SCHOOL OF DENTAL MEDICINE
UNIVERSITY OF BELGRADE

PhD ACADEMIC STUDIES

Study programme
BASIC AND CLINICAL RESEARCH IN DENTISTRY

COURSE BOOK

Belgrade 2020

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Introduction to Methodology and Ethics of Scientific Research	
Course Leader: Božidar B. Brković	
Teacher(s): Božidar B. Brković, Vesna J. Miletić, Miroslav M. Andrić	
Course status: Compulsory	
ECTS: 11	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20MET**
Objectives of the course: The aim of the course is to familiarize PhD students with the basic principles of the scientific methodology and ethics for scientific purposes and the purposes of their PhD dissertation..	
Outcomes of the course: The outcomes of the course refer to the capacity of the PhD students to recognize the importance of a scientific problem and use adequate methodological and ethical principles in order to address it while conducting research and working on their doctoral dissertation.	
Contents of the course: *Theoretical lectures* Science, scientific method, scientific classification; Evaluation of scientific research; Scientific communication; Ethical principles of scientific research; Ethical principles of human research; Good Clinical Practice; Ethical Board; Helsinki Declaration; Planning and carrying out clinical and experimental research; Search and evaluation of scientific literature; Development of scientific research - general principles, scientific problem, hypothesis, objectives; Development of a PhD thesis - general principles and planning; Specificity of PhD thesis development; Writing a PhD thesis; Defense of a PhD thesis and presentation of scientific work; Scientific projects. *Practical sessions – Research activities* Scientific analysis of contribution of scientific evidence, hypotheses and objectives; Presentation of scientific information; Preparing a scientific application; Obtaining the patient's informed consent and providing scientific explanation form; Analysis of Ethical Board activities; Analysis of the terms pertaining to Good Clinical Practice and Lab Practice; Preparation of clinical and experimental protocols; Literature analysis; Practical steps in elaborating a scientific problem, writing hypotheses and objectives; Introduction, materials and methods, *Consort Statement* – practical steps in writing; Discussion, conclusion, summary, literature – practical steps in writing; Preparing a PhD thesis defense; Final PhD thesis analysis.	
Recommended literature: 1. Turabian K. A Manual for Writers of Research Papers, Theses and Dissertations. 7th ed. The University of Chicago Press, 2007. 2. Peat J et al. Scientific Writing: easy when you know how. BMJ Books 2002.	
Number of classes of active teaching: 105	Theoretical lectures: 60 / Practical sessions – Research activities: 45
Teaching and learning methods: small group work, seminars, analysis of research results	

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	40	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	10		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Study Program: Basic and Clinical Research in Dentistry**	

Level of studies: Third	
Course: Medical Statistics	
Course Leader: Biljana R. Miličić	
Teacher(s): Biljana R. Miličić	
Course status: Compulsory	
ECTS: 9	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20STA**

Objectives of the course: Introducing students to the biostatistical methods, tools, techniques, computational skills, and writing rules necessary for statistical thinking, while highlighting its role and limitations in scientific work and practice, including reading practice of statistical aspects of published papers and other literature.

Outcomes of the course:
Students will apply the required biostatistical methods, tools, techniques, computational skills, and writing rules in the critical assessment and independently solve quantitative problems in the field of dental research and practice. The techniques and methods that are an integral part of this the course are the basis for acquiring more advanced and complex methods.

Contents of the course:
Theoretical lectures
This course includes statistical terminology and standard techniques for collecting, grouping, describing, analyzing, and interpreting data, on the one hand, and using the selected statistical software, on the other. It represents an introduction to statistical reasoning, along with an overview of the selected methods of descriptive and inferential statistics and statistical concepts commonly used in dental research and practice. It is oriented towards the application of statistical analyses and interpretation of results rather than the calculations themselves. The use of selected statistical data analysis software is also included.
The orientation of the course is towards the combination of two processes: data generation and statistical analysis, including their interpretation. The main topics are:
• Statistical concepts and terms
• Statistics in the research process
• Exploring data
• Probability and probability distributions
• Sample size and the adequate number of observation units in research
• Statistical decision making in medicine
Practical sessions – Research activities
Practising and gaining experience in the implementation of simple descriptions, evaluation, hypothesis testing, and interpretation; presentation of the results obtained; Acquiring the knowledge of probability and statistics required to prepare for far more specialized knowledge (courses) in this field, including writing and presenting the entire process of analysis with particular reference to the interpretation of the results.

Recommended literature:

1. Schwartz A, Bergus G (2008). Medical Decision Making: A Physician's Guide. Cambridge: Cambridge University Press. Doi:10.1017/CBO9780511722080
2. Katz M (2006) Study Design and Statistical Analysis: A Practical Guide for Clinicians. Cambridge: Cambridge University Press. Doi:10.017/CBO97805511616761
3. Kim JS, Dailey R (2008). Biostatistics for Oral Healthcare. Blackwell Pub Professional, Iowa State University Press, Iowa USA.
4. http://www.psychstat.smsu.edu/sbk00.htm (*Introductory statistics: concepts, models, and applications*, by David W. Stockburger, Revised 2/19/98)
5. http://www.stattsoft.com/textbook/statshome.html (*Electronic Statistics Textbook* - Statsoft)

Number of classes of active teaching: 90	Theoretical lectures: 45	Practical sessions – Research activities: 45

Teaching and learning methods: small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	20
Research paper	30	Practical exam	20
Mid-term test(s)	10	Oral exam	
Seminar(s)	10		

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Principles of Epidemiological Sciences in Dental Public Health	
Course Leader: Svetlana B. Jovanović	
Teacher(s): Svetlana B. Jovanović, Boban Ž. Aničić	
Course status: Elective	
ECTS: 10	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20PEN**
Objectives of the course: To introduce students to epidemiological research in clinical and public health dental practice.	
Outcomes of the course: The students will understand different types of epidemiological research in individual clinical and public health practice; designing an epidemiological study for clinical and population-based research.	
Contents of the course: *Theoretical lectures* Introduction to epidemiology and dental public health, importance for individual clinical dental practice, scientific research and the basics of clinical epidemiology; Measurement of health and disease, health indicators, types and characteristics of indicators, incidence, prevalence, indices, rates; Collection and analysis of data for epidemiological research, data sources; Targeted health research, application of questionnaires; Models of epidemiological research, types of epidemiological studies, prospective and retrospective studies, observational and intervention studies; Methodology of epidemiological studies; Evaluation, evaluation process, evaluation of scientific research, evaluation of community programs; Evidence-based dentistry. *Practical sessions – Research activities* Development of models of epidemic chains of oral diseases and injuries, definition of anti-epidemic measures; Calculation of general and specific indices and rates of morbidity, mortality and complications of general and oral diseases; Development of models of movement of oral diseases using the terms of lifetime and periodic prevalence at a defined time and place; Sample formation for epidemiological, clinical and public health research; Designing a Descriptive Study Model; Development of a cohort study model; Design of anamnestic study model; Design of experimental study models (randomized therapeutic and prevention model and community model); Apply the principles of evidence-based dentistry to the student's planned scientific research; Development of a community intervention model; Evaluation of the integrated / intervention program.	
Recommended literature: 1. Daly B, Batchelor P, Treasure E, Watt R. Essential Dental Public Health. Oxford University Press, 2013. 2. Katz DL, Wild D, Elmore JG, Lucan SC. Jekel's Epidemiology, Biostatistics, Preventive Medicine, and Public Health, 4th Edition. Saunders, Elsevier Inc. Philadelphia, PA. 2013.	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45
Teaching and learning methods: small group work, seminars, analysis of research results		

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Stem Cell Biology and Cell Signalling	
Course Leader: Vesna Z. Danilović	
Teacher(s): Vesna Z. Danilović, Sanja M. Milutinović-Smiljanić, Jelena M. Milašin, Maja P. Miletić, Jelena R. Roganović	
Course status: Elective	
ECTS:10	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20BMS**

Learning objective: The aim of the subject Stem cell biology and cell signalling is to provide a student of doctoral studies with basic knowledge about the origin, characteristics and role of stem cells, as well as with the possibilities of their application in regenerative therapy and their potential role in oncogenesis. The aim is also to address the basics of gene regulatory mechanisms and mechanisms of intercellular communication.

Outcomes of the course:
The student has gained insight into morphological and functional characteristics of stem cells and their role in different physiological and pathological processes. This knowledge allows the student to obtain a thorough understanding of the mechanisms of tissues integrity maintenance, tissue repair and regeneration, and malignant alteration.

Contents of the course:
Theoretical lectures
The origin, phenotype characterisation, and differentiation potency of embryonic, fetal and adult stem cells, as well as of carcinoma stem cells. The basic function of stem cells and their regulatory mechanisms. Possible application of stem cells in regenerative medicine.

Practical sessions – Research activities
Isolation, cultivation and phenotypic characterization of stem cells. Stem cell origin hypotheses. Cytogenetic methods in stem cell research. Transition of epithelial cells into mesenchymal cells. Stem cell plasticity and potential for differentiation. Adult stem cells and normal tissue regeneration. Cancer stem cells. Hypotheses on their role in disease initiation and progression.

Recommended literature:
1. Alberts B, Johanson A, Lewis J, Raff M, Roberts K, Walter P. Molecular biology of the cell,.Garland Science, New York, 2006.
2. McKenzie J, Klein RM. Basic concepts in cell biology and histology, Mcgraw-Hill, New York, 2000.
3. Garant PR. Oral cells and tissues. Quintessence Publishing Co, Inc. 2003.
4. Avery J, Chiego D. Essentials of oral histology and embryology. Elsevier, 2013.

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures		Test	40
Research paper	30	Practical exam	
Mid-term test(s)	15	Oral exam	
Seminar(s)	15		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Biomedical Scientific Informatics	
Course Leader: Đorđe I. Stratimirović	
Teacher(s): Đorđe I. Stratimirović, Biljana R. Miličić	
Course status: Elective	
ECTS: 10	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20BNI**

Objectives of the course:
The goal of this course is to improve PhD students' information literacy skills, providing them with the ability to solve research problems independently and make choices relevant to their study. Introducing students to all aspects of scientific information and helpful research tools, the course aims to support and help the students to ensure successful and timely completion of their PhD degree.

Outcomes of the course:
The student recognizes the need for information and can locate, organize, store and use information effectively to address specific PhD research issues. The student is able to evaluate information and its sources critically, and to understand the economic, legal, social and cultural issues surrounding the use of information, as well as to access and use information ethically and legally.

Contents of the course:
Theoretical lectures
Scientific communications and changes in the structure of scientific communication systems; Biomedical scientific information's publication modalities; Serbian Library Information System and availability of printed and electronic resources; Bibliographic sources of scientific information; Full-text databases (e-books, theses and journals); Bibliometric indicators and evaluation of scientific research; Open Access publishing principles; Search strategies and bibliographic information retrieval; Information organization and ethical and legal information use; Copyright and their protection in the age of the Internet; Using Web 2.0 tools to create and retrieve scientific information
Practical sessions – Research activities
Defining the problem and determining the type and extent of information required; Defining keywords and formulating a search strategy; Selection and search of catalogues, databases and services; Basic, advanced and command search of COBISS/OPAC (Online Public Access Catalogue) and bibliographic sources of scientific information (Web of Science, Scopus, MEDLINE, Serbian Citation Index, Google Scholar, ...); Digital repositories and services (PubMed Central, PloS, DOAJ, DOAR, ROAR, Google Scholar); Analysis and critical evaluation of retrieved information; Using the Clarivate Analytics (Journal Citation Report - Impact Factor), SCOPUS, Google Scholar and SCIndex citation databases; Citation overview production; Other bibliometric indicators (h-index, SNIP – Source Normalized Impact per Paper, ...); Transfer, organization and storage of citations using reference management tools; Creating a bibliography

Recommended literature:
Huvila, Isto. *Information Services and Digital Literacy: In Search of the Boundaries of Knowing*. Oxford: Chandos Publishing; 2012.
Rowley,J E. *Organizing Knowledge: An Introduction to Information Retrieval*. Aldershot, Hants, England: Ashgate; 1992.
Jaćimović J, Petrović R, Živković S. A citation analysis of Serbian Dental Journal using Web of Science, Scopus and Google Scholar. Stomatoloski glasnik Srbije. 2010; 57(4):201-211.

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	
Research paper	30	Practical exam	
Mid-term test(s)		Oral exam	40
Seminar(s)	20		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Biomechanical Principles in Dental Sciences	
Course Leader: Branislav R. Glišić	
Teacher(s): Branislav R. Glišić	
Course status: Elective	
ECTS: 10	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20PBS**
Objectives of the course: The aim of this subject is to introduce the candidates to the effects of orthodontic force on skeletal and dentoalveolar structures, including the possibilities for growth modification.	
Outcomes of the course: The candidate needs to be able to understand biomechanical principles of the effect of forces used in contemporary dentistry, especially during tooth movement.	
Contents of the course: *Theoretical lectures* Theoretical knowledge of biomechanical principles and force delivery to the teeth. Knowledge about the influence of orthodontic forces on teeth and periodontal tissues. Variety of orthodontic forces delivered by different orthodontic appliances. Information about different materials used in orthodontics, properties of stainless steel orthodontic archwires and ligatures, properties of nickel-titanium orthodontic archwires and coil springs, properties of superelastic nickel-titanium orthodontic archwires, and properties of beta-titanium orthodontic archwires. Different types of orthodontic therapy in relation to the patient's age and multidisciplinary approach to the therapy of malocclusions. *Practical sessions – Research activities* The next step will include hands-on course on typodonts with practical approach to orthodontic treatment of malocclusions (class II).	
Recommended literature: Nanda R. Biomechanics and esthetic strategies in clinical orthodontics. St. Louis: Elsevier Saunders; 2005. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 5th ed. St. Louis: Elsevier Mosby; 2013. Graber TM, Neumann B. Removable orthodontic appliances. 2nd ed. Philadelphia: Saunders; 1984. McLaughlin RP, Bennett JC, Trevisi HJ. Systemized orthodontic treatment mechanics. Edinburgh: Mosby; 2001.	

Number of classes of active teaching:	Theoretical lectures:	Practical sessions – Research activities:

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	20
Research paper	50	Practical exam	20
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**			
Level of studies: Third			
Course: Development and Developmental Anomalies of the Orofacial System			
Course Leader: Vesna Z. Danilović			
Teacher(s): Vesna Z. Danilović, Sanja M. Milutinović-Smiljanić			
Course status: Elective			
ECTS:10	**Year and semester of study: I / 1st semester**		
Entry requirements: /	**Course code: D20RAZ**		
Objectives of the course: The objective of the course is to provide students with detailed knowledge related to the normal developmental processes of the orofacial system, the mechanisms of their control, as well as with pathological conditions and developmental anomalies.			
Outcomes of the course: The student demonstrates knowledge of the developmental processes and structures that participate in them, the mechanisms that control them, and the mechanisms of developmental anomalies.			
Contents of the course: *Theoretical lectures* Developmental processes of the orofacial system, development of the stomatodeum, development of the palatum, facial processes. Development of neurocranium and viscerocranium. Muscle and cranial nerve development. Teeth and periodontal development. The development of senses of taste and smell. Developmental anomalies of soft and bone structures. Syndromes. Developmental anomalies of the tooth. *Practical sessions – Research activities* Syndromes: Apert, Krouzon, Ticher - Collins, Dawn, Marphan, Williams.			
Recommended literature: 1. Nancy A.Ten Cate's Oral Histology, Development, Structure, and Function, 9th ed. Mosby, 2017. 2. Avery JK. Oral Development and Histology, 3rd ed. Thieme, 2011.			
Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45	
Teaching and learning methods: small group work, seminars, analysis of research results			
Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	15	Test	40
Research paper	15	Practical exam	/
Mid-term test(s)	30	Oral exam	/
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Radiological Procedures in Dentistry	
Course Leader: Biljana B. Marković Vasiljković	
Teacher(s): Biljana B. Marković Vasiljković	
Course status: Elective	
ECTS: 10	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20RAD**
Objectives of the course: Education and students training in the selection of radiological procedures, analysis and interpretation of the results of radiological diagnostic methods related to the disease of the dentomaxillofacial region and neck.	
Outcomes of the course: Mastering the interpretation of radiological findings in accordance with medical history, laboratory data and disease symptoms. Adoption of an algorithm of different radiological methods in the diagnostics, treatment planning and treatment control of the orofacial region and neck diseases.	
Contents of the course: *Theoretical lectures* Introduction to the principles of radiographic imaging: digital, ultrasound, cone beam and axial computed tomography images, magnetic resonance imaging. Advantages and limitations of individual diagnostic methods. Contraindications and indications based on clinical dental findings. The role of positron emission tomography and scintigraphy in the diagnosis, staging and evaluation of response to splanchnocranial malignancy. *Practical sessions – Research activities* Dentist's role in performing intraoral radiographs, indication and analysis of orthopantomography and of cone beam tomography. Comparison of analog and digital radiographic methods. Different imaging modalities and their possibilities of linear, planar, volume measurements of tissue dimensions and density valid for orthopedic, prosthetic, endodontic and surgical dentomaxillofacial therapy. Establish criteria and search publications for the diagnosis and monitoring of treatment for developmental, acquired, inflammatory, benign and malignant diseases of the orofacial region. Literature results analysis and comparison with national orofacial pathology research.	
Recommended literature: 1. Hubar S.J. Fundamentals of oral and maxillofacial radiology. Wiley Blackwell. 2017. 2. Mallya S.W., Lam E.W.N. White and Paraoh`s oral radiology. Principles and interpretation. 8th edition. Elsevier 2019.	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Publishing in Biomedical Sciences	
Course Leader: Miroslav M. Andrić	
Teacher(s): Miroslav M. Andrić, Božidar M. Brković, Vesna J. Miletić	
Course status: Compulsory	
ECTS: 9	**Year and semester of study: I / 1st semester**
Entry requirements: /	**Course code: D20PUB**

Objectives of the course:
To present basic principles of publishing scientific results in biomedicine, with an emphasis on the intellectual and ethical principles of publishing and to provide students with the essential knowledge and skills needed for writing and the presentation of scientific publications.

Outcomes of the course:
After completing the course, the students have knowledge about the entire process of scientific publishing, recognize the requirements for a high quality scientific paper and have basic skills needed for writing scientific publications. Students are also informed about the process of peer review and have the ability to prepare and present oral presentations in scientific meetings.

Contents of the course:

Theoretical lectures

Reasons for scientific publishing, types of scientific publications, original scientific article (IMRAD formula), review articles – systematic review and meta-analysis, uniform requirements for biomedical journals, publication process, selection of scientific journal, scientometrics, authorship and copyright, open access journals, ethics of publishing

Practical sessions – Research activities

Public registers of clinical trials, Consort statement, reference managers, searching the literature, writing original scientific articles, peer review of scientific articles, manuscript submission and publishing process, oral presentation, poster presentation

Recommended literature:
John Dixon, Louise Alder, Jane Fraser. How to Publish in Biomedicine: 500 Tips for Success. 3rd edition, Boca Raton: CRC Press, 2017; 240 strana

Number of classes of active teaching: 90	Theoretical lectures: 45	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Laboratory Procedures and Functional Testing of the Orofacial Region	
Course Leader: Elena S. Kršljak	
Teacher(s): Elena S. Kršljak, Vesna Z. Danilović, Ivan S. Dožić, Maja P. Miletić, Branka M. Popović, Sanja M. Milutinović Smiljanić, Tatjana M. Todorović, Dušan B. Pavlica, Jelena R. Roganović, Vesna J. Miletić, Jelena M. Milašin, Dragana Ž. Puzović	
Course status: Compulsory	
ECTS: 11	**Year and semester of study: I/ 1st and 2nd semesters**
Entry requirements: /	**Course code: D20LAB**
Objectives of the course: To introduce the candidates to key laboratory methods that should allow them to adequately choose the method / methods for their future scientific work in the corresponding field of dentistry	
Outcomes of the course: The candidates should be theoretically and practically equipped with modern laboratory methods in scientific research in order to choose and apply adequate methods for their doctoral research	
Contents of the course: *Theoretical lectures* Saliva and gingival crevicular fluid as biological samples used for the monitoring of diseases affecting orofacial tissues. The role of cytokines and growth factors in etiopathogenesis of oral tissue diseases. Visualization and quantification methods for bacterial and viral detection in the oral cavity. Testing the blood flow and blood vessels reactivity in the orofacial region. Preparation of biological material for light and electron microscopy. Histomorphometry. Histoenzymatic and immunocytochemistry methods. Nucleic acids and proteins isolation from different biological samples. Mutation analysis of DNA. Gene expression analysis at mRNA and protein levels. Analysis of DNA obtained from hard dental tissues and its forensic application. Functional analysis of stem cells. Examples of new technologies which allow the application of innovative scientific research methods. *Practical sessions – Research activities* Analysis of: electrolyte levels in blood and saliva by flame photometry; blood cells by hematology analyzer; blood coagulation factors by coagulometer. Testing the reactivity of blood vessels in the oral cavity - *in vivo* and *in vitro* methods. Blood flow measurements in oral tissues by laser Doppler flowmetry, analysis of the results obtained. Tissue preparation for light and electron microscopy. Immunohistochemistry – methods, techniques and staining. Bacterial and viral detection methods. DNA and RNA isolation from fresh and fixated tissues. Gene polymerization by polymerase chain reaction (PCR) and different methods for mutation detection (SSCP, RFLP, dPCR). Quantitative PCR in gene alterations analysis. Protein isolation from different tissues and quantification (ELISA and Western blot). Cytotoxicity tests in cell cultures (MTT, Neutral Red, LDH assay), cell differentiation and proliferation tests.	
Recommended literature: 1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. Molecular biology of the cell, 5h ed. Garland Science, New York, NY, 2008. 2. Gartner LP. Cell biology and histology. 8th ed., Lippincott Williams & Wilkins, Baltimore, Maryland, 2018. 3. Boyer R. Concepts in biochemistry. 3rd ed. John Wiley (Wiley Asia Student Edition), Asia, 2006. 4. Avery JK, Chiego DJ. Essentials of Oral Histology and Embryology: A Clinical Approach 4th ed., Mosby, St. Louis, Missouri, 2013. 5.Khalil AR. Regulation of Vascular Smooth Muscle Function. Morgan & Claypool Life Sciences, San Rafael (CA), 2010. 6. Review articles	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods: Small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	40	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	10		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Assessment of Changes in the Quality of the Osseus Fundament from the Aspect of Prosthetic Treatment Planning	
Course Leader: Srdjan D. Poštić	
Teacher(s): Srđan D. Poštić, Biljana B. Marković, Elena S. Kršljak	
Course status: Elective	
ECTS: 10	**Year and semester of study: I/ 1st and 2nd semesters**
Entry requirements: /	**Course code: D20FUN**
Objectives of the course: To inform the students about up-to date methods of assessment of quality of bone and hard supporting tissues in the mouth of a patient prior to therapy and during prosthetic therapeutic treatments.	
Outcomes of the course: The students demonstrate knowledge of the methodology applied when investigating the role of radiographic, laboratory and macroscopic-clinical parameters in the genesis of positive or negative bone remodeling, including their relation to the loading of osseous foundation and prosthetic treatment planning.	
Contents of the course: *Theoretical lectures* Oral bone physiology; Quality of bone; Quality of bone and interrelations to remaining teeth; Changes on oral bone tissue after tooth loss; Positive bone remodeling; Negative bone remodeling; Radiologic methods in the assessment of the condition of bone tissue and quality of bone substances; Assessment of bone density; Quality of oral bone substance of edentulous ridges in partially edentulous mouths; Quality of bone of edentulous alveolar ridge in edentulous mouths; Osteopenic bone changes; Osteoporosis; Prospective studies on the therapy of supporting bone tissues damaged due to negative remodeling, bone density decrease, and edentulous ridge reductions. *Practical sessions – Research activity* An analyses of probable therapeutic directions of a prosthetic treatment; Definitions of risk factors, general and local factors causing bone degradations in partially edentulous mouth and complete edentulous mouth; Application of diagnostic procedures in the assessment of the quality of bone of edentulous ridge; Early diagnostic methods of oral bone changes; Differential diagnostic comparisons of malignant and non-malignant changes of oral bones in edentulous mouths.	
Recommended literature: 1. J.V.Soames, J.C.Southam – Oral pathology, Oxford Medical University . 2. Scientific articles from MEDLINE database. 3. G.A. Zarb, J. Hobkirk, S. Eckert, R. Jacob . Prosthodontic Treatment for Edentulous Patients: Complete Dentures and Implant-Supported Prostheses 13th Edition ISBN-13: 978-0323078443 4. ISBN-10: 0323078443 5. JD Jones, Garcia LT. Removable Partial Dentures: A Clinician's Guide (Paperback)ISBN 10: 0813817064 / ISBN 13: 9780813817064 Published by Iowa State University Press, United States, 2009	
Number of classes of active teaching: **105**	Theoretical lectures: **60** / Practical sessions – Research activities: **45**
Teaching and learning methods: small group work, seminars, analysis of research results	

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

T**able 5.1** Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**			
Level of studies: Third			
Course: Principles of Photography of the Orofacial Region in Scientific Research			
Course Leader: Branislav R. Glišić			
Teacher(s): Branislav R. Glišić			
Course status: Elective			
ECTS: 10	**Year and semester of study: I/1st and 2nd semesters**		
Entry requirements: /	**Course code: D20FOT**		
Objectives of the course: To enable PhD students to independently take photographs of their patients, dental procedures and dental work.			
Outcomes of the course: The PhD student is trained in documenting research results using a variety of photography techniques.			
Contents of the course: *Theoretical lectures* Basic principles of photography, aperture, exposure, depth of field. Photography techniques with digital cameras; digital photo formats. Improving image quality, various configurations of photographic cameras suitable for dental photography. Photographing faces, photographing small objects used in dentistry. Photographing casts. Specificity of photography in various fields of dentistry. *Practical sessions – Research activities* During the practical part of the course, PhD students will become acquainted with the basic principles of making dental extraoral and intraoral photographs with a digital camera, including the ways to improve the quality of images, the specifics of photographing in different dental disciplines and preparing a presentation.			
Recommended literature: Bengel, Wolfgang. Mastering digital dental photography. Quintessence Publishing Co, Ltd, 2006.			
Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45	
Teaching and learning methods: small group work, seminars, analysis of research results			
Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	
Research paper		Practical exam	40
Mid-term test(s)		Oral exam	
Seminar(s)	50		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Research of Biomaterials for Application in Dentistry	
Course Leader: Kosovka B. Obradović Đuričić	
Teacher(s): Kosovka B. Obradović Đuričić, Medić B. Vesna, Lazić M. Vojkan, Radović V. Katarina	
Course status: Elective	
ECTS: 10	**Year and semester of study: I/ 1st and 2nd semesters**
Entry requirements: /	**Course code: D20BMA**
Objectives of the course: To inform students about the characteristics of biomaterials, basic legal and regulatory requirements and standards, and contemporary testing methods of biomaterials	
Outcomes of the course: PhD students are qualified to interpret the results of scientific studies within the scope of biomaterials research, and to organize independent in vitro and in vivo studies.	
Contents of the course: *Theoretical lectures* The main topics covered in the lectures are connected to the ability to determine the toxicity and biocompatibility of biomaterials in dentistry. Additionally, very important parameters include certification, quality assessment and safety of dental materials. The optimization of existing materials, smart materials and tissue engineering will also be discussed in the lectures.. The special emphasis is placed on the current dental materials (zirconia, memory shape alloys) and their usable characteristics, as well as the finite element analysis in testing dental materials. *Practical sessions – Research activity* Getting acquainted with the physical characteristics of materials (ceramics, polymers, dental alloys and composite materials) through practical examples of. High technology in manufacturing and processing dental restorations. Chemical and technological characteristics of dental materials, procedures for thin layer structure modifying, thin films and coatings.	
Recommended literature: 1. O Brien WJ: Dental materials and Their Selection, Quintessence Int, Chicago, 2008. 2. Eliades C, Eliades T, Brantley WA, Watts DC.: Dental Materials in vivo, Aging and related phenomena, Quintessence Inc, Chicago, 2003.	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Research of Reconstructive Methods and Materials	
Course Leader: Saša M. Janković	
Teacher(s): Saša M. Janković, Zoran M. Aleksić, Nataša S. Nikolić Jakoba, Iva Z. Milinković, Vojislav M. Leković	
Course status: Elective	
ECTS: 10	**Year and semester of study: I/ 1st and 2nd semesters**
Entry requirements: /	**Course code: DS20IRM**
Objectives of the course: Upgrading the theoretical knowledge of the principles of hard and soft oral tissue reconstruction in contemporary oral implantology.	
Outcomes of the course: Mastering contemporary aspects of regeneration of alveolar bone defects and osseointegration of dental implants; mastering the methodology of testing dental materials' biocompatibility and modern methods and techniques for oral implantation.	
Contents of the course: *Theoretical lectures* Overview of surgical procedures for augmentation of the attached gingiva and keratinized gingiva; application of different grafts to achieve desired anatomical conditions for implantation; different designs of dental implants - principles of application; osseointegration principles, and the possibility of using bone substitutes and bone reaction, cytotoxicity assay. *Practical sessions – Research activities* Prospective research on defect reconstruction; plastic surgery as part of "gingival recession type" defect reconstruction; augmentation and reconstructive procedures in solving insufficient interdental papillae problem; prospective studies of implantation of bone substitutes; prospective studies in implantology; possibilities of implantation of narrow diameter implants; tests of biocompatibility of dental materials; influence of surgical techniques on the success of implantation procedure; implant loading; application of condensation method for bone deficiency; CAD / CAM technology; application of spectrophotometry in dentistry.	
Recommended literature: 1. Garg AK. Bone Biology, Harvesting, and Grafting For Dental Implants: Rationale and Clinical Applications. Quintessence Publishing Co, 2003. 2. Lambrecht TJ. 3D Modeling Technology in Oral and Maxillofacial Surgery. Quintessence Publishing Co, 2000. 3. O'Brien J. Dental Materials and Their Selection. Quintessence Publishing Co, 2003.	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45
Teaching and learning methods: small group work, seminars, analysis of research results		

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper		Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	50		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**			
Level of studies: Third			
Course: Growth, Differentiation and Regeneration of Oral Tissues			
Course Leader: Zoran M. Aleksić			
Teacher(s): Zoran M. Aleksić, Saša M. Janković, Nataša S. Nikolić Jakoba, Iva Z. Milinković, Vojislav M. Leković			
Course status: Elective			
ECTS: 10	**Year and semester of study: I/ 1st and 2nd semesters**		
Entry requirements: /	**Course code: DS20RDR**		
Objectives of the course: Upgrading the knowledge regarding the process of growth, development and regenerative potential of hard and soft dental tissues as a prerequisite for further fundamental and applicative / clinical research			
Outcomes of the course: Understanding the process of growth, development and regenerative potential of hard and soft dental tissues as well as the method of their analysis; gaining knowledge of the hard and soft oral tissue management by applying tissue engineering concepts and nanotechnologies, as well as the biological basis of osseointegration.			
Contents of the course: *Theoretical lectures* Study of genes essential for dental tissue mineralization; tooth embryology; functions of proteins of extracellular matrix; physiological and pathological bone remodeling; possibilities of gene therapy; concept of biomimetics in the treatment of periodontitis. *Practical sessions – Research activities* Response of the pulp-dentin complex to external stimuli; pulp and periodontium repair processes; principles of guided tissue regeneration and tissue engineering; application of bone tissue regeneration principles in experimental animals, application of soft tissue regeneration principles in experimental animals; specific features of clinical research in implantology; minimally invasive techniques in periodontal surgery; treatment plan in implantology; augmentation procedures in implantology (hard and soft tissues); application of growth factors in implantology.			
Recommended literature: 1. Bartold M, Sampat A. Biology of the Periodontal Connective Tissues. Quintessence Publishing Co, 2003. 2. Brunette D. Critical Thinking: Understanding and Evaluating Dental Research. Quintessence Publishing Co, 2006. 3. Lindhe J (Ed). Clinical Periodontology and Implant Dentistry. Blackwell Publishing Co, 2003. 4. Garant P. Oral Cells and Tissues. Quintessence Publishing Co, 2003.			
Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45	
Teaching and learning methods: small group work, seminars, analysis of research results			
Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper		Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	50		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Physiological States and Systemic Diseases – the Impact on the Orofacial Region	
Course Leader: Saša S. Čakić	
Teacher(s): Saša S. Čakić, Ana Lj. Pucar, Miloš D. Hadži Mihailović, Dragan M. Stanimirović	
Course status: Elective	
ECTS: 10	**Year and semester of study: I/ 1st and 2nd semesters**
Entry requirements: /	**Course code: D20FSB**
Objectives of the course: To acquaint the students with the mechanisms of the emergence of certain physiological and pathological conditions and the possible mechanisms of their association with oral medical pathology at all levels - from clinical to molecular	
Outcomes of the course: The students are familiar with all the potential mechanisms of the emergence of physiological and pathological systemic conditions and their connection with the diverse issues involved in oral medicine, as well as with the indications and methodology of molecular and cellular diagnostics	
Contents of the course: *Theoretical lectures* Mechanisms of the host response to the effect of various etiological factors; Immunology of oral diseases; Periodontal medicine; Potential medical problems related to dental therapy; Biological and physiological aspects of aging; Immunological aspects of aging; Aging and oral tissues (bone tissue, teeth, periodontium); Aging and oral tissues (oral mucosa, salivary glands); Psychological and social aspects of aging; Medical aspects of aging (nutrition, most common systemic diseases, pharmacotherapy); Molecular mechanisms of action of drugs; Psychiatric disorders as a risk factor for BMS; BMS evaluation and therapy; The specificities of the therapeutic approach to orofacial lesions at different ages *Practical sessions – Research activities* Identification of the effects of systemic diseases on oral tissues; Prospective analysis of the effects of systemic diseases on oral mucosa; Importance of clinical signs and symptoms in the diagnosis of orofacial disease Regions; Nutrition as a mediator between oral and systemic diseases; Molecular and biological aspects of acquired bullous diseases; Application of analysis of qualitative and quantitative composition of saliva in diagnostics of oral diseases; Immunological mechanisms of salivary pathogenesis of Sjögren's syndrome; Immune events in periodontium - etiopathogenesis of periodontal disease; Cytokine expression during mucositis; Changes in the oral cavity of patients with malignant diseases; Retrospective and prospective analysis of oral mucositis symptoms; Research and monitoring of medical problems in dentistry; Prevention of medical complications; Identification of oral complications; Development of a modified dental plan of therapy; Oral infections in immunocompromised patients; Clinical evaluation of the pathology, prevention and therapy of oral diseases of the elderly; Drug-induced oral ulceration; Evaluation of drug efficacy in the treatment of recurrent oral ulceration; Specific features of the identification of oral problems in persons with malignant diseases	
Recommended literature: 1. Oral Medicine And Pathology At A Glance by Crispian Scully, Oslei Paes de Almeida, Jose Bagan, Pedro Diz Dios, Adalberto Mosqueda Taylor 2010. 2. Common Medical Conditions: A Guide for the Dental Team by Crispian Scully 2010 3. Scully C, Cawson RA. Medical Problems in Dentistry. Elsevier Churchill Livingstone,2000).	

Number of classes of active teaching: 105	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Procedures for Operating with Experimental Animals	
Course Leader: Elena S. Kršljak	
Teacher(s): Elena S. Kršljak, Maja P. Miletić, Branka M. Popović, Božidar M. Brković	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/ 3rd semester**
Entry requirements: /	**Course code: D20EKS**

Objectives of the course:
To introduce the candidates to legal standards, general ethical principles and procedures applied in scientific research which involves experimental work with animals

Outcomes of the course:
The candidates should be familiar with the basic principles of experimental work with animals for the purpose of scientific research, including the ethical standards and legal aspects applied

Contents of the course:
Theoretical lectures
Legal standards and ethical considerations in scientific research conducted on animals; Good Laboratory Practice and general principles of working with experimental animals, Selected *in vivo* models - breeding, types, maintenance, animal health and possible effects on the experiment; Pain, suffering and stress levels in laboratory animals; Cell cultures preparation using experimental animals; Efficacy of experimental animal models in dental research; Drug application in experimental animal models; Genetically modified organisms, Laws on animal welfare, Ethical Committee of the Republic of Serbia; License for conducting scientific research on experimental animal models

Practical sessions – Research activities
Basic conditions for the accommodation and maintenance of animals; Transportation and grouping of animals, keeping the records; Handling animals during an experiment; Anesthetizing animals; Experimental procedures and surgical techniques; Protocols for animals sacrifice and euthanasia; Examples of using experimental animal models in biomedical research; Experimental work on genetically modified organisms, drug application; Obtaining the license for experimental work on animals, preparing an application for seeking the Ethical Committee approval for conducting experimental work on animals

Recommended literature:
1. National Research Council. Guide for the Care and Use of Laboratory Animals, 8th ed., National Academy of Sciences, USA, 2011.
2. Ward JD. A Manual for Laboratory Animal Management. World Scientific Publishing Co. Pte. Ltd., Singapore, 2008.
3. Bayne K, Turner PV. Laboratory Animal Welfare. Elsevier Inc., USA, 2014.
4. Hau J, Van Hoosier GL, Jr. Handbook Of Laboratory Animal Science, Vol I &II, CRC Press, Boca Raton, Florida, 2003.
5. Chow P, Ng R, Ogden B. Using animal models in biomedical research. World Scientific Publishing Co. Pte. Ltd., Singapore, 2007.
6. Review articles

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 45

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	40	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	10		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies: **Study Program: Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Advanced Medical Statistics	
Course Leader: Biljana R. Miličić	
Teacher(s): Biljana R. Miličić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/ 3rd semester**
Entry requirements: /	**Course code: D20NMS**
Objectives of the course: Introducing students to more sophisticated methods (statistical modeling) in the field of biostatistics which serve as a tool for generating knowledge from a large set of information.	
Outcomes of the course: Acquiring the knowledge needed to define an adequate statistical model which describes the impact of multiple observed factors on the variability of the selected outcome. Application and development of multifactorial statistical analyses and regression models, interpretation of the results obtained, definition of the prediction model for a given outcome, and its application in clinical decision making.	
Contents of the course: *Theoretical lectures* Multivariate analysis of variance; Multivariate analysis of variance with repeated measurements; Kaplan Maier survival curve and Log Rank test used to compare them. Selection of regression models (prediction models) according to the selected outcome describing based on observed independent and associated factors: Logistic regression analysis, multiple linear regression analysis, Cox regression analysis. Method of performing statistical model and interpretation of the obtained results. Advantages and limitations of their application in clinical decision making. Meta-analysis and systematic review - from a problem definition to the interpretation and implementation of the results. *Practical sessions – study research activities* Gaining practical experience in performing complex statistical analyses, selecting factors to model the chosen outcome, selecting an appropriate statistical model, and applying certain software to produce it; Design and presentation of the whole process of analysis with a special emphasis placed on the interpretation of results. Implementation of the results obtained.	
Recommended literature: 1. Kim JS, Dailey R (2008). Biostatistics for Oral Healthcare. Blackwell Pub Professional, Iowa State University Press, Iowa USA. 2. http://www.psychstat.smsu.edu/sbk00.htm (*Introductory statistics: concepts, models, and applications*, by David W. Stockburger, Revised 2/19/98) 3. http://www.stattsoft.com/textbook/statshome.html (*Electronic Statistics Textbook* - Statsoft)	
Number of classes of active teaching:	Theoretical lectures: / Practical sessions – Research activities:
Teaching and learning methods: small group work, seminars, analysis of research results	

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	10
Research paper	40	Practical exam	30
Mid-term test(s)		Oral exam	
Seminar(s)	10		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Transduction Signalling Molecules in Oral Tissues in Physiological and Diseased Conditions	
Course Leader: Jelena R. Roganović	
Teacher(s): Jelena R. Roganović, Božidar M. Brković	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/ 3rd semester**
Entry requirements: /	**Course code: D20TSM**

Objectives of the course:
To introduce the doctoral students with current considerations of regulatory roles of transduction signaling molecules involved in the maintenance of homeostasis of the oral tissues as well as with the methodologies employed in their investigation.

Outcomes of the course:
To enable doctoral students to critically review the regulatory role of transduction signaling mechanisms in the oral tissues, to recognize the scientific problem in this research area and to design scientific research guided by the idea of the applicability of the results.

Contents of the course:
Theoretical lectures
Epigenetic mechanisms of regulation in oral tissues: importance of histone acetyltransferase and non-coding RNA molecules; epigenetic mechanisms in the regulation of oral tissue function in diabetes mellitus (DM) and malignancy; growth factors in the oral tissues and their involvement in DM and malignancy; factors of oxidative-nitrosative stress and their involvement in DM and malignancy; diagnostic and therapeutic potential of transduction signaling molecules.

Practical sessions – Research activities
Methods employed for transduction signaling molecules investigation; oral tissue sampling methods for the analysis of transduction signaling molecules; alterations of transduction signaling mechanisms in oral tissues in DM; alterations of transduction signaling mechanisms in oral tissues in oral cancer; critical review of current articles dealing with regulatory mechanisms in oral tissues in DM and oral cancer.

Recommended literature:

1. Stojić D, Roganović J, Brković B. Functionality of Orofacial Branches Feeding: salivary glands, dental pulp and intraoral anesthetic field. In: *Advances in Medicine and Biology*, vol. 29.New York: Nova publishers, 2012; 59-96.
2. Mauri-Obradors E, Estrugo-Devesa A, Jané-Salas E, Viñas M, López-López J. Oral manifestations of Diabetes Mellitus. A systematic review. *Med Oral Patol Oral Cir Bucal*. 2017;22(5):e586–e594.
3. Hema KN, Smitha T, Sheethal HS, Mirnalini SA. Epigenetics in oral squamous cell carcinoma. *J Oral Maxillofac Pathol*. 2017;21(2):252–259.
4. Baćević M, Brković B,**...** Roganović J. Leukocyte- and platelet-rich fibrin as graft material improves microRNA-21 expression and decreases oxidative stress in the calvarial defects of diabetic rabbits. *Arch Oral Biol.* 2019;102:231-237.
5. Radović N, Nikolić Jakoba N, Petrović N, Milosavljević A, Brković B, Roganović J. MicroRNA-146a and microRNA-155 as novel crevicular fluid biomarkers for periodontitis in nondiabetic and type 2 diabetic patients. *J Clin Periodontol* 2018; 45(6):663-671

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Epidemiological Studies of Orofacial Diseases	
Course Leader: Aleksa B. Marković	
Teacher(s): Aleksa B. Marković, Snježana B. Čolić, Radojica V. Dražić, Bojan M. Gačić, Miroslav M. Andrić, Biljana B. Marković Vasiljković, Bojan D. Janjić	
Course status: elected	
ECTS: 13	**Year and semester of study: II/3rd semester**
Entry requirements: /	**Course code: D20EIR**

Objectives of the course:
To introduce students to the basics of epidemiological studies of diseases of the orofacial region, including the latest diagnostic and therapeutic procedures.

Outcomes of the course:
After completing the theoretical study and research, the students will be able to successfully establish a diagnosis and provide appropriate treatment by means of modern diagnostic and therapeutic techniques.

Contents of the course:
Theoretical lectures
Possibilities for prevention of maxillary sinus injuries; Diagnosis of diseases and injuries of the maxillary sinus; Application of endoscopy in the diagnosis and treatment of injuries and diseases of the maxillary sinus; Specificities of immune responses in the presence of jaw cysts; Studies on the pathogenesis of chronic periapical lesions (HPL); Sinus lift - material testing for sinus lift; Sinus lift - specificities of surgical procedures; X-ray examination of the orofacial region; Specificities of therapeutic procedures for the treatment of jaw cysts; Histopathological studies of jaw cysts; Application of new therapeutic procedures in the treatment of jaw cysts and HPL.

Practical sessions – Research activities
Collection and analysis of scientific documentation; Implementation of new diagnostic procedures in the orofacial region; Implementation of new therapeutic protocols in the orofacial region; Implementation of histological analyses into therapeutic protocols; Application of new X-ray methods in the orofacial region.

Recommended literature:
1. Zoller E, Neugebauer J: Cone-beam Volumetric Imaging in Dental, Oral and Maxillofacial Medicine, Quintessence Publishing C. Ltd, 2008
2. Jensen, Ole T.: The Sinus Bone Graft, Third Edition 2019.
3. Katsuyama H., Jensen SS.: Sinus floor elevation procedures, Quintessence Publishing C. Ltd, 2011
4. Hupp E., Tucker M., Ellis E.: Contemporary Oral and Maxillofacial Surgery, 7 th Edition, Mosby 2018

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activity: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research activities	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Orofacial Pain Control	
Course Leader: Božidar M. Brković	
Teacher(s): Božidar M. Brković, Jelena R. Roganović	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3rd semester**
Entry requirements: /	**Course code: D20KBO**

Objectives of the course: The aim of the course is to familiarize PhD students with the physiological and pathophysiological pain mechanisms related to the scientific approaches in the field of pharmacological and clinical therapeutic principles in the orofacial pain control.

Outcomes of the course: Strengthening the capacities of the PhD students in terms of recognizing the importance of a scientific problem related to orofacial pain control and using current methodological principles to address it while working on their PhD dissertations.

Contents of the course:

Theoretical lectures

Pathophysiological mechanisms of orofacial pain; Classification and clinical aspects of acute and chronic orofacial pain; Current local anesthetics and vasoconstrictors-new approaches in clinical and pharmacological analysis and its scientific level; Current analgesics and pre-emptive analgesia; Principles and combined therapy in dental sedation; Current methodology-controlled local anesthetic delivery and new anesthetic techniques.

Practical sessions – Research activities

Clinical and experimental models for orofacial pain investigations; Protocols for clinical and experimental pain control investigations; Analysis of clinical and laboratory parameters related to orofacial pain control; Analysis of current methodology, local anesthetics and drugs in pain control investigations; Specificities of statistical analysis of the studied parameters and literature analysis.

Recommended literature:

1. Malamed SF. Handbook of Local Anesthesia, Elsevier Mosby 2004.
2. Malamed SF. Sedation: Guide to Patient Management, Mosby 2003.

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	40
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Molecular Mechanisms in Inflammatory Oral Diseases	
Course Leader: Maja P. Miletić	
Teacher(s): Maja P. Miletić, Miroslav M. Andrić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3. semester**
Entry requirements: /	**Course code: D20MMZ**
Objectives of the course: To inform students about the contemporary knowledge of the molecular mechanisms underlying various inflammatory diseases in the oral cavity.	
Outcomes of the course: Gaining contemporary knowledge of the molecular pathogenesis of inflammatory and reactive diseases of the pulp, periapical region and periodontium; gaining a basic understanding of the role and importance of specific biologically active molecules, oxidative stress, and protective and destructive regulatory pathways.	
Contents of the course: *Theoretical lectures* Immune and autoimmune mechanisms in inflammatory diseases of the pulp and supporting tissues of the tooth; Biologically active molecules and their role in the inflammation of the pulp and tooth supporting tissues (inflammatory mediators, cytokines, chemokines, receptors, transduction signaling pathways, mechanism of action); Epigenetic mechanisms in inflammatory diseases of the oral cavity; Role of oxidative stress in the initiation and progression of an inflammatory process and tissue destruction; Importance of matrix metalloproteinases in pulp and periapical tissue disorders; Inflammation and tissue destruction (regulators of bone resorption, association with specific biologically active molecules important for inflammation, activation mechanisms, transduction signaling pathways). *Practical sessions – Research activities* Role of mast cells in inflammatory diseases of the pulp, periapical region and periodontium; Cytokines important for the regulation of inflammation, immune defense and tissue destruction in the oral region; Inflammatory profile of periapical lesions; Role and sources of reactive oxygen species in the pathogenesis of diseases affecting tooth supporting tissues; Matrix metalloproteinases in the pathogenesis of periodontitis and peri-implantitis; Specific transduction signaling pathways important for the resorption of the supporting tissues of the tooth; Inflammation, mesenchymal stem cells and bone regeneration.	
Recommended literature: 1. Braz-Silva PH, Bergamini ML, Mardegan AP, De Rosa CS, Hasseus B, Jonasson P. Inflammatory profile of chronic apical periodontitis: a literature review. Acta Odontol Scand. 2019 Apr;77(3):173-180. doi: 10.1080/00016357.2018.1521005. 2. Hernández-Ríos P, Pussinen PJ, Vernal R, Hernández M. Oxidative Stress in the Local and Systemic Events of Apical Periodontitis. Front Physiol. 2017 Nov 1;8:869. doi: 10.3389/fphys.2017.00869. 3. Jain A, Bahuguna R. Role of matrix metalloproteinases in dental caries, pulp and periapical inflammation: An overview. J Oral Biol Craniofac Res. 2015 Sep-Dec;5(3):212-8. doi: 10.1016/j.jobcr.2015.06.015. 4. Belibasakis GN, Rechenberg DK, Zehnder M. The receptor activator of NF-κB ligand-osteoprotegerin system in pulpal and periapical disease. Int Endod J. 2013 Feb;46(2):99-111. doi: 10.1111/j.1365-2591.2012.02105.x. 5. Liu H, Li D, Zhang Y, Li M. Inflammation, mesenchymal stem cells and bone regeneration. Histochem Cell Biol. 2018 Apr;149(4):393-404. doi: 10.1007/s00418-018-1643-3.	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Materials, Therapeutics and Medical Devices in Restorative and Pediatric Dentistry and Endodontics	
Course Leader: Vesna J. Miletić	
Teacher(s): Jugoslav M. Ilić, Violeta S. Petrović, Tatjana V. Savić-Stanković, Jelena R. Roganović, Ivana S. Radović, Tamara O. Perić, Zoran T. Mandinić, Vesna J. Miletić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3. semester**
Entry requirements: /	**Course code: D20RDE**

Objectives of the course:
To inform students about the contemporary knowledge of materials, dental therapeutics and devices used in prevention, diagnostics and treatment of diseases in restorative and pediatric dentistry and endodontics

Outcomes of the course:
Acquiring knowledge of the properties, local and systemic interaction of materials, dental therapeutics and devices and human tissues; acquiring knowledge and skills in methodology and critical analysis of scientific evaluation of materials, dental therapeutics and devices in restorative and pediatric dentistry and endodontics.

Contents of the course:
Theoretical lectures
Composites, adhesives, glass-ionomer, calcium-silicate cements, devices for tooth bleaching and remineralization of hard tooth tissues, adhesion to tooth substrate, experimental bioactive materials, growth factors in endodontic therapy, anesthetics and analgesics in pain control in endodontics, dental therapeutics with antimicrobial properties in endodontic therapy, endodontic sealers, caries-inducing drugs, pulpal stem cells and bioactive molecules with odontogenic potential in regenerative therapy, local and systemic toxicity of materials, dental therapeutics and devices in dentistry, nanotoxicology in dentistry, potential application and protective mechanisms of bioactive molecules in reduction of cyto- and genotoxicity of dental materials, methods for testing physical, chemical and biological properties of materials, dental therapeutics and devices, clinical trials of materials, dental therapeutics and devices in restorative and pediatric dentistry and endodontics.
Practical sessions – Research activities
Scientific literature search and critical appraisal, training in lab methodology and techniques for testing the properties of materials, dental therapeutics and devices, training in the methodology of clinical trials, conducting pilot experiments, writing and presenting seminar reports.

Recommended literature:

1. Miletic V. Dental Composite Materials for Direct Restorations, Springer 2018. (стр. 1-319),
2. Sidhu SK, Nicholson JW. A Review of Glass-Ionomer Cements for Clinical Dentistry. J Func Biomater 2016;7:E16, 10.3390/jfb7030016. (стр. 1-15), 3. Camilleri J. Mineral trioxide aggregate in Dentistry. Springer 2014. Стр. 1-214.,
4. Hargreaves HM, Cohen S. Cohen' s pathways of the pulp. Mosby Elsevier, St. Louis, 2016.,
5. De Campaigno EAP, Kebir I, Montastruc JL, et al. Drug-Induced Dental Caries: A Disproportionality Analysis Using Data from VigiBase [published correction appears in Drug Saf. 2018 May 8;:]. *Drug Saf*. 2017;40(12):1249–1258. doi:10.1007/s40264-017-0575-5,
6. Huang CC, Narayanan R, Warshawsky N, Ravindran S. Dual ECM Biomimetic Scaffolds for Dental Pulp Regenerative Applications. *Front Physiol*. 2018;9:495. Published 2018 May 25. doi:10.3389/fphys.2018.00495,
7. Botelho J, Cavacas MA, Machado V, Mendes JJ. Dental stem cells: recent progresses in tissue engineering and regenerative medicine. *Ann Med*. 2017;49(8):644–651. doi:10.1080/07853890.2017.1347705
8. Zhang M, Jin J, Chang YN, Chang X, Xing G. Toxicological properties of nanomaterials. *J Nanosci Nanotechnol*. 2014;14(1):717–729. doi:10.1166/jnn.2014.9198
9. Hickel R, Roulet JF, Bayne S, Heintze SD, Mjör IA, Peters M, Rousson V, Randall R, Schmalz G, Tyas M, Vanherle G. Recommendations for conducting controlled clinical studies of dental restorative materials. Science Committee Project 2/98--FDI World Dental Federation study design (Part I) and criteria for evaluation (Part II) of direct and indirect restorations including onlays and partial crowns. J Adhes Dent. 2007;9 Suppl 1:121-47.
10. González-Cabezas C, Fernández CE. Recent Advances in **Remineralization** Therapies for Caries Lesions. Adv Dent Res. 2018 Feb;29(1):55-59.

Number of classes of active teaching: 120	Theoretical lectures:60	Practical sessions – Research activities:60

Teaching and learning methods: small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	40	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	10		

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Prospective and Retrospective Investigations in the Rehabilitation of the Orofacial Region	
Course Leader: Ljiljana Đ. Tihaček Šojić	
Teacher(s): Ljiljana Đ. Tihaček Šojić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/ 3rd semester**
Entry requirements: /	**Course code: D20PRI**
Objectives of the course: To train PhD students to acquire a basic level of scientific preconditions and apply the in scientific research. Also, to train the students to critically examine and review scientific information, to apply the procedures and methods that are based on scientific facts, while minimizing errors in diagnostic procedures, thus providing the optimal choice of a therapeutic modality.	
Outcomes of the course: After completing this course, the student will be able to look at the problems of orofacial rehabilitation, analyze them, and provide a research proposal	
Contents of the course: The course deals with various topics in the field of prosthetics and rehabilitation of the orofacial system using different dental restorations. Special attention is given to research methods in the field of prosthodontics *Theoretical lectures:* Physiological optimal occlusion and its characteristics; Neuromuscular control occlusion and mandibular movements; Systemic factors in the pathogenesis of craniomandibular dysfunction, occlusion as a factor for CMD. CMD prevention and disorders; The principles of occlusion in mobile dental restorations, and restorations on implants; The principles of occlusion in fixed restorations; Preventive aspects of fixed compensations; Biological basis for loss of teeth, biological basis of edentulousness; Clinical and instrumental studies stomatognathic system; Loading of the tissue retaining dental restorations; The distribution of the occlusal load on the supporting tissues OFS; Modern therapy procedures in the treatment of edentulousness; Biomechanics of dental restorations and implants; Evaluation of performance fees on implants; Ceramic system in fixed prosthodontics; Principles of computerized dentistry; Dental restorations and the patient, subjective and objective assessment of the quality of compensations, the impact on the quality of life. *Practical sessions – Research activities*: Collection and analysis of scientific facts; Methods of evaluating the performance of various dental restorations; Analysis of clinical, instrumental, and laboratory methods for research; Therapeutic modalities; Evaluation of existing scientific evidence and empirical facts.	
Recommended :Literature J. Peat, E. Elliott, L. Baur, V. Keena. Scientific Writing. London: BMJ Books, 2002 T. Greenhalgh. How to Read a Paper. London: BMJ Books, 2001. GM Hall. How to Write a Paper. London: BMJ Books, 1998. GM Hall. How to Present at meetings. London: BMJ Books, 2001 F. Chiappelli, P. Prolo, M. Newman, M. Cruz, E. Sunga, E. Concepcion and M. Edgerton Evidence-based Practice in Dentistry: Benefit or Hindrance. J Dent Res 2003 82: 6	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	20	Test	
Research paper	40	Practical exam	
Mid-term test(s)		Oral exam	*40*
Seminar(s)			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Pathohistological Characteristics of Tumors of the Orofacial Region	
Course Leader: Zvezdana B. Tepavčević	
Teacher(s): Zvezdana B. Tepavčević	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/3rd semester**
Entry requirements: /	**Course code: D20PAK**
Objectives of the course: To familiarize PhD students with the most relevant theories about the etiology, epidemiology, pathogenesis and morphological changes of orofacial tumors.	
Outcomes of the course: Mastering the methodology applied in research on orofacial tumors; understanding the essence of the pathological processes underlying human diseases, above all, those affecting the organs of the oral cavity.	
Contents of the course: *Theoretical lectures* Etiology, clinical appearance, histopathological characteristics, differential diagnosis of reactive and giant cell lesions of the maxillofacial system; etiology, clinical appearance, histopathological characteristics, differential diagnosis of odontogenic cysts and cysts of the head and neck soft tissues; morphological features, correlation of clinical, pathohistological and radiological parameters of periapical lesions, pseudocysts and bone lesions; the analysis of pathohistological features of benign and malignant salivary gland tumors; the analysis of pathological features of odontogenic tumors, tumors of the lymphoid and bone tissue of the orofacial region; etiology, clinical appearance, pathohistological characteristics, differential diagnosis of benign and malignant tumors of the skin and oral mucosa. *Practical sessions – Research activities* Modern methods and tools in the diagnosis of reactive and giant cell lesions; examination of immunohistochemical markers of odontogenic and soft tissues of the head and neck; immunohistochemical analysis of benign and malignant salivary gland tumors; the study of periapical lesions, pseudocysts, and bone lesions etiology; development and application research of odontogenic tumors, tumors of the lymphoid and bone tissue of the orofacial region; immunohistochemical analysis of benign and malignant tumors of the skin and mucosa.	
Recommended literature: 1. Kumar V., Abbas A., Aster J. Robbins Basic Pathology 10th edition. Elsevier 2018. 2. Neville B. Oral and Maxillofacial Pathology 3rd edition. Elsevier 2008.	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60
Teaching and learning methods: small group work, seminars, analysis of research results		

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Molecular Genetic Studies of Orofacial Diseases	
Course Leader: Jelena Milašin	
Teacher(s): Jelena Milašin, Branka Popović	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/3rd semester**
Entry requirements: /	**Course code: D20MOL**

Objectives of the course:
To introduce PhD students with basic molecular-genetic mechanisms underlying monogenic and multifactorial diseases in the orofacial and craniofacial regions.

Outcomes of the course:
The students will be able to understand the genetic mechanisms of pathogenesis of neoplastic diseases, developmental anomalies and other conditions of the oral cavity and maxillofacial region.

Contents of the course:
Theoretical lectures
The student will be acquainted with the major genetic and epigenetic alterations underlying benign and malignant tumors of the orofacial region. The role of cancer stem cells, as well as the molecular and cellular mechanisms by which they determine the development, progression, and metastases of tumors will be explained.
The student will also be acquainted with different gene mutations underlying the most common dento-craniofacial developmental anomalies such as hypodontia, amelogenesis imperfecta, dentinogenesis imperfecta, etc.
In addition to analyzing the effects of pathognomonic mutations, the students will also gain insights into gene polymorphisms (germline mutations) that determine the risk of developing certain multifactorial pathologies (jaw cysts, temporomandibular dysfunctions, prognathism / retrognathism, gingival recessions, etc.).
Practical sessions – Research activities
Through practical and experimental work, the students will become acquainted with the assessment of epigenetic status (methylation status) of tumor suppressor genes, the isolation and cultivation of cancer stem cells and the determination of their molecular and cellular phenotype (in samples of oral squamous cell carcinoma and basocellular carcinoma of the head and neck). Through RA, students will acquire knowledge on association studies, i.e. based on the presence of different polymorphisms, they will learn how to predict the risk of developing multifactorial diseases of the orofacial region.

Recommended literature:

- Dos Santos Costa SF, Brennan PA, Gomez RS et al. Molecular basis of oral squamous cell carcinoma in young patients: Is it any different from older patients? J Oral Pathol Med. 2018 Jul;47(6):541-546. doi: 10.1111/jop.12642.
- Hema KN, Smitha T, Sheethal HS, Mirnalini SA Epigenetics in oral squamous cell carcinoma. J Oral Maxillofac Pathol. 2017 May-Aug;21(2):252-259. doi: 10.4103/jomfp.JOMFP_150_17.
- Bailleul-Forestier I, Molla M, Verloes A, Berdal A. The genetic basis of inherited anomalies of the teeth. Part 1: clinical and molecular aspects of non-syndromic dental disorders. Eur J Med Genet. 2008 Jul-Aug;51(4):273-91. doi: 10.1016/j.ejmg.2008.02.00
- Smith CEL, Poulter JA, Antanaviciute A, et al Amelogenesis Imperfecta; Genes, Proteins, and Pathways. Front Physiol. 2017 Jun 26;8:435. doi: 10.3389/fphys.2017.00435. eCollection 2017.

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	30	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	20		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Biochemical Markers in Oral Diseases	
Course Leader: Ivan S. Dožić	
Teacher(s): Ivan S. Dožić, Tatjana M. Todorović	
Course status: Elective	
ECTS: 13	**Year and semester of study:II/3rd semester**
Entry requirements: /	**Course code: D2BPO**
Objectives of the course: To inform the students about the biochemical markers in the blood and saliva and their role in the detection and prevention of oral diseases.	
Outcomes of the course: Mastering the methodology of taking biological samples (blood and saliva) for biochemical marker analyses; gaining basic knowledge about the importance of analyzing biochemical markers when it comes to diseases of the oral cavity (diseases of the salivary glands, periodontal tissues, oral cancer).	
Contents of the course: *Theoretical lectures* Definition and types of biomarkers; Analyses of salivary enzyme activity (amylase, lysozyme, protease, carbonic anhydrase, chitinase) in oral diseases; Salivary proteins (mucins, proline-rich-proteins, defensins, histatins, staterin, calprotectin, cathelicidins, cystatins, lactoferrin, chromogranins, fibronectin) in oral diseases; Enzymatic and non-enzymatic antioxidants in saliva; Biochemical markers in the blood of patients with periodontal disease or oral cancer; Analysis of biochemical markers in the blood and saliva of patients with inflammation or tumors of the salivary glands; *Practical sessions – Research activities* Proper taking of biological material; Blood sampling and treatment (venous, arterial, capillary); Saliva sampling and processing; Commonly used methods for the analysis of biochemical markers in the blood and saliva; Analysis of biochemical markers in the saliva / blood in patients with oral diseases (periodontopathy, oral cancers, salivary gland diseases);	
Recommended literature: 1. Charles F. Streckfus. Advances in Salivary Diagnostics. Springer-Verlag Berlin Heidelberg 2015. 2. Carl A. Burtis, David E. Bruns. Clinical chemistry and molecular diagnostic. Seventh edition. Saunders, an imprint of Elsevier Inc 2015.	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	30	Test	
Research paper		Practical exam	
Mid-term test(s)		Oral exam	40
Seminar(s)	30		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Quality of Life of Patients with Orofacial Diseases	
Course Leader: Vitomir S. Konstantinović	
Teacher(s): Vitomir S. Konstantinović, Milan B. Petrović, Boban Ž. Aničić, Zoran M. Jezdić, Vojkan M. Lazić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/3rd semester**
Entry requirements: /	**Course code: D20KVP**
Objectives of the course: Introducing the candidates to the term and meaning of quality of life of patients with maxillofacial diseases.	
Outcomes of the course: The candidates should understand the essence of quality of life of patients with diseases of the maxillofacial region.	
Contents of the course: *Theoretical lectures* The candidates will learn about the term and definitions of quality of life, as well as about the methods of objective and subjective estimation. The candidates will also learn about the quality of life of patients with maxillofacial trauma, jaw and face deformities, oral malignant tumors, acquired and congenital deformities of the face, upper jaw and palate. Quality of life of patients undergoing polychemotherapy or radiotherapy is particularly highlighted. Also, the students will be introduced to the implantological systems which are used in patients with inadequate alveolar bone dimensions. *Practical sessions – Research activities* The candidates acquire the knowledge and skills necessary for a scientifically based approach to data from the literature concerning the quality of life, perform an objective and subjective assessment of quality of life; form a research file within the framework of assessment of different pathological conditions of the maxillofacial region.	
Recommended literature: Bjordal K, Kaasa S. Psychometric validation of the EORTC Core Quality of Life Questionnaire, 30-item version and a diagnosis-specific module for head and neck cancer patients. Acta Oncol 1992; 31:311–21. Beumer J, Curtis TA, Nishimura R, Beumer J, editors.Maxillofacial rehabilitation: prosthodontic and surgical considerations. St.Louis, 1996.; Konstantinović, VS. Quality of life after surgical excision followed by radiotherapy for cancer of the tongue and floor of the mouth: evaluation of 78 patients. J Cranio Max.-fac Surg, 27:192-197; 1999.; Rogers SN, Harvey-Woodworth CN, Hare J, Leong P, Lowe D. Patients perception of the financial impact of head and neck cancer and the relationship to health related quality of life. Br J Oral Maxillofac Surg. 2012 Jul; 50(5):410-6. ; Epstein J, Santo RM, Guillemin F. A review of guidelines for cross-cultural adaptation of questionnaires could not bring out a consensus. Journal of clinical epidemiology. 2015;68(4):435-412.; Patel N, Hodges SJ, Hall M, Benson PE, Marshman Z, Cunningham SJ. Development of the Malocclusion Impact Questionnaire (MIQ) to measure the oral health-related quality of life of young people with malocclusion: part 1 - qualitative inquiry. Journal of orthodontics. 2016;43(1):7-13.	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	20	Test	20
Research paper	20	Practical exam	
Mid-term test(s)		Oral exam	20
Seminar(s)	20		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Research and Definition of the Risk of Oral Diseases and Dental Injuries	
Course Leader: Zoran R. Vulićević	
Teacher(s): Zoran R. Vulićević, Mirjana D. Ivanović, Dejan Lj. Marković, Vanja V. Petrović, Jelena Č. Mandić, Olivera M. Jovičić, Ivana S. Radović, Tamara O. Perić, Zoran T. Mandinić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3rd semester**
Entry requirements: /	**Course code: D20POV**
Objectives of the course: To inform the students about the contemporary knowledge of etiology and methods for investigating risk factors for oral diseases.	
Outcomes of the course: Mastering the methodology of investigating the etiology of oral diseases and assessing the risk of oral diseases; mastering the methodology used in research on the tests used for an early diagnosis of risk factors for oral diseases.	
Contents of the course: *Theoretical lectures* Epidemiological research relevant for national oral pathology; Investigation of the etiology of caries, tooth erosion, periodontal disease and orthodontic anomalies; Investigating and defining the risk for caries, tooth erosion, periodontal disease and orthodontic anomalies; Risk factors for the occurrence of oral mucosal lesions in children undergoing chemotherapy; Investigation of the pathogenesis of early carious lesions; Investigation of caries pathogenesis and tooth erosion pathogenesis; Prospective studies of early carious lesion therapy and tooth erosion therapy. *Practical sessions – Research activity* Calibrating researchers for epidemiological research on national oral pathology; Development of models for the prevention of oral diseases in a particular population group or environment; Defining risk factors that have already led to orthodontic abnormalities in pediatric patients; Investigation of the etiology of changes in the oral mucosa; Development and application of research on the tests used for the early diagnosis of oral disease risk factors; Diagnostic methods for injuries of the periodontal tissues; Diagnostic methods for hard dental tissue injuries; Methods for determining the risk of injury to the periodontal tissues; Methods for defining the risk for hard dental tissue injury; Modern methods and tools in the diagnosis and therapy of the initial caries lesion; Early diagnosis of malignant diseases of the orofacial region; Methods for defining the risk of developing malignancies.	
Recommended literature: 1. Harris NO, Godoy FG. Primary Preventive Dentistry. Prentice Hall 2003. 2. Welbury R, Duggal MS, Hosey MS (editors). Paediatric dentistry. Fourth edition. Oxford University Press 2012. 3. McDonald R, Avery D. Dentistry for the child and adolescent. Tenth edition. Elsevier 2016.	
Number of classes of active teaching: 120	Theoretical lectures: 60 / Practical sessions – Research activities: 60
Teaching and learning methods: small group work, seminars, analysis of research results	

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Experimental Research of Periodontal Diseases	
Course Leader: Zoran M. Aleksić	
Teacher(s): Zoran Aleksić, Saša Janković, Nataša Nikolić Jakoba, Iva Milinković	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3. semester**
Entry requirements: /	**Course code: D20PAZ**
Objectives of the course: Upgrading the students' knowledge regarding the concepts of active and passive regeneration and bioengineering.	
Outcomes of the course: Up-to-date knowledge about the application of active and passive regeneration, as well as about the use of bioengineering principles in regenerative periodontal treatment.	
Contents of the course: *Theoretical lectures* Application of the concept of passive regeneration in the treatment of induced periodontal lesions in experimental animals; experimental analysis of augmentation procedures in implantology and their influence on osseointegration; experimental analysis of different carriers of bone morphogenetic protein in the treatment of artificially formed periodontal and periimplant defects; application of the concept of active regeneration in artificial periimplant defects; experimental analysis of the impact of grafting materials to wound healing in implantology; soft tissue management in periodontology and implantology. *Practical sessions – Research activities* Research on experimental animals in periodontology; the use of growth factors in the treatment of artificially formed periodontal defects in experimental animals; application of growth factors in implantology; experimental analysis of implant surface conditioning with growth factors; experimental analysis of different types of implant loading; experimental analysis of ceramic endosseous implants; specificities of clinical research.	
Recommended literature: 1. Bartold M, Narayanan AS. Biology of the Periodontal Connective Tissues. Quintessence Publishing Co, 2003. 2. Cochran D. Biomimetics in Periodontal Regeneration. Quintessence Publishing Co, 2003. 3. Lynch SE ,Genco R, Marx RE. Tissue Engineering: Applications in Maxillofacial Surgery and Periodontics. Quintessence Publishing Co, 2000. 4. Romanos GE. Immediate Loading of Endosseous Implants in the Posterior Area of the Mandible: Animal and Clinical Studies. Quintessence Publishing Co, 2005.	

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper		Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)	50		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Prospective and Retrospective Investigations of Dental Tissue Reconstruction	
Course Leader: Slavoljub A. Živković	
Teacher(s): Slavoljub A. Živković, Jugoslav M. Ilić, Vesna J. Miletić, Violeta S. Petrović, Vanja N. Opačić Galić, Katarina R. Beljić Ivanović, Tatjana V. Savić Stanković	
Course status: elective	
ECTS:13	**Year and semester of study: II/ 3.semester**
Entry requirements: /	**Course code: D20PRO**

Objectives of the course:
To acquaint the student with current concepts of etiology, pathogenesis, therapy and repair of diseased pulp and apical periodontium and proper understanding of inflammatory, immune and reparative processes in the pulp and periapical tissue.

Outcomes of the course:
After completing theoretical studies and completed research work, the doctoral student should understand the importance and role of mediators of inflammation and immune response during inflammation and repair of the pulp and apical periodontium, that is, understand the specifics of restorative and endodontic therapy and properly analyze their effects in treatment of diseased teeth .

Contents of the course:
Theoretical lectures
Prospective and retrospective studies related to the etiology, pathogenesis and therapy of diseased pulp and apical periodontium; Research of the pain and response of pulpodentin complex to stimuli; Effects of iatrogenic stimuli during restorative procedures. Minimally invasive procedures in restorative and endodontic therapy; Microcurrent phenomenon; Specifics of canal morphology; Reparative opportunities of pulpodentin complex and periapical tissue; Methodology of monitoring of repair after endodontic therapy. Specifics related to endoperiodontal diseases.

Practical sessions – Research activities
Effects of various restorative materials on the pulpodentin complex; Analysis and significance of microcurrents in clinical settings; The role and importance of the materials used to repair the damaged pulpodentin complex; Current methods and tools in dental therapy with minimal interventions; Clinical significance and analysis of endoperiodontal lesion therapy; Analysis of the role of restorative therapy of endodontically treated teeth; Clinical X-ray analysis of the healing process in apical periodontium. Development and application of various instruments and instrumentation techniques in teeth with specific morphology; Canal instrumentation techniques with different movement of NiTi instruments in a canal.

Recommended literature:

1. Mahmoud Torabinejad, Richard E.Walton „Principles and Practices of endodontics, WB Saunders Company, 2002.
2. Michael Hulsmann, Edgar Schafer, Problems in Endodontics, Etiology, Diagnosis and Treatment, Quintessence Publishing, 2009.
3. Summit JB, Robbins JW, Schwartz RS. Fundamentals of operative dentistry, Chicago, Quintessence, 2001.

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	40
Research paper	50	Practical exam	
Mid-term test(s)		Oral exam	
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Clinical Application of Stem Cells in Dentistry	
Course Leader: Dejan Lj. Marković	
Teacher(s): Miodrag J. Čolić, Milan B. Petrović, Branka M. Popović, Zoran M. Aleksić, Dejan Lj. Marković,	
Course status: Elective	
ECTS: 13	**Year and semester of study: II/3rd semester**
Entry requirements: /	**Course code: D20MAT**

Objectives of the course: To introduce students with contemporary experimental and clinical practice in regenerative dental medicine; methods for the isolation, cultivation and examination of mesenchymal stem/stromal cells from various dental structures, especially from the dental pulp and periodontal ligament; to introduce dental materials and nanomaterials that have bioregenerative potential or can be classified as scaffolds.

Outcomes of the course: Through theoretical work and seminal papers, the students will become familiar with experimental and clinical studies on the application of mesenchymal stem/stromal cells in regenerative dentistry and medicine; to train students for collection, propagation, phenotypic characterization and cryopreservation of mesenchymal stem/stromal cells for the use in regenerative dentistry and medicine; introduction of characteristics of various scaffolds suitable for clinical use in dental medicine.

Contents of the course:

Theoretical lectures

Contemporary evidence-based research in the field of isolation, cultivation, biomodulation and clinical application of stem cells in dentistry; mesenchymal stem/stromal cells isolated from dental tissues; Differentiation of dental stem/stromal mesenchymal cells into odontoblasts and osteoblasts; Development and design of scaffolds and their clinical applications in regenerative and reparative processes in dentistry; Interaction of dental biomaterials and nanomaterials with stem/stromal mesenchymal cells; Clinical application of stem/stromal mesenchymal cells.

Practical sessions – Research activities

Collection, propagation, phenotypic characterization and cryopreservation of stem/stromal mesenchymal cells; identification of odontoblasts and osteoblasts in the culture of stem/stromal mesenchymal cells differentiated in the presence of specific induction differentiation stimuli based on gene and protein expression of characteristic markers; assessment of the effects of new materials/new formulations of dental materials on differentiation of stem/stromal mesenchymal cells from different dental structures into odontoblasts and osteoblasts; results of preclinical and clinical studies on the use of stem/stromal mesenchymal cells in regenerative dentistry and medicine, including immune mechanisms involved in these processes and therapeutic outcomes.

Recommended literature:

1. Michel Goldberg (*edit.*): The Dental Pulp Biology, Pathology, and Regenerative Therapies, DOI 10.1007/978-3-642-55160-4; Springer- 2014
2. Rai S, Kaur M, Kaur S. Applications of stem cells in interdisciplinary dentistry and beyond: An overview. Ann Med Health Sci Res 2013;3:245-54. DOI:10.4103/2141-9248.113670
3. Sema S. Hakki *et al*. Comparison of MSCs Isolated From Pulp and Periodontal Ligament. Journal of Periodontology, DOI: 10.1902/jop.2014.140257
4. Pooja Arora*1 and Vipin Arora2: PEDIATRIC STEM CELLS -THE FUTURE AHEAD, International Journal o Biomedical Research, 3: 11:2012,
5. Dejan Markovic et al. Potential Preservation of Dental Pulp Stem Cells Balk J Stom, 2010; 14:4-7

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	*10*	Test	
Research paper	*50*	Practical exam	
Mid-term test(s)		Oral exam	*40*
Seminar(s)			
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Instrumental Methods in Dentistry	
Course Leader: Đorđe I. Stratimirović	
Teacher(s): Đorđe I. Stratimirović, Vesna Z. Danilović, Sanja M. Mlutinović-Smiljanić	
Course status: Elective	
ECTS: 13	**Year and semester of study: II / 3 semester**
Entry requirements: /	**Course code:D20IMS**
Objectives of the course: To introduce the students to the basic principles of the modern instrumental techniques and methods applicable in dental field research.	
Outcomes of the course: After completing the course, the students will be able to identify the instrumental method necessary for the realization of the set aims of their doctoral theses. Special attention will be given to the students' multidisciplinary orientation with an idea to clarify possible applications of modern instrumental methods for dental tissue and materials characterization. After acquiring the knowledge about the proposed contents, the students will be able to plan the experiments with colleagues working at institutes so that they can maximally utilize the available equipment to conduct research directed towards dentistry.	
Contents of the course: *Theoretical lectures* Scanning electron microscopy (SEM) – working principle, preparation of biological specimens for SEM analysis, investigation of titanium implants surface; transmission electron microscopy (TEM) – dark field imaging, image contrast and interpretation; atomic force microscopy (AFM) working principle, physical basis of the method, investigation of restorative materials' and implants surface roughness, characterization of the cells, proteins and nucleic acids using AFM; micro computed tomography (μCT) working principles, bone structure analysis, analysis of the tooth obturation quality; photoelectron spectroscopy (XPS) and infrared spectroscopy with Fourier transformation (FTIR) – working principles and applications in dental research; Raman spectroscopy – physical basis of the method, determination of the biofilm composition around dental implants, screening of oral tumors using Raman spectroscopy; mass spectroscopy – working principle, chemical analysis of dental ceramics surface, identification of microorganisms in biofilm in peri-implant disease; light microscopy – application in analysis of bone and dental tissue; energy dispersive x ray spectroscopy (EDX) and x ray diffraction analysis (XRD) – working principle, identification of compounds, investigation of healthy and pathological bone; confocal microscopy – working principle, investigation of teeth bleaching effects; finite element analysis – working principle. *Practical sessions – Research activities* SEM – surface characterization of dental materials, investigation of the microgap at tooth-material interface, TEM – characterization of bone and dental tissue; AFM – investigation of dental restorative and implant materials roughness, characterization of cells, nucleic acids and proteins; μCT – analysis of bone structures, analysis of root canal obturation quality; XPS and FTIR – chemical analysis of dental materials surface; light microscopy – application in tooth and bone analysis; confocal microscopy – investigation of the quality of marginal adaptation of dental materials; finite element analysis – utilization for assessment of mechanical stresses within bone structures.	
Recommended literature: Sharma S, Cross SE, Hsueh C, Wali RP, Stieg AZ, Gimzewski JK. Nanocharacterization in dentistry. Int J Mol Sci. 2010; 11:2523-45. Van Meerbeek B, Vargas M, Inoue S, Yoshida Y, Perdigão J, Lambrechts P, Vanherle G. Microscopy investigations. Techniques, results, limitations. Am J Dent. 2000; 13(Spec No):3D-18D. Fincham AG, Moradian-Oldak J, Simmer JP. The structural biology of the developing dental enamel matrix. J Struct Biol. 1999; 126(3):270-99. Marshall GW Jr, Marshall SJ, Kinney JH, Balooch M. The dentin substrate: structure and properties related to bonding. J Dent. 1997; 25(6):441-58. Billington RW, Williams JA, Pearson GJ. Ion processes in glass ionomer cements. J Dent. 2006; 34(8):544-55.	
Number of classes of active teaching: 120	Theoretical lectures: 60 / Practical sessions – Research activities: 60
Teaching and learning methods: small group work, seminars, analysis of research results	

Assessment (maximum number of points: 100)			
Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	
Research paper	30	Practical exam	
Mid-term test(s)		Oral exam	40
Seminar(s)	20		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Modulation of the Oral Biofilm	
Course Leader: Dejan Lj. Marković	
Teacher(s): Dejan Lj. Marković, Milena Ž. Radunović, Tatjana Lj. Marković, Jugoslav M. Ilić, Marina D. Soković, Tamara O. Perić, Ana Lj. Pucar	
Course status: Elective	
ECTS:13	**Year and semester of study: II / 3 semester**
Entry requirements: /	**Course code:D20MOD**

Objectives of the course:
To introduce students to modern oral biofilm research techniques and to develop a scientific approach to the modulation of oral biofilms in order to ensure oral health.

Outcomes of the course:
Mastering the methodology of oral biofilm research; developing skills necessary for the isolation and identification oф oral microorganisms; acquiring knowledge regarding the correlation of various etiological factors and oral biofilm in the maintenance of oral health and its application in clinical practice.

Contents of the course:
Theoretical lectures
Reference to evidence-based research in the field of population specificities of the oral biofilm.
Influence of general / systemic / chronic / infectious or other diseases or conditions on the oral biofilm characteristics. Introduction to the types of secondary metabolites present in plants and fungi with a focus on essential oils and their application in dentistry. Application of secondary metabolites based on their efficacy on oral biofilm and in particular on defined pathogenic microorganisms. The importance of defining appropriate essential oil chemotypes that are clinically effective and clinically safe.
Practical sessions – Research activities
Epidemiological, clinical and laboratory methods for the sampling, cultivation and testing of bacterial and fungal flora in oral biofilm. Examining the association of systemic diseases with the therapy and oral environment ecosystem composition. Analytical systematization of published research on biofilm composition and the chemical, biological and bioinspired agents for its modulation. Learning methods of biohazard testing of agents used for controlling the composition and modulation of the oral biofilm.

Recommended literature:
1. Marinković J., Marković T., Miličić B., Soković M., Ćirić A., Marković D.:Outstanding Efficacy of Essential Oils Against Oral Pathogens. In: Essential Oil Research, Trends in Biosynthesis, Analytics, Industrial Applications and Biotechnological Production (Sonia Malik Ed.), Part 2: Uses of Essential Oils in Various Industries, pg. 211-233. Springer, Cham. [Print ISBN 978-3-030-16545-1 Online ISBN 978-3-030-16546-8], 2019
2. Henk J. Busscher : Oral Biofilms and Plaque Control, Harwood-Academic Publishers , 1999
3. Insight into Oral Biofilm: Primary, Secondary and Residual Caries and Phyto-Challenged Solutions Smitha Chenicheri, Usha R, Rajesh Ramachandran, Vinoy Thomas, Andrew Wood DOI: 10.2174/1874210601711010312

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	10	Test	
Research paper	30	Practical exam	
Mid-term test(s)		Oral exam	*40*
Seminar(s)	20		
Other			

Table 5.1 Subject specification within the study program of doctoral studies

Doctoral Studies **Basic and Clinical Research in Dentistry**	
Level of studies: Third	
Course: Biologically Active Molecules as Inducers of Pulp-Dentin Reparation	
Course Leader: Nevenka Z. Teodorović	
Teacher(s): Nevenka Z. Teodorović, Elena S. Kršljak, Slavoljub A. Živković, Jelena M. Milašin, Vesna Z. Danilović	
Course status:Elective	
ECTS:13	**Year and semester of study:II/3. semester**
Entry requirements: /	**Course code: D20BIO**

Objectives of the course:
The goal of this course is to introduce the students to the basic principles of tissue engineering and the potential of regenerative endodontic therapy procedures in dental practice.

Outcomes of the course:
After completion of the course and study research, the PhD students should understand the basic principles and strategies of alternative therapies of teeth using regenerative endodontic procedures, including the role of growth factors and stem cells in the apical pulp/dentine regeneration, and root canal engineering. The students should be able to apply modern bioactive materials in endodontic root canal therapy.

Contents of the course:
Theoretical lectures
Case study of the basic principles and methodology for regenerative therapy (mainly revascularisation) in teeth with immature roots and teeth in the adult population, the possibility of use of modern drugs and bioactive ceramic endodontic materials. Emphasis on the mechanical action of bioactive mediators (growth factors), the use of stem cells, mechanisms of stimulation of reparative dentinogenesis and pulp and periapical tissues repair.

Practical sessions – Research activities
Experimental analysis of alloplastic materials in endotherapy. Clinical importance of using bioactive materials in endotherapy. Role and usage of dentin-like materials in restorative procedures and endodontic therapy. Radiographic evaluation of outcomes in endodontic therapy of chronic apical periodontitis.

Recommended literature:

1. Tziafas D,Smith AJ,Lesot H. Designing new treatment strategies in vital pulp therapy. Journal of Dentistry 2000;28:77-92
2. Hamdy R,Rendon J,Tabrizion M.ch.8:Distraction Osteogenesis and its challenges in Bone Regeneration.Tal H.Editor In:Bone Regeneration Rijeka:In Tech,2012.
3. Mjor IA.Pulp-dentin biology in restorative dentistry.Quintessence Publishing,2002.

Number of classes of active teaching: 120	Theoretical lectures: 60	Practical sessions – Research activities: 60

Teaching and learning methods:
small group work, seminars, analysis of research results

Assessment (maximum number of points: 100)

Pre-exam requirements	**60 points**	**Final Exam**	**40 points**
Participation in lectures	15	Test	
Research paper	30	Practical exam	20
Mid-term test(s)	8	Oral exam	*20*
Seminar(s)	7		
Other			