the classes, didactic material will be provided, with enough time, to be used by students. Lectures will be held in a single group.

Some assignments (Problem solving and case studies) will consist on the application of the theoretical and practical concepts acquired throughout the course in the resolution of a real clinical case. Students will work in groups and present the resolution of the case at the end of the course.

Practice sessions will be divided into 8 sessions and will have a variable duration depending on their nature. These sessions will take place in the computer room, teaching laboratories or necropsy room. In principle, this activity will be carried out in a single group. If the number of students exceeds 15, they will be divided into two groups.

The assignments will be done individually or in groups. The teachers will provide the necessary documentation and will tutor the students on their work.

The student will need to work independently to study the theoretical topics of the course, the bibliographic search and preparation of papers.

Finally, an evaluation of the assignment will be made by two teachers, and of the theoretical contents by means of a written exam. This will be prepared and evaluated by the different teachers participating in the subject.

4.3. Syllabus

LECTURES:

The course will address the following topics:

SECTION I: INTRODUCTION AND BASIC MOLECULAR TOOLS

Topic 0: Introduction.

Topic 1: Tools based on the detection of nucleic acids. Classic PCR. Quantitative or Real Time PCR (qPCR). Applications of qPCR in microbiological diagnosis. Digital PCR. Digital PCR applications. Non-PCR based nucleic acid amplifications. Unamplified hybridization methods.

Topic 2: Tools based on protein analysis. Antibody-based tools (Western Blotting, ELISA, Immunohistochemistry). Applications in the diagnosis of infectious diseases. Specific techniques for the study and diagnosis of prions PMCA, RTQuick.

SECTION II: MICROBIOLOGICAL DIAGNOSTIC TOOLS

Topic 3: Diagnosis of microorganisms in tissues. Identification of injuries associated with different microorganisms. Rapid diagnostic techniques.

Topic 4: Phenotypic diagnosis of microorganisms. Microbial identification by biochemical and phenotypic tests. Automated microbial identification processes (API and Vitek systems). Yeast and fungus diagnosis.

Topic 5: Genotypic diagnosis of microorganisms. Species identification: analysis of 16S-rRNA, STIs, other genes. Strain identification: PFGE, fingerprints, VNTE, MLST, ribotyping, genome sequencing. Malditoff.

Topic 6: Molecular epidemiology. Application of the common methodologies used in molecular epidemiology (PFGE, RFLP, MIRU-VNTR, MLST, WGS) on different diseases: Tuberculosis, COVID-19, nosocomial infections, etc.

SECTION III: REFERENCE DIAGNOSTICS

Topic 7: Regulation and Reference Diagnostics. Taking and sending samples rules. ISO standards: Accreditation of laboratory methods with PCR. Reference diagnostics with PCR: GMO, species, microorganisms WHO and OIE regulation. Good Laboratory Practice Standards. ISO 17025.

SECTION IV: BIOMARKERS AND PERSONALIZED MEDICINE

Topic 8: Biomarkers. Classification: according to the stage of the disease, according to the nature of the molecule, according to other criteria. Validation of biomarkers.

Topic 9: Personalized medicine. What is exactly Personalized Medicine? Sources of useful data and tools in Personalized Medicine. Omic Sciences. Pharmacogenomics: Concepts on Pharmacogenomics: Pharmacogenomic: tests applied in clinical and useful in therapeutics. Pharmacometabolomics

SECTION VI: TRANSFER TO CLINICAL PRACTICE

Topic 10: Transfer of research results. Projects in collaboration with companies for the transfer of knowledge to society Evaluation of results (Patents and/or industrial secrets). Industrial PhD. Creation of technology-based companies.

SECTION V: VACCINE ENGINEERING

Topic 11. Vaccine design. Concepts. Types of vaccine formulations. Generation of vaccines: conventional methods and genetic engineering. Delivery systems and adjuvants.

Topic 12. Research and Development of new vaccines against tuberculosis. Molecular characterization of vaccines against tuberculosis by omics (lipids, proteins, NGS, ChIP-seq, etc.), immunological characterization in animal models.

Topic 13. Strategies for vaccine formulation. Concepts. New and conventional tools for the search of vaccination candidates. Recombinant LPS technology.

Topic 14. Vaccine safety. Local and systemic reactions. Vaccine failure. Risk-benefit assessment.

SECTION VI: OTHER PREVENTION and IMAGE DIAGNOSIS TOOLS

Topic 15: Non-vaccine alternatives to antibiotic use. The role of micro-biota, phage therapy, probiotics, prebiotics and symbiotics

Topic 16: Diagnosis image. Introduction to Preclinical Molecular Imaging and its Applications in Biomedical Research. Modalities of diagnosis and monitoring by image: Nuclear imaging (PET y SPECT). Computerized Tomography (CT). Ultrasound / Ultrasound Scanner / Laser doppler. Nuclear Magnetic Resonance (RMN). Optical Imaging (Fluorescence / Bioluminescence).

PRACTICE SESSIONS

Practice session I. Design and analysis of qPCR results

Estimated duration: 3 hours.

Room: Computer room.

Contents: Use of online databases and software. Design of primers and probes. Analysis of gene expression results

Activities carried out by the student:

- Nucleotide sequence search in databases
- Use of software for the design of primers and probes
- Use of software for the analysis of qPCR experiments
- Treatment of raw qPCR results
- Differential expression analysis using real data.
- Written test: practice questionnaire.

Practice session II. Protein analysis

Estimated duration: 2 hours.

Room: Molecular Biology Laboratory of the Research Centre for Transmissible Spongiform Encephalopathy and Emerging Animal Diseases (CIEETE), computer room

Contents: Analysis of Western Blott, immunohistochemistry, ELISA and PMCA results

Activities carried out by the student:

- Visit to the CIEETE Molecular Biology lab
- Analysis of western blot and IHC results using Image J software
- Interpretation of the results of the techniques
- Written test: practice questionnaire

Practice session III: Anatomopathologic Diagnosis I: Necropsies

Estimated duration: 2 face to face hours

Room: Necropsies Room of the Veterinary Faculty. Contents: Diagnostic necropsies.

Activities carried out by the student:

- Performing diagnostic necropsies.
- Written test: practice questionnaire

Practice session IV: Anatomopathologic Diagnosis II: quick and histological techniques

Estimated duration: 3h.

Room: Laboratories of Histology and Microbiology.

Contents: Fresh preparations for rapid diagnosis of micro-organisms.

Activities carried out by the student:

- Performing histological diagnostic techniques.
- Identification of microorganisms using histological techniques
- Visualization of infectious agents in peripheral blood
- Written test: practice questionnaire

Practice session V: Anatomopathologic Diagnosis III: Microscopic identification

Estimated duration: 2h.

Room: Microscopy room of the Histology and Pathological Anatomy Unit of the Veterinary Faculty.

Contents: Histological preparations with different lesions associated with the most important microorganisms: Viruses, Bacteria, Fungi, Parasites and Prions.

Activities carried out by the student:

- Identification of microorganisms by microscopical analysis of histological preparations.
- Written test: practice questionnaire

Practice session VI. Phenotypic diagnosis of microorganisms

Estimated duration: 2 face to face hours.

Room: Microbiology and Immunology Unit Laboratory

Contents: Microbial identification by biochemical tests and automated systems

Activities carried out by the student:

- Sampling for bacterial isolation and sowing methods
- Review of the most suitable culture media according to the pathogen of interest.
- Interpretation of the results of the bacterial cultures.
- Performance and interpretation of results using API galleries Bacterial identification by automated methods (Vitek)
- Written test: practice questionnaire

Practice session VII: Genotypic diagnosis of microorganisms

Estimated duration: 1 face to face hour Room: Computer room

Contents: Use of databases for the identification of microorganisms. Sequence analysis. Species identification. Use of databases for identification of strains within a microbial species.

Activities carried out by the student:

- Identification of bacterial species based on DNA sequence analysis: 16S-rRNA, other genes
- Fungal species identification based on DNA sequence analysis.
- Identification of strains within a species (Clostridium difficile) by MLST.
- Written test: practice questionnaire.

Comments: This practice will be done in combination with the theoretical classes of Topic 4.

Practice session VIII: Pre-clinical molecular imaging

Estimated duration: 1 face to face hour

Room: SCT Laboratories Medical Imaging and Phenotyping.

Contents: On-site review of some diagnostic imaging equipment.

Activities carried out by the student:

- Visit to the SCT Laboratories Medical Imaging and Phenotyping at CIBA.
- Equipment and results visualization.

PROBLEMS AND CASES

Problem solving and group cases:

Once the theoretical and practical contents for microbiological diagnosis have been completed, a series of case studies will be presented to students. At the end of the course students will have to present in a 2h session the resolution of these cases. In principle, this activity will be carried out in different groups.

ASSIGNMENTS

Team assignments: Diagnostic Tests and prevention measures for a Disease (Literature Review)

The same groups that carry out the resolution of the practical case will carry out a bibliographic review on the diagnosed disease, compiling the different tools used for its diagnosis and prevention, explaining each one of them and the results obtained.

4.4. Course planning and calendar

The timetable and the programming of the theory and practice sessions of the course will appear throughout the month of September on the website of the Faculty of Veterinary Medicine, at the following address:

http://veterinaria.unizar.es/

The information concerning the assessment dates will be scheduled every year and will be available to the student the first day of the course. Assessments will be delivered after the completion of the other teaching tasks and deadlines will be fixed by the subject coordinator.

Coordinator:
Inmaculada Martín Burriel email: minma@unizar.es

Tutorials:

Office hours will be set on the start day of the course in each academic year.

4.5. Bibliography and recommended resources

The bibliography, presentations and recommended resources will be updated in the ADD, and as far as possible, they will be available before the theoretical and practical sessions, so that the students can consult them previously and thus promote their understanding and more active participation.