UNIVERSITY OF ZAGREB SCHOOL OF MEDICINE

# Plan of the course

# Medical Chemistry and Biochemistry 2

Academic year **2016/2017**

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izv. prof. dr. sc. Željka Vukelić

## I. COURSE AIMS

The course Medical Chemistry and Biochemistry II, as one of the preclinical courses, offers students to acquire knowledge about a human body chemical composition and subcellular organization of molecules as well as about chemical processes within and relating to the living organism. It also gives an insight to biochemical bases of diseases. The course integrates related chemical and biochemical contents to enable students to become familiar with: a) major metabolic pathways in human cells/organism from the chemical point of view (structures of involved molecules, chemistry of reaction steps) including their energetic (thermodynamic) aspect; b) regulation of metabolic processes in human organism. The basic principles of chemistry and biochemistry are grouped around principal thematic units structured pedagogically into a coherent whole comprised of lectures, seminars, and practical. The course provides biochemical basis for: further study of physiology and pharmacology; understanding pathobiochemical processes causing or underlying various diseases; recognizing biochemical methods and principles applied in medical diagnostics of diseases.

The content of the Medical Chemistry and Biochemistry II course comprises: enzyme activity regulation, membrane transport systems, biosignaling, energetic metabolism and cellular respiration, metabolism of carbohydrates, lipids, amino acids and proteins, integration of metabolism, biochemistry of hormones and hormonal regulation of metabolism, nutrition, metabolic roles of certain tissues, organs and body fluids.

The course laboratory practice covers methods for analysis of biomolecules, carbohydrates, lipids, nucleic acids, porphyrins and bile pigments, enzymes in medicine, acid-base and mineral status of a human organism, and urine analysis.

## II. COURSE STRUCTURE

**Course hours:**

Lectures: 29

Seminar: 41

Practicum: 40

**Total hours: 110**

Lectures (L): **29**

Seminars (S): **41**

Practicals (P): **40**

**Total**: **110**

## III. PLAN OF THE COURSE AND COURSE SCHEDULE

### BLOCKS OF THE COURSE

Number of blocks: **1**

| Block number | Start | End |
|---|---|---|
| 1. | 14.11.2016 | 23.12.2016 |

**BLOCKS OF THE COURSE**

Number of blocks: **1**

| Block number | Start | End |
|---|---|---|
| 1. | 14.11.2016 | 23.12.2016 |

**BLOCKS OF THE COURSE SHEME**

Block 1

| Date | Time | Group | Course hours type | Theme | Teaching staff |
|---|---|---|---|---|---|
| Monday 14.11.2016. | 11:30-13:00; MEF Kemija prizemlje | | Lectures | Metabolism of Eukaryotes: an Overview. | izv. prof. dr. sc. Željka Vukelić |
| | 13:30-15:00; MEF Kemija prizemlje | | Lectures | Regulation of Enzyme Activity. | izv. prof. dr. sc. Daria Pašalić |
| Tuesday 15.11.2016. | 11:30-13:00; MEF Kemija prizemlje | | Lectures | Types of Transport Across Membranes. | izv. prof. dr. sc. Daria Pašalić |
| | 13:30-15:00; MEF Kemija prizemlje | | Lectures | Basics of Biosignaling. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| Wednesday 16.11.2016. | 11:30-13:00; MEF Kemija prizemlje | | Lectures | Metabolism of Carbohydrates: an Overview. | izv. prof. dr. sc. Daria Pašalić |
| | 13:30-15:00; MEF Kemija prizemlje | | Lectures | Glycosides, Complex Carbohydrates and Glycoconjugates: Structural Features and Metabolic Role(s). Digestion and Absorption of Carbohydrates. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| Thursday 17.11.2016. | 10:00-11:30; MEF Kemija prizemlje | | Seminar | Glycolysis: Reactions and Regulation. Fates of Pyruvate under Aerobic and Anaerobic Conditions. Stoichiometry of ATP Production by the Complete Oxidation of Glucose. | izv. prof. dr. sc. Željka Vukelić, prof. dr. sc. Svjetlana Kalanj-Bognar |
| | 12:30-14:00; MEF Kemija prizemlje | | Seminar | Gluconeogenesis. Regulation of Glycolysis and Guconeogenesis. | prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić |
| Friday 18.11.2016. | 10:00-11:30; MEF Kemija prizemlje | | Seminar | Pentose Phosphate Pathway. Related Diseases. | prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić |
| | 12:00-13:30; MEF Kemija prizemlje | | Seminar | Glycogen Metabolism: Glycogenolysis & Glycogenesis. Glycogen Storage Diseases. | izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić |
| Monday 21.11.2016. | 10:30-11:15; MEF Kemija prizemlje | | Lectures | Metabolism of Fru, Gal, GlcA, Lac. Additional Monosaccharide Interconversions; Related Metabolic Disorders. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| | 12:30-16:15; MEF Kemija laboratorij | | Practicum | Carbohydrates. | dr. sc. Dragana Fabris, izv. prof. dr. sc. Daria Pašalić, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić, dr. sc. Kristina Mlinac Jerković |

| Date | Time | Group | Course hours type | Theme | Teaching staff |
|---|---|---|---|---|---|
| Tuesday 22.11.2016. | 11:00-12:30; MEF Kemija prizemlje | | Lectures | Overview of Three Stages of Cellular Respiration (Aerobic Metab.): (1) Acetyl~SCoA Production; Oxidative Decarboxylation of Pyruvate; (2) Citric Acid Cycle; (3) Electron Transfer & Oxidative Phosphorylation. Metabolic Fates of Acetyl~SCoA. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| | 13:00-14:30; MEF Kemija prizemlje | | Seminar | Citric Acid Cycle as a Central Metabolic Pathway: Reactions and Regulation. | dr. sc. Dragana Fabris, izv. prof. dr. sc. Željka Vukelić |
| Wednesday 23.11.2016. | 11:00-12:30; MEF Kemija prizemlje | | Seminar | Respiratory Chain & Oxidative Phosphorylation. | izv. prof. dr. sc. Daria Pašalić, izv. prof. dr. sc. Željka Vukelić |
| | 13:00-14:30; MEF Kemija prizemlje | | Lectures | Transporter Systems in the Inner Mitochondrial Membrane. Shuttle Systems for Mitochondrial Oxidation of the Cytosolic NADH. Regulation of the ATP-Producing Pathways: a Summary. | izv. prof. dr. sc. Željka Vukelić |
| Thursday 24.11.2016. | 10:00-11:30; MEF Kemija prizemlje | | Lectures | Simple Lipids: Reminder on Classification, Structure and Nomenclature. Digestion and Absorption of Lipids. Triacylglycerols: Storage and Lipolysis. Overview of Fatty Acids Oxidation and Synthesis. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| | 12:00-13:30; MEF Kemija prizemlje | | Seminar | Lipolysis. Oxidation of Fatty Acids (FA): β-oxidation of Even and Odd C-Number FAs; Very long chain FA shortening; Unsaturated FAs Oxidation; α- and ω-Oxidation. | izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić |
| Monday 28.11.2016. | 10:30-11:15; MEF Kemija prizemlje | | Seminar | Stoichiometry of ATP Production by the Complete Oxidation of FAs. "Ketone bodies" Synthesis (Ketogenesis) and Oxidation | prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Daria Pašalić |
| | 11:45-13:15; MEF Kemija prizemlje | | Seminar | Synthesis of saturated and unsaturated (ω-9, ω-6, ω-3 series) FAs and Eicosanoids. Role of Eicosanoids. | izv. prof. dr. sc. Daria Pašalić, prof. dr. sc. Svjetlana Kalanj-Bognar |
| Tuesday 29.11.2016. | 12:00-13:30; MEF Kemija prizemlje | | Seminar | Metabolism of Cholesterol and Other Isoprenoids (Bile Acids, Steroid Hormones, Vitamins). | izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić |
| | 14:00-15:30; MEF Kemija prizemlje | | Seminar | Lipoproteins: Metabolism and Role(s); Related Diseases. | izv. prof. dr. sc. Daria Pašalić, prof. dr. sc. Svjetlana Kalanj-Bognar |
| Wednesday 30.11.2016. | 12:00-13:30; MEF Kemija prizemlje | | Lectures | Complex Lipids: Reminder on Classification, Structure and Nomenclature. Overview of the Metabolism and Roles as Membrane Components & Second Messengers. | izv. prof. dr. sc. Željka Vukelić |
| | 14:00-15:30; MEF Kemija prizemlje | | Seminar | Metabolism and Role of Ester- and Ether-Linked Phospholipids; Related Disorders. | izv. prof. dr. sc. Željka Vukelić, dr. sc. Kristina Mlinac Jerković |
| Thursday 1.12.2016. | 10:00-11:30; MEF Kemija prizemlje | | Seminar | Sphingolipids: Metabolism and Metabolic Disorders, Roles. Lipids in Signal Transduction. | izv. prof. dr. sc. Željka Vukelić, prof. dr. sc. Svjetlana Kalanj-Bognar |

| Date | Time | Group | Course hours type | Theme | Teaching staff |
|---|---|---|---|---|---|
| | 12:30-16:15; MEF Kemija laboratorij | | Practicum | Lipids. | dr. sc. Dragana Fabris, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić, dr. sc. Kristina Mlinac Jerković |
| Friday 2.12.2016. | 10:30-11:30; MEF Nova vijećnica | SVI | Exam | 1st Control Test | izv. prof. dr. sc. Željka Vukelić |
| | 12:00-15:45; MEF Kemija laboratorij | | Practicum | Acid-Base and Mineral Status of Human Body. | dr. sc. Kristina Mlinac Jerković, izv. prof. dr. sc. Daria Pašalić, izv. prof. dr. sc. Željka Vukelić, prof. dr. sc. Svjetlana Kalanj-Bognar, dr. sc. Dragana Fabris |
| Monday 5.12.2016. | 09:45-10:30; MEF Kemija prizemlje | | Lectures | Protein Digestion and Absorption | izv. prof. dr. sc. Daria Pašalić |
| | 10:45-11:30; MEF Kemija prizemlje | | Lectures | Proteins: Posttranslational Modifications, Targeting (Traffic and Sorting) and Degradation. | izv. prof. dr. sc. Daria Pašalić |
| | 12:30-16:15; MEF Kemija laboratorij | | Practicum | Selected Methods of Separation and Detection of Biomolecules Derived from Biological Materials. | dr. sc. Dragana Fabris, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić, dr. sc. Kristina Mlinac Jerković |
| Tuesday 6.12.2016. | 10:00-11:30; MEF Mašek | | Lectures | Metabolism of Amino Acids and Proteins: an Overview. | izv. prof. dr. sc. Željka Vukelić |
| | 12:00-13:30; MEF Kemija prizemlje | | Seminar | Catabolism of Proteins and of Amino Acid Nitrogen. Fates of Amino Groups. Urea Cycle. Related Disorders. | dr. sc. Kristina Mlinac Jerković, izv. prof. dr. sc. Daria Pašalić |
| Wednesday 7.12.2016. | 09:00-10:30; MEF Mašek | | Seminar | Catabolism of the Carbon Skeleton of Amino Acids. | izv. prof. dr. sc. Daria Pašalić, prof. dr. sc. Svjetlana Kalanj-Bognar |
| | 11:00-11:45; MEF Mašek | | Seminar | Synthesis of Nutritionally Nonessential Amino Acids. | izv. prof. dr. sc. Daria Pašalić, izv. prof. dr. sc. Željka Vukelić |
| | 13:00-16:45; MEF Kemija laboratorij | | Practicum | Urine Analysis. | dr. sc. Dragana Fabris, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić, izv. prof. dr. sc. Daria Pašalić, dr. sc. Kristina Mlinac Jerković |
| Thursday 8.12.2016. | 10:00-11:30; MEF Kemija prizemlje | | Seminar | Biomolecules Derived from Amino Acids. Porphyrins and Bile Pigments. Creatine Phosphate and Creatinine. Glutathione. Biological Amines (Neurotransmitters). Nitric OxideE | dr. sc. Kristina Mlinac Jerković, dr. sc. Dragana Fabris |
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| Date | Time | Group | Course hours type | Theme | Teaching staff |
|---|---|---|---|---|---|
| | 12:30-16:15; MEF Kemija laboratorij | | Practicum | Porphyrins, Hemoglobin and Bile Pigments. | dr. sc. Kristina Mlinac Jerković, izv. prof. dr. sc. Željka Vukelić, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Daria Pašalić, dr. sc. Dragana Fabris |
| Friday 9.12.2016. | 10:00-11:30; MEF Kemija prizemlje | | Seminar | Metabolism of Purine and Pyrimidine Nucleotides. | prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić |
| | 12:30-16:15; MEF Kemija laboratorij | | Practicum | Nucleotides and Nucleic Acids. | dr. sc. Kristina Mlinac Jerković, izv. prof. dr. sc. Daria Pašalić, dr. sc. Dragana Fabris, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić |
| Monday 12.12.2016. | 13:00-16:45; MEF Kemija laboratorij | | Practicum | Enzymes in Medicine | dr. sc. Kristina Mlinac Jerković, izv. prof. dr. sc. Željka Vukelić, prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Daria Pašalić, dr. sc. Dragana Fabris |
| Wednesday 14.12.2016. | 09:30-11:00; CEPAMED dvorana 1 | | Seminar | Hormones: Synthesis, a Way of Action, and Effects. | prof. dr. sc. Svjetlana Kalanj-Bognar, izv. prof. dr. sc. Željka Vukelić |
| | 11:30-13:00; CEPAMED dvorana 1 | | Lectures | Metabolic Pathways Interrelationships & Integration of Metabolism. | prof. dr. sc. Svjetlana Kalanj-Bognar |
| Thursday 15.12.2016. | 10:00-11:30; MEF (C) - Šercer | | Lectures | The Feeding-Fasting Cycle. Metabolism in Starvation. Glucose Homeostasis. Metabolism in Diabetes. | izv. prof. dr. sc. Daria Pašalić |
| | 12:30-13:15; MEF (C) - Šercer | | Seminar | Nutritional Requirements and Principles. | dr. sc. Dragana Fabris, izv. prof. dr. sc. Željka Vukelić |
| Friday 16.12.2016. | 10:00-11:30; MEF (C) - Šercer | | Seminar | The Tissue Division of Labor. | izv. prof. dr. sc. Željka Vukelić, dr. sc. Dragana Fabris |
| | 12:00-13:30; MEF (C) - Šercer | | Seminar | Regulation of the Cell Cycle. Oncogenes, Tumor Suppressor Genes and Apoptosis. (Malignant Transformations.) | dr. sc. Dragana Fabris, dr. sc. Kristina Mlinac Jerković |
| Monday 19.12.2016. | 12:00-13:00; MEF Čačković | SVI | Exam | 2nd Control Test | izv. prof. dr. sc. Željka Vukelić |
| Friday 13.1.2017. | 12:00-13:00; MEF Čačković | SVI | Exam | Exam | izv. prof. dr. sc. Željka Vukelić |

**Department of Chemistry and Biochemistry**

Lectures will take place in hall:

Seminars will take place in hall:

## IV. EXAMINATIONS

**B. Types of examination and examination dates:**

1. Two partial tests (during the course);

2. Final written exam;

| **Regular terms** | **Date** |
|---|---|
| Winter | January 13th, 2017 |
| Summer | June 30th, 2017 |
| | July 14th, 2017 |
| Autumn | September 1st, 2017 |
| | September 15th, 2017 |

**V./I. LIST OF LECTURERS AND TEACHING STAFF**

1. izv. prof. dr. sc. Željka Vukelić
2. prof. dr. sc. Svjetlana Kalanj-Bognar
3. izv. prof. dr. sc. Daria Pašalić
4. dr. sc. Kristina Mlinac Jerković
5. dr. sc. Dragana Fabris

**V./II EXTERNAL ASSOCIATES:**

**V./III UNTENURED LECTURERS:**

**VI. LITERATURE**

**A. Obligatory**

Selected chapters from:

1. Nelson D.L. and Cox M.M.: Lehninger Principles of Biochemistry. 5th Ed., W.H. Freeman (Publisher), 2008; or 4th Ed., Worth Publishers, 2005.

2. McKee T. and McKee J.R.: Biochemistry: The Molecular Basis of Life. 4th Ed., Oxford University Press, 2009.

**B. Additional**

Selected chapters from:

1. Devlin T.E. Ed.: Textbook of Biochemistry with Clinical Correlations. 6th Ed., Wiley-Liss, 2006.

2. Murray R.K., Bender D.A., Botham K.M., Kennelly P.J., Rodwell V.W., and Weil P.A. (Eds): Harper's Illustrated Biochemistry, 28th Ed., The McGraw-Hill Companies, 2009; or 27th Ed., 2006.