UNIVERSITY OF BELGRADE
FACULTY OF VETERINARY MEDICINE
Bulevar oslobođenja 18, 11000 Belgrade

SYLLABUS
DOCTORAL ACADEMIC STUDIES
OF VETERINARY MEDICINE

Belgrade, 2020

OBLIGATORY COURSES

I semester

Course title: Methodology of scientific research work
Lecturer/lecturers: Vladimir Kukolj, Associate Professor; Sanja Aleksić-Kovačević, Full Professor; Neđeljko Karabasil, Full Professor; Milica Kovačević-Filipović, Full Professor; Nevenka Aleksić, Full Professor; Miloš Vučićević, Assistant Professor
Course status: Obligatory
ECTS credits: 4.0
Prerequisite: Enrolled semester in which the course is taken
Course aims A theoretical and practical acquaintance (introduction) of postgraduate doctoral students with basic knowledge and principles of scientific research and interpretation of obtained results, as well as training students for independent design, conducting research in the field of biomedical sciences, and writing articles for scientific and professional journals based on the obtained results.
Course outcomes After completing and passing the course, the student should acquire the necessary knowledge from the methodology of scientific research work which will enable him to independently perform scientific research work and to be able to independently plan, research, and solve a scientific problem and present the obtained scientific results. The student should master the skills of searching the database of literary data, acquire the skill of processing the results of their own research, and master the technique of writing and preparing articles for scientific and professional journals based on the results of their scientific work.
Course content *Lectures* The concept and subject of the methodology of scientific research work. Science, scientific methods, scientific thinking, problem definition, classification, and conducting research. Basic concepts and terms in biomedical scientific research. Stages of the research process. Defining research problems, designing research, and formulating hypotheses. Review and search of electronic literature databases. Ways of conducting research, data collection, and analysis. Introduction to experimental methodology. Experimental research and experiment design - *in vivo* and *in vitro* types of experiments. Analysis of the obtained data and hypothesis testing. Interpretation and presentation of the obtained results - presentation of papers at professional and scientific conferences and journals. Types of scientific papers, elements of scientific work, and errors in writing scientific papers. Citation of papers - databases, impact factor, and categories of scientific journals. Review - procedure, and the decision of the editorial team. Technical preparation of papers for international journals (text, pictures, and graphs) and ways of citing literature. Software for paper preparation, journal selection, and electronic submission of papers. Cover letter, meaning, and writing. Ethical standards in scientific research and intellectual dishonesty in science - plagiarism, and duplicates. Choice of adequate terms - the most common mistakes in the use of Serbian and English in writing a scientific paper. The concept, significance, types, and principles of making a scientific project. Standards of European colleges in education and scientific work in veterinary medicine. Doctoral dissertation as a form of scientific work - application procedure (forms) and presentation.
Recommended literature 1. Savić J, Filipi Matutinović S. 2014, Methodology of Scientific Knowledge II: How to Write, Publish and Evaluate a Scientific Work in Biomedicine. Data Status, Belgrade; 2. Popović Z. 2014, How to write and publish a scientific work. Academic Thought, Belgrade; 3. Ristanovic D, Dacic M. 2006, Fundamentals of methodology of scientific research work in medicine, Velarta, Belgrade; 4. Malmfors B, Garnsworthy P, Grossman M. 2009, Writing and presenting scientific papers. Nottingham University Press, UK. 5. Đurić P. 2014, Introduction to scientific research. Faculty of Medicine, Novi Sad; 6. Vuckovic Dekic Lj, Arsenijevic N. 2014, Evaluating Science and Scientists. Academy of Medical Sciences SLD, Belgrade.

Hours	**Lectures:** 2	**Practicals - SRW:** /

Teaching methods Oral presentation, PowerPoint presentation, demonstration software, simulation of writing, preparation and sending the paper to a scientific journal.
Evaluation and grading (maximum 100 points) From classes10 points, for seminar work 20 points, on the test 70 points. Ratio of points and final grades: 51-60 (6); 61-70 (7); 71-80 (8); 81-90 (9); 91-100 (10).
Knowledge assessment methods written exam and seminar paper.

Course title: Molecular biology of the cell
Lecturer/lecturers: Anita Radovanović, Full Professor; Ivan Jovanović, Full Professor; Danica Marković, Associate Professor; Sanja Aleksić-Kovačević, Full Professor; Zoran Stanimirović, Full Professor; Ninoslav Đelić, Full Professor; Jevrosima Stevanović, Full Professor; Danijela Kirovski, Full Professor; Milica Kovačević-Filipović, Full Professor; Dušan Mišić, Full Professor
Course status: Obligatory
ECTS credits: 7.0
Prerequisites: Enrolled semester in which the course is taken
Course aims enable students to: 1) understand the principles and mechanisms of cell function on a molecular level; 2) acquire knowledge in cell biology which is fundamental for further specialization and research in contemporary biomedicine
Course outcomes After completing this course PhD students should be able to: 1) describe the structure and function of various cell components on a molecular level; 2) explain the interactions between organells and mechanisms of transport inside the cell, as well as communication and cooperation between different cells of eucaryotic organisms; 3) describe the molecular basis of cell development and diferentiation, the role of stem cells in tissue formation and regeneration, as well as the molecular basis of cancerogenesis; 4) recognize the importance of using cell molecular biology methods and techniques.
Course content *Lectures* Origin and functional organization of prokaryotic and eukaryotic cells (cell compartments and topological relationships; Separation and purification methods of cells and organelles); Cell membrane (structural and functional components of the membrane, membrane transport); Nucleus (membrane and lamina; pore complex, transport through pores; nucleolus and ribosome subunits formation); Structure and characteristics of the genetic material (DNA molecules characteristics and organization; replication, repair and recombination of DNA in prokaryotic and eukaryotic organisms; Expression of genetic information and gene expression control; basic genetic techniques); Structure and function of proteins as molecular effectors of biological functions; Sorting, quality control and turnover of cell proteins; Organelles interactions and vesicular transport; Mitochondria (structure and function; genome; dynamics; protein transport in the mitochondria); Cytoskeleton and cell movement; Cell communication (signal molecules; receptors; cell signaling system; molecular basis of hormone function); Cell cycle control, ageing and cell death; Molecular basis of development and differentiation (control mechanisms of cell differentiation during early embryogenesis; epigenetic mechanisms of gene expression control); Stem cells and tissue regeneration; Molecular basis of cancerogenesis. *Practicals - SRW (study research work)*
Recommended literature 1.Alberts et al.: The Molecular Biology of the Cell, 6th ed., Garland Science, 2015. 2. Kierszenbaum A L and Tres L, Histology and Cell Biology: An Introduction to Pathology, 6th ed., Elsevier Science, 2015. 3.Gledić D: Veterinary histology, Veterinary chamber of Serbia, Belgrade 2012. 4.Mihailović M and Jovanović I: Biochemistry, 5th edition, Naucna, Belgrade, 2008. 5. Berg et al.: Biochemistry, 5th ed. Freeman & Co., 2002. 6. Đelić N, Stanimirović Z, Principles of genetics, Elit-Medica, 1-297, 2004.

Hours	Lectures: 4	Practicals - SRW: /
Teaching methods Formal lecture**.** Seminary work, public presentation and defense		
Evaluation and grading (maximum 100 points) Class attendance 10 points, seminary work 20 points, final exam 70 points. Final grade and points relationship: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10)**.**		
Knowledge assessment methods: Seminary work and final exam.		

Course title: Biostatistics and informatics in biomedical sciences
Lecturer/lecturers: Milorad Mirilović, Full Professor
Course status: Obligatory
ECTS credits: 7.0
Prerequisites: Enrolled semester in which the course is taken
Course aims Acquisition of basic knowledge and skills in the application of statistics and informatics in veterinary medicine.

Acquisition of knowledge and mastering of statistical methods for analysis of research results, conducting epidemiological monitoring, genetic testing. Students are trained to design and analyze clinical research in veterinary medicine. Mastering the methods necessary for the systematic organization, processing and application of data, information and knowledge in veterinary medicine.

Course outcomes

Students should be able to independently apply statistical operations in everyday work and in the analysis of experimental results. They are trained to perform methodological research in biostatistics and veterinary medicine. Students are able to independently create and set up experiments, as well as to be able to show concrete understanding in the application of software packages in the calculation of statistical values and statistical analysis.

Course content

Lectures

Introduction to statistics. Ways of collecting data. Arranging quantitative data. Tables and charts. Estimation of empirical distribution parameters. Measures of central tendency. Measures of variation. Theoretical distributions: binomial, Poisson's, normal, t-distribution chi-square, Fisher's. Sample. Independent and dependent samples. Sample-based inference. Confidence interval. Arrangement of qualitative data, contingency tables, χ^2-test, McNeman's test. Risk assessment. Statistical testing of differences. Parametric and nonparametric statistical tests. Testing statistical hypotheses. Analysis of variance. Trend analysis. Types of changes in time series. Correlation analysis. Correlation matrices. Rank correlation coefficient. Linear regression. Curvilinear regression. Multiple regression and correlation. Multivariate methods in data analysis - factor and discriminant analysis. Application of statistical - analytical methods in veterinary medicine.

Introduction to Informatics. Historical development of computer systems. Artificial intelligence. Elements of a personal computer (hardware). System programs (software). Practical classes: Calculation of statistical parameters using software. Database. Data organization in databases. Data management. Use of databases. Microsoft Excel. Excel interface. Excel as a database. Calculation in Excel.

Recommended literature

1. Mirilović M., 2018: Biostatistics, basic textbook, (ISBN 978-6021-127-1; COBIS.SR-ID 268437004), Scientific, KMD, Belgrade;
2. Mirilović M., 2013: Biostatistics with Informatics, Practicum, (ISBN 978-86-81043-74-5; COBISS.SR-ID 202450956), Faculty of Veterinary Medicine, Belgrade;
3. Aviva Petrie, Paul Watson, 2013: Statistics for Veterinary and Animal Science, 3rd Edition, (ISBN: 978-0-470-67075-0);
4. Marinković Erić Jelena, Dotlić R., Janošević Slobodanka, Kocev N., Gajić M., Ile Tatjana, Stanisavljević D., Babić D., 2001: Statistics for researchers in the field of medical sciences, Faculty of Medicine, Belgrade;
5. Lovrić M., 2011: Fundamentals of Statistics, Faculty of Economics, Kragujevac;
6. Ceranić S., 2002: Information systems in agriculture: Faculty of Agriculture, Belgrade.

Hours	Lectures: 4	Practicals – SRW: /

Teaching methods

Interactive theoretical teaching with the use of multimedia presentations, practical work on a computer, seminar work with independent use of literature, electronic databases and statistical analysis of the results.

Evaluation and grading (maximum 100 points): Class attendance – 10 points, Colloquium – 20 points, Term paper – 10 points, Final exam – 60 points.

Knowledge assessment methods Seminar work, Colloquium, final exam.

GENERAL ELECTIVE COURSES
Elective courses - Block I
SEMESTER 1

Course title: Veterinary immunology	

Lecturer/lecturers: Nenad Milić, Full Professor; Natalija Fratrić, Full Professor; Dejan Krnjaić, Full Professor; Dušan Mišić, Full Professor; Jakov Nišavić, Full Professor; Milica Kovačević-Filipović, Full Professor; Saša Trailović, Full Professor; Milica Stojić, Assistant Professor

Course status: Elective

ECTS credits: 8.0

Prerequisites: Enrolled semester in which course is taken

Course aims
Knowledge acquisition about immunity, immune functions, non-specific and specific factors of immunological reactions, antigens and antigen specificity, organization of the immune system, major histocompatibility complex, antibodies, complement system, functions of immunocompetent cells, the regulation of humoral and cellular immune responses, immunity in the fetus and newborn, antigen and antibody reactions, non-specific and specific defense mechanisms against infections caused by bacteria, fungi and viruses, immune tolerance and immunosuppression, immunomodulation, hypersensitivity reactions and autoimmunity.

Course outcomes
Students should know: the basics of immunity, non-specific and specific factors of immune reactions; anatomical and functional organization of the immune system; basic characteristics of the major histocompatibility complex; the structure and function of antibodies; paths of complement activation and its biological effects; functions of immunocompetent cells; regulation mechanisms of humoral and cellular immune reactions; basic characteristics of the immune system in the fetus and newborn; defense mechanisms against infectious agents and tumors caused by oncogenic viruses; basic principles of antigen-antibody reactions, in vitro; mechanisms of development of immune tolerance and basic mechanisms of immunostimulation and immune suppression. Additionally, students should be able to describe the basic mechanisms of type 1 to 4 hypersensitivity reactions as well as to describe the origin and occurrence of autoimmune conditions, i.e. immunodeficiencies.

Course content
Lectures
Veterinary Immunology deals with the study of antigens, organization of the immune system, major histocompatibility complex, antibodies, complement, function of immunocompetent cells, humoral and cellular immune responses and their regulation, immune system in fetuses and newborns, immune response to microorganisms, hypersensitivity reactions and autoimmunity.

Recommended literature
1. Milić N., Krnjaić D., Mišić D., Nišavić J., Radojičić M. (2017) Mikrobiologija sa imunologijom. Naučna KMD, Beograd.
2. Abbas A., Lichtman A. H., Pillai S. (2017) Cellular and Molecular Immunology, 9th Edition, Elsevier.
3. Tizard I. (2017) Veterinary Immunology, 10th Edition, Saunders.
4. Murphy K., Weaver C. (2016) Janeway's Immunobiology, 9th Edition, Garland Science.
5. Alberts B., Johnson A., Lewis J., Morgan D., Raff M., Roberts K., Walter P. (2015) Molecular Biology of the Cell, 6th edition, Garland Science.

Hours	**Lectures:** 3	**Practicals - SRW:**

Teaching methods 1. Formal lecture; 2. Seminar paper

Evaluation and grading (maximum 100 points)
Formal lecture= 10 points. Seminar paper = 20 points. Written exam = 70 points (minimum 36 points). Grading: 6 = 51-60 points; 7 = 61-70 points; 8 = 71-80 points; 9 = 81-90 points; 10 = 91-100 points.

Knowledge assessment methods
Knowledge assessment is based on the results of the written exam and seminar paper.

Course title: Neural and humoral mechanisms of regulations	

Lecturer/lecturers: Danijela Kirovski, Full Professor; Natalija Fratrić, Full Professor; Dragan Gvozdić, Full Professor; Milica Kovačević-Filipović, Full Professor; Olivera Valčić, Assistant Professor

Course status: Elective

ECTS credits: 8.0

Prerequisites: Enrolled semester in which course is taken

Course aims

to introduce students with complex mechanisms of neural and humoral regulations in functioning of organ systems and tissues. Course objective is to introduce students with modern scientific research in the field of neural and humoral mechanisms of regulations in human and domestic animals and to provide application of knowledge in scientific and experimental work.

Course outcomes

Upon successful completion of the course, the students should understand and explain the complex mechanisms of tissue, organ and organ system functions regulations, to analyze their relationships and to apply the acquired knowledge in solving various problems in planning and conducting experiments and interpreting the results. The students should understand and explain the role of different biologically active moleculs in physiological and pathological conditions. The students should interpret, apply and evaluate scientific publications in the field.

Course content

Lectures

Integrative role of the somatic and nervous system in the regulation of physiological and pathophysiological conditions. Mechanisms of pain. Synaptic transmission, neurotransmitters, neuromodulators. Signal molecules, hormones, prohormones, parahormones. Mechanisms of regulation of circulation hormone concentration. Hormone receptors. Endogenous biologically active compounds and their importance in pathological processes. Humoral regulation of hematopoiesis, regulation of angiogenesis, clinical significance of testing in physiological and pathophysiological conditions. A review of energy metabolism and its regulation. Nervous and humoral regulation of the function of the digestive tract, cardiovascular and respiratory systems Physiology and pathophysiology of stress, with special emphasis on the impact of the stress response on the immune system and metabolism.

Recomended literature

1. Božić T, 2007, Patološka fiziologija domaćih životinja, Beograd, 2.Stojić V, 2010, veterinarska fiziologija, IV izd, Naučna KMD, Beograd, 3. Robert Murrey et al, 2003, Harperş Illustrated Biochemistry, 26th edition, Lange Medical Books, USA, 4. Berne RM, Levy MN, Koppen BM and Stanton BA, 2004, Physiology, 5th ed, Mosby, USA, 5. Boron WF and Baulpaep EL, 2003, Medical Physiology, A Cellular and Molecular Approach, Saunders, USA, 6. The biology of animal stress, 2005, ed GP Moberg & JA Mench, USA, 7. Stress Phisiology in Animals, 2000, ed Paul HM Balm, USA.

Hours	Lectures: 3	Practicals - SRW:

Teaching methods

Formal lectures with using audio-visuel methods (Power Point and Prezi presentations, video material). Lectures with active student participation, discussion workshops. Preparation, presentation and analysis of seminar papers in the field

Evaluation and grading (maximum 100 points)

10 points from class participation, 20 points from seminar paper, 70 points from the final test (minimum 36). Points range and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods seminar paper and final test

GENERAL ELECTIVE COURSES
Elective courses - block II
SEMESTER 2

Course title: Integration of the metabolism in domestic animals	
Lecturer/lecturers: Ivan Jovanović, Full Professor; Svetlana Milanović, Associate Professor; Olivera Valčić, Assistant Professor; Danijela Kirovski, Full Professor; Natalija Fratrić, Full Professor; Dragan Gvozdić, Full Professor, Milica Kovačević-Filipović, Full Professor; Snežana Bulajić, Full Professor; Sunčica Borozan, Full Professor; Jelena Ajtić, Full Professor	
Course status: Elective	
ECTS credits: 9.0	
Prerequisites: Enrollment in the semester	
Course aims - Understanding the concept of metabolism, it's organization, molecular effectors and regulation mechanisms. - Understanding the mechanisms of biological oxidation and the system of antioxidative protection. - Understanding the metabolic specificities of tissues with regards to their functions. - Understanding the metabolic specificities of ruminants, birds and fish.	
Course outcomes After the successful completion of the course students should be capable to: - explain the purpose, sequence and interconnection of metabolic processes in the animal organism; - outline the efficiency and importance of the oxidative metabolism; - locate specific metabolic processes in the tissues; - explain specific metabolic transformation in ruminants; - critically organize relevant literature data in the preparation for seminars.	
Course content *Lectures* Thermodynamic aspects of metabolism (5), elements and organization of the metabolism (5), hormones integration of metabolism (5), ultra structural and bioenergetic aspects of the enzyme function (5), metabolic aspects of biological oxidation (5), transport of metabolites in the organism (5), metabolism in the muscle (5), metabolism in the liver (5), metabolism in the eye (2), metabolism in the kidney (3), metabolism in the bone (2), metabolism in the nerve tissue (3), metabolism in the hematopoietic tissue and blood cells (5), proteins of the acute phase of infection (3), metabolism in the skin (2), metabolism and reproductive tissues (2), metabolism in the mammary gland (3), specificities of the metabolism in ruminants, birds and fish (5), seminars (5).	
Recommended literature 1. Mihailović MB, Jovanović IB, 2008, Biohemija, V izd, Naučna, Beograd 2. Stojić V, 2010, Veterinarska fiziologija, Naučna, Beograd 3. Berg JM, Stryer L, Tymoczko JL, Gatto G, 2019, Biochemistry, 9th ed, WH Freeman, New York, USA 4. Voet D, Voet JG, 2010, Biochemistry, 4th ed, John Wiley & Sons, Inc USA 5. Koppen BM and Stanton BA, 2017, Berne & Levy Physiology, 7th ed, Mosby, USA	

Hours	**Lectures:** 5	**Practicals - SRW:** 0

Teaching methods Lectures through multimedia presentation; interactive learning through discussion; writing and defence of the seminary dissertation under mentor supervision.	
Evaluation and grading (maximum 100 points) Active approach during lectures - maximum 15 points; seminary dissertation - maximum 15 points (10 for writing +5 for defense); written final test - maximum 70 points, minimum 36 points. Minimal number of points for passing the exam - 51 points.	
Knowledge assessment methods formative - interaction of the teacher with the auditorium and discussion after each lesson; writing and defence of the seminary dissertation under mentor supervision; summative - written final test.	

Course title: Pathomorphological changes and clinical manifestations of the disease
Lecturer/lecturers: Sanja Aleksić-Kovačević, Full Professor; **Ivan Vujanac, Associated Professor**; Milica Kovačević-Filipović, Full Professor; Danijela Kirovski, Full Professor; Vanja Krstić, Full Professor; Darko Marinković, Associate Professor; Vladimir Kukolj, Associated Professor; Nenad Andrić, Associated Professor; Jovan Bojkovski, Full Professor; Radiša Prodanović, Assistant Professor; Predrag Stepanović, Associated Professor; Natalija Milčić Matić, Research Fellow; Slađan Nešić, Assistant Proffesor; Ivana Vučićević, Assistant Professor; Milan Maletić, Assistant Professor
Course status: Elective
ECTS credits: 9.0
Prerequisites: enrolled in the semester in which the examination is taken
Course aims   Acquiring advanced knowledge regarding molecular mechanisms of the pathological condition development and clinical and morphological manifestations of diseases of different animal species. Understanding of complex and related pathological processes and functional changes in various organ systems, in connection with immune, genetic and metabolic disorders, as well as infectious and other agents. Differential diagnosis and therapeutic decision-making process.
Course outcomes   The student understands the complex mechanisms of occurrence, clinical manifestation and morphology of pathological processes in the organ systems of different animal species. He/she can explain, recognize and compare the specifics of pathological processes in organs and organ systems and use new scientific data from the literature related to this area. The student acquires knowledge that will enable independent scientific research, writing and publishing results of the research in journals of international importance.
Course content   *Lectures*   Cell response to damage: degeneration and cell death, inflammation, growth changes, teratogenesis. Systemic disorders and clinical manifestations: sepsis, endotoxemia, shock. Digestive system cell response to damage and clinical manifestations of diseases of the digestive system. The response of liver cells, biliary system and exocrine pancreas to damage and clinical manifestations. Functional tests. The response of cells and tissues of the respiratory system to damage, clinical manifestations and functional tests. The response of cells and tissues of the cardiovascular system to damage and clinical manifestations. Functional tests. The response of hematopoietic system cells, leukemia and lymphoma. The response of cells and tissues of the urinary system, clinical manifestations and functional tests. The response of cells and tissues of the nervous system and clinical manifestations. CNS disorders and behavior of sick animals. Experimental research in neurology. The response of the reproductive system and clinical manifestations. Skin changes as an indicator of systemic and internal diseases. Musculoskeletal pathology, new hereditary disorders. Endocrine disorders and metabolic diseases. Biochemical markers of endocrine and metabolic disorders. Functional tests. Experimental research.
Recommended literature   1. Pathologic Basis of Veterinary Disease, 6[th]ed, Zachary J (editor), Elsevier, 2016   2. Jubb, Kennedy and Palmer's Pathology of Domestic Animals, 3-Vol. Set, 6[th]ed, Elsevier, 2015   3. Tumors in Domestic Animals, 5[th]ed, Meuten D (editor), Wiley-Blackwell, 2017   4. Special veterinary pathology, Јовановић, Алексић Ковачевић, Кнежевић, Научна, 2019.   5.Nicole A. Heinrich, Melissa Eisenschenk, Richard G. Harvey, Tim Nuttall, Skin Diseases of the Dog and Cat. CRCPress, 2018   6.Bradford P. Smith (Editor), David C Van Metre (Editor), Nicola Pusterla(Editor) Large Animal Internal Medicine 6th Edition, Elsevier, 2018

Hours	Lectures: 5	Practicals - SRW:

Teaching methods Oral and slide presentations, histopathological slide seminar, case reports and comparison with new references in the field.
Evaluation and grading (maximum 100 points) Teaching 20 points, test 80 points. Ratio betwen points and the final mark: 66-70=6, 71-77=7, 78-86=8, 87-93=9, 94-100=10
Knowledge assessment methods Written test

Course title: Environmental protection
Lecturer/lecturers: Radislava Teodorović, Full Proffesor; Ljiljana Janković, Associate Proffesor; Milutin Đorđević, Full Proffesor; Danijela Kirovski, Full Proffesor; Svetlana Grdović, Full Proffesor; Jelena Ajtić, Full Proffesor; Branislava Mitrović, Associate Proffesor; Zoran Stanimirović, Full Proffesor; Neđeljko Karabasil, Full Proffesor; Ivan Vujanac, Associate Proffesor
Course status: Elective
ECTS credits: 8.0
Prerequisites: Enrolled semester in which the exam is taken.
Course aims   To enable students to comprehensively consider the impact of anthropogenic factors on the environment, as well as the risk of environmental pollution from husbandry and facilities of veterinary activity (slaughterhouses and dairy farms).
Course outcomes   Students will be able to see the impact of veterinary activities and livestock production on the environment both locally and globally. The acquired knowledge will be used in the assessment of the risk of environmental pollution from facilities of veterinary activity, as well as in the development of action plans and strategies for environmental protection.
Course content   *Lectures*   Heat stress and the environment. Modulation of farm animal metabolism for purpose of environmental protection. Hierarchical levels of pollutant protection. Physical sources of environmental pollution. Environmental protection with radioecology. Biotic pollutants. Waste as a source of environmental pollution. Risk assessment of environmental pollution from livestock and facilities of veterinary activity. Food waste. Biodiversity and sustainable development. Environmental protection strategy in the 21st century.
Recommended literature   1. Veselinović D, Gržetić I, Đarmati Š, Marković D. (2005): Fizičko - hemijske osnove zaštite životne sredine - knjiga 1: Stanja i procesi u životnoj sredini, Beograd. 2. Marković D, Đarmati Š, Gržetić I, Veselinović D. (2005): Fizičko - hemijske osnove zaštite životne sredine - knjiga 2: Izvori zagađivanja, posledice i zaštita, Univerzitet u Beogradu. 3. G. W. van Loon, C. J. Duffy (2005): Environmental Chemistry - A Global Perspective, Oxford University Press. 4. Lamberti GA, Hauer RF (2017): Methods in stream ecology, 3rd ed 4. Savić I, Terezija V. (2002): Ekologija i zaštita životne sredine, Zavod za udžbenike i nastavna sredstva, Beograd. 5. Ratajac R, Veselinović D, Antonović G, Bošković B, Cvetković M. (2004): Ekologija i zaštita životne sredine, Beograd. 6. Marijana Vučinić, Brana Radenković Damnjanović, Radislava Teodorović, Ljiljana Janković (2006): Bioklimatologija i biometeorologija, Fakultet veterinarske medicine, Beograd. 7. Asaj A. (2003): Higijena na farmi i u okolišu, Medicinska naklada, Zagreb. 8. Ristić M., Radenković Brana, Đorđević M. (2000): Neškodljivo uklanjanje uginulih životinja i nejestivih proizvoda zaklanih životinja, Fakultet veterinarske medicine Univerzitetu Beogradu. 9. Vučemilo M (2008): Higijena i bioekologija u peradarstvu.

Hours	**Lectures:** 3	**Practicals – SRW:** /

Teaching methods Interactive teaching, PowerPoint presentations, seminar papers
Evaluation and grading (maximum 100 points) From teaching: 10 points, for seminar work 20 points, on the test: 70 points (min. 36). The score is formed on the basis of the sum of collected points: 51- 60 (6), 61 -70 (7), 71- 80 (8), 81-90 (9), 9 -100 (10).
Knowledge assessment methods seminar paper, test

Course title: Experimental animals in biomedical research
Lecturer/lecturers: Anita Radovanović, Full Professor; Ivan Milošević, Assistant Professor; Marijana Vučinić, Full Professor; Vladimir Nešić, Associate Professor; Mirjana Milovanović, Associate Professor; Miloš Vučićević, Assistant Professor; Milica Kovačević-Filipović, Full Professor; Danijela Kirovski, Full Professor; Milan Hadži-Milić, Assistant Professor; Ninoslav Đelić, Full Professor; Dušan Mišić, Full Professor; Ksenija Aksentijević, Assistant Professor
Course status: Elective
ECTS credits: 8.0
Prerequisites: Enrolled in the semester in which the class is taught
Course aims The aim of this course is to introduce the most improtant welfare aspects of experimental animals used in biomedical research to PhD students, the different ways of designing an experiment, proper care of experimental animals, as well as specifics in pain and disease recognition; The aim of this course is to introduce the possibilities of using domestic animals as models in biomedical research to PhD students.
Course outcomes After successfully completing this course the doctoral students should be able to: 1) based on the acquired knowledge and skills in the different welfare aspects, physiology and proper care of expertimental and domestic animals used as models in biomedical research, come up with and design experiment procedures in accordance with national and european regulations and laws; 2) recognize pain, stressful reactions and suffering in experimental and domestic animals used as models in biomedical research. 3) diagnose diseases specific for the experimetal animal, have knowledge in the relevant surgical methods and techniques.
Course content *Lectures* Legislative, ethical and scientific aspects of experimental animals welfare; Domestic animals as models in biomedical research (pigs, sheep, bovines, poultry); Designing experiments on animals, procedure and project design; Physiology and behavior elements of animal species used in research; Teaching and accomdating experimental and domestic animals to the procedures used during research; Genetic classification of experimental animals; Proper care of experimental animals, objects and objects conditions; Recognizing pain, stressful reactions and suffering in animals; Anaesthesia, analgesia and their proper use; Euthanasia; Appropriate techniques and surgical procedures; Microbiology – specifics for experimental animals; Recognizing good health and diseases of experimental animals.
Recommended literature 1. Rulebook on the conditions for entry in the register for animal experiments and the content and manner of keeping that register, the training program on the welfare of experimental animals, the application form for approval of animal testing, the manner of care, treatment and deprivation of life of experimental animals, as well as the content and manner keeping records on keeping, reproduction, trade, ie conducting experiments on animals ("Official Gazette of RS", No. 39/10) 2. Festing MF. Overend P, Borja MP, Berdoy M The Design of Animal Experiments Reducing the Use of Animals in Research Through Better Experimental Design, SAGE Publications, 2016 (ISBN1473974631, 9781473974630) 3.Vučinić M, Todorović Z, Trailović S, Nedeljković-Trailović J and others. Experimental animals and experimental models, VKS, 2009.

Hours	Lectures: 3	Practicals – SRW: /

Teaching methods Formal lecture using audio and video (Power Point and Prezi presentations, video materials). Lectures with active participation of students, discussion workshops. Presentation and analysis of seminary work from the field and analysis of European and national regulations from the field.
Evaluation and grading (maximum 100 points) Class attendance 10 points, application for obtaining permits to work with experimental animals 20 points, final exam 70 points. Final grade and points relationship: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).
Knowledge assessment methods can be different:Written exam.

ELECTIVE METHODOLOGICAL COURSES IN THE FUNCTION OF PREPARING A DOCTORAL DISSERTATION

SEMESTER 3

Course title: Methods of cells, tissues and organs investigation in physiological and pathophysiological conditions	

Lecturer/lecturers: Milica Kovačević-Filipović, Full Professor; Danijela Kirovski, Full Professor; Dragan Gvozdić, Full Professor; Natalija Fratrić, Full Professor; Olivera Valčić, Assistant Professor; Sunčica Borozan, Full Professor; Anita Radovanović, Full Professor; Danica Marković, Associate Professor; Svetlana Milanović, Associate Professor

Course status: Elective course in the field of dissertation

ECTS credits: 10.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

The aim of the course is to prepare students for basic laboratory procedures that can be used to collect and preserve samples and to acquire basic theoretical and practical knowledge of various methods that can be used to examine the structure and function of cells, tissues and organs in physiological and pathophysiological conditions.

Course outcomes

Students will 1) correctly collect and process samples for analysis, 2) apply specific methods in their research work 3) combine several methods to adequately analyze the sample 4) notice and solve problems in the laboratory work.

Course content

Lectures

Theoretical and practical classes: Good laboratory practice, laboratory utensils, washing, sterilization. Making a solution, making a standard curve. Blood sampling methods, anticoagulants, short-term and long-term storage of samples. Methods of sampling different body fluids. Tissue sampling methods for biochemical, immunochemical and histological analyzes. Methods of sampling different organs for biochemical and toxicological tests. Methods of staining blood smears and body fluid cells. Histological methods of tissue staining. Determination of protein concentration, isolation and purification of proteins, methods of protein separation: native and SDS PAGE electrophoresis, chromatography. Methods of detection of specific proteins: ELISA, RIA, western blot, immunodiffusion, immuhistochemistry, immunocytochemistry. Flow cytometry. Determination of enzyme activity and isoenzyme forms spectrophotometrically, cytochemically, histochemically: alkaline phosphatase, lactate dehydrogenase, liver enzymes, creatine kinase, antioxidant protection enzymes, ✔-galactosidase.

Functional hemostasis tests. Cultivation of cells in suspension. Functional tests for hematopoietic stem cells. Phagocytosis tests. Cell migration tests. Cultivation of adherent cells. Functional tests for mesenchymal stem cells. Determination of cell viability (trypan blue, annexin), cell cycle testing methods, cell proliferative activity: MTT, HTT and LDH. Laboratory quality control, validation of results, reference values, clinical significance of laboratory test results.

Recommended literature

Vunjak-Novaković G. i Freshney RI. Culture of Cells for Tissue Engineering. Wiley-Liss, 2006 (ISBN -13 978-0-471-62935-1); 2. Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology, 5th Edition Kenneth S. Latimer, (ISBN - 978-0-8138-2014-9); 3. Suvarna, K. S., Layton, C., & Bancroft, J.D. (2012). Bancroft's Theory and Practice of Histological Techniques (7th ed.). New York: Churchill Livingstone. 4. Švob M., Histološke i histokemijske metode. 1974. Svjetlost, Sarajevo 5. Current Protocols Essential Laboratory Techniques, eds. Sean R. Gallagher and Emily A. Wiley, 2008, (Online ISBN: 9780470089941).

Hours	**Lectures: 5**	**Practicals – SRW: /**

Teaching methods Interactive theoretical teaching with the use of multimedia presentations, practical work in the laboratory, independent experiment.

Evaluation and grading (maximum 100 points) Classes - 10, seminar - 10, colloquium - 20, final exam - 60. Ratio of points and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods Seminar paper, colloquium, exam

Course title: Methods of microbiological and immunological diagnostics

Lecturer/lecturers: Nenad Milić, Full Professor; Dejan Krnjaić, Full Professor; Dušan Mišić, Full Professor; Jakov Nišavić, Full Professor; Marina Radojičić, Associate Professor

Course status: Elective methodological subject in the function of preparing a doctoral thesis

ECTS credits: 10.0

Prerequisites: enrolled semester in which the course is taken

Course aims

Acquiring knowledge about microbiological and immunological methods used in microbiological diagnostics to identify isolated microorganisms and to gain insight into the immune status of infected, diseased and immunized individuals.

Course outcomes
The student should be able to: perform sampling, packaging, and sending of materials for laboratory examination; use a microscope; prepare and stain microscopic slides; perform isolation of bacteria in pure culture and identify isolated microorganisms using classical and molecular methods of laboratory diagnostics. Also, the student should know the basic principles of agglutination, precipitation, complement fixation test, enzyme-linked immunosorbent assays - ELISA, hemagglutination and inhibition of hemagglutination, as well as to be able to independently interpret the obtained results. The student should be able to set up the primary tissue culture, maintain cell lines and to recognize the appearance of cytopathic effect characteristic for certain viruses. The student should know the basic principles of direct and indirect immunofluorescence, as well as to perform these methods independently and interpret the obtained results. The student should know the basic principles of molecular methods used in virological and bacteriological diagnostics and how to perform some of these methods independently as well as to interpret the obtained results.

Course content

Lectures

Diagnostic methods for fungal infections. Sterilization. Microbiological media. Sample processing. Biochemical reactions. Methods of isolation and identification of aerobic, anaerobic and capnophilic bacteria, as well as fungi of veterinary importance. Methods of isolation and identification of animal viruses. Serological reactions. Molecular methods in microbiology.

Practical laboratory work.

Recommended literature

1. Milić N., Krnjaić D., Mišić D., Nišavić J., Radojičić M. (2017) Mikrobiologija sa imunologijom. Naučna KMD, Beograd.

2. Ašanin R., Krnjaić D., Milić N. (2014) Priručnik sa praktičnim vežbama iz mikrobiologije sa imunologijom Naučna KMD, Beograd.

3. Nišavić J., Milić N., Knežević A. (2013) Laboratorijska dijagnostika virusnih infekcija, Naučna KMD, Beograd.

4. Mišić D. (2013) Metode mikrobiološke dijagnostike–ispitivanje osetljivosti bakterija na antibiotike, Elit Medica, Beograd.

5. Markey B., Leonard F., Archambault M., Cullinane A., Maguire D. (2013) Clinical Veterinary Microbiology, Mosby, Elsevier.

6. Pestana E., Belak S., Diallo A., Crowther J.R., Viljoen G.J. (2010) Early, rapid and sensitive veterinary molecular diagnostics - real time PCR applications, Springer, Netherlands.

7. Quinn P.J., Markey B.K., Leonard F.C., Hartigan P., Fanning S., Fitzpatrick E.S. (2011) Veterinary Microbiology and Microbial Disease, 2nd Edition, Wiley-Blackwell.

Hours	**Lectures:** 5	**Practicals - SRW:**

Teaching methods 1. Practical laboratory work. 2. Formal lecture 3. Seminar paper

Evaluation and grading (maximum 100 points) Laboratory work = 10 points. Formal lecture = 10 points. Seminar paper = 20 points. Oral exam = 60 points (minimum 31 points). Grading: 6 = 51-60 points; 7 = 61-70 points; 8 = 71-80 points; 9 = 81-90 points; 10 = 91-100 points.

Knowledge assessment methods Knowledge assessment is based on the results of the oral exam and seminar paper.

Course title: Food testing methods
Lecturer/lecturers: Mirjana Dimitrijević, Full Professor; Neđeljko Karabasil, Full Professor; Snežana Bulajić, Full Professor; Dragan Vasilev, Associate Professor; Silvana Stajković, Assistant Professor
Course status: Elective methodological course in the function of preparing a doctoral thesis
ECTS credits: 10.0
Prerequisites: Enrolled semester in which the course is taken
Course aims
The primary objective of the course is to acquaint students with both classical and state-of-the-art methods used in food analysis, and in part to successfully master them. Students would gain skills that will benefit them in facing the challenges during their scientific and professional development, which relate to food testing. During the course, students would also focus and be able to make the right choice in the use of methods in the preparation of a doctoral dissertation, as well as in their further scientific work.
Course outcomes
Upon successful completion of the course, students should be able to:

• qualitatively sample food for analysis depending on the type of intended test;

• qualified to choose the category of methods and the method itself for the intended examination;

• know and partially master the classical chemical, physical and physicochemical, as well as modern instrumental

methods of food testing;
• know and partially master the methods for isolation of certain pathogenic microorganisms from food, as well as fast microbiological methods;
• know and partially master the methods for genotyping pathogenic microorganisms isolated from food;
• know and partially master the methods for testing the susceptibility of bacteria isolated from food to antibiotics / antimicrobial drugs.

Course content

Lectures

Methods of sampling, packaging, transport and storage of the sample. Sample preparation for analysis and accompanying documentation. Selection of methods for analysis and sequence of tests. Chemical, physical and physicochemical methods. Instrumental methods. HPLC, GC (GLC) - principle and application. Electrophoresis, Western Blot- principle and application. AAS - Determination of heavy metal content. Methods for isolation of pathogenic microorganisms from food and their identification. Rapid microbiological methods of pathogen analysis in food. Alternative methods for the detection of pathogenic microorganisms in food. Molecular methods for genotyping pathogenic bacteria isolated from food. Methods for testing antimicrobial resistance of bacteria isolated from food. Demonstration of basic chemical and physico-chemical analyzes. Spectrophotometry. Chromatography. Electrophoresis. Some methods for isolation and identification of foodborne pathogens. Preparing presentations.

Recommended literature

1. Handbook of food analytical chemistry (2005) Edited by Ronald E. Wrolstad Terry E. Acree Eric A. Decker Michael H. Penner David S. Reid Steven J. Schwartz Charles F. Shoemaker Denise Smith Peter Sporns 2. Food Analysis (2017) Editors: Nielsen, Suzanne (Ed.)

Hours	Lectures: 5	Practicals – SRW:

Teaching methods Theoretical classes: classical, oral with visual support (presentation). Practical classes: demonstration of methods, independent work on a computer, preparation of presentations, presentation.

Evaluation and grading (maximum 100 points) From classes - 10 (min. 5) points. Preparation and presentation of a 10-minute presentation of literature work - 40 (min. 21) points. Final test - 50 (min. 26) points. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods: Test

Course title: Experimental models and methods in pharmacology and toxicology
Lecturer/lecturers: Saša Trailović, Full Professor; Mirjana Milovanović, Associate Professor
Course status: Elective methodological subject in the function of preparing a doctoral thesis
ECTS credits: 10.0
Prerequisites: Enrolled semester in which the course is taken

Course aims

To learn basic methods and techniques in experimental pharmacology and toxicology. To know the way of choosing an adequate research method and its correct application. To know specific statistical methods of processing the results of pharmacological and toxicological research and to present these results correctly.

Course outcomes

As a result of the course, the student must know all the most important methods of experimental pharmacological and toxicological tests and to process the results obtained in the test with adequate statistical methods. To present the obtained results in an adequate way in the works he publishes.

Course content

Lectures

Statistical and other calculations in pharmacology and toxicology; Solutions: molar concentration, percentage concentration; Dose determination and dose calculation; Methods of examining the relationship between dose (concentration) and the effect of a drug (toxin). Methods of pharmacological tests on anesthetized and non-anesthetized animals; Test methods on isolated organs. *Caenorhabditis elegans* as an experimental model. Equipment for tests on isolated organs, measurements of isometric and isotonic contractions of various tissues of mammals and invertebrates. *Special part Experimental pharmacology*: Tests of drugs that act on the CNS: Methods of testing sedative effects; Methods of anticonvulsant testing; Methods of testing the anxiolytic effect; Excitation test methods. Trials of drugs that act on the peripheral nervous system. Spontaneous and forced locomotor activity; Rota-rod test; Neuromuscular preparation of the diaphragm. Test methods for analgesics. Methods of drug testing on the cardiovascular system: Direct and indirect measurement of blood pressure; Isolated blood vessel tests; Tests on a Langendorff isolated heart. Methods of testing drugs that act on the respiratory system: Tests on isolated rings of the trachea and bronchi; Pulmonary perfusion model; Investigations of the effects of drugs acting on the gastrointestinal tract: Model of isolated ileum; Model of isolated gastric segment;

Isolated colon segment model; Liver perfusion model; In vivo model of testing the effect of drugs on the peristatic of the digestive tract. Tests of drugs that act on the uterus; Isolated uterus model. Examination of drugs acting on the urinary system: A model of renal perfusion. Trials of drugs that act on parasites; Neuromuscular preparation *Ascaris suum*. Pharmacokinetic experimental models. *Special part Experimental toxicology*: Acute toxicity testing methods; Subacute toxicity test methods; Chronic toxicity testing methods; Inhalation toxicity test methods; Dermal toxicity testing methods; Methods of ocular toxicity testing; Dermal irritation test methods; Reproductive toxicity test methods; Teratogenicity testing methods; Carcinogenicity testing methods.

Recommended literature

Goethe J. W. (2002): Drug Discovery and Evaluation, Pharmacological Assays, Second Completely Revised, Updated, and Enlarged Edition, Springer-Verlag Berlin Heidelberg New York. 2. Seethala R., Fernandes P. (2001) Handbook of Drug Screening, Marcel Dekker, Inc. 3. WormBook, http://www.wormbook.org.

Hours	Lectures: 5	Practicals - SRW:

Teaching methods Theoretical classes; preparation of seminar paper, public presentation and defense.
Practical classes: work in the laboratory, laboratory task.

Evaluation and grading (maximum 100 points) From lecturing 10 points, for seminar work 20 points, on the test 70 points (minimum 36). Ratio of points and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods Oral exam

Course title: Diagnostics of parasitic zoonoses

Lecturer/lecturers: Zoran Kulišić, Full Professor; Nevenka Aleksić, Full Professor; Tamara Ilić, Associate Professor; Danica Bogunović, Assistant Professor

Course status: Elective methodological course in the field of PhD dissertation

ECTS credits: 10.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

Introducing students to the etiology, morphological and morphometric characteristics, life cycle, epizootiological and epidemiological characteristics of causative agents, pathogenesis and clinical picture of parasitic zoonoses, which are important for clinical and laboratory diagnostics. In addition to endemic pathogens of importance for animal and human health, the course includes exotic parasites that have the potential for becoming endemic in the future. A significant segment of the course relates to the parasites transmitted through food of animal origin and the vectors of parasitic and infectious zoonotic diseases.

Course outcomes

Student should be qualified to suspect the existence of a parasitic zoonosis, select and properly collect material for laboratory analysis; safely handle potentially infectious material; apply the most suitable diagnostic method; identify the causative agent based on morphological and morphometric characteristics, individually interpret the obtained results of the analyses; diagnose parasitic zoonosis based on all available diagnostic parameters

Course content

Lectures

Parasite species of importance for veterinary medicine showing zoonotic potential: blood parasites (protozoa and helminths), gastrointestinal parasites, arthropods, vectors of parasitic and infectious zoonotic diseases, parasites that are transmitted by the food of animal origin. Morphological, biological and immunological characteristics of parasites, pathogenesis, life cycles, transmission pathways, resilience of preparasitic stages, distribution in the environment.

Recommended literature

1. Kulišić Z, *Helmithology*, Serbian Veterinary Chamber, Belgrade, 2001; 2. Teodorović V, Bunčić O, Kulišić Z, Radenković-Damnjanović B, Teodorović R, Đorđević M, Mirilović M, *Trichinella – trichinellosis*, Naučna KMD d.o.o., Beograd, 2007; 3. Bauerfeind R, von Graevenitz A, Kimmig P, Schiefer HG, Schwarz T, Slenczka W, Zahner H, *Zoonoses: Infectious Diseases Transmissible From Animals and Humans* (4th ed.), AMS Press, Washington DC, 2016; 4. Blagburn B (ed.), *Pfizer Atlas of Veterinary Clinical Parasitology*, The Gloyd Group Inc., Wilmington, 2000; 5. LaMann G (Ed.), *Veterinary parasitology*, Nova biomedical Press, Inc., New York, 2010; 6. Gunn A & Pitt S, *Parasitology. An integrated Approach*, Willey-Blackwell Publishing, New Jersey, 2012; 7. Ridley JW, *Parasitology for Medical and Clinical Laboratory Professionals*, Delmar Cengage Learning, Delmar, 2012; 8. Elsheikha H & Khan NA (Eds.), *Essentials of Veterinary Parasitology*, Caister Academic Press, Pooley, 2011.

Hours	Lectures: 5	Practicals – SRW:

Teaching methods Oral presentations, video presentations, seminars.

Evaluation and grading (maximum 100 points) Lectures: 10 points (min. 6)

Seminar: 10 points (min. 6)
Practicals-SRW: 20 points (min. 11)
Oral exam: 60 points (min. 31)
Points/grade ratio: 51-60=6, 61-70=7, 71-80=8, 81-90=9, 91-100=10.

Knowledge assessment methods: Oral exam, seminary paper – essay.

Course title: Modern instrumental methods in veterinary medicine	

Lecturer/lecturers: Jelena Ajtić, Full Professor; Nikola Krstić, Full Professor; Branislava Mitrović, Associate Professor

Course status: Elective methodological course in the field of PhD dissertation

ECTS credits: 10.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

The objective of this course is to first provide a general overview and then further understanding of the physical foundations of the modern methods used in veterinary diagnostics and therapy.

Course outcomes

On successful completion of the course, students should be able to:
– identify physical foundations of a given method or instrumentation they use in their research,
– list and logically link the components of the measurement process,
– recognize possible error sources in the measurement process,
– theoretically modify the process to obtain greater measuring confidence,
– estimate whether a given method or instrumentation is appropriate for use in a hypothetical experiment,
– discuss advantages and disadvantages of a given method or instrumentation.

Course content

Lectures

Ultrasound diagnostics and therapy. Doppler techniques. Electrode and microelectrode techniques. Electrodiagnostics and electrotherapy. Thermography and thermotherapy. Optical and electron microscopy. Application of ultraviolet, infrared and visible radiation. Application of laser radiation. Roentgen techniques. Detectors and dosimeters of ionizing and nonionizing radiation. Basics of monitoring of the environment.

Recommended literature

J. Ajtić, D. Popović, Fizičke osnove dijagnostičkih i terapijskih metoda, Veterinarska komora Srbije, Beograd, 2013.

D. B. Popović, M. B. Popović, M. Janković, Biomedicinska merenja i instrumentacija. Akademska misao, Beograd, 2010.

A. G. Webb, Principles of Biomedical Instrumentation. Cambridge University Press, Cambridge, UK, 2018.

J. G. Webster, H. Eren (editors), Measurement, Instrumentation, and Sensors Handbook, Second Edition, CRC Press, Taylor & Francis Group, Boca Raton, FL, USA, 2014.

Hours	**Lectures:** 5	**Practicals – SRW:** /

Teaching methods Theoretical interactive lectures

Evaluation and grading (maximum 100 points) Lectures: 10 points, Seminar paper: 20 points**,** Written exam: 70 points (minimum 36) Points ratio and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81 - 90, (9), 91 - 100 (10).

Knowledge assessment methods Seminar paper, written exam

Course title: Clinical trial methodology	

Lecturer/lecturers: Miloš Vučićević, Assistant Professor; Milan Maletić, Assistant Professor; Natalija Milčić Matić, Research Fellow; Ivan Vujanac, Associate Professor; Nenad Andrić, Associate Professor; Sonja Radojičić, Full Professor; Radmila Resanović, Full Professor; Nikola Krstić, Full Professor

Course status: elective, methodological

ECTS credits: 10.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

The main goal is to acquaint doctoral students with the types of clinical research in veterinary medicine, the specifics of clinical and experimental research on different species of animals and the basic principles of planning, organizing and conducting clinical trials.

Course outcomes

Student able to plan, organize, control and perform clinical trials on different species of animals, create a database,

manipulate them and publish the results
Course content
Lectures
Research work in clinical pathology and animal therapy. Basic clinical disciplines. Types of clinical trials. Epizootiological testing methods. Making retrospective and prospective studies. Compatibility between individual species of animals, choice of experimental animals; Extrapolation of results from one animal species to another and humans. Planning and implementation of clinical trials. Interpretation of clinical trial results. Writing scientific reports. Publication and evaluation of results. Specifics in clinical trials in certain species of animals.

Recommended literature
Jalali M, Saldanha FYL, Jalali M, 2017, Basic Science Methods for Clinical Researchers, Elsevier Science
Laake P, Benestad HB, 2015, Research in Medical and Biological Sciences: From Planning and Preparation to Grant Application and Publication, Elsevier Science
Ruxton GD, Colegrave N, 2016, Dizajniranje istraživanja u biomedicinskim znanostima, Medicinska naklada

Hours	Lectures: 5	Practicals – SRW: /

Teaching methods Interactive teaching, public presentation and discussion
Evaluation and grading (maximum 100 points) Lecture activities (40), written exam (60)
Knowledge assessment methods: written exam

Course title: Molecular-genetic diagnostics in veterinary medicine
Lecturer/lecturers: Zoran Stanimirović, Full Professor, Jevrosima Stevanović, Full Professor, Vladimir Dimitrijević, Associate Professor, Mirjana Dimitrijević, Full Professor, Dušan Mišić, Full Professor, Miloš Vučićević, Assistant Professor
Course status: Elective methodology course in the field of PhD thesis
ECTS credits: 10.0
Prerequisites: Enrolled semester in which the course is taken
Course aims
Gaining theoretical and practical knowledge about application of molecular-genetic methods in diagnostics of pathogens and disturbances of various etiology in veterinary medicine. The course should point to efficacy and need of these methods in modern clinical and lab investigations.
Course outcomes
Students are capable of: sample collection, preparation of samples and extraction of nucleic acids; PCR mix preparation and *in vitro* amplification of DNA using PCR; visualisation of PCR products, electrophoretic analysis and DNA sequencing; absolute and relative quantification of nucleic acids using real-time PCR and RT-real-time PCR; analysis of real-time PCR results, single cell gel electrophoresis (comet assay) and analysis of oxidative stress. Students are able to apply these techniques in research and diagnostics of hereditary diseases, genome analysis, forensic examinations and DNA/RNA analysis of the pathogens of domestic and exotic animals, hunting game and honey bees.
Course content
Lectures
Application, advantages and drawbacks of molecular-genetic methods in veterinary diagnostics. Rules of conduct and safety measures in the laboratory. Sample collection and processing, and nucleic acid extraction. The principles of *in vitro* DNA amplification (Polymerase Chain Reaction – PCR). Performing of PCR assay. Visualisation of PCR products. Electrophoretic analysis. DNA sequencing. Nucleic acid quantification – real-time PCR (qPCR). Interpretation of real-time PCR results. Absolute quantification. High Resolution Melting (HRM) technology. Reverse transcription PCR (RT-PCR). Relative quantification: analysis of gene expression levels – application in immunology, pharmacology, nutrigenomics and genetic toxicology. Application of molecular-genetic methods in hereditary disease diagnostics and genome analysis of domestic and exotic animals, hunting game and honey bees. DNA sex determination of mammals and birds. Analysis of DNA markers in forensic veterinary medicine (individual identification). Molecular-genetic methods in the analysis of domestic and wild animal pathogens. DNA diagnostics of hereditary and pathogen-induced diseases in pets. Biochip (DNA microarray) analysis. Animal microbiome analysis using *Next-Generation Sequencing* (NGS). Molecular characterisation of foodborne microbial pathogens. Molecular-genetic analysis in laboratories with second and third biosafety level (BSL 2 and 3) protection. Single cell gel electrophoresis (comet) assay oxidative stress analysis.
Recommended literature
1. Đelić N., Stanimirović Z.: Principles of genetics, Faculty of Veterinary Medicine, University of Belgrade, Data status, Belgrade, 2019.
2. Kulić M., Stanimirović Z., Djelić N., Novaković M.: Human genetics, School of Medicine, Foča, University of Eastern Sarajevo, Foča, 2010.

3. Cunha MV, Inácio J (Eds.): Veterinary infection biology: Molecular diagnostics and high-throughput strategies, Humana Press, 2015.

4. van Pelt-Verkuil E.,. van Leeuwen W.B, te Witt R (Editors): Molecular Diagnostics, Part 2: Clinical, Veterinary, Agrobotanical and Food Safety Applications, Springer, Singapore, 2017.

5. Stevanović J., Stanimirović Z., Glavinić U.: Molecular-genetic methods in veterinary medicine. Faculty of Veterinary Medicine, University of Belgrade, authorised manusript, 2020.

6. Melinda D. Merck Veterinary Forensics: Animal Cruelty Investigations 2nd Edition, Wiley-Blackwell; 2 edition, 2012.

Hours	Lectures: 5	Practicals - SRW: /

Teaching methods Apart from theoretical instructions, practical individual work with students is done. Interactive work in the Laboratory for genetics of domestic animals, hunting game and honey bees, at the Department of Biology. The available equipment of the Laboratory enables adequate tuition. Student and tutor rotation system enables each candidate to independently perform each diagnostic technique.

Evaluation and grading (maximum 100 points): Class attendance – 10 points, Term paper – 20 points, Final exam – 70 points (min. 36).

Knowledge assessment methods: Term paper, Exam.

ELECTIVE COURSES IN THE FIELD OF DOCTORAL DISSERTATION

3 or 4 SEMESTER

Course title: ECG and EHO diagnostics	
Lecturer/lecturers: Predrag Stepanović, Associate Professor	
Course status: Elective course in the field of doctoral dissertation	
ECTS credits: 5.0	
Prerequisites: Enrolled semester in which the course is taken	

Course aims

To enable postgraduate doctoral students for quality access to patients with cardiorespiratory symptoms, to practice proper examination of cardiac patients according to existing protocols, to apply the order of general and special examination, to get acquainted with document management, ECG and ultrasonographic diagnosis of the heart , in undertaking and monitoring therapy and dietary and prophylactic measures.

Course outcomes

Upon completion of the course, students should be able to distinguish pathological heart tones by auscultation and their construction and interpretation according to the classification, then, they should perform ECG recording, determine its characteristics and describe them in the findings, and basic parameters of echosonographic examination and to get acquainted with the way of writing the findings.

Course content

Lectures

General examination of a cardiological patient: Assessment of skin, mucous membranes, pulse, respiration, blood pressure, fundus, and introduction to groups of drugs and dietary principles applied in the cardiology of veterinary patients. electrocardiography: Anatomical and physiological and electrophysiological characteristics of the heart, specifics of clinical examination of patients with diseases of the cardio-respiratory system, assessment of respiration and present problems, simultaneous auscultation and assessment of femoral pulse, necessary hematological and biochemical examinations of blood and urine, basis and interpretation of findings, ECG pulse recording methods, electrophysiology of depolarization, amplitude and interval measurements. Evaluation of complete ECG record: heart block, extrasystoles, paroxysmal tachycardia, stress test, preparation of the patient for stress test, writing the final findings, monitoring and Holter diagnostics in veterinary cardiology. echocardiological diagnosis: physical principles of ultrasound diagnostics, artifacts in ultrasound diagnostics, operator errors that may occur during the examination, echocardiographic diagnosis of congenital heart disease, echocardiographic assessment of associated heart disease, correct interpretation of echocardiography findings v. hepaticae, free fluid in the abdomen, pericardium and thorax, native and ultrasound-guided biopsy of the pericardium - pericardiocentesis. *Practicals – SRW (study research work)* Work with patients in the Cardiology Cabinet.

Recommended literature

1.Acierno MJ, Brown S, Coleman AE, Jepson RE, Papich M, Stepien RL, Syme HM, 2018, ACVIM consensus statement: Guidelines for the identification, evaluation, and management of systemic hypertension in dogs and cats, *J Vet Intern Med*. 32 (6), 1803-1822. 2. Fox PR, Sisson D, Moise NS, 1999, Electrophysiologic mechanisms for arrhythmias. In: Textbook of Canine and Feline Cardiology, Principles and Clinical Practise, 2nd Ed., WB Saunders, Philadelphia, USA, 291-305. 3. Kittleson MD, Kienle RD, 1998, Physical exam, In:. Small Animal Cardiovascular Medicine, Kittleson MD, Kienle RD, Elsevier Health Sciences Division, St. Louis, USA, p. 347-361 4. Kittleson MD, Kienle RD, Echocardiography, In: Kittleson MD, Kienle RD, 1998, Small Animal Cardiovascular Medicine, Elsevier Health Sciences Division, St. Louis, USA, 95-115. 5. Luis-Fuentes V, Swift S, 2002, ECG interpretation in small animals, practical guidelines, In: Manual of Small Animal Cardiorespiratory Medicine and Surgery, BSAVA, Cheltenham, 114-123. Martin MWS, Corcoran B, 2006, Diseases of the valves and endocardium, In: Notes on Cardiorespiratory Disease of the Dog and Cat, 2nd Ed, Wiley-Blackwell, Oxford, UK, 106-116. 7 Nelson RW, Couto CG, 2009, Management of heart failure, In: Small Animal Internal Medicine, 4rd Ed, Elsevier Health Sciences Division, St. Louis, USA, 53-72. 8. Nelson RW, Couto CG, 2003, Myocardial diseases of the dog, In: Small Animal Internal Medicine, 3rd Ed., Elsevier Health Sciences Division, St. Louis, USA, 130-142.9,Tilley LP, Malvern PA, 1992, Interpretation of common cardiac arrhythmias. Management of cardiac arrhythmias, In: Essentials of canine and feline electrocardiography, 3rd Ed., Lea *&* Febiger, Philadelphia, USA, 127-207. 10. Tilley LP, Malvern PA, 1992, Interpretation of P-QRS-T deflections. In: Essentials of canine and feline electrocardiography, 3rd Ed, Lea *&* Febiger, Philadelphia, USA, 127-207.

Hours	**Lectures:** 1	**Practicals - SRW:** 2

Teaching methods Theoretical classes in the form of video-beam presentations with text, pictures and films, review and interpretation of Ro recordings on films and CDs, and practical classes in the clinic during the examination and control of patients who come with their owners.

Evaluation and grading (maximum 100 points) Oral exam, test, practical exam, seminar paper, published scientific paper. The oral exam, test and practical exam carry 30 points each and the seminar paper 10 points.
Points ratio and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81 - 90, (9), 91 - 100 (10).

Knowledge assessment methods oral exam, project presentation, writing a scientific paper and publishing in a peer-reviewed journal, or seminar paper.

Course title: Application of econometric methods in productivity assessment and animal health control
Lecturer/lecturers: Milorad Mirilović, Full Professor; Drago Nedić, Full Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken
Course aims Students should get acquainted with certain econometric methods used in the system of control of productivity and animal health and their application to reach the optimal solution in animal therapy or in the control of infectious diseases.
Course outcomes Upon successful completion of the course, students are able to recognize the ways and models of economic monitoring of the production process, as well as the recognition and application of appropriate econometric procedures and flow modeling, in the event of infectious diseases.
Course content *Lectures* Theoretical concepts of economic analysis, qualitative and quantitative analysis in veterinary medicine; marginal analysis - total, average and marginal value; static methods in the assessment of animal productivity and development of animal health control programs - the criterion of profitability, economy and productivity, the return on investment, the criterion of technical equipment; dynamic methods in the assessment of animal productivity and development of animal health control programs - net present value criterion, internal rate of return , cost-benefit ratio, payback period method, liquidity assessment, annuity criterion; application of discounting methods and calculation of discount rate in the development of animal health control programs; program evaluation in conditions of uncertainty - critical point method, sensitive analysis, probability analysis; decision method in conditions with and without probability - minimax, maximax, maximin and Laplace criterion, expected monetary value and expected regret; partial analysis; cost-benefit analysis; linear programming; defining deterministic and stochastic models in animal health control and their application in veterinary medicine; application of simulation models in veterinary medicine (Monte Carlo and Delphi method).

Recommended literature 1. Tešić M. Milan, Nedić N. Drago, 2015: Veterinary Economics. Textbook. Faculty of Veterinary Medicine, Belgrade; 2. Milan Tešić, Drago N. Nedić, 2011: Veterinary Practice Management, textbook, Faculty of Veterinary Medicine, Belgrade; 3. Milan M. Tešić, Drago N. Nedić, Nada Tajdić, 2013: Veterinary Economics - practicum. Textbook. Faculty of Veterinary Medicine, Belgrade; 4. Mirilović M., 2018: Biostatistics, basic textbook, (ISBN 978-6021-127-1; COBIS.SR-ID 268437004), Scientific, KMD, Belgrade; 5. Mirilović M., 2013: Biostatistics with Informatics, Practicum, (ISBN 978-86-81043-74-5; COBISS.SR-ID 202450956), Faculty of Veterinary Medicine, Belgrade; 6. Rushton, J., 2009: The Economics of Animal Health and Production. ISBN: 978 1 84593 194 0		
Hours	**Lectures: 1**	**Practicals – SRW: 2**
Teaching methods Teaching is performed using audiovisual techniques with practical examples, with the preparation of a seminar paper and critical discussion.		
Evaluation and grading (maximum 100 points): Class attendance – 10 points, Term paper – 20 points, Final exam - 70 points.		
The knowledge assessment methods Seminar work, test, final exam.		

Course title: Mathematical modeling of biological systems and processes
Lecturer/lecturers: Jelena Ajtić, Full Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the exam is taken
Course aims The objective of this course is to introduce students to the principles of mathematical modelling, classification and categorisation of models and their application in biomedical research, with a short introduction to machine learning.
Course outcomes

On successful completion of the course, students should be able to:
– give the principles of mathematical modelling in biomedical research,
– enumerate different types of biophysical models,
– describe one model,
– differentiate between supervised and unsupervised machine learning,
– give examples of machine learning in biomedicine.

Course content
Lectures
Basic principles of mathematical modelling in biomedical sciences and classification of models. Modelling processes: heat transfer, muscle contraction, action potential generation and propagation. Fundamentals of compartmental analysis. Cybernetic models. Informatics models of biological systems. Rheological models of biological tissues and fluids. Modelling of adaptation mechanisms. Thermodynamic models. Modelling transport processes at the cell membrane. Basics of machine learning.

Recommended literature
J. Ajtić, D. Popović, Fizičke osnove dijagnostičkih i terapijskih metoda, Veterinarska komora Srbije, Beograd, 2013.
R. C. Deo, 2015. Machine Learning in Medicine, Circulation 132(20): 1920–1930. doi:10.1161/CIRCULATIONAHA.115.001593.
B. P. Ingalls, Mathematical Modelling in Systems Biology, An Introduction. The NIT Press, Cambridge, Massachusetts, USA, 2013.
O. Theobald, Machine Learning for Absolute Beginners, Second Edition, O. Theobald, 2017.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Theoretical interactive lectures

Evaluation and grading (maximum 100 points)
Lectures: 10 points
Seminar paper: 20 points
Written exam: 70 points (minimum 36)
Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods: Seminar paper, written exam

Course title: Experimental animals and experimental models
Lecturer/lecturers: Marijana Vučinić, Full Professor; Saša Trailović, Full Professor; Jelena Nedeljković-Trailović, Full Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken

Course aims
1) Introduction to the purpose of using experimental animals (EA) and experimental models (EM) in basic, translational and regulatory researches and the educational process in biomedical sciences. 2) Understanding of basic ethical, scientific, professional and legal principles of work with EA and EM (animal alternatives, non-animal alternative models, *in vitro*, *ex vivo*, *in silico* models). 3) Training for independent work with EA and EM in the educational process in biomedical sciences, scientific, translational and regulatory researches.

Course outcomes
Upon successful completion of the course, students should be able to: 1) Independently design a research plan based on understanding the ethical, scientific, professional and legal principles of working with EA 2) Independently fill out ethical forms and apply for a license to work with EA. 3) Independently determine the degree of invasiveness of research on EA. 4) Apply a method of reducing the degree of invasiveness of research on EA to the lowest level. 5) Sample biological material from EA. 6) Recognize the risks for the occurrence of suffering and prevent the suffering of EA 7) Conduct pharmacotherapy on EA whose physical, physiological and emotional well-being is impaired. 8) Make a decision on the fate of EA at the end of the research. 9) Conduct, ethical evaluation, harm-benefit analysis and retrospective research analysis.

Course content
Lectures
Types of EA and OM and research in which they are used. Regulatory (institutional, national and international) basis of work with EA. Ethical basis and ethical evaluation of the work of OZ (ethical evaluation and harm-benefit analysis). Procedure for issuing a license to work with EA. Rules and principles of work with EA - rule "5 freedoms", "3R" rule, "ARRIVE instruction", inspection plan. Invasiveness of procedures on EA. Forms used in

working with EA (application form, specification of research on EA, non-technical research summary, "ARRIVE" checklist, retrospective analysis). Errors in EA research - ethical, scientific and professional error. Procedure with EA after the end of the research. Procedure with biological material and corpses. Extrapolation of results obtained on EA and EM. Risk when working with EA.

Practicals – SRW (study research work): Restraining and marking EA. Drug application. Sampling of blood and other biological material from EA. Dose and blood sample volume. Enrichment of living conditions and behavior of EA (structural, functional, manipulative, nutritional, sensory, social enrichment).

Recommended literature
1. Vučinić M, Todorović Z, Trailović S, Nedeljković-Trailović J *et al*. Eksperimentalne životinje i ekperimentalni modeli. BKC, 2009.- 2. Kilkenny C, Browne WJ, Cuthill IC *et al*. Improving Bioscience Research Reporting: The ARRIVE Guidelines for Reporting Animal Research. PLoS Biol 8(6): e1000412, 2010.– 3. Directive 2010/63/EU on the protection of animals used for scientific purposes. – 4. Hawk CT, Leary SL, Morris TH (eds). Formulary for Laboratory Animals. Third edition, IA, USA: Blackwell Publishing 2005. – 5. Rai J, Kaushik K. Reduction of Animal Sacrifice in Biomedical Science & Research through Alternative Design of Animal Experiments. Saudi Pharm J. 26(6):896-902, 2018. - 6. Smith D, Anderson D, Degryse AD *et al*. Classification and reporting of severity experienced by animals used in scientific procedures: FELASA/ECLAM/ESLAV Working Group report. Lab Anim. 52, suppl): 5-57, 2018. - 7. Davies, G.F. Harm-Benefit Analysis: opportunities for enhancing ethical review in animal research. Lab Anim 47, 57–58, 2018. - 8. Bespalov A., Michel M., Steckler T. (eds) Good Research Practice in Non-Clinical Pharmacology and Biomedicine. Handbook of Experimental Pharmacology, vol 257. Springer, Cham, 2019. – 9. Lewis DI. Animal experimentation: implementation and application of the 3Rs. Emerg Top Life Sci. 3 (6): 675–679, 2019. – 10. Andersen ML, Winter LMF. Animal models in biological and biomedical research - experimental and ethical concerns. An. Acad. Bras. Ciênc., 91, suppl. 1, e20170238, 2019.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical, interactive and practical classes and one seminar

Evaluation and grading (maximum 100 points) Active participation in theoretical classes - 10 points; Assessment of practical work with EAs – 10 points; Seminar - 40 points; Final exam (oral) - 40 points. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods Active participation in theoretical classes - 10 points; Practices – 10 points; Seminar - 40 points; Oral exam - 40 points

Course title: Physiology and biochemistry of body fluids	

Lecturer/lecturers: Danijela Kirovski, Full Professor; Natalija Fratrić, Full Professor;

Course status: Elective course in the field of doctoral dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims
to introduce students with mechanisms that are involved in regulation of importantnt parametars of body fluids homeostasis, as well as with origin, concentration, half-life, metabolism and function of blood plasma and serum, limph, cerebrospinal fluid, body cavities fluids, sperm, folicular fluid, body excreta, saliva, milk and eggs.

Course outcomes
Upon successful completion of the course, the students should know the biochemical composition nad physiological roles of body fluid components. Students should independently select and appy the method for quantitative detection of organic components of body fluids in scientific research. The student should understand the importance of use of body fluids that are taken by non-invasive methods, like salive, milk and urine, in research.

Course content
Lectures
Origin, concentration, half-life, metabolism, function and methods for quantitive and qualititive detection of organic and inorganic components of blood plasma and serum. Values, methods of determination and mechaniss of regulation of homeostasis parameters. Biochemical composition of erythrocytes and leukocytes, metabolism and function. Types and function of coagulation factors. Origin, quantitative abd qualitative characteristics and function of lymph components and drainge. Mechanism of formation, composition, function and patterns of elimination of excess fluids from body cavities. Production, transport and function of CSF elimination of excess, value of intracranial presure and its determination. Formation, composition, function and degradation of skin ointmentingredients. Composition, physical, phyicochemical propertes and function of follicular fluid components. The formation of the egg, its transport, composition physical, phyicochemical properties and function of varius ingredients. Production, composition, physical, phyicochemical propertes and function of constituents of body excreta. Milk production, excretion mechanism. Methods for quantitative and qualitative detection of proteins.

Recommended literature

1. Berne RM, LevyMN, Koppen BM, Stanton BA, 2004, Physiology, 5th ed, Mosby, USA, 2. Boron WF, Baulpaep EL, 2016, Medical Physiology, A Cellular and Molecular Approach, Saunders, USA, 3. . Sherwood Laurealee, 2011, Human Physiology, From Cells to Systems, 8th ed, Thomson, Brooks/Cole, Australia., 4. Berg JM, Tymoczko JL, Stryer L, 2002, Biochemistry, 5th ed, WH Freeman & Co, New York, USA, 5. Voiet D, Voiet JG, 2004, Biochemistry, 3rd ed, John Wiley & Sons, Inc, USA, 6. Ganong WF, 2001, Review of Medical Physiology, XXi ed, Appleton & Lange, Med Publication, 7. Guyton AC, Holl JE 2010, Textbook of medical physiology, XX ed, 8. Stojić V, 2010 Veterinarska fiziologija, Naučna KMD, Beograd. 9. Shanmugam S, Kumar TS, Panneer Selvam K, 2019, Laboratory handbook on biochemistry. PHI Learning Pvt. Ltd.		
Hours	**Lectures:** 1	**Practicals – SRW:** 2
Teaching methods Formal lectures by using audio-visuel methods (Power Point and Prezi presentations, video material). Lectures with active student participation, discussion workshops. Preparation, presentation and analysis of seminar papers in the field		
Evaluation and grading (maximum 100 points) 10 points from class participation, 20 points from seminar paper, 70 points from the final test (minimum 36). Points range and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).		
Knowledge assessment methods seminar paper and final test		

Course title: Radiation hygiene
Lecturer/lecturers: Branislava Mitrović, Associate Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken
Course aims   to learn the students with modern instrumental methods of measuring radioactivity; that students acquire the knowledge necessary for the implementation of regular control of animal feed, water, food of plant and animal origin; that students acquire the knowledge necessary for the implementation of measures for the protection of animals and agricultural production in the case of radioactive contamination of the environment, in order to obtain radiation-hygienically safety of food of animal origin.
Course outcomes   - know the sources of radiation in the environment and distinguish between natural and produced radionuclides;   - perform sampling, packaging and sending of samples in order to determine the content of radioactive elements;   - interpret the obtained results in accordance with the applicable legislation;   - propose measures that can exclude migrations of radionuclides from the food chain: soil-plants-animals-humans;   -perform dosimetry control and clinical examination of animals in case of radioactive contamination of the environment;   - conduct the radioactive decontamination of animals.
Course content   *Lectures*   The place and role of radiation hygiene in veterinary medicine. The origin of radiation in the environment. Dosimetry and radiation detection. Possibilities of radioactive contamination of the environment. Anthropogenic radionuclides and their toxicological significance in the organism (resorption, transfer, deposition and elimination). Natural and artificial radioactivity of foodstuffs of plant and animal origin. Radiation protection for occupationally exposed persons and the general public. Organization of the work of the veterinary service in the conditions of increased radioactive contamination of the environment. Application of agrotechnical protection measures in case of radioactive contamination of the environment. Organization of work in extensive and intensive animal's production. Organization of work in dairies and slaughterhouses, with the application of appropriate processing procedures in case of increased radioactivity. Bioindicators and their importance in monitoring the presence of natural and produced radioactivity. Radioactive contamination of wild animals. Organization of monitoring and its importance in radiation protection. Legislation in the field of ionizing radiation protection.   *Practicals – SRW (study research work):* gamma spectrometry

Recommended literature Mitrović Branislava, Andrić Velibor, Dragan Šefer: Praktikum iz radiobiologije i radijacione higijene. Beograd, 2016. Michael Pöschl and Leo M. L. Nollet: Radionuclide Concentrationsin Food and the Environment, Taylor & Francis Group 2006.		
Hours	**Lectures:** 1	**Practicals – SRW:** 2
Teaching methods: lectures, movies and practical work in laboratory for gamma spectrometry		
Evaluation and grading (maximum 100 points) from teaching 10 points, for seminar work 20 points, on the test		

70 points (min. 36). Ratio of points and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods Written and oral.

Course title: Radiobiology and radiopathology

Lecturer/lecturers: Branislava Mitrović, Associate Professor

Course status: Elective course in the field of doctoral dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

to learn the students theoretically with the effects of ionizing radiation on mammals and the possibilities of applying ionizing radiation in veterinary medicine; to learn students to implement measures of protection against ionizing radiation in the workplace.

Course outcomes

- to introduce the students with the possibilities of using ionizing radiation in veterinary medicine in the diagnosis and treatment of animal diseases;
- understand the mechanisms of changes in mammalian tissues and organs caused by ionizing radiation;
- recognize changes in patients caused by radiotherapy;
-recognize radiation injuries and radiation sickness in domestic animals in emergency radiological situations;
-implement the protection against ionizing radiation in accordance with the applicable legislation.

Course content

Lectures

Sources of ionizing radiation in the environment. The use of ionizing radiation in veterinary medicine. Radiotherapy. Dosimetry and radiation detection. Theories of direct and indirect effects of radiation. Radiological damage at the cell level: changes in the membranes; sail sensitivity; chromosomal aberrations; synthesis processes; cell division; lethal effects. Repair of radiation damage; tumour suppressor genes. Radiation risk. Factors influencing the degree of radiation injuries. Radiopathology - radiation injuries. Radiation changes in tissues and organs. Radiation sickness: acute forms of radiation syndrome in domestic animals; chronic radiation syndrome. Beta burns in various species of domestic animals. Protection measure in case of radiological accidents in order to protect people and animals from irradiation and contamination. Legislation in the field of radiation protection.

Recommended literature

Mitrović Branislava, Andrić Velibor, Dragan Šefer: Praktikum iz radiobiologije i radijacione higijene. Beograd, 2016. Michael C. Joiner and Albert J. van der Kogel: Basic Clinical Radiobiology, Taylor & Francis Group 2019.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods: lectures.

Evaluation and grading (maximum 100 points) from teaching 10 points, for seminar work 20 points, on the test 70 points (min. 36). Ratio of points and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods: Written and oral.

Course title: Physical therapy

Lecturer/lecturers: Nikola Krstić, Full Professor; Mirjana Lazarević Macanović, Full Professor; Marko Mitrović, Assistant Professor

Course status: Elective course in the field of doctoral dissertation

ECTS credits: 5.0

Prerequisite: Enrolled semester in which the course is taken

Course aims

During the course, postgraduates get acquainted with modern methods of physical therapy, its laws, possibilities and scope, and learn the skills of handling various devices used in physical medicine. The aim of the course is to explain and adopt the postulate that the application of the rehabilitation program in patients with dysfunction of various organ systems is not in the literal removal of anatomical and physiological damage, but rather in establishing the optimal functional state of the organism according to its remaining capabilities, and thus improving the quality of life.

Course outcomes
Upon successful completion of this course, students should be able to: - know the general principles and laws of physical therapy, to make the differences of its stimulating effect, as well as to independently use and choose among different methods of physical treatment; - master the ways of functioning of various devices in physical therapy and application techniques; - perform an initial evaluation of the patient's physiological status; - establish an individual therapy plan, form a treatment protocol and present it to the animal owner in an appropriate way; - make a comparative analysis of the findings obtained on the basis of medical history, clinical and orthopedic examinations, as well as the results of physical therapy examinations obtained through specific tests; - make a physical therapy diagnosis, give a prognosis of the disease and perform physical therapy treatment.

Course content
Lectures Laws of physical therapy, theoretical basis, mechanisms of therapeutic effect. Electrodiagnostics of abdominal organs and locomotor system. Electrotherapy. Magnetotherapy. Phototherapy. Laser therapy. Thermotherapy. Pelotherapy, parafango, keritherapy. Hydrotherapy. Balneotherapy and aerosol therapy. Masotherapy (kinesitherapy, chirotherapy and mechanotherapy). Ultrasonotherapy. *Practical classes.* Application of devices for physical therapy on clinical material.

Recommended literature
1. Bockstahler, B, Levine, D, Millis, D. (2004), *Essential Facts of Physiotherapy in Dogs and Cats – Rehabilitation and Pain Management*, Babenhausen: BE VetVerlag 2. Mc Gowan, C, Goff, L, Stubbs, N. (2007) *Animal Physiotherapy (Assessment, Treatment and Rehabilitation of Animals)*, New Jersey: Blackwell Publishing 3. Millis, L. D, Taylor, A. P. (2004), *Canine Rehabilitation and Physical Therapy*, Philadelphia: WB Saunders 4. Petrović, B, Draganović, B, Gligorijević, J. (1972), *Fundamentals of Physical Medicine for Students of the Faculty of Veterinary Medicine*, Belgrade: Institute for Textbooks Publishing and Teaching Aids 5. Šehić, M, Butković, M, Stanin, D. (1997), *Physical Medicine in Therapy and Diagnostics of Domestic Animals*, Zagreb: Faculty of Veterinary Medicine

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Power Point presentations for each lecture as well as work with physical therapy devices.

Evaluation and grading (maximum 100 points) classes 10 points, for seminar work 20 points, test 70 points (minimum 36 points). Points / final grade ratio: 51–60 (6), 61–70 (7), 71–80 (8), 81–90 (9), 91-100 (10).

Knowledge assessment methods can be different: written exams, oral exam, project presentation, seminars, etc

Course title: Swine disease
Lecturer/lecturers: Jovan Bojkovski, Full Professor; Ivan Vujanac, Associate Professor; Radiša Prodanović, Assistant Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims Student has obligation to understand problems of pig health care at all stages of production on commercial farms. Also, students are enable to comprehenhesively understand the ethiopatogernesis ,clinical sign, dignosis and therapy.
Course outcomes Upon completion of the course, students will acquire the following knowledge: to solve health problems and apply prophylactic measures, understand production procedures on commercial pig farms and apply the acquired knowledge on a commercial farm through evaluation of biosecurity measures and advice on production management on commercial pig farms.

Course content
Lectures
    1. Biosecurity on commercial farms
    2. Breeding disease by suckling pigs with health control.
    3. Breeding disease by weaned piglets with health control
    4. Heath control by pregnant soews
    5. Health control by fatten sows
Practicals - SRW (study research work)
    1. Regular health check on commercilal pig farms

2. Organisation consalrting on commercial pig farms		
3. Evaluation biosegurity measures on commercial farms		

Recommended literature

Jeffrey J. Zimmerman, Locke A. Karriker, Alejandro Ramirez, Kent J. Schwartz, Gregory W. Stevenson, and Jianqiang Zhang (2019) Diseases of Swine, 11th edition, Iowa State University, USA, https://lib.dr.iastate.edu/vdpam_books/1

Šamanc A. H., Bolesati svinja, Naučna KMD, 2009.

Hours	**Lectures:** 1	**Practicals - SRW:** 2

Teaching methods Interactive lectures, with discusion clinical cases on pig cxommercial farms. Preacical lesssons on pig commercial farms:Independent resolution clinical cases on commercial pig farm

Evaluation and grading (maximum 100 points) review clinical cases in form paper article

Knowledge assessment methods seminar work

Course title: Comparative anatomy of domestic animals, mammals and poultry

Lecturer/lecturers: Verica Mrvić, **Full Professor;** Miloš Blagojević, Associate Professor; Milena Đorđević, Assistant Professor; Ivana Nešić, Assistant Professor

Course status: Elective course in the field of doctoral dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

Knowledge of the technique of preparation and identification of the muscles of the fore and hind limbs, head and neck of domestic animals and poultry. Initiation of blood vessels with acrylic paints and vascularization of muscles and organs of the thoracic, abdominal and pelvic cavities. Examination of the structure, vascularization and innervation of the heart and associated arteries and veins. Extending the knowledge and understanding morphology, topography and vascularization of the endocrine glands. Introducing the nervous system to muscle innervation. Sense of sight, hearing, balance, smell and taste. The skin and its derivatives. Poultry - bones, muscles, organs, endocrine glands, cardiovascular and lymphatic system, nervous system, senses and skin. Training of candidates for the production of anatomical preparations.

Course outcomes

Students should be able to establish an appropriate work plan and demonstrate knowledge of all anatomical techniques that will be used for the purpose of the study; to know the organs and organic systems covered by the program, their macroscopic structure, their position and spatial relationship in certain species of domestic animals.

Course content

Lectures

Theoretical classes: Morphology and structure of cartilage. Origin and development of bones, bone structure, bone connections, joints and ligaments. Muscle structure, vascularization and innervation. Body cavities, serosa, internal organs. Structure, vascularization and innervation of the heart, arteries, veins, bloodstream. Morphology, topography, vascularization of endocrine glands. Nervous system. Sense of sight, hearing, balance, smell and taste. Morphology, topography, vascularization, innervation of skin and its derivatives. Topography of extremities, head, neck, organs of the thoracic, abdominal and pelvic cavities of domestic animals. Poultry: bones, muscles, organs, endocrine glands, cardiovascular and lymphatic system, nervous system, senses and skin.

Recommended literature

1. König, Liebich 3. edition, 2007, Veterinary Anatomy of domestic Mammals, Textbook and color atlas.

2. Introduction to Veterinary Anatomy and Physiology Textbook, 2015, Elsevier, Victoria Aspinall, Melanie Capello,

3. King's applied anatomy of the central nervous system of domestic mammals, 2017, Geoff Skerritt,

4. Anatomy and physiology of farm animals, 2018, Anna Dee Fals, Christianne Magee,

5. Hill's atlas of veterinary clinical anatomy, 2006, Hill s pet nutrition int.

6. Done S.H., Goody P., Evans S.A., Stickland N.C. 2005, Color atlas of veterinary anatomy. Volume 3: The Dog and Cat

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods theoretical classes, practical classes, seminar papers

Evaluation and grading (maximum 100 points) Teaching 10 points; seminar paper 20 points; test 70 points (minimum 36). Points ratio and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods: seminar paper, test

Course title: Comparative anatomy of experimental animals

Lecturer/lecturers: Miloš Blagojević, Associate Professor; Verica Mrvić, Full Professor; Ivana Nešić, Assistant Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken
Course aims   PhD student learns the morphology and structure of organs and organ systems of experimental animals (rat, mouse, rabbit, ground squirrel, guinea pig), as well as topographic position of organs and organ systems in order to apply this knowledge in experimental work on these animals.
Course outcomes   PhD student needs to know the anatomy of experimental animals as a precondition for the proper set up of experiment on these species.
Course content   *Lectures*   Bone morphology. Skeletal muscle morphology. Morphological studies of the digestive, respiratory organ systems and urogenital tract. Cardiovascular and lymphatic system morphology. Morphology of nervous system, skin and senses. Topography of head and neck. Topography of the extremities. Topography of thoracic, abdominal and pelvic cavity.   *Practicals - SRW (study research work)*: Practical work on preparations.
Recommended literature   1. Popesko P, Rajtová V and Horák J. (2002): Colour Atlas of Anatomy of Small Laboratory Animals: Volume 1. Saunders Ltd, Philadelphia-London. 2. Popesko P, Rajtová V and Horák J. (2003): Colour Atlas of Anatomy of Small Laboratory Animals: Volume 2. Saunders Ltd, Philadelphia-London. 3. Popesko P. (1992): A Colour atlas of the anatomy of small laboratory animals: Volume 2, Rat, mouse and golden hamster. Wolfe, London. 4. Hageman E and Schmidt G. (1960): Ratte und Maus. Academic Press, London-New York. 5. Cook M. (1965): The anatomy of the Laboratory Mouse. Academic Press, London-New York. 6. Hebel R and Stromberg M. W. (1976): Anatomy of the Laboratory Rat. Williams-Wilkins Company, Baltimore.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Theoretical teaching, practical teaching (laboratory work), seminary work
Evaluation and grading (maximum 100 points) Presentation 10 poins, practical test 20 points, test (multiple-choice) 70 points. Ratio of points and final grade: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10)
Knowledge assessment methods written exam, oral exam, presentation of the project, seminaries etc.

Course title: Morphology of the nervous and endocrine systems and their mutual interaction
Lecturer/lecturers: Milena Đorđevic, Assistant Professor
Course status: Elective
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is conducted
Course aims   The main goal of the course is to determine the knowledge acquired in basic academic studies as well as to gain new knowledge in the field of anatomy of the nervous system and anatomy of the endocrine system, as well as a knowledge about the close connection and interdependence of these two systems.
Course outcomes   Upon successful completion of the course, students should know the morphology of the nervous and endocrine systems. Students will acquire knowledge of the topographic anatomy of the nervous and endocrine systems, with special reference to the vascular structure of the hypothalamic-pituitary portal system and their morpho-functional interaction
Course content   *Lectures and Practicals - SRW (study research work)*   Introduction to the nervous and endocrine systems; morphofunctional divisions of the central, peripheral and autonomic nervous systems; presentation of the structures of the forebrain, midbrain and rhomboid brain important for the control of the hypothalamus and endocrine organs; morphology of the portal hypothalamic-pituitary system and its significance; elements of the peripheral nervous system important for endocrine gland control   Work with anatomical samples (fresh and in formalin)
Recommended literature   Feldman E, Nelson R, Reusch J. C, Scott- Moncrieff C, 2014, Canine and Feline Endocrinology, 4th Edition, Saunders, Elsevier, Missouri;   Drekić D, Lozanče O, 2010. Anatomy of the nervous system, endocrine glands, sense organs and skin of domestic

animal, Scientific book, Belgrade;
Dyce K.M, Sack W.O.Wensing C.J.G, 2010, Textbook of veterinary anatomy, Saunders, Elsevier, Missouri
Williams RH, 1974, Textbook of Endocrinology, Medical Book, Belgrade-Zagreb;
McDonald LE, 1980, Veterinary Endocrinology and Reproduction, Lea & Febiger, Philadelphia,
Everett NB, 1972, Functional neuroanatomy, Lea & Febiger, Philadelphia.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods
Lectures, practical sesion, seminar papers

Evaluation and grading (maximum 100 points) Lecture attendance 30 points, seminar paper 50 points, test 20 points (minimum 11). The ratio of points and
final grades: 51-60 (6), 61-70 (7), 81-90 (9), 91-100 (10).

Knowledge assessment methods: written exam - test and seminar paper

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Course title: Veterinary hematology
Lecturer/lecturers: Milica Kovačević-Filipović, Full Professor; Jelena Francuski Andrić, Assistant Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken

Course aims
The aim of the course is to enable students to acquire 1) comparative theoretical knowledge in hematology; 2) knowledge regarding modern methodological approaches and technologies used in veterinary diagnostics of hematological disorders.

Course outcomes
1) Recognition of blood cells on a blood smear; 2) Making algorithms for the diagnosis of hematological changes; 3) Distinguishing the advantages and disadvantages of hematological analyzers and other equipment used in hematological tests 4) Combining changes related to blood cells with hemostasis and proteinemia in order to analyze hematological disorders.

Course content
Lectures and Practicals - SRW (study research work)
Organic components of blood plasma, their concentration and function; disorders and laboratory techniques for their determination. Erythrocyte count, their morphological, biochemical, metabolic and physiological characteristics; disorders. Laboratory techniques used in erythrocyte testing. Number of granulocytes (neutrophils, basophils, eosinophils), their morphological, biochemical, metabolic and physiological characteristics; disorders. Number of agranulocytes (lymphocytes and monocytes), their morphological, biochemical, metabolic and physiological characteristics; disorders. Laboratory techniques used in the examination of leukocytes. Platelet count, their morphological, biochemical, metabolic and physiological characteristics; disorders. Laboratory techniques used in platelet testing. Regulation of the hematopoietic process. Blood stem cells and their disorders. Coagulation factor disorders. Laboratory techniques for determining bleeding time, coagulation time and prothrombin time. Importance. Anticoagulants. Blood groups of dogs and cats.

Recommended literature
Shalm`s Veterinary Hematology, 6th edition, Wiley-Blackwell, (2010) USA
Mary Anna Thrall: Veterinary hematology and clinical chemistry, 2nd edition, Wiley-Blackwell, (2012) USA
Harvey JW, Veterinary Hematology - A Diagnostic Guide and Color Atlas, 1st edition, Elsevier, (2012) USA

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Interactive theoretical teaching with use of multimedia presentation, seminars.

Evaluation and grading (maximum 100 points) Classes - 10, seminar - 10, colloquium - 20, final exam - 60. Ratio of points and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods Seminar paper, colloquium, exam

Course title: Molecular markers for determination of parentage, pedigree and characterization of animal species and breeds
Lecturer/lecturers: Jevrosima Stevanović, Full Professor; Zoran Stanimirović, Full Professor; Vladimir Dimitrijević, Associate Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which the course is taken

Course aims
Mastering the use of molecular markers in parentage testing, pedigree and kinship analysis, and characterisation of animal species and breeds.
Course outcomes
The participants are taught to complete appropriate material sampling, DNA extraction, amplification of targeted microsatellite DNA regions, separation of PCR products using capillary electrophoresis and the analysis of the obtained data.
They understand the significance of parentage testing, pedigree verification and characterization of species and breeds in programs of animal breeding and selection.
Students are capable of completing molecular genetic analyses aimed at the characterization of species and breeds, and the analysis of parentage and pedigree.
They acquire knowledge to process raw data obtained in the procedures of molecular characterisation of species and breeds, parentage and pedigree analysis, and know the factors which influence the sensitivity and precision of the applied tests.

Course content

Lectures

From Mendel's laws to molecular markers. Quantitative and molecular genetics. Genetic structure of animal populations. Determination of population relationships. Nuclear and mitochondrial DNA (mtDNA). Types of molecular markers. Family tree and gene map construction. The use of nuclear DNA markers (autosomal microsatellites) in parentage analysis (most frequently in paternity testing), individual pedigree identification and verification, in population diversity analysis (intra-breed and inter-breed genetic diversity assessment), genetic distance assessment, assessment of genetic interrelationships and assessment of gene mixing in populations (between even closely related breeds) and mapping loci for quantitative traits. Use of mtDNA markers in learning domestication, i.e. for the identification of wild predecessors of domesticated animal species and the detection of geographic models of genetic diversity (biogeographic research); for the detection of hybridisation between species or subspecies of domestic animals and for phylogenetic analysis (reconstruction of evolutionary inter- and intra-species relationships).

Practicals - SRW (study research work):

Molecular characterisation and diagnostic genetic markers. The use of DNA markers in the characterisation of species and breeds, and the analysis of animal parentage and pedigree.

Recommended literature

1. Đelić N, Stanimirović Z: Principles of genetics, Faculty of Veterinary Medicine, University of Belgrade, Data status, Beograd, 2019.
2. Stevanović J, Stanimirović Z, Glavinić U: Molecular-genetic methods in veterinary medicine, Faculty of Veterinary Medicine, University of Belgrade, Authorised manuscript, 2020.
3. Oldenbroek K, van der Waaij L: Wageningen University and Research Centre, the Netherlands, 2014.
4. FAO: Molecular genetic characterization of animal genetic resources. FAO Animal Production and
Health Guidelines. No. 9. Rome, 2011.

Hours	**Lectures:** 1	**Practicals - SRW:** 2

Teaching methods Apart from theoretical instructions, practical individual work with students is done. Interactive work in the Laboratory for genetics of domestic animals, hunting game and honey bees, at the Department of Biology. The available equipment of the Laboratory enables adequate tuition. Student and tutor rotation system enables each candidate to independently perform each diagnostic technique.

Evaluation and grading (maximum 100 points) Class attendance – 10 points, Term paper – 10 points, Final exam – 80 points (min. 41).

Knowledge assessment methods Term paper, Final exam.

Course title: Molecular ecology and behaviour of hunting game and exotic animals
Lecturer/lecturers: Ninoslav Đelić, Full Professor; Zoran Stanimirović, Full Professor; Jevrosima Stevanović, Full Professor; Miloš Vučićević, Assistant Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which the course is taken
Course aims
Application of molecular biology methods in conservation genetics and investigation of ecological genetics and genetics of animal behaviour. Assessment of biological variation (biodiversity) and relations among species, and use of molecular markers in forensic investigations and detection of hunting game and exotic animal pathogens.
Course outcomes

On completing the course, students are capable of applying techniques of molecular genetics for preservation, control and protection of autochthonous, endemic, and relict species of hunting game and exotic animals. They are familiar with basic molecular-genetic methods for diagnostics and monitoring of diseases of hunting game and exotic animals caused by ambient changes in the environment. They know the molecular-genetic techniques for monitoring of marker-genes and their products in the programs of rearing, selection and boosting the resistance to diseases, and in conservation genetics and forensic research.

Course content

Lectures

Genetic structure and gene maps of hunting game and exotic animals. Analysis of microbiome of hunting game and exotic animals using the *Next Generation Sequencing* (NGS). Application of molecular-genetic techniques in the analysis of genome and monitoring of zoogeographical origin of hunting game and exotic animals. Molecular adaptations and genomics of the environment. Genetics of behaviour and biodiversity protection. Preservation, control and protection of autochtonous, endemic and relict species of hunting game and exotic animals. Application of molecular-genetic methods in diagnostics and monitoring of diseases of hunting game and exotic animals, caused by ambient changes and viral, fungal, bacterial and protozoan pathogens (PCR, real-time PCR, RT-PCR, PCR-RFLP, biochips – DNA microarray). Application of molecular-genetic techniques for monitoring marker genes and their products in programs of breeding, selection and boosting resistance to diseases.

Practicals – SIR (student research work):

Analysis of mitochnodrial DNA (mtDNA) and microsatellites in molecular ecology research of hunting game and exotic animals. Analysis of species-specific DNA regions of hunting game and exotic animals in forensic determination of origin.

Recommended literature

1. Đelić N., Stanimirović Z.: Principles of genetics, Faculty of Veterinary Medicine, University of Belgrade, Datastatus, Belgrade, 2019.

2. Stevanović J., Stanimirović Z., Glavinić U.: Molecular-genetic methods in veterinary medicine. Faculty of Veterinary Medicine, University of Belgrade, authorised manusript, 2020.

3. Rowe G, Sweet M, Beebee T: An introduction to molecular ecology, Oxford University Press, 2017.

4. Stevanović J., Stanimirović Z., Djelić N.: Zoology, CID, Faculty of Veterinary Medicine, University of Belgrade, Belgrade 2013.

5. Ristić Z.: Zoology of hunting game and game taxonomy (fured game), 1st part, IK „Ljubostinja" Trstenik, Novi Sad, 2013.

6. Van Pelt-Verkuil E, van Leeuwen W.B, te Witt R (Editors): Molecular Diagnostics, Part 2: Clinical, Veterinary, Agrobotanical and Food Safety Applications, Springer, Singapore, 2017.

Hours	Lectures: 1	Practicals - SRW: 2

Teaching methods Apart from theoretical instructions, practical individual work with students is done. Interactive work in the Laboratory for genetics of domestic animals, hunting game and honey bees, at the Department of Biology. The available equipment of the Laboratory enables adequate tuition. Student and tutor rotation system enables each candidate to independently perform each diagnostic technique.

Evaluation and grading (maximum 100 points) Class attendance – 10 points, Term paper – 10 points, Final exam – 80 points (min. 41).

Knowledge assessment methods Term paper, Final exam.

Course title: Molecular ecology and behaviour of the honey bee	
Lecturer/lecturers: Zoran Stanimirović, Full Professor; Jevrosima Stevanović, Full Professor	
Course status: Elective course in the field of doctoral dissertation	
ECTS credits: 5.0	
Prerequisites: Enrolled semester in which course is taken	

Course aims

Mastering the molecular-genetic techniques used in studying the ecology, behaviour and protection of the honey bee. Studying the diversity of the honey bee, bee pathogens and their interaction; the impact of diet, supplements and drugs on the health status of bee colonies.

Course outcomes

After completing the course, students are expected to (1) understand the use of molecular genetic methods in studying the ecology, behaviour and protection of the honey bee, (2) understand and be able to perform basic molecular-genetic methods in the study of bee diversity and bee pathogens, and their interaction, (3) are able to perform molecular-genetic methods to examine the effects of drugs, supplements and supplementary feed on the health status of bees, (4) know how to apply molecular-genetic methods for the detection, identification and quantification of the causative agents of bee and bee brood diseases: viruses, bacteria, protozoa, fungi and

ectoparasites.	

Course content

Lectures

Genetic analyses of the honey bee. Mitochondrial and nuclear DNA assessment of genetic diversity and protection of the honey bee ecotypes. Gene flow as an indicator of migratory beekeeping, commercial breeding and introduction of queens. Molecular genetics in beekeeping and selection programs aimed to increase disease resistance. Bee behaviour genetics. Coefficient of heritability of hygienic and grooming behaviour to suppress bee mite reproduction. Molecular-genetic determination of drone sex alleles in order to determine the genotype of queens with an aim to select and rear high quality queens. Measurement of gene expression levels by molecular genetic methods (real-time PCR) - application in physiology, immunology, pharmacology, nutrigenomics and genotoxicology. Analysis of oxidative stress for the purpose of biomolecule damage assessment in healthy and infected bees. Molecular characterization and typing of bee and bee brood pathogens: detection, identification and quantification of viruses, bacteria, protozoa, fungi and ectoparasites. Investigation into the influence of drugs, supplements and supplementary feed on bee survival, oxidative stress, expression of genes important for immunity and oxidative stress and on the loads of pathogens. Use of biochips (DNA microarray). Analysis of bee microbiome using *next-generation sequencing* (NGS).

Practicals - SRW (study research work): Nucleic acid extraction, amplification of conserved mitochondrial DNA regions, nuclear DNA amplification (PCR, real-time PCR, RT-PRC, PCR-RFLP, LAMP), visualization of results by gel electrophoresis and sequencing, usage of the obtained results in bee genome and molecular diversity analysis. Analysis of gene expression levels using the relative quantification real-time PCR method. Analysis of oxidative stress parameters as a function of biomolecule damage assessment in bees. Molecular detection, identification and quantification of bee pathogens using PCR, real-time PCR, RT-PCR and PCR-RFLP methods.

Recommended literature

1. Stanimirović Z, Soldatović B, Vučinić M: Biology of the bee – The honey bee, Faculty of Veterinary Medicine, Medicinska knjiga – Medicinske komunikacije, Beograd, p. 375, 2000.
2. Ćirković D, Stanimirović Z: Manual in beekeeping, Naučna KMD, Beograd, 2018.
3. Stevanović J, Stanimirović Z, Glavinić U: Molecular-genetic methods in veterinary medicine, Faculty of Veterinary Medicine, University of Belgrade, Authorised manuscript, 2020.
4. Dietemann V, Ellis JD, Neumann P (eds.): The COLOSS BEEBOOK Volume II: Standard methods for *Apis mellifera* pest and pathogen research. Journal of Apicultural Research, International Bee Research Association IBRA, ISSN: 0021-8839; ISBN: 978-0-86098-275-3 Vol. 52, 2013.
5. Van Pelt-Verkuil E, van Leeuwen WB, te Witt R (Editors): Molecular Diagnostics, Part 2: Clinical, Veterinary, Agrobotanical and Food Safety Applications, Springer, Singapore, 2017.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Apart from theoretical instructions, practical individual work with students is done. Interactive work in the Laboratory for genetics of domestic animals, hunting game and honey bees, at the Department of Biology. The available equipment of the Laboratory enables adequate tuition. Student and tutor rotation system enables each candidate to independently perform each diagnostic technique.

Evaluation and grading (maximum 100 points) Class attendance – 10 points, Term paper – 10 points, Final exam – 80 points (min. 41).

Knowledge assessment methods Term paper, Final exam.

Course title: Animal nutrigenetics and nutrigenomics
Lecturer/lecturers: Jevrosima Stevanović, Full Professor; Zoran Stanimirović, Full Professor; Branko Petrujkić, Associate Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which the course is taken
Course aims Explanation of the connection between diet and animal genome, i.e. how nutrients influence the activity of health-related and production-related genes (nutrigenomics), and how the influence of diet on health and animal production traits depends on genetic predispositions (nutrigenetics).
Course outcomes On completing the course the students will know that by the modification of diet and using dietary supplements many genes related to animal health and production can be influenced. They will know that (1) molecular basis of nutrient influence on animal gene expression, as well as that the utilization of substances depends on individual genetic predisposition and the quantities of ingested substances; (2) to optimize nutrition and chose appropriate dietary supplements in order to maintain animal health and increase their productive performance, taking into consideration their genetic predispositions and the cost-effectiveness of production.

Course content
Lectures
The object and the importance of nutrigenetics and nutrigenomics. Molecular interactions between nutrition and genes. Development of nutrition strategies for improvement of animal health and welfare, disease prevention, increased efficacy of feed utilization and sustainable livestock production.
Nutrigenetics: The connection between genetic variability and response to nutrients. Genetic polymorphism - the cause of variations in food utilisation in individuals of the same species. Methods for genetic polymorphism detection. Nutrition alternatives based on genetic polymorphism analysis. Foetal programming: the influence of subnutrition in gestation on the offspring metabolism. Individualized nutrition of pets and supplementation in compliance with the individual genetic predispositions. Examples of optimising meals in accordance with animal genetic predispositions.
Nutrigenomics: The influence of nutrients (bioactive, functional food and dietary supplements) on gene activity. Methods of detecting effects of nutrients on gene expression. Integration of "*omics*" technologies (transcriptomics, proteomics and metabolomics) in nutrigenomics research. Nutrigenomics and immunity. Nutrigenomics and diseases. Nutrigenomics and reproduction. Nutrigenomics and animal production traits. Examples of proven positive and negative effects of nutrients (fatty acids, and vitamin, mineral and protein supplements) on the expression of genes related to immunity, detoxication, oxidative stress, development, apoptosis, metabolic pathways and homeostasis control.
Practicals – SRW (study research work): Individual practical work in the Laboratory.

Recommended literature
1. Fenech M, El-Sohemy A, Cahill L, Ferguson LR, French TA, Tai ES, Milner J, Koh WP, Xie L, Zucker M, Buckley M: Nutrigenetics and nutrigenomics: viewpoints on the current status and applications in nutrition research and practice. *Journal of Nutrigenetics and Nutrigenomics* 4(2) 69-89, 2011.
2. Schwartz B: New criteria for supplementation of selected micronutrients in the era of nutrigenetics and nutrigenomics. *International Journal of Food Sciences and Nutrition* 65 (5) 529-538, 2014.
3. Đelić N, Stanimirović Z: Principles of genetics, Faculty of Veterinary Medicine, University of Belgrade, Data status, Beograd, 2019.
4. Nowacka-Woszuk J: Nutrigenomics in livestock—recent advances. *Journal of Applied Genetics* 61 (1) 93-103, 2020.
5. Stevanović J, Stanimirović Z, Glavinić U: Molecular-genetic methods in veterinary medicine, Faculty of Veterinary Medicine, University of Belgrade, Authorised manuscript, 2020.

Hours	Lectures: 1	Practicals - SRW: 2

Teaching methods
Apart from theoretical instructions, practical individual work with students is done. Interactive work in the Laboratory for genetics of domestic animals, hunting game and honey bees, at the Department of Biology. The available equipment of the Laboratory enables adequate tuition. Student and tutor rotation system enables each candidate to independently perform each diagnostic technique.

Evaluation and grading (maximum 100 points) Class attendance – 10 points, Term paper – 10 points, Final exam – 80 points (min. 41).

Knowledge assessment methods Term paper, Final exam.

Course Title: Metabolic diseases of poultry and mycotoxicosis
Lecturer/lecturers: Radmila Resanović, Full Professor; Miloš Vučićević, Assistant Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which the course is taken
Course aims
• Acquiring new knowledge about the specifics of poultry metabolism
• Detailed introduction to metabolic diseases of poultry
Acquisition of knowledge in the field of poultry mycotoxicology
Course outcomes
Upon completion of this course students should be able to:
Identify the causes and predisposing factors for metabolic diseases of poultry.
Diagnose metabolic diseases.
Assess the impact of metabolic diseases on the performance, welfare of poultry and the economic effects of production.
To cope the basic principles of diagnosis of mycotoxicosis.

To cope the methods of detoxification and detoxification of mycotoxins.
Assess the impact of mycotoxins on the performance and welfare of poultry.
Assess the socio-economic damage caused by mycotoxin poisoning.
To create a program for the prevention of metabolic diseases.
To create a program for the prevention of mycotoxin poisoning.

Course content

Lectures

Poultry metabolism; nutritional metabolic diseases of mercury; ascites; sudden death syndrome; round heart and aortic rupture; fatty liver and kidney syndrome; Spiling mortality syndrome; foot problems; treatment of metabolic diseases; prevention of metabolic diseases; aflatoxicosis, ochratoxicosis, trichothecene mycotoxicosis; other mycotoxicosis; diagnosis of poultry mycotoxicosis; nutritional strategy for the prevention of mycotoxicosis; detoxification; detoxification; mycotoxin residues in poultry-derived foods; legislation regarding mycotoxins

Practicals - SRW:

Recommended literature

Swayne DE et al. 2019, Diseases of Poultry, 14th Edition, John Wiley & Sons, Inc

Summer JD, Adams CA, Leeson S, 2013, Metabolic Disorders in Poultry, Context

Diaz DE, 2005, The Mycotoxin Blue Book, Nottingham University Press

Hours	Formal lectures: 1	Practicals - SRW: 2

Teaching methods Interactive teaching, PowerPoint presentations, and practical teaching

Evaluation and grading (maximum 100 points) Class attendance – 10 points, written – 40 points, oral exam – 50 points

Knowledge assessment methods The method of evaluation can be different, listed in the table are just some of the options: (written exams, oral exam, project presentation, seminars, etc.

Course Title: Oncogenic and non-oncogenic immunosuppressive diseases of poultry
Lecturer/lecturers: Radmila Resanović, **Full Professor;** Miloš Vučićević, Assistant Professor; Darko Marinković, Associate Professor
Course status: Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which the course is taken

Course aims
- Acquisition of new knowledge in poultry immunology
- Understanding of the causes and mechanisms of immunosuppression

Detailed introduction to the material that treats oncogenic and non-oncogenic immunosuppressive diseases of poultry

Course outcomes

Upon completion of this course, doctoral students should be able to:
- Identify the causes of immunosuppression
- Assess the impact of immunosuppression on poultry performance and welfare.
- Assess of the socio-economic damage caused by immunosuppression.
- To create a program to prevent the occurrence of immunosuppression.
- To diagnose: poultry leucosis, Marek's disease and reticuloendotheliosis
- To diagnose: infectious bursal disease, infectious anemia, reovirus infections and hydropericardium syndrome
- Assess the impact of immunosuppression on poultry performance and welfare.
- To make a vaccination program in accordance with the epizootiological situation and the production category of poultry.
- To react adequately when the mentioned pathology appears on the farm

Course content

Lectures

Basic characteristics of the immune system of birds; mechanisms of immunosuppression; "Recognition" of immunosuppression; stress-induced immunosuppression; causes leading to immunosuppression; immunosuppression during incubation; immunosuppression during rearing period; immunosuppression during exploitation; Marek's disease; leucosis; reticuloendotheliosis, infectious bursal disease, infectious anemia; reovirus infections; hydropericardium syndrome; the impact of immunosuppression on the welfare of poultry, the impact of immunosuppression on the economic parameters of production; biosecurity protocols in the prevention of immunosuppression; development of vaccine programs for the prevention of immunosuppressive diseases

Practicals - SRW:		
Diagnosis of diseases in farm conditions; Interpretation and evaluation of laboratory results; Autopsy of poultry corpses; Analysis of histopathological preparations		
Recommended literature		
• Swayne DE et al. 2019, Diseases of Poultry, 14th Edition, John Wiley & Sons, Inc.		
• Maclachlan NJ, Dubovi EJ, 2018, Fenner's Veterinary Virology 4E, Elsevier Science		
• Kaupp BF, 2020, Poultry Diseases and Their Treatment, Alpha Editions		
Hours	**Lectures**: 1	**Practicals - SRW:** 2
Teaching methods Theoretical classes; practical teaching; laboratory exercises; work in the autopsy room, preparation and analysis of histological specimens		
Evaluation and grading (maximum 100 points) Class attendance – 10 points, written – 40 points, oral exam – 50 points		
Knowledge assessment methods The method of evaluation can be different, listed in the table are just some of the options: (written exams, oral exam, project presentation, seminars, etc.		

Course title: Homeostasis of body fluids and electrolytes		
Lecturer/lecturers: Natalija Fratrić, Full Professor; Vanja Krstić, Full Professor; Dragan Gvozdić, Full Professor		
Course status: Elective course in the field of doctoral dissertation		
ECTS credits: 5.0		
Prerequisites: Enrolled semester in which the course is taken		
Course aims		
Introducing students to the mechanisms of homeostasis of body fluids and electrolytes and provide easier understanding of the most complex organism disorders that follow disturbancies of homeostatic mechanisms; To allow easier identification of complex disorders of fluid and electrolyte balance and to familiarize them with the methods used in the study of these disorders.		
Course outcomes		
Student should know the homeostasis of body fluids and electrolytes, understand the mechanisms of disorders of homeostasis, know experimental models and test methods for diagnostics of disorders of homeostasis of body fluids and electrolytes and know basic principles of fluid and electrolytes replacement.		
Course content		
Lectures		
The role of the kidney in the homeostasis of body fluids, neuroendocrine regulation of homeostasis, other mechanisms, acid-base balance. Disorders of water balance, dehydration and hyperhydration. Electrolyte balance disorders. Disturbances of acid-base balance. Shock. Methods for testing fluid and electrolyte balance. The basic principles of treatment with fluids.		
Recommended literature		
KS, Kamel, ML, Halperin, Fluid, Electrolyte and Acid-Base Physiology, 5th edition, Elsevier/Saunders, Philadelphia, 2017. Di Bartola SP, Fluid, Electrolyte and Acid-Base Disorders, 4th edition, Elsevier/Saunders, St. Louis, 2012. Trailović D, Poremećaji prometa vode i elektrolita u pasa i mačaka: Etiopatogeneza, dijagnostika i terapija: Visio mundi academic press, Novi Sad, 1994.		
Hours	**Lectures:** 1	**Practicals – SRW:** 2
Teaching methods Interactive lessons, PowerPoint presentations, seminars, public presentations and discussion.		
Evaluation and grading (maximum 100 points) Activities during lecture 20 points, Seminars 20 points, Test paper 60 points.		
Knowledge assessment methods written exam, oral exam, presentation, seminars etc.		

Course title: Clinical pathology and therapy of equides
Lecturer/lecturers: Vanja Krstić, Full Professor; Petar Milosavljević, Full Professor; Ružica Trailović, Associate Professor
Course status: : Elective course in the field of doctoral dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which the course is taken
Course aims

Understanding the mechanisms of disorders of individual organs and organ systems of horses is easier recognizing such disorders; Mastering techniques and methods of testing disorders of individual organs and introduction to clinical and experimental research methods in clinical pathology of horses.

Course outcomes

The student should recognize the anatomical and physiological specifics of horses, know the etiopathogenesis and diagnosis of diseases of certain organs and organ systems in horses and the specifics of horse pathology in relation to other species of animals and humans, apply clinical and experimental methods of testing individual systems of organs and describe obtained results.

Course content

Lectures

Genetic factors and horse pathology. Systemic disorders in equine pathology. Etiopathogenesis and diagnosis of gastrointestinal, respiratory, cardiovascular, hemolymphatic diseases, musculoskeletal, nervous, endocrine system and skin. Dietary errors and metabolic disorders. Horse sports medicine. Clinical and experimental methods of testing individual systems of horse organs.

Practicals SRW (study research work)

Recommended literature

Trailović D, Bolesti kopitara, Naučna KMD, Beograd, 2011.

Reed SM, Bayly WM, Selon DC, Equine Internal Medicine, 3rd edition, Saunders/Elsevier, St. Louis, 2010.

Orsini JA, Divers TJ, Equine Emergencies. Treatment and Procedures, Saunders/Elsevier, St. Louis, 2008

Celia Marr, Bowen M, Cardiology of the Horse 2nd Edition, Saunders Elsevier, 2010

Hinchcliff K, Kaneps A, Equine Sports Medicine and Surgery: Basic and clinical sciences of the equine athlete 2nd Edition, Sounders Elsevier, 2014

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Interactive teaching, PowerPoint presentations, seminars, public presentation and discussion.

Evaluation and grading (maximum 100 points)

Knowledge assessment methods:

Course title: Clinical pathology and therapy of dogs

Lecturer/lecturers: Vanja Krstić, Full Professor; Nenad Andrić, Associate Professor; Predrag Stepanović, Associate Professor; Milica Kovačević-Filipović, Full Professor

Course status: Elective course in the field of doctoral dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

Recognition and understanding of the occurrence of disorders of individual organs and organ systems of dogs. Mastering the techniques and methods of examining disorders of individual organs and getting acquainted with clinical and experimental research methods in the clinical pathology of dogs.

Course outcomes

Students should: gather appropriate information about dogs' health problems; make a reasonable number of possible diagnoses; investigate possible diagnoses using appropriately directed history taking from dog owners and selective physical examination of patients; develop an appropriate and feasible patient management plan.

Course content

Lectures

Etiopathogenesis and diagnosis of diseases of the gastrointestinal system of dogs. Etiopathogenesis and diagnosis of diseases of the respiratory and cardiovascular systems. Etiopathogenesis and diagnosis of diseases of the hemolymphatic and immune systems. Etiopathogenesis and diagnosis of diseases of the musculoskeletal system. Etiopathogenesis and diagnosis of diseases of the urogenital system. Etiopathogenesis and diagnosis of skin diseases. Etiopathogenesis and diagnosis of diseases of the nervous and endocrine systems. Dietary errors and metabolic disorders. Oncology in dogs. Imaging diagnostics in dogs. Specifics of clinical pathology of certain dog systems in relation to other species of animals and humans. Clinical and experimental methods of testing individual organ systems of dogs

Practicals - SRW (study research work)

Work with patients at the Clinics of the Faculty of Veterinary Medicine

Recommended literature

1. Ettinger SJ, Feldman EC, Textbook of Veterinary Internal Medicine, 5th ed, Saunders, Philadelphia, 2000,

2. Popović N, Lazarević M, Skin diseases, FVM, Belgrade, 1998,

3. Trailović D, Gastroenterology of dogs and cats, Etiopathogenesis, diagnostics and therapy, FVM, Belgrade,

1999,
4. Trailović D, Disorders of water and electrolyte turnover in dogs and cats, Second edition, FVM, Belgrade 2007,
5. Krstić N, Krstić V, Radiological and endoscopic diagnosis of gastrointestinal and respiratory diseases system of dogs and cats, FVM, Belgrade, 2007.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes, PowerPoint presentations, seminars, public presentation and discussion, practical exercises on clinics

Evaluation and grading (maximum 100 points)
Test, seminar papers, public presentations. Within the compulsory classes and on the exam, students can collect 100 points: 40 from pre-exam obligations (class attendance, seminar papers) and 60 on the exam.
The exam is taken in writing in the form of a test. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10)

Knowledge assessment methods seminar paper, test

Course title: Clinical pathology and therapy of cats
Course status: Elective course in the field of doctoral dissertation

Lecturer/lecturers: Nenad Andrić, Associate Professor; Vanja Krstić, Full Professor; Predrag Stepanović, Associate Professor; Vladimir Magaš, Associate Professor

ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims
Understanding the mechanisms of disorders of certain organs and organ systems of cats and easier recognition of such disorders.

Course outcomes
Mastering the techniques and methods of examining disorders of certain organs (Ultrasound of abdomen, Collecting samples from altered tissue or body cavities, Assessment of body mass, Assessment of behavior) and getting acquainted with clinical and experimental research methods in clinical pathology of cats.

Course content
Lectures
Basic anatomical and physiological specifics of cats; genetic factors and feline pathology. Systemic disorders in feline pathology. Etiopathogenesis and diagnosis of diseases of the gastrointestinal system of cats, Etiopathogenesis and diagnosis of diseases of the respiratory and cardiovascular systems. Etiopathogenesis and diagnosis of diseases of the hemolymphatic and immune systems. Etiopathogenesis and diagnosis of diseases of the musculoskeletal system. Etiopathogenesis and diagnosis of diseases of the urinary system, Etiopathogenesis and diagnosis of diseases of the nervous and endocrine systems. Dietary errors and metabolic disorders. Specifics in the clinical pathology of certain systems of cats in relation to other species of animals and humans
Practicals - SRW (study research work)
Practical exercises at the Clinic of small animal disease, Case reports with discussion

Recommended literature
1. Ettinger S.J., Feldman E.C.: Textbook of Veterinary Internal Medicine. 5th ed., Saunders, Philadelphia, 2000. -
2. Chandler E.A., Gaskell C.J., Gaskel R.M.: Feline Medicine and Therapeutics, 3rd ed, Blackwell, Oxford, 2004. -
3. D. Trailović: Gastroenterologija pasa i mačaka: Etiopatogeneza, dijagnostika i terapija, FVM, Beograd, 1999. -
4. D. Trailović: Poremećaji prometa vode i elektrolita u pasa i mačaka, Drugo izdanje, FVM, Beograd 200

Hours	Formal lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes: PowerPoint presentations, seminars, public presentation and discussion
Practical classes: Exercises at the Clinic of small animal disease, Case reports presentation

Evaluation and grading (maximum 100 points) Within the compulsory classes and on the exam, students can collect 100 points: 40 from pre-exam obligations (class attendance, seminar papers) and 60 on the exam. The exam is taken in writing in the form of a test. The grade is formed on the basis of the sum of collected points: 66-70 = 6; 71-77 = 7; 78-86 = 8; 87 = 93 = 9; 94-100 = 10.

Knowledge assessment methods Test, seminar papers, public presentations.

Course title: Clinical dietetics of dogs and cats
Lecturer/lecturers: Jelena Nedeljkovic-Trailović, Full Professor; Branko Petrujkić, Associate Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0

Prerequisites: Enrolled semester in which the course is taken

Course aims

The aim of the course is to adopt new information from clinical nutrition and animal dietetics, which exceeds the scope of teaching in this area in undergraduate studies. In this way, we would ensure that DAS students would acquire knowledge, skills and competencies in the field of animal nutrition, an important factor in the prevention of a significant number of diseases and support in the treatment of dogs and cats.

Course outcomes

After completing the course, students should: Have the ability to make the correct choice of special commercial diets based on the diagnosis of the diseased animal. Be able to recommend supplements (for feed) that can be used as aids in special categories of animals (service and working dogs), as well as supplements that can be used as a support therapy in various pathological conditions of animals. Have fully mastered the strategy for formulating special meals-recipes (which can be prepared by animal owners)). Have mastered the use of special software databases for meal optimization for sick animals that need meal correction.

Course content

Lectures

Dietetics in Veterinary Medicine, nutrition of old and obese animals, nutrition in allergies and intolerance to food components, nutrition in skeletal diseases, nutrition in cardiovascular diseases, gastrointestinal diseases, kidney diseases, endocrine disorders, urinary tract diseases, urinary tract diseases, liver and pancreas disorders, in oncological diseases of dogs and cats, nutritional idiosyncrasies of certain breeds of dogs and cats, as well as the diet of neonats and orphans of dogs and cats. Special diet for service and working dogs used for racing and agility programs.

Practicals - SRW (study research work):

Work with special bases for meal optimization in sick animals, as well as bases for meal optimization (for official and sports dogs).

Recommended literature

1. Manual of Veterinary dietetics, Buffington, CAT, Holloway C, Abood SK, W.B. Saunders\Elsevier Science 2004.
2. Home prepared dogs and cats diet, Schenck AP, Blackwell Publishing, USA 2010.
3. Canine and Feline Nutrition A Resource for Companion Animal Professionals, 3rd edition, Case LP, Daristole L, Hayek MG, Foess Raasch M, Elsevier Inc. 2011.
4. Small animal clinical nutrition, Hand MS, Thatcher CD, Remillard RL, Roudebush P, Novtony BJ, Lewis LD, Mark Morris Institute, 2010.

Hours	Lectures: 1	Practicals - SRW: 2

Teaching methods Theoretical classes and practical block classes with individual student work. Active and concrete practical work with software for meal optimization, as well as practical work in the clinic for small animals in agreement with colleagues from the clinic. The doctoral student's rotation system and tutor for each diagnostic technique enable each candidate to be able to work independently after completing the course.

Evaluation and grading (maximum 100 points) Scoring: 10 points from classes, 20 points for seminar work, 70 points at the exam

Knowledge assessment methods The methods of knowledge assessment can be different: (written exams, oral exam, project presentation, seminars, etc.

Course title: Prevention of animal behavioral disorders

Lecturer/lecturers: Marijana Vučinić, Full Professor; Katarina Nenadović, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

1) Acquiring knowledge about the causes of disorders and pathological forms of behavior of farm animals, traditional and non-traditional pets, animals in zoos, sports, working and experimental animals. 2) Training for independent recognition of the causes of disorders and pathological forms of animal behavior. 3) Training for independent application of mechanisms and preventive measures for prevention of disorders and pathological forms of animal behavior

Course outcomes Upon successful completion of the course, students should be able to: 1) Recognize the causes of disorders and pathological forms of behavior specific to certain necessary categories of animals - farm animals, traditional and non-traditional pets, animals in zoos, sports, working and experimental animals. 2) Apply mechanisms and preventive measures to prevent the occurrence of behavioral disorders. 3) Apply mechanisms and measures to alleviate or eliminate the behavioral disorders.

Course content
Lectures
Behavioral norm. Behavioral goal. The ability of animals to predict and control events in their living environment (prediction of stimulus action, stimulus control and memory of consequences). Environmental factors that animals can control. Environmental factors that animals cannot control. The role of different behavioral strategies in predicting and controlling environmental events. The role of man (owner, farm worker, zoo, laboratory or animal user) in the development of behavioral disorders in animals. Behavioral deficit. Causes of behavioral disorders in different categories of animals - living conditions, human-animal relationship. Manifestation of behavioral disorders of different use categories of animals. Behavioral engineering in the prevention and treatment of disorders and pathological forms of behavior of different categories of animals. Modification of living conditions. Behavior modification.
Practicals - SRW (study research work)

Recommended literature
1) Young RJ. Environmental Enrichment for Captive Animals. Blackwell Science, UFAW, 2003. – 2) Kurtycz LM. Choice and control for animals in captivity. The psychologist 28, 892-895, 2015. - 3) Abramson CI, Kieson E. Conditioning methods for animals in agriculture: a review. Ciênc. Anim. Bras., Goiânia, 17, 3, 359-375, 2016 . – 4) Marchant-Forde JN. The Science of Animal Behavior and Welfare: Challenges, Opportunities, and Global Perspective. Frontiers in Veterinary Science 2, 16, 2015. - 5) Guidelines for the Use of Animals. Guidelines for the treatment of animals in behavioural research and teaching. Animal Behaviour 135, I-X, 2018. -6) Bacon H. Behaviour-Based Husbandry—A Holistic Approach to the Management of Abnormal Repetitive Behaviors. Animals 8, 7, 103, 2018. – 7) Houpt KA. Domestic Animal Behavior for Veterinarians and Animal Scientists, 6th Edition, Wiley-Blackwell, 2018. – 8) Greggor AL, Blumstein DT, Wong BBM et al. Using animal behavior in conservation management: a series of systematic reviews and maps. Environ Evid 8, 23, 2019.- 9) Shalvey E, McCorry M, Hanlon A. Exploring the understanding of best practice approaches to common dog behaviour problems by veterinary professionals in Ireland. Irish Veterinary Journal 72, 1, 2019.– 10) Puurunen J, Hakanen E, Salonen MK et al. Inadequate socialisation, inactivity, and urban living environment are associated with social fearfulness in pet dogs. Sci Rep 10, 3527, 2020.

Hours	Lectures: 1	Practicals - SRW: 2

Teaching methods Theoretical classes with interactive work and discussion

Evaluation and grading (maximum 100 points)
Active participation in theoretical classes - 20 points; Seminar paper - 30 points; Oral exam: 50 points. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods Active participation in theoretical classes - 20 points; Seminar - 30 points; Oral exam - 50 points

Course title: Organic waste and environmental protection
Lecturer/lecturers: **Radislava Teodorović, Full Professor;** Ljiljana Janković, Associate Professor; Milutin Đorđević, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims
The aim of the course is for students to understand the importance of proper storage of organic waste, the role of organic waste and wastewater from slaughterhouses and dairy farms in environmental pollution (water, air and soil) and the risks that may arise in animal waste management.
Course outcomes
Upon completion of the course, students should be able to apply the knowledge related to conventional and alternative ways of processing organic waste in order to reduce environmental pollution. They will also expand the knowledge on the proper management of animal waste as well as on the microbiological and physicochemical properties of wastewater from slaughterhouses and dairy farms and methods of their treatment.
Course content
Lectures
Concept, definition and classification of organic waste. Significance of measures in solving the removal and processing of organic waste. Methods of testing the impact of organic waste on environmental pollution. Ecological and epidemiological-epizootiological significance of liquid and solid garbage. Solid and liquid manure processing technology. Harmless removal of dead animals and inedible products of slaughtered animals. Animal waste management risk assessment. Concept, definition and classification of wastewater. Wastewater treatment technology. International and national legal regulation of environmental protection.

Practicals - SRW (study research work)

Recommended literature
1. Miler L, Flori G. (2018): Postupanje s leševima na malim i srednjim gazdinstvima za uzgoj stoke – praktični aspekt. FOCUS ON, br 13. Rim. FAO. http://www.fao.org/3/ca2073rs/CA2073RS.pdf.
2. Ristić M., Radenković Brana, Đorđević M. (2000): Neškodljivo uklanjanje uginulih životinja i nejestivih proizvoda zaklanih životinja, Fakultet veterinarske medicine Univerzitet u Beogradu
 3. Radenković-Damnjanović B. (2010): Praktikum iz zoohigijene, Fakultet veterinarske medicine Univerzitet u Beogradu.
4. Asaj A. (2003): Higijena na farmi i u okolišu, Medicinska naklada, Zagreb.
5. Dewi I., at all. (2004): Pollution in livestock production systems, CAB International Wallingford, Oxon.
6. Dinges R. (1982): Natural Systems for Water Pollution Control.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes, PowerPoint presentations, seminar paper

Evaluation and grading (maximum 100 points) From teaching 10 points, seminar paper 20 points, from the test 70 points. Ratio of points and final grades: 66-70 = 6; 71-77 = 7; 78-86 = 8; 87-93 = 9; 94-100 = 10

Knowledge assessment methods: seminar paper, test

Course title: General hygiene measures and preventive measures in veterinary medicine

Lecturer/lecturers: Radislava Teodorović, Full Professor; Ljiljana Janković, Associate Professor; Milutin Đorđević, Full Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims
Students should understand the importance of proper implementation of general hygienic and preventive measures (disinfection, disinsection, pest control and quarantine) in animal housing facilities and other facilities of veterinary activities and to be able to work independently.

Course outcomes
Upon successful completion of the course, students should be able to independently design a plan for the implementation of appropriate general or preventive measures in special situations, in animal housing facilities, food processing plants of animal origin, in various means of transport and to apply appropriate methods for control of the effectiveness of the implemented measures.

Course content
Lectures
Significance of implementation of veterinary - preventive measures. Disinfection (concept and significance of disinfection; methods and types). Disinfection for the most important animal diseases. Soil disinfection. Disinfection of animal housing facilities, industrial facilities. Water disinfection. Disinfection of means of transport. Disinsection (concept, meaning and methods, performing of disinsection). Pest control (concept, methods, epidemiological-epizootiological significance of pest control). Deodorization of facilities. Quarantine (significance, types, organization of quarantine). Basic regulations for disinfection, disinsection and pest control in veterinary medicine. The importance of implementing hygienic and sanitary measures in animal housing facilities and the environment. Types of hygienic and sanitary measures in animal housing facilities. Implementation of hygienic and sanitary measures in special situations. Implementation of hygienic and sanitary measures in the environment.
Practicals - SRW (study research work)

Recommended literature
Asaj A. (2003): Higijena na farmi i okolišu. 2. Hristov S. (2002): Zoohigijena, Poljoprivredni fakultet Univerzitet u Beogradu. 3. Asaj A. (2000): Zdravstvena dezinfekcija u nastambama i okolišu, Medicinska naklada, Zagreb. 4. Asaj A. (1999): Deratizacija u praksi. Medicinska naklada, Zagreb. 5. Smith RH, Meyer AN, (2016): Rodent control methods: non-chemical and non-lethal chemical, with special reference to food stores. In: Rodent pests and their control, 2nd ed. CAB International, Boston. 6. Linton HA, Hugo WB, Russell AD, (1987): Disinfection in veterinary and farm animal practice. Oxford. 7. Asaj A (2000): Zdavstvena dezinsekcija. Medicinska naklada, Zagreb.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods theoretical classes, seminar paper

Evaluation and grading (maximum 100 points) From teaching 10 points, seminar paper 20 points, on the test 70 points. Ratio of points and final grades: 66-70 = 6; 71-77 = 7; 78-86 = 8; 87-93 = 9; 94-100 = 10

Course title: Parasitic zoonoses
Lecturer/lecturers: Tamara Ilić, Associate Professor; Nevenka Aleksić, Full Professor; Zoran Kulišić, Full Professor; Danica Bogunović, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims Acquisition of contemporary knowledge on zoonotic pathogens of parasitic etiology and causative agents showing zoonotic potential which are important for public health. Getting familiar with latest scientific data on the epidemiology, clinical aspects, diagnostic approaches, therapeutic possibilities, modern prophylactic protocols and monitoring of the occurrence, maintenance and spread of existing and possibly emergent parasitic zoonoses.
Course outcomes The doctoral student should be able to: 1) select relevant information related to the animals' health problems, including information from the animal owner perspective; 2) improve the skills necessary for keeping epizootiological diaries and recognizing sensitive epizootiological points related to parasitic infections of importance for public health; 3) set a realistic number of possible diagnoses for undifferentiated cases of parasitic zoonoses, which are suspected; 4) propose effective causal therapy based on the determined prevalence of the disease; 5) clearly define the proposals of the Programme of measures of importance for public health, which would be in accordance with the current and valid ESCCAP (European Scientific Counsel Companion Animal Parasites) guidelines and 6) implement timely demanding tasks of surveillance of potentially zoonotic parasitoses, with individual improvement and application of critical thinking.
Course content *Lectures* Epizootiology of parasitic zoonoses during human evolution. Etiopathogenesis of zoonotic coccidia, flagellates and ciliates. Intestinal zoonotic helminthoses (ascariosis, visceral and cutaneous *larva migrans*, trichuriosis, dipilidiosis, human larval alariosis). Cardiorespiratory zoonotic helminthoses (heartworm disease, respiratory capillariosis). Ocular zoonotic parasitoses (toxoplasmosis, giardiosis, amoebiosis, cysticercosis, toxocarosis, dirofilariosis, gnathostomosis, hydatidosis, thelaziosis). Parasitic zoonoses of the urogenital tract (schistosomosis / bilharziosis, cystic echinococcosis, trichomonosis, filarioses, urogenital myiases, sarcoptosis). Epizootiology and monitoring of arthropod infestations that are important for public health. *Practicals - SRW (students' research work)*
Recommended literature 1) Weese SJ, Fulford BM. Companion animal zoonoses. 2nd Edition, Blackwell Publishing Ltd., Iowa, USA, pp. 319, 2011. 2) Caffrey RS. Parasitic helminths: targets, screens, drugs and vaccines. 1st Edition, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, pp. 516, 2012. 3) Dhaliwal SBB, Juyal DP. Parasitic zoonoses. 1st Edition, Springer India, New Delhi, India, XXI, pp. 135, 2013. 4) Snowden KF, Budke CM. Dogs, zoonoses and public health. 1st Edition, CABI Publishing, Texas, USA, pp. 259, 2013. 5) Singh KS. Human emerging and re-emerging infections: viral and parasitic infections, Volume I. 1st Edition, Conscious Leadership, LLC., Chicago, USA, pp. 1017, 2015. 6) Mullen RG, Durden AL. Medical and veterinary entomology. 3rd Edition, Academic Press, Waltham, USA, pp. 792, 2018. 7) Moraru MG, Goddard J. The Goddard guide to arthropods of medical importance. 7th Edition, CRC Press, Boca Raton, USA, pp. 392, 2019.

Hours	**Lectures:** 1	**Practicals – SRW:** 2
Teaching methods Oral presentations, video presentations, seminars		
Evaluation and grading (maximum 100 points) Lectures: 10 points (min. 6) Seminar: 10 points (min. 6) Practicals-SRW: 20 points (min. 11) Oral exam: 60 points (min. 31) Points/grade ratio: 51-60=6, 61-70=7, 71-80=8, 81-90=9, 91-100=10.		
Knowledge assessment methods: Oral exam, seminary paper – essay.		

Course title: Economics and management in veterinary medicine
Lecturer/lecturers: Drago Nedić, Full Professsor; Milorad Mirilović, Full Professsor

Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisite: Enrolled semester in which course is taken
Course aims Students should acquire: - wider knowledge of the application of economics in the work of veterinary practice, animal treatment, preventive measures as well as on farms in animal husbandry, nutrition and production of products of animal origin; - wider knowledge in the field of management in order to be able to establish and manage veterinary practice, to develop a good organization and strategic plan, to manage human and material resources, to make work plans, to establish good clientele and marketing for stable work and progress large, mixed or small practices.
Course outcomes Students should be trained to be capable managers and leaders of veterinary practice; to be able to analyze the market and the work of the competition and then choose the best jobs and become more competitive in the field they deal with. They should establish a higher level of trust of users of veterinary services and thus lead to better application of veterinary and sanitary measures in all segments of veterinary activities.
Course content *Lectures* Theoretical basis of economics - macro and micro economics, agro and veterinary economics; the importance of economics in controlling animal health and herd productivity; theory and factors of production; production optimization; definition, cost function, type and classification of costs, method of determining costs; the importance of marginal and opportunistic costs in veterinary medicine; determining the income statement and balance sheet; classification and determination of economic damages; economics of veterinary and sanitary measures; business and financial risk in veterinary medicine; economic evaluation and business decision making; market - type and division; law of supply and demand; demand elasticity and epidemiological situation; producer and consumer surplus / deficit depending on the epidemiological situation; international trade and animal health; marketing mix in veterinary medicine; determining the competitive position of veterinary practice in conditions of full competition; management theory - basic terms and definition; basic functions of management and veterinary epidemiology - planning, organization, management and control; strategic and operational management; defining goals and applying appropriate methods; development cycle of veterinary practice; clienting in veterinary medicine - establishing relationships within practice, between practice, practice and clients, practice and suppliers; veterinary organization and professional development *Practicals - SRW* Development of appropriate tasks for certain methodological units such as: establishment of veterinary practice; development of a plan and organizational scheme; .market analysis; increasing the number and level of veterinary services; development of a long-term professional development plan; economic analysis and farm management and more.
Recommended literature 1. Tešić M. Milan, Nedić N. Drago, 2015, Ekonomika veterinarstva. Udžbenik. Fakultet veterinarske medicine, Beograd; 2. Jonathan Rushton, 2016, Animal Health Economics: An Introduction. CABI Publishing, ISBN: 1845939581, 256 pages; 3. Milan Tešić, Drago N. Nedić, 2011, Menadžment veterinarske prakse, udžbenik, Fakultet veterinarske medicine, Beograd; 4. Milan M. Tešić, Drago N. Nedić, Nada Tajdić, 2013, Ekonomika veterinarstva - praktikum. Udžbenik. Fakultet veterinarske medicine, Beograd; 5. Fejzić Nihad i Sabina Šerić, 2004, Ekonomika zdravlja životinja, Univerzitet u Sarajevu, Veterinarskifakultet, Sarajevo; 6. Đuričin Dragan, Kaličanin Đorđe, Lončar Dragan, Vuksanović Herceg Iva, 2018, Menadžment i strategija, Ekonomski fakultet Beograd, 901 stranica; 7. Maggie Shilcock Georgina Stutchfield, 2008, Veterinary Practice Management, 2nd Edition, A Practical Guide, Saunders Ltd., 256 pages.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes are performed with the application of audiovisual techniques, and practical with data collection and preparation of various essays, models, analyzes, discussions, plans and seminar papers
Evaluation and grading (maximum number of points 100) Written and oral. Assessment of knowledge (max. No. 100 points): from teaching 10 points, for seminar work 20 points, on the test 70 points (min. 36). Points ratio and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).
Knowledge assessment methods The method of knowledge assessment can be different: (written exams, oral

exam, project presentation, seminar paper, etc.

Course title: Forensic veterinary medicine	

Lecturer/lecturers: Vladimir Nešić, Associate Professor; Jelena Aleksić, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

To provide the PhD student with a broad understanding of general pathological changes that include the mechanisms of cellular response to injury, determination of life and postmortem changes, exclusion or confirmation of violent death of an animal, as well as determining the duration of illness in legal matters before the court. . To take a leading role in society in relation to the use and care of animals.

Course outcomes

After completing the course and practical classes, the PhD student will be able to independently perform forensic autopsies, to adequately assess lifelong and postmortem changes, as well as to see the differences between intentional and unintentional injuries. Also, the PhD student will be able to independently assess the weapon that caused the injury, as well as to adequately sample material for molecular, toxicological and other analyzes in the field of veterinary forensics. The PhD student will have knowledge of veterinary ethics and deontology, which relate to the rights, obligations and responsibilities of veterinary experts towards animals, owners and the profession.

Course content

Lectures

Legal system and veterinary medicine; Animal proof; Characteristics of intentionally inflicted injuries - penetrating and non-penetrating wounds; Burns; Suffocation; Sexual abuse; Neglect; Fighting animals; Determination of postmortem interval; Forensic assessment of pathological conditions and diseases; Special forensic methods in the field of ballistics, toxicology, entomology and molecular genetics. Professional veterinary ethics and deontology. Ethical, civil and criminal responsibility of veterinarians.

Practicals SRW (study research work)

Forensic autopsies; Expertise based on court records.

Recommended literature

1. Aleksić J., Aleksić Z. (2019), Forensic Veterinary Medicine - General Part, Faculty of Veterinary Medicine, University of Belgrade.

2. Marinković D., Nešić V. (2013), Animal autopsy technique with basics of thanatology, Faculty of Veterinary Medicine, University of Belgrade, Belgrade.

3. Merck M. (2012), Veterinary forensics: Animal cruelty investigations 2nd edition, Wiley-Blackwell, Iowa, USA

4. Brooks J. (2018), Veterinary forensic pathology volume 1, Springer Nature, Pennsylvania, USA.

5. MullanS., Fawcett A. (2017) Veterinary Ethics: Navigating Tough Cases, 5m Publishing; 1 edition, UK.

6. Rollin B.E. (2006) An Introduction to Veterinary Medical Ethics: Theory and Cases, Wiley-Blackwell; 2 edition, USA.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Lectures; work in the autopsy room; practical classes in the form of expertise; mentoring, esseay

Evaluation and grading (maximum 100 points) Participation in formal lecture10 points, Participation in practicals 20, seminars 10, Oral exam 50

Knowledge assessment methods essay, exam

Course title: National and EU regulations in veterinary medicine	

Lecturer/lecturers: Vladimir Nešić, Associate Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course objectives

The aim of the course is to provide the PhD student with basic knowledge of national and EU regulations in the field of veterinary medicine, with special emphasis on the control of infectious animal diseases and zoonoses, animal welfare, domestic and international trade in animals and products, as well as hygiene of food, products and animal by-products. The goal is for the PhD student to know how to find and apply the valid regulations in the

field of veterinary medicine in specific situations.
Course outcomes
After completing the course and practical classes, the student will have the knowledge to understand the legal terms of EU regulations, will be able to independently distinguish between binding and non-binding legal acts of the EU, as well as to apply knowledge of welfare during control of transport and traffic of animals. the facilities in which they are kept. It is expected that the student will be able to recognize and systematically present the advantages of harmonizing national with EU regulations.
Course content
Lectures
Types and manner of enactment of domestic normative acts. Sources of EU legislation. Organization and affairs of the veterinary service. International Veterinary Organizations (OIE, WVA, WSAVA); Monitoring and control of infectious animal diseases and zoonoses; Regulations governing animal welfare, domestic and international trade and protection of animals during transport; Legislation relating to the protection of wildlife.
Practicals SRW (study research work)
Interpretation of international and national regulations in the field of veterinary medicine; Practical work with the veterinary inspector during the inspection in the field of control of food and products of animal origin; business controls veterinary dispensaries, stations, pharmacies, clinics, shelters for abandoned animals, kennels, boarding houses, etc.
Recommended literature
Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law')
Directive 2010/63 / EU on the protection of animals used for scientific purposes
Directive 2003/99 / EC on the monitoring of animal diseases and infections
Council Regulation (EC) No 1/2005 on the protection of animals during transport and related operations
Directive 92/118 / EEC - animal health and public health requirements for trade in and imports into the EU of certain products
Regulation (EU) 798/2008 - List of non-EU countries, territories or zones from which poultry and poultry products may be imported into and transit through the Community and the veterinary certification requirements
National veterinary laws and regulations, as well as other European legislation.

Hours	Lectures: 1	Practicals – SRW: 2
Teaching methods Lectures; mentoring, seminar work, field work		
Evaluation and grading (maximum 100 points) Participation in formal lecture 10 points, participation in practicals 20 points, seminars 20, oral exam max. 50 points		
Kowledge assessment methods: essay, exam		

Course title: Zoonoses and the concept of One health
Lecturer/lecturers: Sonja Radojičić, Full professor; Sonja Obrenović, Associate Professor; Dragan Bacić, Associate Professor
Type of course: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims
Introducing students to zoonoses of different etiology and type of transmission, environmental factors that affect the occurrence, maintenance and spread of zoonoses, contagiousness index, risk assessment and spread of diseases, development of methods of effective control and eradication.
Course outcomes
the student should distinguish between the basic epizootiological / epidemiological determinants within the One Health concept, to determine the importance of monitoring certain parameters important for the occurrence of movement, control, suppression and eradication of enzootics and epizootics as well as epidemics; to determine the interrelationships of ecological parameters and zoonoses; to compile epizootiological models and health schemes as well as to determine risk analysis; to identify and be prepared for potential bioterrorism and protection from bioterrorism
Course contents
Lectures
Anthropozoonoses, zooanthroposes, amphixenosis, orthozonoses, metazoonoses, cyclozoonoses and saprozoonoses (occurrence, modes of spread, extent and methods of control); General principles. Protection against specific infectious diseases of animals and humans. Bioclimatology, vectors and their distribution, maintenance of pathogens in vectors (biological and mechanical), ecosystem and sustainability of pathogens, factors influencing

the change of susceptibility of the species, transmissible infectious diseases of zoonotic character; infection of particular regions/areas, biodiversity, environment and its impact on the occurrence and maintenance of infection in biological reservoirs; Bioterrorism and levels of biosecurity, change of pathogenicity and bioengineering in the service of aggression (bacteria, viruses, toxins). Particularly dangerous zoonoses and risk analysis of occurrence, spread, control and eradication measures, impact on the socio-economic position of society. Bacterial zoonoses. Models of active surveillance of district infections. Prophylaxis measures and education of the population. Viral zoonoses with special reference to arbovirus infections and hemorrhagic fevers (Crimean Congo, Dengue, Marburg, Ebola, hantanvirus infection, Omsk fever), ortho and paramyxovirus infections of importance to animals and humans (Influenza, Nipah, Hendra).

Practicals- SRW (study research work)

Recommended literature
Yamada, A., Kahn, L.H., Kaplan, B., Monath, Th.P., Woodall, J., Conti, 2014, Confronting Emerging Zoonoses, The One Health Paradigm, Springer-Verlag, Berlin, Hedelberg
Lefere Pc, Blancou J, Chermette R, Uilenberg G, 2010, Infectious and Parasitic Diseases of Livestock, Volume I Lavoisier, 2010.
Colville J, Berryhill D.: Handbook of Zoonoses: Identification and Prevention, St. Louis, Mo, London, Mosby Elsevier, 2007.
Radojičić S., i sar.: Infektivne bolesti životinja-specijalni deo, autorsko izdanje, Beograd, 2011.
Mackenzie, J.S., Jeggo, M., Daszak, P., Richt, J.A., 2013, One Health: The Human-Animal-Environment Interfaces in Emerging Infectious Diseases, Springer-Verlag, Berlin, Hedelberg

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Theoretical lectures, seminar work, discussion

Evaluation and grading (maximum points 100) Activites during lectures 10, seminar 30, oral exame 60. Ratio betwen points and the final mark: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Kowledge assessment methods written exam, oral exam, presentation, seminar work etc.

Course title: Viral diseases of honey bees
Lecturer/lecturers: Sonja Radojičić, Full professor; Sonja Obrenović, Associate Professor; Dragan Bacić, Associate Professor
Type of course: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims   to understand bee viral diseases and their impact on the survival of the bee community. To be acquainted with the epizootiological situation of viral diseases in Europe and in our country, viral infections of bees, sources of infection, infected bee colonies, diseased brood, queens and natural swarms, pathogenesis of viral infections of bees, morphological and biochemical characteristics of viruses, risk assessment and spread, by developing methods of effective control, suppression and eradication of infectious diseases of bees.
Course outcome   Upon completion, students will be able to determine the basic epizootiological determinants that have an impact on bee health, to monitor certain parameters of importance for the emergence, movement, control and eradication of viral diseases of bees; define the interrelationships of phenomena in the epizootiology of bee diseases; form epizootiological models of health as well as conduct risk analysis; make an adequate plan to protect honey bees from specific infectious diseases.
Course content   *Lectures*   Bee paralysis (acute and chronic): occurrence, movement and eradication measures, methods of active surveillance. Sacbrood, occurrence and influence of bioclimatic phenomena on the origin and spread of diseases. Deformed wing virus and cloudy wing virus. Infectious diseases caused by Apis iridescent virus and Kashmir bee virus. Influence and control of queens for the presence of viral infections in bees, Effect of various stress factors on the bee community (lack of space, food and water, atmospheric disasters, infections with other types of pathogens - bacteria, fungi or parasites) on the occurrence and spread of viral infectious diseases. Import of queens from other regions, poor adaptation of queens to the new biotope and increased susceptibility to diseases. Influence of other pests on the spread of viral diseases of bees; *Aethina tumida*, *Tropilaelaps clarae*, inappropriate therapy as a cause of disease, misuse of antibiotics in American foulbrood and European foulbrood and other factors for the occurrence and spread of viral infections in bees.   *Practicals- SRW (study research work)*   Serological diagnostic methods, TFA, PCR.

<table>
<tr><td colspan="3">Recommended literature
Perveen Farzana, Viral Diseases of Honeybees: Viral Infections in Honeybees, 2011, Lambert Academic Publishing
Larissa Bailey B. Ball 1991, Honey Bee Pathology, 2nd Edition, Academic Press
Aubert,M, Ball B, Fries I, et al. 2008, Virology and the Honey Bee, European Commission Directorate-General for Research, Unit E4 - Agriculture, Forestry, Fisheries, Aquaculture
Hachiro Shimanuki and David A. Knox, Diagnosis of Honey Bee Diseases, 2000, United States Department of Agriculture Agricultural Research Service Agriculture Handbook Number 690</td></tr>
<tr><td>Hours</td><td>Lectures: 1</td><td>Practicals – SRW: 2</td></tr>
<tr><td colspan="3">Teaching methods Theoretical lectures, seminar work, discussion, student research work</td></tr>
<tr><td colspan="3">Evaluation and grading (maximum points 100) Activites during lectures 10, seminar 30, oral exame 60.
Ratio betwen points and the final mark: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).</td></tr>
<tr><td colspan="3">Kowledge assessment methods: written exam, oral exam, presentation, seminar work etc.</td></tr>
</table>

<table>
<tr><td>Course title: Biological hazards of food</td></tr>
<tr><td>Lecturer/lecturers: Mirjana Dimitrijević, Full professor; Neđeljko Karabasil, Full professor; Dragan Vasilev, Associate professor; Dr Snežana Bulajić, Full professor</td></tr>
<tr><td>Course status: Elective course in the field of dissertation</td></tr>
<tr><td>ECTS credits: 5.0</td></tr>
<tr><td>Prerequisites: Enrolled semester in which course is taken</td></tr>
<tr><td>Course aims
The aim of the course is for students to acquire knowledge of food microbiology, as well as to be able to consider the sources of food contamination, conditions for reproduction of microorganisms and procedures that can prevent the reproduction and survival of microorganisms important for food safety. Also, based on the acquired knowledge, they can predict when microorganisms, possibly present in food, will be important from the point of view of food safety.</td></tr>
<tr><td>Course outcomes
Upon successful completion of the course, students should be able to:
• know the epidemiological significance of foodborne diseases;
• know food as a substrate for the reproduction of microorganisms, as well as sources and routes of food contamination by pathogenic microorganisms;
• master methods for isolation, identification and typing of microorganisms important for food safety;
• master methods for detecting toxins in food;
• understand and correctly interpret microbiological criteria;
• based on knowledge of the conditions for reproduction of microorganisms and knowledge of methods for their elimination or prevention of reproduction, consider and predict the safety of the product.</td></tr>
<tr><td>Course content
L ectures
Epidemiological significance of foodborne diseases. Food is most often involved in food poisoning. Food contamination pathways and factors important for microorganism growth and / or toxin formation and survival of microorganisms in food. Alimentary intoxications (staphylococcal enterotoxins, Clostridium botulinum toxins). Alimentary infections (Salmonella species, Escherichia coli O157: H7, Listeria monocytogenes, Campylobacter spp, Yersinia entetocolitica, Aeromonas hydrophila, Bacillus cereus, Clostridium perfrigens). Causes of zoonoses (Mycobacterium, Brucella, Coxiella burnetii). Foodborne viral diseases (Norwalk virus, Astrovirus, Calcivirus, Parvovirus, Rotavirus, enteroviruses, infectious jaundice virus). Protoses (Giardia lamblia, Cryptosporidium parvum, Entamoeba histolityca). Mycotoxins in foods of animal origin. Microbiological criteria. Importance of antimicrobial resistance for food safety of animal origin. Predictive microbiology.
Practicals- SRW (study research work)
Indications for sampling. Food sampling for microbiological testing: two-class plan, three-class plan. Chemical, immunological, molecular genetics methods, biological and physical methods for the detection of microorganisms or toxins in food. Isolation of food poisoning microorganisms (isolation, identification, typing) and detection of toxins. Microbiological examination of surfaces.</td></tr>
<tr><td>Recommended literature
1. Jay James M, Loessner Martin J, Golden David A (2005) Modern Food Microbiology, Seventh edition, Springer; 2.https://efsa.onlinelibrary.wiley.com/journal/18314732; 3. Foodborne Pathogens and Disease, Published Monthly . 4. Foodborne Pathogens 2nd Edition (2009) Hazards, Risk Analysis and Control, Editors: Clive de Blackburn Peter McClure. 5. Foodborne Diseases - A volume in Handbook of Food Bioengineering (2018) Edited by: Alina Maria Holban and Alexandru Mihai Grumezescu</td></tr>
</table>

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes, preparation of seminar paper, public presentation and critical discussion, practical classes in the laboratory for microbiological testing of food of animal origin

Evaluation and grading (maximum 100 points) 10 points from classes, 20 points for seminar work, 70 points for oral part of exam. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods Seminar paper, oral exam

Course title: Food biopreservation

Lecturer/lecturers: Snežana Bulajić, **Full professor;** Dragan Vasilev, Associate professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims
understand the biological processes involved in conversion of raw materials into finished food products; comprehend the role of beneficial microorganisms in extending *shelf life* and enhancing food *safety*

Course outcomes
As a result of participation in this course, students will
- differentiate between food quality and safety
- explain metabolisms of lactic acid bacteria
- analyse the bacteriocin application in an ecological context
- manage the food fermentation process in hygienic environments
- determine the antimicrobial activity of lactic acid bacteria

Course content
Lectures
1. Fermentation process – basis of biopreservation; Role of lactic acid bacteria (LAB); Antagonism – the competitive exclusion principle; Starter culture – selection criteria
2. Bacteriocins – definition; Bacteriocins *vs* antibiotics; Classification scheme; Mechanism of action; Antimicrobial spectrum, Bacteriocin application in food industry
3. Antimicrobial Compounds of Low Molecular Mass: organic acids, H_2O_2, CO_2, diacetyl, acetaldehyde, fatty acids, reuterin
4. Antimicrobial enyzmes: lysosome, lactoperoxidase, lactoferrin

Practicals- SRW (study research work)
In-vitro screening of LAB antimicrobial activity

Recommended literature
Hammami, R., Fliss, I., Corsetti, A., eds., 2019, Application of Protective Cultures and Bacteriocins for Food Biopreservation, Lausanne: Frontiers Media

Gálvez A, López RL, Pulido RP, Burgos MJG, 2014, Food Biopreservation, SpringerBriefs in Food, Health, and Nutrition. Springer, New York, NY

Lacroix C, ed., Protective Cultures, Antimicrobial Metabolites and Bacteriophages for Food and Beverage Biopreservation, 2011, Woodhead Publishing, UK

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Lecture with demonstrations, discussions and in-class activities. Laboratory work.

Evaluation and grading (maximum 100 points) Active participation in formal lectures – 10 points; seminar – 30 points; final exam (written exam) – 60 points

Knowledge assessment methods seminar work, test

Course title: Chemical and physical contaminants of food

Lecturer/lecturers: Mirjana Dimitrijević, Full professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims
The primary goal of the course is for students to be introduced and trained to fully understand the importance of pollutants, contamination routes, their diagnosis, as well as possible implications for human health. Also, based on the acquired knowledge, students could anticipate and point out the danger of chemical and physical contaminants that could be present in food, and could significantly affect food safety.

Course outcomes

Upon successful completion of the course, students should be able to:
- know in detail contaminants, contamination routes and risk assessment;
- know metabolic pathways and diagnostics;
- know the methodology and legal regulations for testing contaminants;
- know the possibilities of decontamination and procedures with contaminated food of animal origin.

Course content

Lectures

- Antimicrobial drugs (antibiotics, sulfonamides, nitrofurans and antiparasitics): routes of contamination, pharmacological and toxicological significance, metabolism, toxic significance, diagnostics, MRL, legal regulations.
- Anabolics and tranquilizers: routes of contamination, natural and synthetic anabolics, principle of action, toxic significance, diagnostics, legal regulations.
- Heavy metals and arsenic: routes of contamination, toxic significance, diagnostics, decontamination, legal regulations.
- Polychlorinated biphenyls and dioxins: routes of contamination, toxic significance, diagnostics, decontamination, legal regulations.
- Mycotoxins: routes of contamination, toxic significance, diagnostics, decontamination, legal regulations.
- Nanotechnology in food. Significance and use of nanopackaging in the food industry.

Practicals- SRW (study research work)

- Microbiological methods for the detection of antibiotic residues in food, Physico-chemical methods for the detection of chemical contaminants in food. AAS - Determination of heavy metal content.

Recommended literature

1.Vlado Teodorović and Mirjana Dimitrijević: Chemical and physical contaminants of food of animal origin, Textbook (2011) (ISBN 978-86-6021-034-2; COBISS.SR-ID 182291212, Faculty of Veterinary Medicine, Belgrade; 2. Hodgson, Textbook of modern toxicology, 3rd ed, Wiley (2004); 3 .BasicFood Hygiene course www.allsafe.org.uk ; 4. EFSA Journal http://www.efsa.europa.eu/; 5.Persistent Organic Pollutants and Toxic Metals in Foods 1st Edition (2013). Editors: Martin Rose Alwin Fernandes

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Theoretical classes, preparation of seminar paper, public presentation and critical discussion, practical classes in the laboratory for testing food of animal origin.

Evaluation and grading (maximum 100 points) 20 points from classes, 30 points for seminar work, 50 points for oral exam. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods seminar paper, oral exam

Course title: Food preservation by physical and chemical methods
Lecturer/lecturers: Dragan Vasilev, Associate Professor; Snežana Bulajić, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken

Course aims

Students deepen specific knowledge about physical and chemical methods of food preservation acquired during basic studies and to enable their efficient application in the preparation of a doctoral dissertation and further scientific research.

Course outcomes

Upon successful completion of classes, students should be able to:
- describe the physical, chemical and biological methods of food preservation.
- explain the mechanisms of action of these methods on food safety, quality and sustainability.
- know their importance within integrated food production control systems.
- know the possibilities and effects of mutual combination of certain physical, chemical and biological methods of food preservation.
- critically consider the possibilities of applying food preservation methods of importance for their scientific research work.

Course content

Lectures

1. Food spoilage: Causes and manifestations of spoilage. 2. Basics of canning: Physical and chemical methods of canning; Antimicrobial parameters. 3. Refrigeration and freezing: Inhibition of microorganisms by low

temperatures, Physical basis and procedures of refrigeration and freezing, Storage of chilled and frozen foods; Defrosting; Chilled and frozen products. 4. Salt canning: Salts for canning, Influence of salt on microorganisms and foods; Salting and pickling procedures and risks. 5. Smoking: Obtaining and processing smoke; Physical properties and chemical composition of smoke; Influence of smoke on microorganisms and foods; Smoking procedures and risks. Smoked products. 6. Drying: Physical bases and drying and lyophilization procedures; Impact of drying on micro-organisms and food quality; Water activity; Dried products. 7. Heat treatment: Influence of high temperatures on microorganisms, Heat treatment procedures, Determination of lethality of heat treatment; Heat treatment control; Influence of heating temperatures on foodstuffs. Heat treated products. 8. Other canning methods: High pressure canning; Ultraviolet radiation, Ionizing radiation. 9. Additives. 10. Packing. Instrumental and laboratory methods of control of conservation procedures.

Practicals- SRW (study research work): Instrumental and laboratory methods of control of conservation procedures.

Recommended literature
1. Teodorović V., Karabasil N., Dimitrijević M., Vasilev D., 2015, Higijena i tehnologija mesa, Fakultet veterinarske medicine Beograd. 2. Teodorović V, Bunčić O, Karabasil N, Dimitrijević M, Vasilev D., 2012, Higijena i tehnologija mesa, Praktikum, FVM, Beograd. 3. Vuković, I, 2012, Osnove tehnologije mesa, 4. izdanje, VKS, Beograd; 4. Katić V. i Bulajić S., 2018, Higijena i tehnologija mleka, Fakultet veterinarske medicine Beograd.

Hours	**Lectures:** 1	**Practicals – SRW: 2**

Teaching methods Theoretical classes using Power Point presentations. Practical classes in food production facilities and laboratories.

Evaluation and grading (maximum 100 points) 10 points from classes, 20 points from seminar work, 70 points from oral exam. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods: seminar paper, oral exam.

Course title: Food quality and nutritional value
Lecturer/lecturers: Nedeljko Karabasil, **Full professor**; Radoslava Savić Radovanović, Assistant Professor; Silvana Stajković, Assistant Professor; Nikola Čobanović, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims That students understand the complexity and connection of process steps in the food production chain (meat, eggs, fish and seafood, mixed foods, etc.) and their importance for the quality and nutritional value of products.
Course outcomes Upon successful completion of the program, it is expected that students will be able to: - assess the quality of food in a broader sense, considering the hygienic, technological, nutritional, sensory and market / consumer parameters of product quality.
Course content *Lectures* Quality management and standards. Food quality parameters: hygienic, technological, nutritional, sensory and market consumer. Responsibility for food quality (government agencies, producers and consumers). Trends in food production and consumption. Nutritional and energy value of food. *Practicals- SRW (study research work)* Sensory analysis of the selected product.
Recommended literature Selected books covering the field of food quality such as: Essentials of Food Science, 4th edition, Vickie A. Vaclavik and Elizabeth W Cristian. 2014, Springer; Food Analysis, 5th edition. Suzanne Nielsen, Editor, 2017, Springer; Handbook of Meat, Poultry and Seafood Quality, Leo M.L.Nollet, 1st edition, 2007, Blackwell Publishing; etc.

Hours	**Lectures:** 1	**Practicals: – SRW: 2**

Teaching methods - Interactive theoretical classes - Analytical work in a group

Evaluation and grading (maximum 100 points) Active participation in theoretical classes - 40 points; preparation and presentation of seminar paper - 60 points.

Knowledge assessment methods Preparation and presentation of seminar paper

Course title: Scientific foundation of integrated food safety system
Lecturer/lecturers: Snežana Bulajić, Full Professor; Neđeljko Karabasil, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims -acquire knowledge of food safety management system by applying prerequisite programs and HACCP system - understand the concept of acceptable risk level

Course outcomes
Upon successful completion of this course students will be able to:
    - apply measures of Good Hygiene and Good Manufacturing Practice during food processing
    - participate in the development of flow diagram
    - successfuly analyze the hazard for each processing step
    - define critical control points
    - develop and implement measures to eliminate or reduce hazard to an acceptable level
    - validate and verify applied measures

Course content *Lectures* Food production chain- mutual interconnection and dependence of all of its segments. The basic principle of Food Hygiene. Analysis of Codex Alimentarius documents and intepretation of EU and Serbian Food Hygiene Legislation. Food contamination. Food safety prerequisite programs: Good Hygiene and Good Manufacturing Practice, Sanitation Standard Operating Procedure. Microbiological, chemical and physical hazards (identification, characterization and quantification). Risk analysis: assessment, management, and risk communication. The HACCP Basics. The use and interpretation of food microbiological criteria. Food chain monitoring (environmental contaminants, drug residues and food allergens). *Practicals- SRW (study research work)* Development, implementation and validation of HACCP plan in relation to specific production process and hazard/food combination
Recommended literature Food Safety Management System. 2014, Edited by Yasmine Motarjemi, Huub Leelieveld, Elsevier HACCP and ISO 22000:Application to Foods of Animal Origin Edited by Ioannis S. Arvanitoyannis, 2009 Blackwell Publishing Ltd.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods Lecture with demonstrations, discussions and in-class activities. Field work and laboratory studies.
Evaluation and grading (maximum 100 points)
Knowledge assessment methods Active participation in formal lectures – 10 points; seminar – 30 points; final exam (written exam) – 60 points

Course title: Primary food production
Lecturer/lecturers: Neđeljko Karabasil, Full Professor; Mirjana Dimitrijević, Full Professor; Radoslava Savić Radovanović, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims That students understand the complexity and connection of process steps in the food production chain (meat, eggs, fish and seafood, milk, etc.), the application of the rules of good manufacturing practice and good hygiene practice and traceability of the process; the importance of raw materials as substrates and the impact of technological processes on the quality and usability of products.
Course outcomes Upon successful completion of the program, students are expected to be able to**:** -   Apply adequate animal welfare conditions in the meat production chain -   Analyze and improve premortem conditions important for meat quality -   Define, develop and apply the rules of good production practice and good hygiene practice in the food

production chain
-     Identify key sources of hazards/risks and apply adequate control measures in the food production chain

Course content
Lectures
Animal welfare in the meat production chain and importance for meat quality. Food production facilities and technical-technological conditions. Principles of good practice producers and good hygiene practices. Veterinary control in the food chain. Animal slaughter operations, hazards / risks and usability of meat. Milk production and primary processing, hazards / risks and usability of the product. Transport and distribution of food. Principles of integrated control systems in primary production. Traceability in the food production chain.
Practicals- SRW (study research work)
Analysis, development and application of the rules of good manufacturing practice and good hygiene practice for the selected process in primary production.

Recommended literature
Selected books covering the area of the food production chain such as: Sustainable Meat Production and Processing, Edited by Charis M. Galanakis., 2019, Elsevier. Good Practicies for the meat industry. FAO Animal production and Health manual, 2004, Rome, FAO / UN and others.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods
- Interactive theoretical classes
- Analytical work in a group

Evaluation and grading (maximum 100 points) Active participation in theoretical classes - 40 points; preparation and presentation of seminar paper 60 points.

Knowledge assessment methods preparation and presentation of seminar paper

Course title: Instrumental food analysis
Lecturer/lecturers: Silvana Stajković, Assistant Professor; Neđeljko Karabasil, Full Professor;
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken

Course aims
That students understand the principles, complexity and connection of steps in the application of modern instrumental analytical techniques of food analysis (milk and dairy products, meat and meat products, eggs, honey, mixed foods, etc.) and their importance for food quality assessment.

Course outcomes
Upon successful completion of the course, students are expected to be able to:
- select and apply techniques and methods for determining the chemical composition of food, for analyzing the physical and physico-chemical properties of food, for detecting food adulteration, for detecting and quantifying contaminants and allergens in food and to identify and describe instrumental methods for assessing certain sensory properties of food;
- conduct food quality assessments based on instrumental food analysis.

Course content
Lectures
Importance of instrumental food analysis, its development and application of methods and techniques in food quality assurance. Consideration of general requirements in modern food analysis (speed, accuracy, reproducibility, sensitivity, selectivity, material costs). Sample characteristics and purpose of instrumental analysis. Introduction to instrumental techniques that include chromatographic, optical, electrochemical and immunochemical methods of food analysis in order to detect and identify food components and their quantitative analysis. Application of the mentioned techniques in the analysis of group composition and individual components of food, contaminants, allergens and selected sensory attributes.
Practicals- SRW (study research work)
Performance of chromatographic, optical, electrochemical (potentiometry) and immunochemical methods.

Recommended literature
Selected books covering the area of food quality such as: Essentials of Food Science, 4th edition, Vickie A. Vaclavik and Elizabeth W Cristian. 2014, Springer; Food Analysis, 5th edition. Suzanne Nielsen, Editor, 2017, Springer; Handbook of Meat, Poultry and Seafood Quality, Leo M.L.Nollet, 1rst edition, 2007, Blackwell Publishing; etc.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods
- Interactive theoretical classes
- Analytical individual work and group work

Evaluation and grading (maximum 100 points) Active participation in theoretical classes - 40 points; preparation and presentation of seminar paper 60 points.

Knowledge assessment methods Presentation of seminar paper.

Course title: Farm animal nutrition

Lecturer/lecturers: Dragan Šefer, Full Professor; Radmila Marković, Full Professor; Stamen Radulović, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

To functionally expand the acquired knowledge of the subject Animal Nutrition in undergraduate studies; The aim of subject is that student can, taking into account the differences between different animal species as well as the diversity of production categories within the same animal species, formulate meals to ensure optimal animal health and achieve maximum production results; that student has a wide view of various physiological processes in the body of animals caused by errors in animal nutrition, whether these errors occurred as a result of poor production and storage of feed or errors in meal formulation; that the student acquires knowledge about clinical nutrition, the connection between diet and certain animal diseases and ways of prevention and therapy.

Course outcomes

With the acquired knowledge and skills, the student is trained for daily independent work in institutions related to animal production; knows and understands the principles of nutrition of different production categories of animals while respecting the specifics and differences and can timely notice and react to irregularities and problems that occur due to inadequate nutrition.

Course content

Lectures

Theoretical classes: Physiological features of nutrition of different animal species and categories. Utilization and selection of nutrients for different species and categories. Nutrient needs. Feeding of breeding animals. Influence of diet on reproduction. Nutrition of young animals. Animal nutrition in fattening and the impact of nutrition on meat quality. Nutritional disorders and dietary measures.

Theoretical classes with interactive learning with the application of audio-visual methods (PowerPoint presentations and films), practical work in the laboratory of the Department of Animal Nutrition and Botany, seminar papers.

Practicals

Practical field work (animal feed factories and farms).

Recommended literature

1. Opšta ishrana- dr Dragan Šefer, dr Zlatan Sinovec, FVM, 2008; 2. Ishrana domaćih životinja- Jovanović R., Dujić D., Glamočić D.: Stylos-izdavaštvo, Novi Sad, 2000; 3. Bezbednost hrane za životinje- Marković R., Petrujkić B., Šefer D., FVM, 2018; 4. Mikotoksini- pojava, efekti i prevencija- Sinovec Z., Resanović R., Sinovec S., Caligraph, Beograd, 2006; 5.Ohratoksin A u hrani za životinje, štetni efekti, detekcija i mogućnost zaštite, 2017, Dr Jelena Nedeljković-Trailović, Srđan Stefanović; 6.Ishranom životinja do funkcionalne hrane, 2018- Dr Radmila Marković, Milan Ž.Baltić; 7. Ishrana domaćih životinja- dr Nemanja Ševković, dr Simeon Pribićević, dr Isidor Rajić, Naučna knjiga, 1980; 8. Amino acids in animal nutrition- Michael Pack et al. Corall Sanivet.2002; 9. Peradarstvo- G.Kralik, E.Has-Schon, D.Kralik, M.Šperanda. Poljoprivredni fakultet Osijek, 2008; 10. Ishrana ovaca- Prof. dr Radomir Jovanović, Stylos-izdavaštvo, 1996; 11. Nutritional Biotechnology in the Feed and Food Industries. Proceeding of Alltech's symposium, 2006; 12. Ishrana koza- dr Nurgin Memiši, Dipl ing Frida Bauman, Savez udruženja odgajivača ovaca i koza Srbije, 2007; 13. Ishrana svinja- dr Stanimir Kovčin, Štamparija za grafičku delatnost, 1993.; 14. Metode procjene i tablice kemijskog sastava i hranljive vrijednosti krepkih krmiva. D.Grbeša, Hrvatsko agronomsko društvo, 2004.

Hours	Lectures: 1	Practicals – SRW: 2
Teaching methods		

-theoretical classes;

-preparation of seminar paper; exposure and defense

Evaluation and grading (maximum 100 points) Class attendance: 10 points; seminar paper: 20 points; test: 70 points (min. 36) Ratio of points and final grades: 51-60 (6); 61-70 (7); 71-80 (8); 81-90 (9), 91-100 (10)

Knowledge assessment methods can be different: (written exams, oral exam, project presentation, seminars, etc

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Course title: Animal nutrition and food of animal origin quality
Lecturer/lecturers: Dragan Šefer, Full Professor; Dragan Vasilev, Associate Professor; Radmila Marković, Associate Professor
Course status: Elective course in the field of dissertation
ECTS credits: 5.0
Prerequisites: Enrolled semester in which course is taken
Course aims Enabling students to notice the connection between animal nutrition in intensive livestock and yield parameters and food quality (meat, eggs, milk).
Course outcomes After passing the exam, the student is able to influence the nutritional value of food by choosing and interacting nutrients as well as using various additives (selenium, conjugated linoleic acid, flaxseed oil, vitamins, fatty acids, pigments ...) in the diet for animals (obtaining "functional food").
Course content *Lectures* Nutrients used in animal nutrition with values of macro and microelement content and their importance and relationship in animal nutrition. Influence of omega-6 and omega-3 fatty acids in animal feed on their content and importance in food of animal origin. Influence of animal nutrition on production results and nutritional value of foods of animal origin (increase in the content of microelements, vitamins; improvement of fatty acid composition -n3 / n6 ratio; increase in the content of conjugated linoleic acid in food of animal origin - milk, eggs ect.). *Practicals* Meal formulation for certain animal species and categories with the aim of obtaining foods of animal origin with increased content of a certain ingredient (minerals or fatty acids) or better production results of animals due to different genetic basis, housing conditions and meal composition.

Recommended literature

1. Ishranom životinja do funkcionalne hrane, 2018- Dr Radmila Marković, Milan Ž.Baltić; 2. Opšta ishrana- dr Dragan Šefer, dr Zlatan Sinovec, FVM, 2008; 3. Bezbednost hrane za životinje- Marković R., Petrujkić B., Šefer D., FVM, 2018; 4. Grubić G., Adamović M.: Ishrana visokoproizvodnih krava, Prosveta, Niš, 1998.; 5. Jovanović R., Dujić D., Glamočić D.: Ishrana domaćih životinja, Stylos-izdavaštvo, Novi Sad, 2000.

6. McDowell L.R.: Minerals in animal and human nutrition. Academic Press, Inc. 1992., 7. McDowell L.R.: Vitamins in animal nutrition. Academic Press, Inc. 1981; 8. Mikotoksini- pojava, efekti i prevencija- Sinovec Z., Resanović R., Sinovec S., Caligraph, Beograd, 2006; 9.Ohratoksin A u hrani za životinje, štetni efekti, detekcija i mogućnost zaštite, 2017, Dr Jelena Nedeljković-Trailović, Srđan Stefanović; 10.Animal Feeding and Nutrition, 2016, Okoro Negasi, Astral International Pvt. Ltd.; 11. Sustainable Swine Nutrition, 2012, Lee I. Chiba, Willey –Black Well Publishing; 12. Teodorović V., Karabasil N., Dimitrijević M., Vasilev D., 2015, Higijena i tehnologija mesa, Fakultet veterinarske medicine, Beograd; 13. Baltić M. i Karabasil N. 2011, Kontrola namirnica animalnog porekla, VKS, Beograd.

Large number of review papers are available to students on the recommendation of teachers from the current field.

Hours	**Lectures:** 1	**Practicals – SRW:** 2

Teaching methods

-theoretical classes;

-practical work and learning about nutrition on the farm and analyzing the impact of different meal formulations on the results of the nutritional value of food of animal origin;

Evaluation and grading (maximum 100 points) Class attendance: 10 points; seminar paper: 20 points; test: 70 points (min. 36) Ratio of points and final grades: 51-60 (6); 61-70 (7); 71-80 (8); 81-90 (9), 91-100 (10)

Knowledge assessment methods seminar paper, test

Course title: Feed safety
Lecturer/lecturers: Radmila Marković, Associate Professor; Dragan Šefer, Full Professor; Branko Petrujkić,

Associate Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims
The aim of the subject is that students acquires knowledge about the importance of feed and food safety. Possibilities of contamination of feed during processing, canning and storage, as well as factors that affect feed spoilage. Acquiring knowledges about biological (bacteria, parasites, poisonous, harmful and depressant plants), chemical (heavy metals, pesticides, mycotoxins, surpluses and deficiencies of microelements in animal feed) and physical hazards (foreign bodies) in feed and their importance for animal health and the potential for harmful substances to be transfered into food. Gaining knowledge about the impact of feed and selected feeds on the production results of animals.

Course outcomes
After passing the exam in the subject of Animal Feed Safety, the student should: 1. Recognize the conditions under which there may be a spoilage of feed as well as to recognize changes if they have already occurred 2. Defines the degree of change in feed quality and its impact on the health and production results of animals fed such feed 3. Be able to identify irregularities and problems caused by inadequate nutrition and take adequate measures.

Course content
Lectures
Storage of feed. Feed preservation. Feed preparation. Spoilage and harmfulness of feed: biological, chemical and physical hazards. Significance of bacteria and mold. Feed parasites. Feed poisoning: mycotoxins, organic toxins, inorganic substances. Regulations on maximum permissible harmful and prohibited substances in feed.
Practicals
Sampling. Organoleptic examination. Determining the usability of feed. Basics of analytical procedures: chemical, mycotoxicological and bacteriological analyzes.

Recommended literature
1. Bezbednost hrane za životinje- Marković R., Petrujkić B., Šefer D., FVM, 2018; 2. Opšta ishrana- dr Dragan Šefer, dr Zlatan Sinovec, FVM, 2008; 3. Mikotoksini- pojava, efekti i prevencija- Sinovec Z., Resanović R., Sinovec S., Caligraph, Beograd, 2006; 4. Proizvodnja smeša koncentrata za životinje. N.Đorđević, B.Dinić, 2011; 5. Ishrana domaćih životinja-Prof.dr. Radomir Jovanović, Dr Dragutin Dujić, Doc dr Dragan Glamočić, Stylos-izdavaštvo, Novi Sad, 2000; 6. Metode procjene i tablice kemijskog sastava i hranljive vrijednosti krepkih krmiva. D.Grbeša, Hrvatsko agronomsko društvo, 2004; 7. Animal Feed Contamination: Effects on Livestock and Food Safety, Elsevier Science, 2012; 8. Animal Feed: Types, Nutrition & Safety (Agriculture Issues and Policies, 2011, Sarah R. Borgearo.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods
-theoretical classes;
-practical work in the laboratory of the Department of Animal Nutrition and Botany, practical work in the field, seminar papers

Evaluation and grading (maximum 100 points) Class attendance: 10 points; seminar paper: 20 points; test: 70 points (min. 36) Ratio of points and final grades: 51-60 (6); 61-70 (7); 71-80 (8); 81-90 (9), 91-100 (10)

Knowledge assessment methods: seminar paper, test

Course title: Histology and embryology

Lecturer/lecturers: Anita Radovanović, Full Professor; Danica Marković, Associate Professor; Tijana Lužajić Božinovski, Assistant Professor; Ivan Milošević, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims
The aim of the course is to: 1) teach doctoral students to undrerstand the functional connections of cells in various tissues and organic systems which are part of their research, as well as the regularity of their development during embriogenesis; 2) doctoral students should understand the mechanims establishing relationship beween mother and embryo; 3) recognize the possibilities of aplication of different histological methods in experimental research and diagnostics..

Course outcomes

Using the acquired knowledge in histology and embriology in their research planning; To be able to diferentiate and compare histological methods and forsee their use in the research.

Course content

Lectures

Development and morphofunctional charateristics of tissues (epithelial, muscle, connective, nerve) the certain organic systems (nervous system, circulatory system, lymphatic system, respiratory system, digestive system, urinary system, endrocine system, reproducive system, skin, sensory organs) depending on the issues of doctoral diseration; Mechanisms of establishing relationship between mother and embryo; Extraembional membranes formation and placentation.

Practicals - SRW (study research work)

Preparation of histological sections, light microscopy (classical, histochemistry and immunohistochemistry, impregnation). Principles and techniques of electron microscopy. *In situ* hybridization. Analysis of the stained sections. Quantification of results: morphometry and stereology.

Recommended literature

1. Gledić D, Veterinary histology, Veterinary chamber of Serbia, Belgrade, 2012.

2. Ross M.H., Pawlina W.: Histology: A Text And Atlas With Correlated Cell and Molecular Biology, 6th edition, Lippincott Williams & Wilkins, Baltimore;Wolters Kluwer business. Philadelphia, 2011.

3. Eurell JA, Frappier BL: Dellman's Textbook of Veterinary Histology 6th edition, Blackwell, Publishing, Oxford, 2006.

4. Suvarna K, Layton C, Bancroft JD Curchill Livingstone Theory and Practice of Histological Techniques., 2012;

5. McGeady TA et.al.n Veterinary Embryology, 2nd Edition Wiley-Blackwell 2017.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Formal lectures, introduction to practical work in a histology lab, project assignment.

Evaluation and grading (maximum 100 points) Class attendance 10 points, project presentation 20 points, final exam 70 points (minimum 36). Final grade and points relationship: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods can be different: Written exam, project presentation

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Course title: Stem cells and their role in tissue homeostasis and regenerative medicine

Lecturer/lecturers: Milica Kovačević-Filipović, Full Professor; Anita Radovanović, Full Professor; Danica Marković, Associate Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

The aim of the course is to enable students to 1) understand tissue homeostasis through the prism of dynamic renewal and self-renewal of tissues and organs; 2) differentiate between the regenerative capacities of various tissues 3) discuss the importance of stem cells in neoplastic processes, acute and chronic inflammation and degeneration; 4) understand the importance of stem cells in the field of regenerative medicine.

Course outcomes

1) Describe the basic characteristics of stem cells 2) Explain the regenerative capacity of different tissues 3) Combine in theoretical terms, different approaches to stem cell testing; 4) Describe the possibilities of using stem cells for therapeutic purposes;

Course content

Lectures and Practicals - SRW (study research work)

Stem Cells (SC): definition, classification and origin of different types. Cell differentiation. Explanation of terms: Toti-, pluri-, multi- and unipotency. Cloning. Embryonic and fetal SC. SC from the blood of the umbilical cord and Warton's pith. SC hematopoiesis. Angiogenesis. Mesenchymal SC. Osteogenesis. Chondrogenesis. Adipogenesis. MJ originates from endoderm and ectoderm. Tissue tissue with higher and lower regenerative potential: nervous system, muscles, endothelium, liver. Induced pluripotent SC. Cryopreservation of cells. Clinical application. Tissue engineering. Biomaterials and biocompatibility. Tissue reaction to biomaterials. Analysis of research results obtained by different techniques.

Recommended literature

Vunjak-Novaković G., Freshney RI. Culture of Cells for Tissue Engineering. Wiley-Liss, 2006 (ISBN -13978-0-471-62935-1); **2.** Tatjana Božić, Pathophysiology of domestic animals, 2012 (ISBN 978-86-6021-051-9). 3. Bongso A. i Lee EH, Stem Cells – From Bench to Bedside – World Scientific Publishing Co. Pte. Ltd, 2005 (IBN 981-256-126-9)

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Interactive theoretical teaching with use of multimedia presentation, seminars.

Evaluation and grading (maximum 100 points) Classes - 10, seminar - 10, colloquium - 20, final exam - 60. Ratio of points and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods Seminar paper, colloquium, exam

Course title: Clinical endocrinology	

Lecturer/lecturers: Danijela Kirovski, Full Professor; Ivan Vujanac, Associated Professor; Vanja Krstić, Full Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

to train a student for complex perception of endocrine regulation and control of organ systems and tissues on molecular level. The goal is to train a student for application of laboratory techniques in clinical diagnostic of endocrine diseases and scientific research in the field.

Course outcomes

Upon successful completion of the course, students should overview the patterns of endocrine system functions regulations, as well as to understand the conection between endocrine system functions and the occurrence of various diseases. Student should also bi enable to apply obtained knowledge during solving of different problems in experimental and clinical work. Student should indipendly choose, apply and value different methods for hormone concentrations analysis important for clinical investigations.

Course content

Lectures

The role of certain hormones in the pathogenesis of endocrine diseases in domestic animals, Integrative role of the endocrine system in the regulation of various physiological and pathophysiological conditions,. Basic research principels in endocrinology. Growth hormone and antagonists. The role of hormones in the disorder of mineral metabolism. Hormonal regulation of calcium and phosphorus metabolism. Hypo and hyperthyroidism. Endocrine aspects of stress in domestic animals. The role of pancreatic endocrine cell function in the occurance of metabolic diseases. Glycemic homeostasis. Insulin resistance, Laboratory techniques in the diagnosis and research of endocrine diseases.

Recommended literature

1. Božić T, 2007, Patološka fiziologija domaćih životinja, Beograd, 2. Šamanc H, Kirovski D, 2008, Adrenokortikalni system goveda, Naučna, Beograd, 3.Stojić V, 2010, Veterinarska fiziologija, IV izd, Naučna KMD, Beograd, 4. Paul HM Balm, 2000, Stress Phisiology in Animals, 5ed, USA. 5. Pineda M, Doocley MP, 2013, McDonalds Veterinary Endocrinology and Reproduction, Iowa State Press, USA. 6. Willard, Michael D., and Harold Tvedten, 2011, Small Animal Clinical Diagnosis by Laboratory Methods-E-Book. Elsevier Health Sciences, 7. Behrend E, Gunn-Moore D., 2013, Clinical endocrinology of companion animals. Rand J, Campbell-Ward M, editors. Wiley-Blackwell.

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Formal lectures with using audio-visuel methods (Power Point and Prezi presentations, video material). Lectures with active student participation, discussion workshops. Preparation, presentation and analysis of seminar papers in the field

Evaluation and grading (maximum 100 points) 10 points from class participation, 20 points from seminar paper, 70 points from the final test (minimum 36). Points range and final grades: 51-60 (6), 61-70 (7), 71-80 (8), 81-90 (9), 91-100 (10).

Knowledge assessment methods seminar paper and final test

Course title: Fish diseases	

Lecturer/lecturers: Maja Marković, Full Professor; Ksenija Aksentijević, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 5.0

Prerequisites: Enrolled semester in which course is taken

Course aims

Provide students with state of the art information to increase their knowledge in the field of laboratory diagnostics of certain fish diseases, and prepare them to independently diagnose, treat and implement disease prevention measures in aquaculture, ornamental fish, and open water fisheries.

Course outcomes
After completing the course, students will have advanced knowledge of the aquatic veterinary biosecurity principles, fish disease prevention, control and eradication approaches. They will also achieve advanced expertise in bacterial, viral, fungal, and parasitic diseases of fish; be prepared to act in case of suspected infectious disease outbreak and apply basic and advanced microbiological, virological and immunological laboratory diagnostic methods to make an accurate diagnosis and master the principles of disease treatment.

Course content
Lectures
Fish diseases and their characteristics. Principles of fish disease prevention and control (biosecurity). Infectious diseases of fish: viral; bacterial; parasitic; fungal. Non-infectious diseases: Diseases due to poor environmental conditions and contaminants; Nutritional deficiencies; Neoplasms, injuries and genetic diseases; Biosecurity measures to prevent and control the occurrence of infectious fish diseases.
Practicals - SRW (study research work) practical classes in the laboratory and on fish farms - sampling, bacteriological diagnostics, parasitological diagnostics, ELISA TEST, PCR test.

Recommended literature
1.   Fish diseasese and disorders, Three Volume Set, Patrick T. K. Woo, Publisher CABI, Published 28th March 2011, ISBN 9781845935801
2.   Fish Pathology, 4th Edition, Ronald J. Roberts, Wiley-Blackwell, May 2012, ISBN: 978-1-444-33282-7
3.   Bolesti riba – PRAKTIKUM, Maja Marković, Ksenija Aksentijević, 2017, ISBN: 978-86-81043-55-4

Hours	Lectures: 1	Practicals – SRW: 2

Teaching methods Formal lecture, Practical laboratory work, Seminar paper

Evaluation and grading (maximum 100 points) Laboratory work = 10 points. Formal lecture = 10 points. Seminar paper = 20 points. Oral exam = 60 points (minimum 31 points). Grading: 6 = 51-60 points; 7 = 61-70 points; 8 = 71-80 points; 9 = 81-90 points; 10 = 91-100 points.

Knowledge assessment methods: is based on the results of the oral exam and seminar paper.

Course title: Imaging diagnostics
Lecturer/lecturers: **Nikola Krstić, Full Professor;** Mirjana Lazarević Macanović, Full Professor; Marko Mitrović, Assistant Professor; Vanja Krstić, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken

Course aims
Student should learn the principles of functioning of certain devices and technical systems used in radiological diagnostics of various small animals and horses diseases, but also to know how to operate certain x-ray and ultrasound diagnostics devices.During the teaching of this subject, postgraduates improve their skills of analyzing and interpreting the obtained image of the interior of the organism on an x-ray or screen, in order to detect pathological processes, make an exact diagnosis of the disease and control the applied therapy.

Course outcomes
Upon completion of this course, students should be able to:
- master the techniques of x-ray imaging and the basics of digital and technological processing of an x-ray image;
- master the differentiation of tissue shadows on the radiograph and recognize projection effects;
- master x-ray topographic anatomy and x-ray physiology;
- recognize and analyze pathological changes visible on the radiograph;
- summarize various radiological techniques used in veterinary practice;
- perfect the x-ray diagnostics;
- assess and manage urgent radiological cases;
- upgrade the skills of ultrasound examination and interpretation of ultrasound images;
- master ultrasound diagnostics;
perform demanding tasks on time, along with self-improvement and application of critical thinking.

Course content
Lectures
X-ray room (basic principles of construction). X-ray device (basic and auxiliary parts). Nature and formation of x-rays. Basic properties of x-rays. Interaction of x-rays and matter. Biological effects of x-rays. Principles of protection against ionizing radiation and high voltage. Origin and characteristics of x-ray image – x-ray constants (focus-object distance, focus-film distance and object-film distance). Basic and special imaging techniques in diagnostic radiology. Native and contrast methods of x-ray examination, interpretation of x-ray image. Analog and

digital radioscopy and radiography. Special purpose x-ray devices. Computed tomography, magnetic resonance. Prevention and protection against ionizing radiation. Radiological diagnostics of diseases of the digestive system, respiratory system, heart and large blood vessels of the thorax, urogenital system and bone and joint system. Possibilities and limitations of x-ray examination. Forensic x-ray diagnostics. Physical characteristics of ultrasound. Interaction of ultrasound and matter. Ultrasound image (ways of displaying the image on the display, orientation, balancing and interpretation of the image). Artifacts in ultrasound imaging. Basic principles of Doppler ultrasonography. Ultrasonography of the liver, gallbladder, bile ducts, pancreas, spleen, kidneys and bladder.
Practical classes. Working with patients within the cabinet for radiological and ultrasound diagnostics.

Recommended literature
1. Burk, R. R, Ackerman, N. (1996), *Small Animal Radiology and Ultrasonography – A Diagnostic Atlas and Text*, Philadelphia: W. B. Saunders Company
2. Cordula, P. N, Ralf, T. (2001), *Diagnostic Ultrasonography of the Dog and Cat*, London: Manson Publishing Ltd.
3. Krstić N, Lazarević Macanović, M. (2002), *Practicum in Radiology for Students of Veterinary Medicine*, Belgrade: publishers authors
4. Krstić, N, Krstić, V. (2007), *X-ray and Endoscopic Diagnostics of Digestive and Respiratory System Diseases in Dogs and Cats*, Belgrade: publishers authors
5. Krstić, N, Lazarević Macanović M, Milošević, H.(2014),*Physical Principles of Radiological and Ultrasound Diagnostics*, Belgrade: publishers authors
6. Ruth, D.(2010), *Handbook of Small Animal Radiology and Ultrasound Techniques and Differential Diagnoses*, Philadelphia: Saunders
7. Thrall, D. E. (2013), *Textbook of Veterinary Diagnostic Radiology (6th ed.*), Philadelphia: Saunders

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods: Theoretical classes with Power Point presentations. Analysis of parts of collection of several thousand archival radiographs for conducting practical classes, as well as working with patients within the clinic.

Evaluation and grading (maximum number of points 100) classes attending 10 points, seminar work 20 points, test 70 points (minimum 36). Points–final grades ratio: 51–60 (6), 61–70 (7), 71–80 (8), 81–90 (9), 91–100 (10).

Knowledge assessment methods can be different: written exams, oral exam, project presentation, seminars, etc.

Course title: Infertility in domestic animals
Lecturer/lecturers: Slobodanka Vakanjac, Full Professor; Miloš Pavlović, Associate Professor; Vladimir Magaš, Associate Professor; Miloje Đurić, Assistant Professor; Milan Maletić, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims   Students learn and get acquainted with the forms of sterility of domestic, laboratory and wild animals and deepen specific knowledge acquired in undergraduate studies; to enable the student to fully understand physiological and pathological events in reproductive system of domestic animals, to understand temporary and permanent sterility; to effectively use the previous knowledge and understand the outcome of changes and diseases.
Course outcomes   After successful completion of the course, students are able to recognize the forms, course and duration of sterility with knowledge of nutrition disorders, metabolism, hormonal disorders and metabolic status of animals and herds, in male and female animals; get detailed knowledge of protocols for testing and determining the mechanisms of hormonal regulation and regulation of metabolism that take place in the reproductive tract; sterility specificities in ruminants, equidae, pigs, carnivores, and birds.
Course content   *Lectures*   Reproductive disorders in female animals: ovarian dysfunction, anestrus, ovarian abnormalities, subestrus, nymphomania, prolonged estrus, "split" estrus, physiological mechanisms of estrus, endocrine disorders, ovulatory disorders, fertilization disorders, infertility abnormalities, fertilization abnormalities, structural barriers to fertilization, atypical fertilization, embryonic losses, embryonic mortality, abortion, fetal mortality, prenatal and neonatal mortality, gestational disorders, puerperium disorders, fetal membrane retention, uterine infections and congenital malformations. Reproductive disorders in males: ejaculation disorders, congenital malformations, cryptorchidism, testicular aplasia, sperm abnormalities, testicular and accessory gonadal diseases, inability to mate, inability to fertilize, infertility and chromosomal aberrations, mineral deficiencies and toxicity   *Practicals – SRW (study research work)* Examination of ova of domestic animals, examination of follicles and

| cysts on the ovaries of cows and mares, ultrasound folliculometry, examination of abnormal and disturbed ejaculates in bulls, stallions, boars, rams and goats |

| **Recommended literature** |
| 1. Hafez, E.S.E., Hafez, B. (2000) Reproduction in Farm animals. Seventh edition, Lippincot Williams & Wilkins, 2. Pavlović i sar. (2018) Porodiljstvo, sterilitet i veštačko osemenjavanje. Naučna KMD, Nova Poetika, Beograd; 5. Noakes E. Noakes., Parkinson J. Timothy. Gary C. W. England (2009) Arthur`s Veterinary Reproduction and Obstetrics |

Hours	**Lectures:** 2	**Practicals – SRW:** 4

| **Teaching methods** Theoretical classes. Preparation of seminar essay, public presentation. Work in the laboratory for sperm examination, pathohistological examination of reproductive tissues. Analytical discusions of individual clinical cases. Clinical examination of the ovaries and genital tract using ultrasound. Examination of oocytes |

| **Evaluation and grading (maximum 100 points)** class attendance 10 points, seminar essay 20 points, test 70 points (minimum 36). Relation and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10). |

| **Knowledge assessment methods:** seminar essay, test |

| **Course title:** Artificial insemination and cryology of sperm in domestic animals |

| **Lecturer/lecturers: Slobodanka Vakanjac, Full Professor;** Miloš Pavlović, Associate Professor; Vladimir Magaš, Associate Professor; Miloje Đurić, Assistant Professor; Milan Maletić, Assistant Professor |

| **Course status:** Elective course in the field of dissertation |

| **ECTS credits:** 10.0 |

| **Prerequisites:** Enrolled semester in which course is taken |

| **Course aims** |
| Students should learn teoretical and practical knowledge regarding artificial insemination (AI) in domestic and wild animals, laboratory and exotic animals and deepen the knowledge acquired in undergraduate studies; to be able to observe and perform cryopreservation of semen and AI; to effectively use obtained knowledge from previously mastered subjects. |

| **Course outcomes** |
| Detailed knowledge of the reproductive physiology of domestic and wild mammals, birds and fish; how to use gained knowlegde to increase the reproduction efficiency in animals by artificial insemination and the cryobiology of animal sperm; detailed knowledge of the estrus cycle, signs of estrus and sperm, sperm collection and insemination of animals; specifics of reproduction and insemination of cattle, equidae, pigs, sheep and goats, carnivores, poultry, fish, insects and bees. |

| **Course content** |
| *Lectures* |
| History of artificial insemination, importance of artificial insemination, methods of sperm collection sperm, frequency of sperm collection, characteristics of sperm originating from different domestic species, sperm quality testing, sperm quality examination and evaluation, sperm concentration, sperm morphology, sperm storage and dilution, sperm metabolism, classical sperm preservation, deep frozen sperm preservation, sperm transport, insemination techniques, basic knowledge of estrus detection, optimal time of insemination and methods of sperm introduction, synchronization of estrus and ovulation of domestic mammals, induction of superovulation, in vitro fertilization, embryo production, embryo transplantation, molecular biology of reproduction, genetic determinants involved in gonad development, genital aspects of reproductive functions and reproduction control, ovarian development, testicular development, spermatogenesis, duration of spermatogenesis in certain animal species, sperm collection management, technique of X and Y sperm separation and their differences, karyotype sperm. |
| *Practicals - SRW (study research work)* |
| Induction of estrus in domestic mammals, collection of ova (surgical and non-surgical method), sperm collection from bulls, rams, goat, boars, stallions and dogs, examination and evaluation of sperm, dilution and freezing of bull and boar sperm. AI in cows, pigs, sheep, bitches and fish. |

| **Recommended literature** |
| **1**. Hafez, E.S.E., Hafez, B. (2000) Reproduction in Farm animals. Seventh edition, Lippincot Williams & Wilkins, 2. Pavlović i sar. (2018) Porodiljstvo, sterilitet i veštačko osemenjavanje. Naučna KMD, Nova Poetika, Beograd. 3. McDonald I. E. & Pineda, M. H. (1989) Veterinary endocrinology and reproduction, Lea &Febiger, Philadelphia, London, 4. Jimmy L. Howard & Robert A. Smith (1999) Food animal practice 4, 5. Noakes E. Noakes., Parkinson J. Timothy. Gary C. W. England (2009) Arthur`s Veterinary Reproduction and Obstetrics |

Hours	**Lectures:** 2	**Practicals – SRW:** 4

| **Teaching methods** Theoretical classes, preparation of seminar essay, public presentation, poster at scientific conferences, project presentation. Work in the andrology laboratory, on farms and in artificial insemination centers during the examination, staining, dilution and freezing of mammalian sperm and artificial insemination of domestic |

mammalian females, poultry, fish and bees
Evaluation and grading (maximum 100 points) class attendance 10 points, seminar essay 20 points, test 70 points (minimum 36). Relation and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).
Knowledge assessment methods seminar essay, test

Course title: Reproductive management in farm animals
Lecturer/lecturers: Slobodanka Vakanjac, Full Professor; Miloš Pavlović, Associate Professor; Vladimir Magaš, Associate Professor; Miloje Đurić, Assistant Professor; Milan Maletić, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims To enable students to evaluate, monitor and plan the reproduction of animals on the farm; to be trained for complete reproduction control (reproduction management) of domestic farm animals as well as for planning the reproduction on farms (cattle, pigs, sheep and goats, ungulates, carnivores). Students will be able to more efficiently use obtained knowledge from previously mastered subjects in practical work.
Course outcomes Upon successful completion of the course, students will acquire the following knowledge: detailed knowledge of reproduction of farm animals (domestic mammals), knowledge of nutrition management, health and reproduction; knowledge of service periods, insemination index, estrus and parturition induction, and especially reproductive management in cattle and monitoring of reproductive parameters and offspring on the farm.
Course content *Lectures* Features of reproduction in cattle, sheep and goats, horses, pigs, birds and pets. Pregnancy control of cows, sheep and goats, pigs, mares, laboratory, wild animals and pets. Pregnancy diagnosis in domestic mammals, birth control, induction of labor, normal and pathological puerperium, ovarian cycle, folliculogenesis, service period, optimal insemination time, insemination index, calving time, number of live births, reproductive management (keeping reproductive lists), perinatal and postnatal mortality, connection between nutrition management and reproduction in cattle and pig production, analysis of biochemical findings and metabolic profile results, phase nutrition profile on farms *Practicals – SRW (study research work)* Clinical, laboratory and ultrasound diagnosis of pregnancy in domestic mammals. Herd fertility control and analysis of the causes of subfertility and sterility in the herd and on the farm. Keeping a reproductive lists on farms. Induction of estrus and childbirth in mammals. Cow control in peripartal period. Clinical examination of the genital tract of female and male mammals. Clinical and laboratory methods of determining pregnancy, ultrasound diagnosis of pregnancy of mammals
Recommended literature 1. Hafez, E.S.E., Hafez, B. (2000) Reproduction in Farm animals. Seventh edition, Lippincot Williams & Wilkins, 2. Pavlović i sar. (2018) Porodiljstvo, sterilitet i veštačko osemenjavanje. Naučna KMD, Nova Poetika, Beograd. 3. McDonald I. E. & Pineda, M. H. (1989) Veterinary endocrinology and reproduction, Lea &Febiger, Philadelphia, London, 4. Jimmy L. Howard & Robert A. Smith (1999) Food animal practice 4, 5. Noakes E. Noakes., Parkinson J. Timothy. Gary C. W. England (2009) Arthur`s Veterinary Reproduction and Obstetrics

Hours	**Lectures:** 2	**Practicals – SRW:** 4

Teaching methods Theoretical classes. Preparation of seminar essay, public presentation, practical work on farms
Evaluation and grading (maximum 100 points) class attendance 10 points, seminar essay 20 points, test 70 points (minimum 36). Relation and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).
Knowledge assessment methods: seminar essay, test

Course title: Diseases of ruminants
Lecturer/lecturers: Ivan Vujanac, Associate Professor; Jovan Bojkovski, Full Professor; Radiša Prodanović, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims Obtaining modern theoretical and practical knowledge from selected thematic areas of ruminants diseases. Understanding the mechanisms behind and clinical manifestations of large and small ruminants diseases.

Overcoming techniques and methods used to determine disorders of individual organs and introduction to clinical and experimental research methods in clinical pathology of small and large ruminants. Differential diagnosis of diseases and elements for therapeutic and prophylactic decision making.

Course outcomes

The student understands the etiopathogenesis, clinical manifestations, as well as methods of diagnosis and protocols of therapy and prophylaxis of diseases of large and small ruminants. It can explain, recognize and compare disorders in the functioning of individual organs and organ systems. Connecting theoretical research work with practical-clinical solutions in intensive cattle, sheep and goat breeding. He uses recent scientific data from the literature in the mentioned field, which will enable him to independently perform scientific research work, write and publish research results in domestic and international journals.

Course content

Lectures

Neuro-endocrine mechanisms of regulation of the function of organs and systems in intensive breeding of domestic ruminants, Synergism of nonspecific and biological factors in the etiology and pathogenesis of ruminants diseases; Contemporary aspects in the diagnosis and treatment for the diseases of large and small ruminants; Diseases of the digestive system; Liver and pancreas diseases; Respiratory diseases; Diseases of the cardiovascular system; Diseases of the urinary system; Energy and mineral metabolism disorders of of large and small ruminants; Differential diagnosis of downer cow syndrome; Micronutrient deficiency, hypovitaminosis and avitaminosis; Locomotor disfunction and diseases; Skin diseases; Tuberculosis; Paratuberculosis; Jejunal hemorrhage syndrome; Bovine viral diarrhea; Diferential diagnosis of CNS disorders.

Practicals – SRW (study research work)

Work with patients and SRW.

Recommended literature

Radojičić Biljana, Bojkovski Jovan, Jonić Branko, Ćutuk Ramiz. Bolesti preživara, Akademska misao, 2017.

Šamanc A. Horea. Bolesti organa za varenje kod goveda, Naučna KMD, 2009.

Šamanc A. Horea Bolseti respiratornog i kardiovaskularnog sistema goveda, Naučna KMD, 2010.

Radostits Otto M., Clive C. Gay, Kenneth W., Hincheliff, and Peter D.: Veterinary medicine, A textboock of disease of cattle, horses, sheep, pigs, and goats, Saunders Elsewere, 2010.

Aitken I.D. Diseases of sheep. Blackwell Publishing, 2007.

Peter Cockcroft. Bovine medicine, 3rd edition, John Wiley & Sons, Ltd, 2015.

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Power Point Lectures. Public presentation of seminar papers with discussion. Practical classes on the cattle, sheep and goat farms.

Evaluation and grading (maximum 100 points) 10 points from teaching, 20 points for seminar work, 70 (min 36) points on the test. Points ratio and final grades: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods written exam and seminar paper.

Study program: Veterinary clinical toxicology	
Lecturer/lecturers: Vitomir Ćupić, Full Professor; Saša Ivanović, Assistant Professor	
Course status: Elective course in the field of dissertation	
ECTS credits: 10.0	
Prerequisites: Enrolled semester in which course is taken	

Course aims

to provide students with the latest scientific and professional knowledge about the possibilities and ways of contamination of animals and humans with numerous toxic substances, such as: pesticides (insecticides, herbicides, rodenticides, fungicides, molluscicides), drugs, chemical substances from animal feed, industrial chemicals, heavy metals , toxic plants and animal poisons and their active substances, to learn about their toxicokinetics, mechanism of action, degree of toxicity to various species of domestic and wild animals, as well as the risk of intoxication. Also, the aim of the course is to train students to recognize the clinical picture of poisoning and make a diagnosis using biochemical-hematological, chemical-toxicological findings of blood, urine, feces, milk, food, water or the contents of the digestive system and organs, or parts of the organs of dead animals. The main goal of the course is to teach students to prevent intoxication, and if they occur to apply appropriate specific and / or non-specific therapy (general and spot-on or symptomatic therapy)

Course outcomes

 is for the student to learn ways to prevent and treat poisoning.

Course content

Lectures

Toxicokinetics of xenobiotics, action of toxic substances (biotoxins, pesticides, drugs, industrial chemicals,

animal feed additives, metals and minerals, plants, etc.) and their effects on the cardiovascular system and blood, gastrointestinal, hepatobiliary, nervous system, reproductive, respiratory, urinary, musculoskeletal, endocrine system, skin and mucous membranes. The effect of toxins on each of these organ systems includes: mechanism of action, toxicity and risk factors for animals and humans, clinical picture of poisoning, changes in biochemical parameters of blood and animal excreta, blood counts, pathomorphological and histological changes, differential diagnosis, final diagnosis of poisoning , treatment, prognosis and prevention of poisoning.

Practicals – SRW (study research work)

Recommended literature
1. Ćupić V, Muminović M, Kobal S, Velev R, Pharmacology for students of veterinary medicine, III supplemented and amended edition, Naučna KMD, Belgrade, 2019; 2. Jezdimirović M. Veterinary Pharmacology 4, revised and supplemented edition, Faculty of Veterinary Medicine, Belgrade, 2010; 3. Ćupić V. The most common poisonings in veterinary practice, Belgrade, III. amended edition, Naučna KMD, Belgrade, 2015; 4. Adams, R.H,: Veterinary Pharmacology and Therapeutics, 8th edition, Iowa State University Press/Ames, Iowa, 2001 5.Gupta RC. Veterinary Toxicology. 3 ed. 2018

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Theoretical classes are conducted through interactive learning, with the use of audio-visual methods (Power -Point presentations),
Evaluation and grading (maximum 100 points) Participation in formal lecture10 points, seminars 20 points, written exam 70 points.
Knowledge assessment methods written exam, seminar work

Course title: Mechanisms of drugs action
Lecturer/lecturers: Saša Trailović, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims To learn the known and defined mechanisms of action of drugs from different pharmacodynamic groups, which are used in veterinary medicine. To learn how the mechanisms of action of drugs are examined and analyzed.
Course outcomes That the student understands the mechanisms by which drugs achieve effects (therapeutic and side effects). That the student can choose the appropriate method of examining the mechanisms of action of drugs in research. That the student in scientific work defends and explains the results of his own research on the mechanism of action of drugs.
Course content *Lectures* General part: Pharmacodynamics-action of drugs on the organism, types and character of action, place and mechanisms of action of drugs; Receptors-drug interaction, receptors and transmembrane signal transduction, consequences of drug binding to the receptor (receptor internalization, agonist-antagonist system), receptor desensitization and regulation of pharmacological receptors. Ionic channels, enzymes and cellular transport systems as sites of drug action. Quantitative aspects of drug action, dose-effect relationship. Drug interactions, synergism and antagonism. Selectivity of action, side effects of drugs, side effects of genetic origin and pharmacogenetics, allergic reactions. Drug dependence, mechanisms of occurrence and types of drug dependence. Special part: Mechanisms of action of drugs in the CNS and neurotransmitters of the CNS. Cholinergic and adrenergic receptors, mechanism of function. Types of cholinergic drugs, anticholinergic drugs. Adrenergic drugs, adrenomimetics and adrenolytics. Histamine and antihistamines. Serotonin and antagonists. Mechanisms of action of drugs acting on the cardiovascular system (heart rate stimulators, antiarrhythmic drugs, antihypertensives, antiadrenergic drugs, antihypertensive vasodilators, ACE inhibitors), nitric oxide. Pharmacology of the urinary system, mechanism of action of diuretics. Blood pharmacology, mechanism of action of drugs. Pharmacology of the respiratory system, mechanism of action antitussives, mucokinetics, expectorants, mucolytics. Digestive tract pharmacology, mechanism of action of drugs. Antimicrobial drugs, mechanism of action, bacteriostatics and bactericides, bacterial resistance to antimicrobial drugs. Antiparasitic drugs, mechanism of action, endoantiparasitics, ectoantiparasitics, mechanisms of resistance. Chemotherapy of malignant diseases, general mechanisms of action, resistance to cytostatics, specific mechanisms of action (alkylating agents, antimetabolites, hormones, cytostatic antibiotics, radioactive iodine, cancer vaccines).

Practicals – SRW (study research work) Drug-dose-effect relationship, gradual and quantal, experimental presentation on isolated rat ileum. Calculation of the mean effective dose from the obtained results (ED50). Probit analysis and nonlinear regression. Gaddum/Schild EC50 shift. Synergism and antagonism-experimental presentation on rat blood pressure. Processing of the obtained results, Software for studying the effect of drugs on blood pressure in rats - introduction to the method of work, data recording, methods. Effect of antiparasitic drugs on the neuromuscular preparation *Ascaris suum*.

Recommended literature James M. Ritter & Rod J. Flower & Graeme Henderson & Yoon Kong Loke & David MacEwan & Humphrey P. Rang (2019): Rang & Dale's Pharmacology, 9th Edition, Elsevier.

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Oral lectures and practical work in laboratories at the Department of Pharmacology and Toxicology.

Evaluation and grading (maximum 100 points) Pre-examination obligations: Activity during classes - 10 points Final exam: Practical exam - 30 points and Oral exam - 60 points

Knowledge assessment methods Practical and oral exam

Study program: Efficacy and safety of drug use in veterinary clinical practice

Lecturer/lecturers: Vitomir Ćupić, Full Professor; Saša Ivanović, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 10.0

Prerequisites: Enrolled semester in which course is taken

Course aims First of all that students understand the importance of monitoring, and to learn the methods used in testing the efficacy and safety of drugs intended for certain indications in target species and categories of animals. The purpose of the course is to train students to recognize the profile of adverse reactions in certain groups of drugs and to treat them, as well as to register new adverse reactions not provided for in the instructions, which may occur due to impaired pharmacokinetics, pharmacodynamics or hypersensitivity of a particular species or category of animals.

Course outcomes After passing the exam, students will be able to conduct a rational one pharmacotherapy, apply effective and safe drugs and perform pharmacovigilance

Course content *Lectures* Verification of the antibacterial efficacy of newly registered antimicrobial drugs in relation to the efficacy of existing already registered drugs from the same chemical group on target animals, in the predicted indications, both in clinical conditions and in vitro. (6). Determining the tolerability of the use of newly registered antimicrobial drugs using several times higher doses than recommended therapeutic, monitoring changes in the values of biochemical parameters of blood and urine, clinical signs of possible toxicity, production results and food consumption in target species and categories of animals (6). Verification of the antiparasitic efficacy of newly registered antiparasitic drugs in relation to the efficacy of existing already registered drugs from the same chemical group on target animals, in the predicted indications in clinical and in vitro conditions. Determination of tolerability - safety of use, especially of newly registered endetocides in target species of animals, according to the indications determined by the manufacturer (18). Examination of tolerability of anti-inflammatory drugs in potentially sensitive animal species by monitoring local gastric tolerance, blood biochemical parameters and changes in blood count, as well as systemic and local anti-inflammatory efficacy. Examination of the efficacy of new drugs and their dosing regimen (dose size, administration interval and duration of therapy) in the prevention and treatment of septicemia and septic shock (15) *Practicals – SRW (study research work)*

Recommended literature 1. Ćupić V, Muminović M, Kobal S, Velev R. Pharmacology for students of veterinary medicine, III supplemented and amended edition, Naučna KMD, Belgrade, 2019; 2. Ćupić V, Trailović D, Dobrić S, Kobal S, Nonrrational consumption of drugs in veterinary medicine: danger to animal and human health. Contemporary Agriculture, 2006; (3-4): 64-70; 3. Cupic V, Jezdimirovic M, Dobric S, Ivanovic S, Cupic-Miladinovic D. Safety of antimicrobial drugs. 26. Conference of veterinarians of Serbia. Zlatibor, 10-13. 09. 2015; 4. Ćupić V, Dobrić S, Kobal S, Milovanović M, Ivanović S. Investigation and monitoring of side effects during drug development. Proceedings and short contents. 19th conference of veterinarians of Serbia with international participation. Vrnjacka Banja, September 26-29, 2007; 5 Ćupić V, Ivanović S, Velev R, Vasilev S, Žugić G, Bošnjak I, Borozan N. Significance of pharmacovigilance in veterinary medicine. Proceedings of the 14th Congress of

Pharmacologists and the 4th Congress of Clinical Pharmacology of Serbia. Novi Sad, September 18 - 21, 2019, p. 228		
Hours	**Lectures: 2**	**Practicals – SRW: 4**
Teaching methods Theoretical classes are conducted through interactive learning, with the use of audio-visual methods (Power -Point presentations),		
Evaluation and grading (maximum 100 points) Participation in formal lecture 10 points, seminars 20 points, written exam 70 points.		
Knowledge assessment methods written exam, seminar work		

Course title: Microbiology
Lecturer/lecturers: Nenad Milić, Full Professor; Dejan Krnjaić, Full Professor; Dušan Mišić, Full Professor, Jakov Nišavić, Full Professor; Marina Radojičić, Associate Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims   Acquiring knowledge about structural, physiological and antigenic characteristics of pathogenic and non-pathogenic microorganisms, the process of infection and etiopathogenesis of bacterial, fungal and viral infections as well as non-specific and specific defense mechanisms from infectious agents.
Course outcomes   The student should know the shape and structure of microorganisms, to know how to perform sterilization, to know the principles of isolation of bacteria in pure culture and identification methods, to know the principles of serological diagnostic methods, to know the methods of virus isolation in tissue cultures, as well as the isolation of viruses, chlamydia and rickettsia in embryonated chicken eggs and to know the basic principles of molecular diagnostic methods.
Course content   *Lectures*   The most important structural and physiological characteristics of bacteria; Environmental influence on microorganisms; Genetics of microorganisms; Infection and immunity; Characteristics of the following genera or groups of bacteria: *Pseudomonas, Burkholderia, Aeromonas, Campylobacter, Vibrio, Escherichia coli, Enterobacter, Klebsiella, Proteus, Salmonella, Pasteurella* and *Mannheimia, Bordetella, Haemophilus, Actinobacillus, Moraxella, Fusobacterium, Bacteroides, Brucella, Micrococcus, Staphylococcus, Streptococcus, Lactobacillus, Corynebacterium, Trueperella* and *Rhodococcus, Listeria, Erysipelotrix, Bacillus, Clostridium, Mycobacterium, Nocardia, Actinomyces, Serpulina - Brachispira, Borrelia, Treponema, Leptospira, Mycoplasma, Chlamydia* and *Chlamydophila, Rickettsia, Coxiella*, *Ehrlichia*. Morphological and structural characteristics of yeasts and molds; Physiology of yeasts and molds; Fungi as pathogens; Morphological and biological properties of the following genera of fungi: *Blastomycetes, Hyphomycetes, Phycomycetes, Ascomycetes, Basidiomycetes, Candida, Cryptococcus, Mucor, Aspergillus, Penicillium, Trichophyton, Microsporum, Histoplasma*; General characteristics of animal viruses; Viral infections and antiviral defense of the organism; Morphological and biological characteristics of the following groups of viruses: *Poxviridae; Herpesviridae; Hepadnaviridae; Adenoviridae; Asfarviridae; Papillomaviridae and Polyomaviridae; Parvoviridae; Circoviridae; Picornaviridae; Caliciviridae; Reoviridae; Birnaviridae; Togaviridae; Flaviviridae; Arenaviridae; Coronaviridae; Retroviridae; Bunyaviridae; Ortomyxoviridae; Paramyxoviridae; Rhabdoviridae* and *Arteriviridae.*   *Practicals - SRW (study research work)*
Recommended literature   1. Milić N., Krnjaić D., Mišić D., Nišavić J., Radojičić M. (2017) Mikrobiologija sa imunologijom, Naučna KMD, Beograd.   2. Ašanin R., Krnjaić D., Milić N. (2014) Priručnik sa praktičnim vežbama iz mikrobiologije sa imunologijom Naučna KMD, Beograd.   3. Nišavić J., Milić N., Knežević A. (2013) Laboratorijska dijagnostika virusnih infekcija, Naučna KMD, Beograd.   4. Mišić D. (2013) Metode mikrobiološke dijagnostike–ispitivanje osetljivosti bakterija na antibiotike, Elit Medica, Beograd.   5. Markey B., Leonard F., Archambault M., Cullinane A., Maguire D. (2013) Clinical Veterinary Microbiology, Mosby, Elsevier.   6. MacLachlan N.J., Dubovi E.J. (2016) Fenner's Veterinary Virology, 5th Edition, Academic Press.   7. Quinn P.J., Markey B.K., Leonard F.C., Hartigan P., Fanning S., Fitzpatrick E.S. (2011) Veterinary Microbiology and Microbial Disease, 2nd Edition, Wiley-Blackwell.

Hours	**Lectures: 2**	**Practicals – SRW: 4**

Teaching methods Formal lecture
Evaluation and grading (maximum 100 points) Formal lecture = 10 points. Seminar paper = 20 points. Oral exam = 70 points (minimum 36 points). Grading: 6 = 51-60 points; 7 = 61-70 points; 8 = 71-80 points; 9 = 81-90 points; 10 = 91-100 points.
Knowledge assessment methods Knowledge assessment is based on the results of the oral exam and seminar paper.

Course title: Animal parasitic diseases
Lecturer/lecturers: Nevenka Aleksić, Full Professor; Tamara Ilić, Associate Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims   Broadening the knowledge acquired during previous education about parasitic infections and diseases of animals. Providing in-depth insight into etiology, global epizootiology/epidemiology, pathogenesis, pathology, immunity and clinical signs. Getting acquainted with indirect diagnostic methods applied for diseases which cannot be or can hardly be diagnosed with parasitology methods only. Learning parasitic infections of wild animals and foodborne infections. Building awareness of the problem of resistance to contemporary antiparasitic medicines.
Course outcomes   On completing the course, the students are capable of (1) establishing the diagnosis of parasitic infections using direct and indirect, molecular biological methods, (2) deciding on adequate therapy, esp. in compliance with the animal species and raising system, (3) implementing measures aimed at decreasing the possibility of resistance development against anti-parasite medication by parasites.
Course content   *Lectures*   **Parasitic infections of the blood**: babesiosis, theileriosis, anaplasmosis, heartwater.   **Parasitic infectionse of the digestive system of mammals**: coccidiosis (Equidae, cattle, small ruminants, pig, rabbit and carnivores), cryptosporidiosis, balantidiosis, tapeworm and roundworm infections of carnivores, equine oxiurosis.   Grazing animals' parasitic infections: fluke infections (fasciolosis, dicrocoeliosis and paramphistomosis), tapeworm infections od ruminants and Equidae, parasitic gastroenteritis of ruminants, strongylidosis of Equidae.   Farm animal infections – herd problems (Buxtonella spp, Neospora caninum, Cryptosporidium spp).   Roundworm infections of the digestive system affecting several animal species: ascaridosis, hookworm infections, trichurosis, oesophagostomosis.   **Respiratory infections** of ruminants (Dictyocaulus filaria, D. viviparus, Protostrongylinae), Equidae (D. arnfieldi), the pig (Metastrongylus elongatus, M. pudendotectus), carnivores (Crenosoma vulpis, Angiostrongylus vasorum, Capillaria spp) and poultry (Syngamus trachea, Cyathostoma spp).   **Urinary infections** (Klossiella equi, Eimeria truncata, Capillaria plica, C. feliscati, Dioctophyma renale, Stephanurus dentatus, Schistosoma matthei).   **Sexually transmitted infections** (Tritrichomonas foetus and Trypanosoma equiperdum).   **Internal myiases (**Hypoderma spp, Gasterophyllus spp., Oestrus ovis etc.).   **Skin infections**: mange, demodicosis, external myiases.   **Parasitic infections of other organs** of domestic and wild animals (Angiostrongylus spp., Aelurostrongylus abstrusus, Schistosoma spp).   **Temporary parasites** and their importance to animal and human health (ticks, fleas, chewing and biting lice, mosquitoes, blackflies, midges and sandflies).   **Infections of poultry and other birds**: coccidiosis, histomoniasis, tritrichomonosis, spironucleosis, heterakidosis, amidostomosis.   **Foodborne infections**: neosporosis, sarcocystosis, toxoplasmosis, larval cestodoses, trichinellosis, anisakiosis.   **Zoonoses**: leishmaniosis, creeping eruption, strongyloidosis, cysticercosis.   Immunity to parasitic infections. Mechanisms of evading the hosts' immune response. Methods of pasture parasitic infection control. Prophylaxis of ectoparasitic infestation. Vector control. Resistance to antiparasitic medicines.   *Practicals*   Direct methods of parasitic diagnostics. Molecular-biology methods in use in the diagnostics of parasitic infections.
Recommended literature   1) Dimitrijević S, Ilić T. 2011, Clinical parasitology, Published by the authors and Interprint, Belgrade 2) Zajac MA, Conboy AG. Veterinary clinical parasitology. 8ht Edition, Wiley Blackwell, New Jersey, USA, 2012. 3) Aleksic N. Parasitic diseases, Published by the author, 2020. 4) Aleksić N. Manual from clinical parasitology, Published by the

author, 2020. 5) Taylor AM, Coop LR, Wall LR. Veterinary Parasitology. 4th Edition, Wiley Blackwell, New Jersey, USA, 2016. 6) Deplazes P, Eckert J, Mathis A, Von Samson-Himmelstjerna G, Zahner H. Parasitology in veterinary medicine. 1st Ed, Wageningen Academic Pub, Gelderland, Netherlands, 2016. 7) Despommier DD, Griffin OD, Gwadz WR, Hotez JP, Knirsch C. Parasitic Diseases. 6th Ed., Parasites Without Borders, Inc. NY, 2017. 8) Saari S, Näreaho A, Nikander S. Canine Parasites and Parasitic Diseases. 2nd Edition, Academic Press, Waltham, 2019.

Hours	Lectures: 2	Practicals - SRW: 4

Teaching methods Lectures, interactive teaching, practice in the laboratory.

Evaluation and grading (maximum 100 points) Participation in lectures 10 points (min. 6), seminary paper – essay 10 points (min. 6), student's research work 20 points (min. 11). Oral exam 60 points (min. 31). Grading: 51-60 points (6), 61 -70 (7), 71-80 (8), 81 - 90 (9) and 91 - 100 (10).

Knowledge assessment methods Oral exam, seminary paper - essay.

Course title: Parasitology	

Lecturer/lecturers: Zoran Kulišić, Full Professor; Danica Bogunović, Assistant Professor

Course status: Elective course in the field of dissertation

ECTS credits: 10.0

Prerequisites: Enrolled semester in which course is taken

Course aims
Making the students familiar with taxonomy, morphological and morphometric characteristics of animal parasites in the field of protozoology, helminthology and arachnoentomology; parasite life cycle, host-parasite interactions, adaptation and survival mechanisms of parasites inside the host and in the external environment, as well as with the relevant and modern laboratory methods of parasitic diagnostics.

Course outcomes
Student should be qualified to properly select, collect and process material for laboratory analysis; to select the most suitable method of laboratory diagnostics; identify taxonomic position of parasites based on their morphological characteristics; individually apply modern method of laboratory diagnostics; critically analyze obtained results and draw appropriate conclusions; present the obtained results in details in the form of an oral and written report

Course content
Lectures
Parasite species important for the veterinary medicine in the field of protozoology, helminthology and arachnoentomology; taxonomic position, morphological, biological and immunological characteristics of the parasites; host-parasite interaction, prevalence, life cycle and parasite transmission pathways. Control and eradication measures.
Practicals - SRW (study research work)

Recommended literature
1. Kulišić Z, Helmithology, Serbian Veterinary Chamber, Belgrade, 2001; 2. Teodorović V, Bunčić O, Kulišić Z, Radenković-Damnjanović B, Teodorović R, Đorđević M, Mirilović M, Trichinella – trichinellosis, Naučna KMD d.o.o., Beograd, 2007; 3. Bauerfeind R, von Graevenitz A, Kimmig P, Schiefer HG, Schwarz T, Slenczka W, Zahner H, Zoonoses: Infectious Diseases Transmissible From Animals and Humans (4th ed.), AMS Press, Washington DC, 2016; 4. Blagburn B (ed.), Pfizer Atlas of Veterinary Clinical Parasitology, The Gloyd Group Inc., Wilmington, 2000; 5. LaMann G (Ed.), Veterinary parasitology, Nova biomedical Press, Inc., New York, 2010; 6. Gunn A & Pitt S, Parasitology. An integrated Approach, Willey-Blackwell Publishing, New Jersey, 2012; 7. Ridley JW, Parasitology for Medical and Clinical Laboratory Professionals, Delmar Cengage Learning, Delmar, 2012; 8. Elsheikha H & Khan NA (Eds.), Essentials of Veterinary Parasitology, Caister Academic Press, Pooley, 2011; 9. Bowman DD, Georgis' Parasitology for Veterinarians, 10th Edition, Elsevier Health Sciences, 2014.

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Lectures, seminars

Evaluation and grading (maximum 100 points)
Lectures: 10 points (min. 6), Seminar: 10 points (min. 6), Practicals: 20 points (min. 11), Oral exam: 60 points (min. 31) Points/grade ratio: 51-60=6, 61-70=7, 71-80=8, 81-90=9, 91-100=10.

Knowledge assessment methods: Oral exam, seminary paper – essay

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Course title: Infectious diseases of animals	

Lecturer/lecturers: Sonja Radojičić, Full Professor; Sonja Obrenović, Associate Professor; Dragan Bacić, Associate Professor

Course status: Elective course in the field of dissertation

ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims to understand infectious diseases of animals and zoonoses, their epizootiology, etiology, pathogenesis, to recognize the clinical findings, contagiousness index, recognize characteristic autopsy findings, and differentially diagnostically significant diseases, explain and understand diagnosis, apply therapy and prophylaxis of infectious animal diseases. Apply methods of effective control, suppression and eradication of existing infection and especially dangerous diseases, as well as to suspect and apply measures in case of bioterrorism.
Course outcomes 1. students understand the basic epizootiological determinants as well as the basic mechanisms of changing the virulence and pathogenicity of microorganisms, 2. to distinguish the basic mechanisms of defense against infection, the functioning of the immune system during infection, immunopathogenesis and tissue damage mechanisms during infection, 3. to use and monitor individual parameters of importance for the occurrence, movement, control, suppression and eradication of enzootics and epizootics, 4. to independently analyze epizootiological data and define the spatial and temporal movement of infectious diseases (enzootics and epizootics), 5. to distinguish between similar infectious diseases. 6. to independently describe the basic principles of emergency national plans, and assess the basic characteristics of diagnostic tests, 7. to form a set of measures to protect against specific infectious diseases, 8. to perform risk analysis in such cases, as well as to establish objective suspicion of bioterrorism and the application of bioterrorism protection measures.
Course contents *Lectures* 1. General infectology, developmental path of infectology, significance of infectious diseases, epizootiological aspects, methods of control and protection against epizootics, pathogenesis of infectious diseases, clinical features of infectious diseases, general principles of diagnostics of infectious diseases, assessment of significance of diagnostic tests and methods, assessment of diagnostic test results, prophylaxis (general and specific) of infectious diseases, control measures of infectious diseases, eradication of infectious diseases, risk analysis, bioterrorism. 2. Special infectology, infectious diseases significant for a number of animal species, diseases caused by members of the same species or genus, infectious diseases of cattle, infectious diseases of sheep and goats, infectious diseases of horses, infectious diseases of pigs, infectious diseases of birds, infectious diseases of lagomorphs and unclassified infectious animal diseases. *Practicals - SRW (study research work)*
Recommended literature Lefere Pc, Blancou J, Chermette R, Uilenberg G, 2010, Infectious and Parasitic Diseases of Livestock, Volume I and II Lavoisier, 2010. Fernandez PJ White W, 2016, Atlas of transboundary Animal Diseases, OIE, revised 2016. Radojičić, Valčić, Đuričić (2011), Infektivne bolesti životinja – specijalni deo, autorsko izdanje Valčić, M. (2004) Specijalna epizootiologija – prvi deo. Veterinarska komora Srbije, Michael Thrusfield M, 2007, Veterinary epidemiology Third Edition, Blackwell Science Ltd, a Blackwell Publishing company Martin, W. S. i sar. (1987) Veterinary epidemiology, principles and methods, Iowa Sт. Univ. Gordis L, 2013, Epidemiology, 5th Edition, Elsevier

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Theoretical lectures, seminar work, discussion
Evaluation and grading (maximum 100 points) Activites during lectures 10, seminar 30, oral exame 60. Ratio betwen points and the final mark: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).
Knowledge assessment methods Way of assessing can be different. Attending lecturers 10, seminar paper 30, oral exam 60.

Course title: Epizootiology of animal infectious diseases
Lecturer/lecturers: Sonja Radojičić, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken
Course aims to acquaint students with the basic elements of epizootiological work, for the purpose of properly defining epizootiological studies, monitoring movements and surveillance in the study of infectious animal diseases, training students to work on the analysis of epizootiological data and defining epizootiological measures.
Course outcomes

After completing the course, the student should differentiate and list the basic epizootiological determinants, to apply monitoring of certain parameters relevant to the occurrence, movement, control, suppression and eradication of enzootics and epizootics, to apply analysis of epizootiological data, determine spatially and temporally defined movements of infectious diseases (enzootics and epizootics), to apply the basic principles of emergency national plans, to evaluate the basic characteristics of diagnostic tests and analyze their results, to determine the interrelationships of phenomena in epizootiology, to form epizootiological models and schemes of health and risk analysis, to understand control methods and protection against epizootics.

Course content

Lectures

The concept and methods of epizootiology, ways in which enzootics and epizootics affect the production characteristics and health status of animals. Epizootiological concepts and basic principles of characterization of infectious diseases. Morbidity, mortality, mortality rate, prevalence, incidence. Ways of originating and temporal and spatial distribution of infectious diseases (enzootic and epizootic). Epizootiological factors and determinants. Microorganism, basic characteristics of causative agents of infectious animal diseases. Pathogenicity and virulence of viruses, bacteria, protozoa, fungi that cause systemic mycoses as well as unclassified causes of infectious animal diseases. Ways in which microorganisms impact the functioning of macroorganisms and disorders in homeostasis. Resistance of microorganisms. Macroorganism. Basics of susceptibility and resistance of animals, general characteristics of resistance, general characteristics of specific resistance to certain groups of microorganisms and to certain causes of infectious diseases. Entrance door of the microorganism. Dissemination of microorganisms in the host body. The immune system during infection and the ways in which microorganisms avoid the defense factors of the macroorganism. Immunopathogenesis. External factor. Ecological factors influencing the occurrence of enzootics and epizootics. Basic principles of epizootiological work. Methods of control and protection against epizootics. General framework plan for epizootic control. Primary and secondary barrier systems. Epizootiological measures and strategies of epizootic control. Surveillance and monitoring of epizootiological data. Phases in epizootic control, propagative epizootic, point-sourse epizootic. Risk analysis assessment (qualitative and quantitative). Risk identification, assessment, management and communication. Epizootiological characteristics for the region of the most significant infectious diseases that have significant epizootic potential.

Practical classes

The student in the epizootiological laboratory gets acquainted with the methods of collecting and presenting epizootiological data and processes various methods of data analysis on examples.

Recommended literature

Valčić, M 1998. General Epizootiology

Radojičić, Valčić, Đuričić 2011. Special infectious diseases of animals, Thrusfield, M. (2018) Veterinary epidemiology. Bleckwell, 4th Edition

Dohoo, I. Et al. 2003. Veterinary epidemiology res. AVC Inc. Charlottetown, Canada, Martin, W. S. i sar. (1987) Veterinary epidemiology, principles and methods, Iowa Sт. Un. Gordis L, (2013), Epidemiology, 5th Edition, Elsevier

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Theoretical classes, discussion, seminar paper, public presentation

Evaluation and grading (maximum 100 points) Activites during lectures 10, seminar paper 30, oral exame 60.
Ratio betwen points and the final mark: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods Oral exam, seminary paper - essay.

Course title: Vaccinology
Lecturer/lecturers: Sonja Radojičić, Full Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken

Course aims

To acquaint students with vaccines and other biological preparations, immune response in the body that occur after the application of vaccines, the processes of their production, factors that may reduce the effectiveness of the vaccination program, adequate use and expected results of vaccination

Course outcomes

Students should understand the importance of vaccines and other biological preparations as a necessary part of specific prophylaxis, describe the processes of production and control of the most important vaccines whose use is provided by international laws, define new trends in vaccine production and their potential for animal health preservation. Students should independently assess when and in which cases the use of vaccines is justified and when not, as well as to evaluate the positive and negative effects of vaccination in the control and eradication of

infectious animal diseases, to create a valid vaccination program depending on the epizootiological situation in the country and region.

Course content

Lectures

History and significance of immunoprophylaxis, Types of immunization procedures, Passive immunization, Active immunization, classification of vaccines, Inactivated vaccines, Attenuated vaccines, Adjuvants, Vaccine production methods, Evaluation of vaccine efficacy, Validation of vaccines-potency, safety, sterility, Methods of vaccine application, Mistakes in vaccination, Side effects after the use of biological preparations, Control of vaccines, The most important vaccines in veterinary medicine, New trends in vaccine production, veterinary vaccines for non-infectious diseases, veterinary vaccines for fertility, the role and importance of vaccines in oncology, control elements and production.

Practicals - SRW (study research work)

Recommended literature

1**.** Ian Tizard, Veterinary immunology, An introduction, 2017, 10th Edition, Philadelphia, Saunders

2. Ian Tizard, Vaccines for Veterinarians, 2020, 1st Edition, Elsevier

3. Animal vaccination, 2006, Part 1, Development, production and use of vaccines, OIE

4. Animal vaccination, 2006, Part 2 Scientific, economic, regulatory and socio-ethical aspects, OIE

5. Mims'Pathogenesis of infectious diseases, 2001, 3th Edition, San Diego, Academic Press,

6. Meeusen et al. 2007. Current Status of veterinary vaccines, Clinical Microbiology reviews Vol 20 No 3 489-510

7. Manual of Diagnostic Test and Vaccines for Terrestrial Animals, Access online

Hours	Lectures: 2	Practicals – SRW: 4

Teaching methods Theoretical lectures, seminar work, discussion

Evaluation and grading (maximum 100 points) Activites during lectures 10, seminar 30, oral exame 60.
Ratio betwen points and the final mark: 51-60 (6), 61 -70 (7), 71-80 (8), 81 - 90 (9), 91 - 100 (10).

Knowledge assessment methods can be different. Maximum score is 100.

Course title: Pathology
Lecturer/lecturers: Sanja Aleksić-Kovačević, Full Professor; Darko Marinković, Associate Professor; Vladimir Kukolj, Associate Professor; Slađan Nešić, Assistant Professor; Ivana Vučićević, Assistant Professor
Course status: Elective course in the field of dissertation
ECTS credits: 10.0
Prerequisites: Enrolled semester in which course is taken

Course aims

To enable advanced knowledge related to the mechanisms of occurrence and morphology of pathological processes, sublethal and lethal damage, circulatory disorders, inflammation, growth, oncology and teratology. Acquiring knowledge about the specific and comparative differences of pathological processes in certain organ systems in different animal species regarding immune, genetic and metabolic disorders, as well as infectious agents. Introduction to new morphological diagnostics methods.

Course outcomes

The student should: describe the mechanisms of occurrence and morphology of pathological processes.

To emphasize the morphological difference between sublethal and lethal damage, circulatory disorders, inflammation and neoplastic processes.

To acquire knowledge and skills that will enable independent diagnostics and scientific research, writing and publishing scientific references in the field of pathology.

Course content

Lectures

Sublethal and lethal cell damage. Cell death criteria. Molecular mechanisms. Apoptosis. Mechanism and morphology of dyscyclia. Disorders in microcirculation. Leukocyte disorders.

Mechanism of acute and chronic inflammation. Oncologic pathology.

Regeneration. Organization. Tissue regeneration factors. Immunodeficiency. Autoimmune diseases. Pathology of the gastrointestinal system, liver, pancreas. Pathology of the respiratory system. Pathology of the heart and blood vessels. Pathology of the hematopoietic system. Pathology of bones, joints and muscles. Pathology of the nervous system. Pathology of the reproductive system. Dermatopathology.

Practical classes from pathohistology and immunohistochemistry. Sampling. The choice of fixative. Sample preparation and histochemical staining methods. Molecular methods in pathology. Necropsy technique and necropsy protocol. Descriptive pathology. Digital photography. Processing, presenting and publishing results from macroscopic and microscopic morphology.

Practicals - SRW (study research work) Personal study of macroscopic and microscopic case presentations.		

Recommended literature
1. Special Veterinary Pathology, 2nd edition, Jovanovic, Aleksić-Kovačević, Knežević, Naučna, 2019.
2. Pathologic Basis of Veterinary Disease, 6th ed, Zachary J (editor), Elsevier, 2016
3. Jubb, Kennedy and Palmer's Pathology of Domestic Animals, 3-Vol. Set, 6th ed, Maxie G (editor), Elsevier, 2015
4. Tumors in Domestic Animals, 5th ed, Meuten D (editor), Wiley-Blackwell, 2017
5. Ultrastructural Pathology, 2nd ed, Cheville N (editor), Wiley-Blackwell, 2009
6. Robbins and Cotran Pathologic Basis of Disease, 9th ed, Kumar V, Abbas A, Aster J (editors), Elsevier, 2014
7. Journal of Veterinary pathology, Journal of Comparative Pathology

Hours	**Lectures:** 2	**Practicals – SRW:** 4

Teaching methods Oral and slide presentations, histopathology slide seminar, case reports, pathology section, discussion microscope, work in histopathology and immunohistochemistry laboratory.

Evaluation and grading (maximum 100 points) Teaching 10 points, written assay 20 points, test 70 points (min 36). Ratio of points:final grade: 66-70=6, 71-77=7, 78-86=8, 87-93=9, 94-100=10

Knowledge assessment methods Written test, written assay, necropsy, pathohistological diagnosis