



**Sveučilište u Rijeci**  
University of Rijeka



Sveučilište u Rijeci • Fakultet dentalne medicine  
University of Rijeka • Faculty of Dental Medicine  
Krešimirova 40/42 • 51000 Rijeka • CROATIA  
Phone : +385 51 559 200; 559 202, 559 203

**Course:** Materials in dental medicine

**Course Coordinator:** Zoran Kovač, DMD, PhD, Professor

**Department:** Department of Prosthodontics

**Study program:** Integrated Undergraduate and Graduate University Study of Dental Medicine

**Study year:** 2

**Academic year:** 2024/2025

## SYLLABUS

**Course description (a brief description of the course, general instructions, where and in what form the lessons are organized, necessary equipment, instructions for attendance and preparation for classes, student obligations, etc.):**

The course will include historical overview of the materials used in dental medicine, their standardization, structure and properties. It will also include applied metallography, metallic structure and its dependence upon the type of structure. It will go through the structure of isolated atom, properties and particulars of structure as well as bonds between them (ionic, polar, metallic, and covalent). Formation of the crystalline networks, crystallization, re-crystallization, electrochemical stability of the alloys. Types and division of alloys (noble and non-noble). Division of noble alloys in 4 types. Composition and properties of AgPd–alloy, Pd-alloy, Ti-alloy, alloys for metal-ceramics, properties of Co-Cr, Cr-Mo alloy. Polymers used for faceting (acrylic, isosit and the group of materials with improved mechanical properties). Bond between esthetic materials with metallic alloy – mechanical, chemical. Dental ceramics, types, categorization, optic properties, types of bonds between the metal and ceramic. Pure ceramic systems. Cements – types, application, composition and properties. Impression materials in dental prosthetics, non-elastic (plaster, thermoplastic materials), elastic (condensation and addition silicones, polysulphides and polyethers, reversible and irreversible hydrocolloids), their properties and mode of use. As accessory materials we use plaster, wax, fillers (categorization, composition and properties). As building materials, beside the mentioned, the following are used: polymers, Co-Cr-Mo alloys, polymers for fabrication of dentures, materials for rebasing, artificial teeth (ceramic, acrylic), materials for implants, dental amalgams, composite materials, cements, adhesives and orthodontic materials.

### Assigned reading:

Shen, C. Phillips' Science of Dental Materials, Thirteenth Edition. ClinicalKey.

### Optional/additional reading:

### COURSE TEACHING PLAN:

#### The list of lectures (with topics and descriptions):

L1. Introduction to the course

Learning outcomes:

Explain the learning scope of the course.



Define terms and application of dental materials, tasks, goals, as well as ways of grouping and controlling according to the applied standardization.

## L2. Structure and chemical stability of materials in dental medicine.

Learning outcomes:

Define types and division: metals, ceramics, polymers, composites, glass ceramics - chemical composition, structure, microstructure characterization, mechanical properties, chemical resistance, color.

Explain chemical structure, composition and physical-mechanical properties of all dental materials used in dental medicine, adopt them and apply the most favorable material from those offered.

## L3. Materials for impressions

Learning outcomes:

Define all types of impression materials used in dental prosthetics, chemical composition, methods of preparation, application and handling. Recognize the importance of following the manufacturer's recommendations for each impression material.

## L4. Gypsum (composition, division and application)

Learning outcomes:

Explain the chemical composition of plaster, its division and application in dental medicine. To explain the significance of the physical properties of plaster for the precision of the prosthetic prosthesis. To clarify the observance of instructions on proper storage of plaster, preparation, pouring and hardening.

## L5. Wax (types, composition and characteristics)

Learning outcomes:

Define types of waxes as auxiliary materials, as well as their physical properties. explain how certain additives affect their quality.

## L6. Materials for investment and casting

Learning outcomes:

List the types of investment masses, properties, composition, properties. Explain how each component affects the contraction or expansion of the investment mass. explain which and what properties of investment masses are important for the precision of the cast prosthetic restoration.

## L7. Applied metallurgy-metals (metals)

Learning outcomes:

Define metals, explain and adopt the properties of metals and know which pure metals are used in dental medicine. Explain their chemical structure.

## L8. Applied metallurgy - metal alloys

Learning outcomes:

Get to know all types of metal alloys important for dental prosthetics. To understand the physical-mechanical and chemical properties of alloys and to acquire all the knowledge necessary for their application, as well as to learn about the equipment necessary for the use of alloys in the production of all types of prosthetic replacements.

## L9. Materials for covering dentine wounds and filling root canals



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Learning outcomes

define the materials used to cover a dentine wound and know how to choose the appropriate material from those offered.



L10. Aesthetic materials for dental cavity fillings

Learning outcomes:

Explain the offered aesthetic materials, their structures, mechanical properties, adhesive bonding system and explain how to choose the appropriate material.

L11. Amalgam (composition, types, method of obtaining and application)

Learning outcomes:

Define the elements that form amalgam, describe the methods of obtaining amalgam. explain the concepts of trituration, amalgamation, condensation. Analyze positive and negative characteristics as well as biocompatibility. Recognize discoloration and corrosion, as well as describe the procedure of clinical work.

L12. Optical properties of aesthetic materials in dental medicine

Learning outcomes:

Explain the optical characteristics of aesthetic materials that affect color. Define the term color; tone, saturation and brightness. Analyze the coefficients of reflection, absorption, transmission, translucency, fluorescence, as well as the index of light refraction.

L13. Materials for implants

Learning outcomes:

Define the term implant. List the types of implants and the materials they are made of. Explain the surgical stages of implantation, the reaction of alveolar bone to implants (materials), types of osteogenesis.

L14. Empres technique, Cad-cam technique

Learning outcomes:

Explain the technique of making metal-free ceramic restorations from glass-ceramic reinforced with leucite. Explain the method of inserting pre-softened and ceraminized glass-ceramics into a refractory block mold under pressure at high temperature. Explain computer-designed crown technology and ceramic machining.

L15. Cementing agents

Learning outcomes:

State the classification and application of cements in dental medicine. Compare their characteristics with each other. Explain how to choose the appropriate cement and apply it correctly. Explain the hardening reaction and the chemical structure of individual cements.

**The list of seminars with descriptions:**



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**S1. Types of printing materials**

Learning outcomes:

Analyze all types of impression materials, division of application, chemical composition, chemical hardening reaction, manipulation and their physical and mechanical properties.

**S2. Types of plaster, production of working models, application**

Learning outcomes.

Analyze and compare the types of dental plasters, methods of obtaining them, the correct way of preparation, use and application in dental prosthetics and orthodontics. Argue the physical properties of dental plasters.

**S3. Waxes, types, way of working**

Learning outcomes:



Describe the methods of obtaining dental waxes, their chemical composition, division and application in dental prosthetics. Analyze dental waxes for specific purposes as well as wax distortion.

**S4. Alloys for crowns and bridges**

Learning outcomes:

Analyze precious and non-precious metal alloys that are used to make crowns and bridges where the aesthetic material is a polymer. Clarify the connection between these alloys and polymers.

**S5. Dental materials and surrounding tissues**

Learning outcomes:

Argue and explain the behavior of the surrounding living tissues in response to the presence of building dental materials permanently or occasionally present in the oral cavity.

**S6. Alloys for ceramics**

Learning outcomes:

Analyze all types of dental alloys, precious and non-precious, on which it is applied and baked. Argue and explain the connection between alloys and ceramics.

**S7. Types of polymers and their application**

Learning outcomes:

Define and analyze all types of polymers that are used to make prosthetic bases for partial and complete dental prostheses, as well as methods of hardening. Describe soft acrylate and silicone polymers for supporting prostheses.

**S8. Synthetic resins in fixed prosthetics**

Learning outcomes:

To analyze the synthetic resins used as aesthetic coverings in fixed prosthetics, their chemical composition, properties and production technology.

**S9. Materials in oral surgery**

Learning outcomes:

Describe all types of materials used in oral surgery from instruments to implants.

**S10. Materials in orthodontics**

Learning outcomes:

Analyze and explain the use of dental materials in orthodontics, starting from impression materials, plaster, alloys for hooks and arches to ceramic brackets and acrylates for retainers.

**S11. Materials in pedodontics**

Learning outcomes:

Explain which dental materials are used in children's dentistry.

**S12. Materials for investment and casting**

Learning outcomes:

Comment on all types of input materials, division, application as well as preparation technology. Analyze the heating regime of the refractory block, casting methods as well as the types of apparatus used for this purpose.

**S13. Ceramics, types of ceramics**



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Learning outcomes:



Describe and explain which types of ceramic materials are used in dental medicine - dental prosthetics. Division according to type, firing temperature, method of shaping and hardening, as well as according to their application.

S14. A type of alloy for ceramics

Learning outcomes:

Explain and describe all types of dental alloys that are used for fixed prosthetic works. Especially highlight the desirable properties for realizing the metal-ceramic connection.

S15. Zircon, its use

Learning outcomes:

Analyze and comment on which zirconium is used in dental prosthetics, the methods of obtaining it and which equipment is used to make prosthetic replacements made of zirconium.

**The list of practicals with descriptions:**

**Students' obligations:**

This course will prompt the students to analyze and choose the best material for every technological and clinical task.

Student passed all the obligatory 1<sup>st</sup> and 2<sup>nd</sup> year courses.

Class attendance, make a seminar presentation and pass the mandatory colloquium.

**Assessment (exams, description of written / oral / practical exam, the scoring criteria):**

ECTS credit rating system:

Student evaluation is carried out according to the current Rulebook of the University of Rijeka. Students are graded using the ECTS (A-F) and numerical system (1-5). Grading in the ECTS system is carried out by absolute distribution.

During the duration of the course, students will be able to collect 100 grade points (maximum 70 grade points during the semester and maximum 30 grade points during the final exam).

The method of obtaining evaluation points is shown in the table:

Activity	Maksimalni broj ocjenskih bodova
Activity	10
Seminar	40
Colloquium	20
Final exam	30
<b>Total</b>	<b>100</b>

The colloquium is a written test consisting of 20 questions (5 answers are offered for each question), of which 1 or 2 answers can be correct. A student who gets more than 10 points in





If the student has less than 10 points in the colloquium, he has the right to write the correction of the colloquium once, if he does not pass even then, he is graded with a grade of insufficient (1) and must re-enroll in the course.

The final exam (up to 30 evaluation points) consists of five questions (up to 6 evaluation points each) that the student chooses and is completed in writing in the form of an essay. For the right to access the final exam, it is necessary to collect a minimum of 35 points during the semester, while the minimum number of points for the final exam is 15.

Grades are formed as follows:

Numerical grade ECTS grade Percentage

excellent (5) A - 90 to 100%

very good (4) B - 75 to 89.9%

good (3) C - 60 to 74.9%

sufficient (2) D - 50 to 59.9%

insufficient (1) F - 0 to 49.9%

**Other important information regarding to the course:**

**COURSE SCHEDULE (for academic year 2024/2025)**

Date	Lectures (time and place)	Seminars (time and place)	Practicals (time and place)	Instructor
18.3.2025.	L1,L2,L3 (8.00-10.15)	S1,S2,S3 (10.15-12.30; 13.00-15.15)		Zoran Kovač, DDM, PhD, Assistant Professor
19.3.2025.	L4,L5,L6 (8.00-10.15)	S4,S5,S6 (10.15-12.30; 13.00-15.15)		Zoran Kovač, DDM, PhD, Assistant Professor
25.3.2025.	L7,L8,L9 (8.00-10.15)	S7,S8,S9 (10.15-12.30; 13.00-15.15)		Zoran Kovač, DDM, PhD, Assistant Professor
26.3.2025.	L10,L11,L12(8.00-10.15)	S10,S11,S12(10.15-12.30; 13.00-15.15)		Zoran Kovač, DDM, PhD, Assistant Professor
28.3.2025.	L13,L14,L15 (8.00-10.15)	S13,S14,S15 (10.15-12.30; 13.00-15.15)		Zoran Kovač, DDM, PhD, Assistant Professor

**Sist of Sectures, seminars and practicaSs:**



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	<b>LECTURES (Topics)</b>	<b>Teaching hours</b>	<b>Socation/Secture room</b>
L1	Introduction to the course (Purpose and tasks, historical overview, standardization)	1	Krešimirova 42



L2	Structure and chemical stability of materials in dental medicine. (Types and division: metals, ceramics, polymers, composites, glass ceramics - chemical composition, structure, microstructure characterization, mechanical properties, chemical resistance, color...).	1	Krešimirova 42
L3	Materials for impressions	1	Krešimirova 42
L4	Gypsum (composition, division and application)	1	Krešimirova 42
L5	Wax (types, composition and characteristics)	1	Krešimirova 42
L6	Materials for embedding and casting	1	Krešimirova 42
L7	Applied metallurgy-metals	1	Krešimirova 42
L8	Applied metallurgy - metal alloys	1	Krešimirova 42
L9	Dental Filing Gold and Its Manipulation	1	Krešimirova 42
L10	Aesthetic materials for dental cavity fillings	1	Krešimirova 42
L11	Amalgam (composition, types, method of obtaining and application)	1	Krešimirova 42
L12	Optical properties of aesthetic materials in dental medicine	1	Krešimirova 42
L13	Materials for making implants	1	Krešimirova 42
L14	Empres technique, Cad-cam technique	1	Krešimirova 42
L15	Cementing agents	1	Krešimirova 42
<b>TOTAS TEACHING HOURS</b>		<b>15</b>	

	<b>SEMINARS (Topics)</b>	<b>Teaching hours</b>	<b>Socation/Secutre room</b>
S1	Types of impression material	2	Krešimirova 42
S2	Types of gypsum, production of working models, application	2	Krešimirova 42
S3	Dental waxes, types and way of its working	2	Krešimirova 42
S4	Alloys for dental crowns and bridges	2	Krešimirova 42
S5	Dental materials and surrounding tissues	2	Krešimirova 42
S6	Alloys for ceramics	2	Krešimirova 42
S7	Types of polymers and their application	2	Krešimirova 42
S8	Synthetic resins in fixed prosthetics	2	Krešimirova 42
S9	Materials in oral surgery	2	Krešimirova 42
S10	Materials in orthodontics	2	Krešimirova 42
S11	Materials in pedodontics	2	Krešimirova 42
S12	Materials for embedding and casting	2	Krešimirova 42
S13	Ceramics, types of ceramics	2	Krešimirova 42
S14	Types of alloys for ceramics	2	Krešimirova 42
S15	Zircon and its use	2	Krešimirova 42
<b>TOTAS TEACHING HOURS</b>		<b>30</b>	



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	<b>FINAS EXAM DATES</b>
1.	31.3.2025.
2.	02.6.2025.
3.	03.9.2025.