REQUIREMENTS

Semmelweis University, Faculty of Dentistry

Name of the course: Medical chemistry

Credit value: 4

Lessons *(in hours)*: 56 **lectures:** 28 **practicals:** 28 **seminars: –**

Type of the course: **compulsory** **obligatory elective** **elective**

Frequency of announcement *(per semester or year)*: per year

Academic year: 2022/23/1

Subject code[1]: FOKOMBT304_1A

Lecturer of the course: Csaba Sőti MD, PhD

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The goals of the course in point of view of the education:
The principal aim of the course is to prepare students for the understanding of the subjects of Biochemistry, Molecular cell biology, Physiology and Pharmacology. This requires a firm knowledge of the foundations of general, organic and inorganic chemistry.

Location of the course *(address of lecture hall, seminar room etc.)*:
EOK, 1094 Budapest, Tűzoltó utca 37-47.; Chemistry lab rooms #1-5

Competences acquired by completion of the course:
The role of the subject in the preclinical studies is to summarize that basic knowledge, which is fundamental for understanding molecular biological and biochemical processes in humans under physiological and pathological conditions.

Pre-study requirements and prerequisites of course registration and completion:
This is a subject in the first semester, there is no pre-study requirement.

Number of students required for announcement of course *(min., max.)*: Max.: 108 students

Method of course registration: Neptun

Detailed course/lecture description[2]: *(to facilitate credit recognition in other institutions)*

General chemistry:

1. Secondary bonds and interactions (Miklós Csala)
2. Chemical equilibria (Miklós Csala)
3. Acid-base theories, pH (Miklós Csala)
4. pH of strong or weak acids and bases (Miklós Csala)
5. The theory of buffers (Veronika Zámbó)
6. Buffers of physiological importance, cation and anion hydrolysis, pH of salt solutions (Gábor Bőgel)
7. Solubility of salts and bases, the solubility product (Farkas Sarnyai)
8. Laws of dilute solutions. Specific and equivalent conductivity (Gergely Keszler)
9. Thermodynamics 1 – Enthalpy (Miklós Csala)
10. Thermodynamics 2 – Entropy (Miklós Csala)
11. Thermodynamics 3 – Direction of reactions (Miklós Csala)
12. Electrochemistry 1 (Miklós Csala)
13. Complex compounds, reactive oxygen species (Péter Szelényi)

Organic chemistry:

14. Nomenclature of organic compounds, constitution of organic compounds (Zsolt Rónai)
15. Configuration and conformation of organic compounds (Zsolt Rónai)
16. Classification and reactions of hydroxyl compounds (Gergely Keszler)
17. Classification and reactions of oxo compounds (Gergely Keszler)
18. Structure, function and reactions of organic acids (Szabolcs Sipeki)
19. Nitrogen-containing organic compounds (Szabolcs Sipeki)

20. Sulfur or phosphorus-containing organic compounds (Szabolcs Sipeki)

Practices:

1. Introduction, acid-base titration 1 (titration of strong acids) ***(4×45 min)***
2. Acid-base titration 2 (titration of weak acids). Relationship between conductivity and dissociation ***(4×45 min)***
3. Titration curves, consultation (buffers) ***(4×45 min)***
4. Electrochemistry, consultation ***(4×45 min)***
5. Permanganometry ***(4×45 min)***
6. Determination of the ionization constant of phenol red by photometry ***(4×45 min)***
7. Complexometry. Precipitation titration ***(4×45 min)***

Courses *(obligatory and elective)* which in part or entirely overlap the topics of above course:
The thematic deliberately overlaps with that of Basics of medical chemistry elective subject. The latter is offered for the students with various levels of former knowledge in chemistry to help them understand the material of the compulsory subject.

Special academic work required for completion of the course[3]:
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Attendance on practices and lectures, replacement in case of missed sessions:
Attendance of at least 75% of the practical lessons is obligatory.

Consequences of absence from sessions and exams:
Attendance of at least 75% of the practical lessons is required for getting signature.

Method of checking acquired knowledge during the study period[4]:
Optional written midterm test (30 min on week 13, about the laboratory measurements during the semester. Performance at the laboratory work during the whole semester is also taken into account at the evaluation.

Requirements of an accepted semester *(signature of the lecturer)*:
Attendance of at least 75% of the practical courses is required for getting signature.

Type of the exam: written + oral

Requirements of the exam[5]:

I. General chemistry

1. The covalent bond, the molecular geometry of inorganic molecules (e.g. carbon monoxide, carbon dioxide, ammonia). Ionization energy, electron affinity, electronegativity. The ionic bond, hydroxylapatite and fluoroapatite
2. The structures of polyatomic ions, the complexes
3. The secondary bonds and intearctions between molecules
4. Laws of dilute solutions: vapor pressure, freezing point depression, boiling point elevation
5. The phenomenon of osmosis, its biological significance, isotonic, hypotonic and hypertonic solutions
6. Chemical equilibria, the equilibrium constant and the degree of dissociation, their correlation. The Le Châtelier principle (example: formation, properties, salts, practical use of hypochlorous acid.)
7. Gas mixtures: partial pressure, volume %. The composition of the air. Dissolution of gases in liquids, Henry's law, the decompression sickness
8. The structure and dissociation of water. Acid-base theories. The pH and pOH concept, calculation of the pH of strong acids or bases, and their titration curves. Acid-base indicators
9. The dissociation of weak acids and bases, the concept of specific and equivalent conductivity, their correlations with the dissociation. Titration curves of weak acids
10. The buffers: principle, mechanism of action, calculation of the pH. The titration curves of polyprotic acids (phosphoric acid)
11. Buffers of physiological importance
12. The first law of thermodynamics. Heat of reaction, combustion heat, heat of formation. Hess' law
13. The second law of thermodynamics. The direction of the chemical reactions, Gibbs free energy
14. Oxidation, reduction, oxidation number, standard reduction potential
15. The galvanic cells: arrangement, reactions, calculation of the electromotive force
16. Types of electrodes, redox systems of biological importance
17. The concentration cells, the principle of measuring the pH

II. Organic chemistry

18. The concept of isomerism, types of structural isomerism, nomenclature of organic compounds
19. Geometric isomerism in unsaturated and cyclic compounds
20. Stereoisomerism, chiral compounds, optical activity, D–L and R–S nomenclature
21. Conformations of organic compounds, examples with open chain and cyclic molecules
22. Properties and reactions of alkenes

23. Characteristics, reactions and biological roles of aromatic compounds
24. Alcohols, enols, phenols
25. Oxo compounds: aldehydes and ketones. Their chemical reactions, the mechanism of the nucleophilic addition. Oxo-enol tautomerism
26. Properties and reactions of compounds containing a carboxyl group
27. Substituted carboxylic acids (Halogenated, oxo-, hydroxy-; aromatic; mono-, di- and tricarboxylic acids)
28. Nitrogen-containing organic compounds: classification and properties of amines
29. Carboamides, amides of the carbonic acid, imines

III. Laboratory

30. Principle of concentration determination by volume measurement: titrations
31. Titration of strong acids and bases
32. Titration of weak acids and bases
33. Conductivity measurement, determination of weak acid dissociation
34. Titration of gastric juice
35. Titration curves of mono- and polyprotic acids
36. Titration based on redox reaction: permanganometry
37. Complexometry: determination of copper concentration
38. Electrochemical measurements: the Daniell cell, concentration cell, redox and non-polarizable electrodes
39. Principle of spectrophotometry, areas of application: determination of the K_d value of the phenol red indicator
40. Precipitation titration

Grading of courses[6]:
The oral and written exam is based on the topic list announced in the beginning of the semester, and it takes place before a committee of two (examiner and co-examiner). The exam can be passed if all these topics are sufficiently answered. Students pick 3 questions (general chemistry, organic chemistry, practice) and a calculation problem to be solved in writing. Students, who achieve at least 12 points at the practical midterm and at the labs during the semester, get exempted from picking the practical question. The bonus is valid during the whole exam period (in case of an unsuccessful exam).

Exam registration: Neptun

Rules of repeating exams: According to general regulation

List of textbooks, lecture notes and recommended textbooks:
Ebbing-Gammon: General Chemistry, latest edition
Hrabák-Csermely-Bauer: Principles of Organic Chemistry (2nd edition, 2007, editor: A. Hrabák)
Sasvári: Bioorganic compounds
Tóth: Concise inorganic chemistry for medical students
Hrabák: Laboratory Manual – Medical Chemistry, Biochemistry and Molecular Biology (fourth edition, 2015)
Hrabák: Selected Collection of Chemical Calculations and Biochemical Exercises (latest edition)
E-learning system (Moodle)

Signature of course lecturer:

Signature of head of department:

Date of submission: 9/5/2022

Opinion of OKB:

Notes from the Dean's Office:

Signature of Dean:

[1] Filled out by the Dean's Office following approval
[2] Detailed and numbered for each week of theoretical and practical lessons one by one, indicating the names of lecturers and instructors
[3] Eg. field practice, medical chart analysis, survey conducting, etc.
[4] Eg. homework, report, midterm exam etc. Topics, dates, method of retake and replacement.
[5] List of topics in case of theoretical exam, thematic and method in case of practical exam.
[6] Method of inclusion of theoretical and practical exams. Method of inclusion of midterm assessments.