COURSE INFO - *BIOCHEMISTRY WITH CHEMISTRY*

The course consists of:

- lectures (76 h)
- recitations (review sessions, discussions on exams) (48 h)
- experimental labs and computer modeling (54h)
- partial exams and final exam (12 h)

LECTURES:
Outlines and presentations (PDF files) can be found at: http://www.medschool.cm-uj.krakow.pl (Syllabi & Course Materials → Biochemistry with Chemistry 1st year, 6-year program.

SEMINARS AND RECITATIONS

Topics for seminars will be provided earlier (on the school website). At the end of the eleven seminars (marked Q) the students will be subjected to a closing test covering the topics of each seminar (multiple-choice questions or open questions, graded from 0 - 5 points included in the total number of points for the Biochemistry course). During the second semester, each student will prepare a Power Point presentation on a chosen topic (graded from 0 - 5 points, added to the total number of points collected during the Biochemistry course). List of presentation topics will be available on the School website.

Seminars are compulsory – **maximum two absences per year** are allowed to receive credit for the course.

LABORATORIES include: **Computer modeling (CM)** and **Experimental labs (EL).** The labs are **compulsory – maximum two absences per year** are allowed to receive credit for the course.

- **CM** (2 in the 1st semester) **evaluation**: up to 4 points per lab included into the total points collected during the course of Biochemistry.

- **Experimental labs**:

1) **Lab Manuals** and **Lab Reports** will be provided earlier and all students are obliged to have them during the Lab.
2) Students are also obliged to bring, graph paper, calculator, pencil and a ruler. It is mandatory to use lab coats during the laboratory.
3) On the laboratory classes - using cell phones, tablets or PCs is not allowed. To perform any calculations, student should have normal calculator.
4) You are required to complete your report before the end of the lab and hand it to the teacher.
5) If you cannot attend your lab, for an important reason (illness, participation in competitions organized by the Department or the University), you can contact the responsible teacher (dr Dulińska-Litewka (mblitewk@cyf-kr.edu.pl) and **get the permission** of attending the lab with the other group.
6) **Labs evaluation:** up to 4 points per lab (2 points from the short test and 2 from lab reports) included into the total points collected during the Biochemistry course.

In laboratories long lab coats and closed shoes (protecting from spills and broken glass) are required - to maintain the cleanliness of the lab external shoes must be changed. Gloves are provided in the labs and should be worn when working with hazardous chemicals. Ask the lab staff if you do not find suitable gloves stocked in your classroom.

GRADING:
Four regular exams (multiple choice tests, 50 questions) will be organized during the year. **Final exam** (multiple choice test, 100 questions) will be held at the end of the course and will cover the whole course including the theoretical basis of experimental labs. During the entire course, a student can

accumulate jointly for the laboratory classes, seminars and exams up to 411 points (100%). A student, who accumulated 247 points (60%) will receive the credit for the course and numbers of the points accumulated during the entire academic year will be converted to a grade according to a straight percentage scale. The following percentage scale will serve as a guideline for grade assignment (however, the scale might be adjusted to take into account exam difficulty and overall class performance):
> 85 - very good (5.0)
81 – 85% - good plus (4.5)
76 – 80 % - good (4.0)
71 – 75 % - satisfactory plus (3.5)
60 – 70 - satisfactory (3.0)

To pass the makeup exam you will have to get minimum 60% points from the test (multiple choice test, 100 questions, 1 point each).

COURSE TEXTBOOKS

- **RECOMMENDED**

1. Chemistry, International Student Version, 6^{th} – 7^{th} edition, James E. Brady, Neil D. Jespersen, Alison Hyslop.

2. Marks' Basic Medical Biochemistry: A Clinical Approach By Michael Lieberman Allan Marks, (2013)

- **SUPPLEMENTARY**

1. Harper's Biochemistry, 30th edition (2015), by Robert K. Murray, D. K. Granner, P. A. Mayes, V. W. Rodwell
2. Lippincott's Illustrated Reviews: Biochemistry, by Pamela C Champe, R A Harvey, D R Ferrier **(2014)**
3. Organic Chemistry – a short course. 10-13^{th} edition **(2011**) by Harold Hart, Leslie E. Craine and David J.Hart

Contact information

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Office hours: by arrangement

Course Title: Biochemistry with Chemistry
Coordinator /contact: Dr hab. Maria Wróbel /e-mail: mbwrobel@cyf-kr.edu.pl
Responsible person/contact: Dr hab. Maria Wróbel /e-mail: mbwrobel@cyf-kr.edu.pl
Address: Chair of Medical Biochemistry, Kopernika 7
Year: 1-6
Total number of hours: **190**
Lectures: **76**
Seminars: **30**
Labs/Practicals: **54**
Others (e.g. recitation): **18**
Exams: **12**

Conduct/Dress Code: **white coat (labs)**

Student's Evaluation:
- grading scheme: Students have to achieve 60% of total points (MCQ tests: partial, final and labs)
- absence allowed: labs - 1 per each semester
- type of the final crediting: MCQ test – June 9, 2017
- retake information: MCQ test – September 25, 2017

ECTS: 13

3rd week Sep 19-23	Tu	10:15-12:30	Preliminary course in Chemistry Rec.1	3	Gr. A,B,C,D E,F,G H,I,J	Basic concepts of chemistry: Periodic table of elements, elements, atomic number and mass of elements. Definitions: Dalton, Mole, molar mass, calculations the molar mass of: molecules, ions and compounds. The rules of naming acids, bases and salts	dr Sławomir Olszowski dr Barbara Stopa dr D. Ciołczyk-Wierzbicka	CH r.5 r.8
	Th	10:15-12:30	Preliminary course in Chemistry Rec.2	3	Gr. A,B,C,D E,F,G H,I,J	Percentage % and molar concentrations – calculations. Dilution. Dilution factor and Mixing rule ("Rule of the Cross"). Concentrations – recalculations: M, mM and μM. Calculation of products concentrations in reaction mixtures. Logarithms – calculations	dr J. Dulińska-Litewka dr D. Ciołczyk-Wierzbicka dr Sławomir Olszowski	CH r.5 r.8
4th Sep 26-30	Tu	10:15-12:30	Preliminary course in Chemistry Rec. 3	3	Gr. A,B,C,D E,F,G H,I,J	Chemical equilibria. Chemical equilibrium, equilibrium law(expression), equilibrium constant. Le Chatelier's Principle. Weak and strong electrolytes. Ionic equilibria: a. Ionic equilibria – dissociation reactions. Brönsted-Lowry concept of acids and bases. Acid-base conjugated pair. Strong and weak acids and bases. Dissociation constants of weak acids (Ka) and bases (Kb). pK. b. Water dissociation. Ion product of water. pH concept. pH calculations. c. Percentage dissociation α.	dr Barbara Stopa dr Sławomir Olszowski dr J. Dulińska-Litewka	CH r.5 r.8
	Th	10:15-12:30	Preliminary course in Chemistry Rec.4	3	Gr. A,B,C,D E,F,G H,I,J	1. Naming hydrocarbons (IUPAC). Alkanes, alkenes alkynes, cycloalkanes, cycloalkenes, aromatic compounds, halogen substitutions, alcohols, ketons, thiols, aldehydes and carboxylic acids, esters, ethers, thioeters. 2. Selected reactions of alkanes, alkenes, alkynes and aromatic compounds: a. Products of substitution and elimination reactions - organic halides, b. Electrophilic addition to alkenes (addition of unsymmetric reagents to alkens; Markownikov's rule), c. aromatic substitution, d. Alcohols - dehydratation, oxidation and ester formation, e. Alcohols - addition reaction to the carbonyl group – hemiacetal, f. Thiols (oxidation to disulphide or sulfo derivatives)	dr D. Ciołczyk-Wierzbicka dr Barbara Stopa dr J. Dulińska-Litewka	CH r.5 r.8
5th week	Tu	12.00-13.45	Lec 1	2	Whole	**Water as a solvent. Weak interactions in aqueous solutions.** Composition of body fluids. The	dr S. Olszowski	LH

Oct 3-7					class	four organic basic elements, essential dietary minerals and microelements. Weak interactions in water solutions – hydrogen bond, hydrophobic and van der Waals interactions – examples of biological importance. Water as a reactant – hydrolysis reactions . Electronegativity of elements. Polar and nonpolar molecules. Electrostatic interactions of water. The fitness of the aqueous environment for living organisms. Semipermeable membranes – osmotic and oncotic pressure. Colloidal solutions. Osmotic pressure and Donnan Membrane Equilibria.		
		14.00-15.30	sem1	2	Gr.E,F	**Typical organic reactions. Carbocations, carboanions and free radicals. Nucleophiles and electrophiles. Isomers** – classification and examples constitutional (tautomerisation of carbonyl compounds) and stereoisomers (conformational and configurational /enantiomers, diastereomers and cis-trans isomers/). Naming (chemical and **common names)** and **characteristic reactions** of simple organic **alcohols, thiols, aldehydes and carboxylic acids**.(Alcohols - dehydratation, dehydrogenation and esterification reactions with oxoacids or carboxylic acids. Oxidations of thiols. Alcohols - addition reaction to the carbonyl group – hemiacetal, acetal. Aldol condensation.) **Aromatic compounds –** definition and properties. Q	dr B. Stopa	room 5
					Gr.G,H		dr S. Olszowski	room 8
					Gr. I,J		dr J. Dulińska-Litewka	CH
	Th	11.45-13.15	sem 1	2	Gr. A,B	**Typical organic reactions. Carbocations, carboanions and free radicals. Nucleophiles and electrophiles. Isomers** – classification and examples constitutional (tautomerisation of carbonyl compounds) and stereoisomers (conformational and configurational /enantiomers, diastereomers and cis-trans isomers/). Naming (chemical and **common names)** and **characteristic reactions** of simple organic **alcohols, thiols, aldehydes and carboxylic acids**.(Alcohols - dehydratation, dehydrogenation and esterification reactions with oxoacids or carboxylic acids. Oxidations of thiols. Alcohols - addition reaction to the carbonyl group – hemiacetal, acetal. Aldol condensation.) **Aromatic compounds –** definition and properties. Q	dr B. Stopa	room 5
					Gr.C,D		dr S.Olszowski	Room 8
	Fr	10.00-13.00	Lab 1	4	Gr. A	**Safety regulations for laboratory classes. Calculations:** molar and percent concentration of a solution, preparing a solution of known molarity by dilution. **Absorption spectroscopy.**	dr S. Olszowski	lab 1
					Gr. B		dr B. Stopa	lab 2
					Gr. C		dr J. Dulińska-Litewka	lab 3
					Gr. D		dr D. Ciołczyk-Wierzbicka	lab 4
6th week Oct 10-14	Mo	12.15-13.45	Lec 2	2	whole class	**Ionic equilibria.** Water dissociation. pH concept. Brönsted-Lowry concept of acids and bases. Acid-base conjugated pair. Strong and weak acids and bases. Dissociation constants of weak acids (K_a) and bases (K_b). Buffer solutions. Henderson-Hasselbalch equation. **Basics of pH and water homeostasis in human organism.** Buffer solutions – mechanism of action. Biological buffer systems (bicarbonate, phosphate, ammonia and protein). Bicarbonate buffer – components, pH. Normal ranges of bicarbonate buffer parameters in blood. Carbon dioxide transport in blood. Oxygen transport - role of hemoglobin. Regulation of bicarbonate concentration – role of kidneys. Simple acid – base disorders.	dr B. Stopa	LH
	Tu	12.00-13.45	Lec 3	2	whole class	**Basics of thermodynamics. Spontaneity of chemical reactions.** Enthalpy change ΔH Bond energies (enthalpies). The 1st law of thermodynamics. Entropy change ΔS. The 2nd law of thermodynamics. ΔG^o and equilibrium constant. Spontaneity of chemical reactions - ΔG. The free energy change and the equilibrium constant. Biological standard conditions. Coupled reactions. ATP. High-energy phosphates. **Oxidation – reduction reactions.** Oxidation, reduction – definitions. Oxidation numbers. Galvanic cells. Standard and biological standard reduction half-cell potentials. Half-cell potentials under nonstandard conditions - Nernst equation.	dr S. Olszowski	CH
		14.00-15.30	sem 2	2	Gr. E,F	**Ionic equilibria**. Slightly soluble salts - solubility product constant K_{sp} and solubility calculations. Common ion effect. **Buffers.** Buffer solutions-definition and examples. Henderson - Hasselbach equation. Buffer capacity and pH calculations. **Protein ligand complexes formation – calculation of dissociation constants.** Q	dr B. Stopa	room 5
					Gr.G,H		dr S. Olszowski	room 8
					Gr. I,J		dr D. Ciołczyk-Wierzbicka	CH
		16.45-19.45	Lab 1	4	Gr. E	**Safety regulations for laboratory classes. Calculations:** molar and percent concentration of a solution, preparing a solution of known molarity by dilution. **Absorption spectroscopy.**	dr J. Dulińska-Litewka	lab 2
					Gr. F		dr D. Ciołczyk-Wierzbicka	lab 4

	Th	11.45-13.15	sem 2	2	Gr. A,B	**Ionic equilibria**. Slightly soluble salts - solubility product constant K_{sp} and solubility calculations. Common ion effect. **Buffers.** Buffer solutions-definition and examples. Henderson & Hasselbach equation. Buffer capacity and pH calculations. **Protein ligand complexes formation – calculation of dissociation constants.** Q	dr S. Olszowski	room 5
					Gr.C,D		dr J. Dulińska-Litewka	room 8
	Fr	10.00-13.00	Lab 1	4	Gr.G	**Safety regulations for laboratory classes. Calculations:** molar and percent concentration of a solution, preparing a solution of known molarity by dilution. **Absorption spectroscopy.**	dr S. Olszowski	Lab 1
					Gr. H		dr B. Stopa	lab 2
					Gr. I		dr J. Dulińska-Litewka	lab 3
					Gr. J		dr B. Ostrowska	lab 4
7th week Oct 17-21	Mo	12.15-13.45	Lec 4	2	Whole class	**Proteins I.** Folding of proteins and levels of their organization. Globular and fibrous proteins. Connective tissue proteins. Collagen. Diseases of collagen synthesis. Protein structure-function relationship. Conformational diseases – amyloidoses, prion diseases.	Dr. Barbara Piekarska	CH
	Tu	12.00-13.45	Lec 5	2	Whole class	**Proteins II.** Physicochemical properties of proteins in solution. Protein stability and denaturation. Methods of protein separation and analysis. Serum proteins. Plasma proteins in diagnosis of diseases. Lipoproteins and glycoproteins.	Dr. Barbara Piekarska	CH
		14.00-15.30	sem 3	2	Gr. E,F	**Amino acids**. Aliphatic and aromatic amines. Amines as bases. Addition to aldehydes – Schiff base formation. Amino acids - classification. Acid-base properties of amino acids – predominant ionic forms at different pH. Isoelectric point – calculations. Peptide bond. Peptides and proteins. Levels of protein structure. Stabilization of protein structure. Isoelectric point of peptides and proteins. Q	dr D. Ciołczyk-Wierzbicka	r. 5
					Gr.G,H		dr S. Olszowski	r. 8
					Gr. I,J		dr J. Dulińska-Litewka	CH
	Th	11.45-13.15	sem 3	2	Gr. A,B	**Amino acids**. Aliphatic and aromatic amines. Amines as bases. Addition to aldehydes – Schiff base formation. Amino acids - classification. Acid-base properties of amino acids – predominant ionic forms at different pH. Isoelectric point – calculations. Peptide bond. Peptides and proteins. Levels of protein structure. Stabilization of protein structure. Isoelectric point of peptides and proteins. Q	dr S. Olszowski	r. 5
					Gr.C,D		dr B. Stopa	r. 8
	Fr	10.00-13.00	Lab 2	4	Gr.A	**Acids, bases and buffers. pH meter – basis of action. Potentiometric titration of a strong / weak acid**.	Dr D. Gil	Lab 1
					Gr.B		dr B. Stopa	lab 2
					Gr.C		dr J. Dulińska-Litewka	lab 3
					Gr.D		dr D. Ciołczyk-Wierzbicka	lab 4
8th week Oct 24-28	Mo	12.15-13.45	Lec 6	2	Whole class	**Proteins III**. Heme proteins: myoglobin, hemoglobin, cytochromes. Pathological hemoglobins.	Dr. B. Piekarska	CH
	Tu	12.00-13.45	Lec 7	2	Whole class	**Basis of chemical kinetics.** Definition of a reaction rate. Rate law, rate constant and rate order. Factors affecting reaction rates (c, T, pH). Arrhenius equation. Collision theory and Transition State theory. Activation energy. Reaction mechanism. Integrated rate law for 1st order reaction – half-life. Progress curve. Catalysis – examples of inorganic catalysts. Biocata/ysts.	Dr J. Dulińska-Litewka	CH
		14.00-15.30	sem 4	2	Gr. E,F	**Basics of thermodynamics. Spontaneity of chemical reactions. Chemical kinetics.** Spontaneity of chemical reactions - ΔG . Calculations of the **free energy change** under standard (ΔG^{o}), biological standard ($\Delta G^{o'}$) and nonstandard conditions (ΔG). ΔG^{o} and equilibrium constant K. Calculations of K and concentrations at equilibrium from thermodynamic data (entalphy ΔH, entropy ΔS etc). Definition of a reaction rate. Rate law, rate constant and rate order. Factors affecting reaction rates. Reaction rate theories. Activation energy. Reaction mechanism. Determination of the reaction order and the rate low and from experimental data. Integrated rate law for 1st order reaction – half-life. Progress curve. Calculations. Q	dr B. Stopa	r. 5
					Gr.G,H		dr S. Olszowski	r. 8
					Gr. I,J		dr J. Dulińska-Litewka	CH
		16.45-19.45	Lab 2	4	Gr. E	**Acids, bases and buffers. pH meter – basis of action. Potentiometric titration of a strong / weak acid**.	Dr D. Gil	lab 2
					Gr. F		dr S. Olszowski	lab 4
	Th	11.45-13.15	sem 4	2	Gr. A,B	**Basics of thermodynamics. Spontaneity of chemical reactions. Chemical kinetics.** Spontaneity of chemical reactions - ΔG . Calculations of the **free energy change** under standard (ΔG^{o}), biological standard ($\Delta G^{o'}$) and nonstandard conditions (ΔG). ΔG^{o} and equilibrium constant K.	dr J. Dulińska-Litewka	r. 5
					Gr.C,D		dr S. Olszowski	CH

						Calculations of K and concentrations at equilibrium from thermodynamic data (entalphy ΔH, entropy ΔS etc). Definition of a reaction rate. Rate law, rate constant and rate order. Factors affecting reaction rates. Reaction rate theories. Activation energy. Reaction mechanism. Determination of the reaction order and the rate low and from experimental data. Integrated rate law for 1st order reaction – half-life. Progress curve. Calculations. Q		
	Fr	10.00-13.00	Lab 2	4	Gr. G	**Acids, bases and buffers. pH meter – basis of action. Potentiometric titration of a strong / weak acid**.	Dr S. Olszowski	lab 1
					Gr. H		dr D. Gil	lab 2
					Gr. I		dr J. Dulińska-Litewka	lab 3
					Gr. J		dr D. Ciołczyk-Wierzbicka	lab 4
9th week Nov 2-4 We-Fr						----------		
	Fr	10.00-13.00	Lab 3	4	Gr. G	**Amino acids and proteins.** Paper chromatography of amino acids. Calculating pI of peptides and proteins using computer program. Characteristic reactions of amino acids. Dialysis.	dr S. Olszowski	lab 1
					Gr. H		dr B. Stopa	lab 2
					Gr. I		dr. J. Dulińska-Litewka	lab 3
					Gr. J		dr B. Ostrowska	lab 4
10th week Nov 7-10 Mo-Th	Mo	12.00-13.45	Lec 8	2	Whole class	**Enzymes I.** The protein catalysts of cells. Chemistry of the active site. Coenzymes. Classifications of enzymes.	Prof. Laidler/dr. Maria Wróbel	LH
	Tu	12.00-13.45	Lec 9	2	Whole class	**Enzymes II.** Enzyme specificity and catalytic power. Michaelis-Menten and allosteric kinetics. Inhibition of enzyme activity. Drugs as specific inhibitors of enzymes.	Prof. Laidler/dr. Maria Wróbel	LH
		14.00-16.15	Lab 4	3	Gr. E,F	Computer modeling. Proteins.	Mgr Mateusz Banach	
					Gr G,H		dr Monika Piwowar	
		16.30-18.45	Lab 4	3	Gr. A,B	Computer modeling. Proteins.	Mgr Mateusz Banach	
					Gr. C,D		dr Monika Piwowar	
		16.45-19.45	Lab 3	4	Gr. E	**Amino acids and proteins.** Paper chromatography of amino acids. Calculating pI of peptides and proteins using computer program. Characteristic reactions of amino acids. Dialysis.	dr. J. Dulińska-Litewka	lab 2
					Gr. F		dr S. Olszowski	lab 4
11th week Nov 14-18	Mo	12.15-13.45	Lec 10	2	Whole class	**Enzymes III.** Mechanism of enzyme catalysis (lysozyme, serine proteases, ribonuclease). Control of enzyme activity. Isoenzymes. Diagnostic enzymes.	Prof. Laidler/dr. Maria Wróbel	LH
	Tu	14.00-15.30	sem 5	2	Gr. E,F	**Case I.** Sickle cell anemia (supplementary materials on the website!) **Case II.** Acetylcholinesterase inhibition (supplementary materials on the website!).	dr D. Ciołczyk-Wierzbicka	r. 5
					Gr.G,H		dr J. Dulińska-Litewka	r. 8
					Gr.I,J		dr. D. Gil	CH
		16.30-18.45	Lab 4	3	Gr. I,J	Computer modeling. Proteins.	Mgr Mateusz Banach	
		16.45-19.45	Lab3	4	Gr. A	**Amino acids and proteins.** Paper chromatography of amino acids. Calculating pI of peptides and proteins using computer program. Characteristic reactions of amino acids. Dialysis.	dr S. Olszowski	lab 1
					Gr. B		dr D. Gil	lab 2
					Gr. C		dr. J. Dulińska-Litewka	lab 3
					Gr. D		dr D. Ciołczyk-Wierzbicka	lab 4
	Th	11.45-13.15	Sem 5	2	Gr. A,B	**Case I.** Sickle cell anemia (supplementary materials on the website!) **Case I,.** Acetylcholinesterase inhibition (supplementary materials on the website!).	dr. D. Gil	r. 5
					Gr.C,D		Dr J. Dulińska-Litewka	CH
	Fr	10.00-13.00	Lab 5	4	Gr. A	**Proteins.**	Dr A. Bentke	lab 1
					Gr. B		dr. D. Gil	lab 2
					Gr. C		dr H. Jurkowska	lab 3
					Gr. D		dr. K. Kocemba	Lab 4
12th								

week Nov 21-25	Tu	12.00-13.45	rec 5		Whole class	**Review**. Carbon compounds. Isomers. Water. Weak interactions in aqueous solutions. Covalent bonds. Ionic equilibria. pH Concept. Buffer solutions. Basics of thermodynamics. Basis of chemical kinetics. Amino acids, proteins and enzymes.	dr J. Dulińska-Litewka	CH
		16.45-19.45	Lab 5		Gr. E	**Proteins.**	Dr J. Dulińska-Litewka	lab 2
					Gr. F		dr. B.Piekarska	lab 4
	Fr	10.00-13.00	Lab 5	4	Gr. G	**Proteins.**	Dr. B. Piekarska	lab 1
					Gr. H		Dr A. Bentke	lab 2
					Gr. I		dr H. Jurkowska	lab 3
					Gr. J		dr. K. Kocemba	lab 4
13th week Nov 28-Dec 2	Mo	12.15-13.45	**Ex.1**	2	Whole class	**Test 1.** Carbon compounds. Isomers. Water. Weak interactions in aqueous solutions. Covalent bonds. Ionic equilibria. pH Concept. Buffer solutions. Basics of thermodynamics. Basis of chemical kinetics. Amino acids, proteins and enzymes.	dr B. Stopa dr J. Dulińska-Litewka	LH CH
	Tu	12.00-13.45	Rec2	2	Whole class	**Discussion on Exam I.**	dr J. Dulińska-Litewka	CH
		14.00-15.30	sem 6	2	Gr. E,F	**DNA chemical structure.** Physicochemical properties of DNA. DNA polymerases, endo- and exonucleases. **Q**	dr. Barbara Piekarska	r. 5
					Gr.G,H		dr K. Kocemba	r. 8
					Gr.I,J		dr. M. Wróbel	CH
		16.30-18.45	Lab 6	3	Gr. I,J	**Computer modeling.** Genomics	Dr Monika Piwowar	
		16.45-19.45	Lab 7		Gr. E	**Enzyme kinetics.**	dr H. Jurkowska	
					Gr. F		dr K. Kocemba	
	Th	11.45-13.15	sem 6	2	Gr. A,B	**DNA chemical structure.** Physicochemical properties of DNA. DNA polymerases, endo- and exonucleases. **Q**	dr. Barbara Ostrowska	r. 5
					Gr.C,D		dr. M. Wróbel	CH
	Fr	10.00-13.00	Lab 7		Gr. E	**Enzyme kinetics.**	Dr A. Bentke	
					Gr. H		dr. B. Piekarska	
					Gr. I		dr K. Kocemba	
					Gr. J		dr. Barbara Ostrowska	
14th week Dec 5-9	Mo	12.15-13.45	Lec 11	2	Whole class	**DNA I.** Watson and Crick model of DNA. Types of DNA structure (A, B and Z DNA). Viral, bacterial and eukaryotic DNA. Interaction of nucleic acids and proteins. Nucleosomes and higher order structures. Chromosome structure.	dr. M. Wróbel	LH
	Tu	12.00-13.30	Lec 12	2	Whole class	**DNA II.** Replication of DNA and its enzymatic machinery. Telomere maintenance. Cutting and joining DNA - restriction endonucleases, DNA ligases. Recombinant DNA molecules.	dr. M. Wróbel	LH
		14.00-16.15	Lab 6	3	Gr.A,B	**Computer modeling.** Genomics.	Dr Monika Piwowar	
	Fr	10.00-13.00	Lab 7	4	Gr. A	**Enzyme kinetics.**	Dr A. Bentke	
					Gr. B		dr. B. Piekarska	
					Gr. C		dr. G. Gil	
					Gr. D		dr. H. Jurkowska	
		12:45-15.00	lab 6	3	Gr.,G,F	**Computer modeling.** Genomics	Dr Monika Piwowar	
15th week Dec 12-16	Mo	12.15-13.45	Lec 13	2	Whole class	**Mutations** and DNA repair systems.	dr. M. Wróbel	LH
	Tu	12.00-13.45	Lec 14		Whole class	**RNA I.** Physicochemical and biological properties of RNA. Types of RNA: rRNA, mRNA, hnRNA, tRNA. Ribonucleoprotein particles. Levels of RNA organization - three-dimensional structure of RNA. Bacterial and eukaryotic RNA polymerases. DNA dependent synthesis of RNA.	dr. P. Laidler	CH

		14.00-16.15	Lab 6	3	Gr. C,D	**Computer modeling.** Genomics.	Dr Monika Piwowar	
		16.30-18.45	Lab 6	3	Gr.G,H		Dr Monika Piwowar	
	Th	11.45-13.15	sem 7	2	Gr. A,B	**Introduction to laboratories "From gene to protein".**	dr. D. Gil	ChMB r. 5
					Gr.C,D		Dr. H. Jurkowska	CH
	Fr	10.00-13.00	Lab 8	4	Gr. A	**Laboratories.** "From gene to protein" – part 1.	dr. A. Bentke	lab 1
					Gr. B		dr. D. Ciołczyk-Wierzbicka	lab 2
					Gr. C		dr. D. Gil	lab 3
					Gr. D		dr H. Jurkowska	lab 4
16th week Jan 9-13	Mo	12.15-13.45	Lec 15	2	Whole class	**RNA II.** Posttranscriptional processing of hnRNA. Transcription units. Inhibitors of transcription. RNA dependent synthesis of DNA. Regulation of transcription in Prokaryotes - the operon system.	dr. P. Laidler	CH
	Tu	12.00-13.45	Lec 16	2	Whole class	**Basic genetic engineering methods**: DNA sequencing, DNA amplification (cloning, PCR), genomic and cDNA libraries, DNA electrophoresis, blotting, detection (probes), RFLP.	dr. B. Piekarska	CH
		14.00-15.30	sem 7	2	Gr. E,F	**Introduction to laboratories "From gene to protein".**	dr. B. Piekarska	ChMB r. 5
					Gr.G,H		dr J. Dulińska-Litewka	ChMB r. 8
					Gr.I,J		dr. D. Gil	CH
		16.45-19.45	Lab 8	4	Gr. E	**Laboratories.** "From gene to protein" – part 1.	dr. J. Dulińska-Litewka	lab 2
					Gr. F		dr. B. Piekarska	lab 4
	Fr	10.00-13.00	Lab 8	4	Gr. G	**Laboratories.** "From gene to protein" – part 1.	dr. B. Ostrowska	lab 1
					Gr. H		dr. K. Kocemba	lab 2
					Gr. I		dr H. Jurkowska	lab 3
					Gr. J		dr. J. Dulińska-Litewka	lab 4
17th week Jan 16-20	Mo	12.15-13.45	Lec 17	2	Whole class	**Human Immunodeficiency Virus.** Structure, genome, infection cycle, reverse transcription. Detection tests. Antiretroviral drugs – nucleoside and non-nucleoside reverse transcriptase inhibitors, protease inhibitors.	dr. B. Piekarska	CH
	Tu	12.00-13.45	Lec 18	2	Whole class	**Protein synthesis.** Genetic code and its properties. The components of the protein biosynthesis apparatus. Initiation, elongation and termination of the peptide chain. Synthesis of short peptides.	dr. B. Piekarska	CH
		14.00-15.30	Sem 8	2	Gr.E,F	**Oxidation – reduction reactions.**	dr B. Stopa	room 5
					Gr.G,H	Oxidation, reduction – definitions. Oxidation numbers. Galvanic cell. Cell and half-cell potentials.	dr S. Olszowski	room 8
					Gr. I,J	Standard reduction half cell potentials E^0. Half-cell potentials under biological standard conditions ($E^{0\prime}$) and nonstandard conditions (E). Spontaneity of redox reactions. Calculation involving the Nernst equation (ΔE,K). Electron flow direction in respiratory chain reactions. Q	dr J. Dulińska-Litewka	CH
		16.45-19.45	Lab 9	4	Gr. E	**Laboratories.** "From gene to protein" – part 2.	dr. H. Jurkowska	lab 2
					Gr. F		dr B. Ostrowska	lab 4
					Gr. G		Dr A. Bentke	
					Gr.H		Dr. K. Kocemba	
	Th	11.45-13.15	Sem 8	2	Gr. A,B	**Oxidation – reduction reactions.**	dr S. Olszowski	room 5
					Gr.C,D	Oxidation, reduction – definitions. Oxidation numbers. Galvanic cell. Cell and half-cell potentials. Standard reduction half cell potentials E^0. Half-cell potentials under biological standard conditions ($E^{0\prime}$) and nonstandard conditions (E). Spontaneity of redox reactions. Calculation involving the Nernst equation (ΔE,K). Electron flow direction in respiratory chain reactions. Q	dr J. Dulińska-Litewka	room 8
	Fr	10.00-13.00	Lab 9	4	Gr. A	**Laboratories.** "From gene to protein" – part 2.	dr J. Dulińska-Litewka	lab 1
					Gr. B		dr. K. Kocemba	lab 2
					Gr. C		dr. D. Gil	lab 3
					Gr. D		dr D. Ciołczyk-Wierzbicka	lab 4

18th week Jan 23-27	Mo	12.15-13.45	Lec 19	2	Whole class	**Protein processing, targeting and degradation.** Posttranslational modifications. Synthesis of glycoproteins and the role of glycosylation in targeting of proteins. Inhibitors of protein biosynthesis. Mechanisms involved in protein degradation.	dr. B. Piekarska	CH
	Tu	12.00-13.45	Lec 20	2	Whole class	**Mitochondrial respiratory chain**. Mitochondrion as a power plant. Electron transport. Oxidative phosphorylation. Inhibitors of electron transport and oxidative phosphorylation. **The tricarboxylic acid cycle (TCA).** The concept of catabolism, sources of acetyl-CoA. Oxidative decarboxylation of alpha ketoacids. Reactions of citric acid cycle. Control of TCA. Anaplerotic reactions.	dr. B. Piekarska	CH
		14.00-15.30	rec 3	2	Gr.E,F	**Review.** Nucleic acids structure & metabolism. Protein biosynthesis and targeting.	dr. M. Wróbel	room 5
					Gr.G,H		dr. B. Piekarska	room 8
					Gr. I,J		dr J. Dulińska-Litewka	CH
		16.45-19.45	Lab 9		Gr.I	**Laboratories. "From gene to protein" – part 2.**	dr. H. Jurkowska	
					Gr.J		dr. B. Ostrowska	
	Th	11.45-13.15	rec 3	2	Gr. A,B	**Review.** Nucleic acids structure & metabolism. Protein biosynthesis and targeting.	dr. M. Wróbel	room 5
					Gr.C,D		dr. B. Piekarska	room 8
	Fr	10.00-13.00	Lab 10	4	Gr.E	**Laboratories.** "From gene to protein" – part 3.	dr K. Kocemba	lab 1
					Gr.H		dr. B. Ostrowska	lab 2
					Gr.I		dr. H. Jurkowska	lab 3
					Gr.J		dr D.Ciołczyk-Wierzbicka	lab 4
19th week Jan 30-Feb 3	Mo	12.15-13.45	**Ex. 2**	2	Whole class	**Test 2.** Nucleic acids structure & metabolism. Protein biosynthesis and targeting.	dr. B. Piekarska	LH
							dr. M. Wróbel	CH
	Tu	12.00-13.45	Rec 4	2	Whole class	**Discussion on Exam II.**	Dr. M. Wróbel	CH
	Fr	10.00-13.00	Lab 10	4	Gr. A	**Laboratories.** "From gene to protein" – part 3.	dr J. Dulińska-Litewka	lab 1
					Gr. B		dr. B. Ostrowska	lab 2
					Gr. C		dr D.Ciołczyk-Wierzbicka	lab 3
					Gr. D		dr H. Jurkowska	lab 4
		13.15-16.15	Lab 10	4	Gr. G	**Laboratories.** "From gene to protein" – part 3.	dr. D. Gil	lab 2
					Gr. F		dr J. Dulińska-Litewka	lab 4

Course Title: Biochemistry with Chemistry
Coordinator /contact: Dr hab. Maria Wróbel /e-mail: mbwrobel@cyf-kr.edu.pl
Responsible person/contact: Dr hab. Maria Wróbel /e-mail: mbwrobel@cyf-kr.edu.pl
Address: Chair of Medical Biochemistry, Kopernika 7
Year: 1-6
Total number of hours: **190**
Lectures: **76**
Seminars: **30**
Labs/Practicals: **54**
Others (e.g. recitation): **18**
Exams: **12**

Conduct/Dress Code: **white coat (labs)**

Student's Evaluation:
- grading scheme: Students have to achieve 60% of total points (MCQ tests: partial, final and labs)
- absence allowed: **labs - 1 per each semester**
- type of the final crediting: **MCQ test – June 9, 2016**
- retake information: **MCQ test – September 25, 2017**
ECTS: 13

20th week Feb 20-24	Mo	12.15-13.45	sem 9	2	Gr. A,B Gr.C,D	**Carbohydrates.** Definitions and classification. Monosaccharides. Fischer projection formulas. Chirality – L and D sugars. The cyclic hemiacetal structures of monosaccharides – Haworth projections. Pyranose and furanose structures. Anomers. Mutarotation. Epimers. Reduction and oxidation of monosaccharides. Glycosides. Derivatives of monosaccharides of biological importance. Disaccharides. Polysaccharides. Starch and glycogen. Glycosaminoglycans. Glycoproteins. Q	dr B. Stopa dr S. Olszowski (k) x2	room 5 CH
	Tu	12.00-13.45	Lec 21	2	Whole class	**Metabolic routes in organisms.** Overview of metabolic routes. Bioenergetics. Thermodynamics: free energy, chemical equilibria, group transfer potential. Phosphorylation at the substrate level. Coupling of the thermodynamically favourable and unfavourable reactions. Oxidation of NADH and $FADH_2$.	Dr. M. Wróbel	LH
		14.00-15.30	sem 9	2	Gr.E,F Gr.G,H Gr. I,J	**Carbohydrates.** Definitions and classification. Monosaccharides. Fischer projection formulas. Chirality – L and D sugars. The cyclic hemiacetal structures of monosaccharides – Haworth projections. Pyranose and furanose structures. Anomers. Mutarotation. Epimers. Reduction and oxidation of monosaccharides. Glycosides. Derivatives of monosaccharides of biological importance. Disaccharides. Polysaccharides. Starch and glycogen. Glycosaminoglycans. Glycoproteins. Q	dr B. Stopa dr S. Olszowski dr J. Dulińska-Litewka	room 5 room 8 CH
	Th	14.15-16.00	Lec 22	2	Whole class	**Carbohydrate metabolism I.** Digestion and absorption of carbohydrates from intestinal tract. Central role of G-6-P in intracellular carbohydrate metabolism. Oxidation of glucose and other monosaccharides: glycolysis and pentose phosphate shunt, individual reactions and control sites (regulatory mechanisms). Oxidative decarboxylation of pyruvate.	dr. M. Wróbel	LH
	Fr	10.00-13.00	Lab 11	4	Gr. A Gr. B Gr. C Gr. D	**Laboratories.** "From gene to protein" – part 4.	dr. D. Gil Dr. K. Kocemba dr Halina Jurkowska dr A. Bentke	Lab 1 Lab 2 Lab 3 Lab 4
21st week	Mo	10.00-13.00	Lab 11	4	Gr. I Gr. J	**Laboratories.** "From gene to protein" – part 4.	Dr. K. Kocemba (k) x3 dr D. Ciołczyk-Wierzbicka	lab 3 lab 4

Feb 27-Mar 3		12.15-13.45	sem 10	2	Gr. A,B	**Reactive oxygen species (ROS).** The tetraelectron reduction of the molecular oxygen (O_2). ROS – examples, synthesis in vivo, Fenton reaction. Metabolic and toxic effects of ROS. Oxidative stress. Enzymatic and nonenzymatic defence of organism against ROS:SOD, glutathione and its role (peroxidase, reductase system), catalase, anioxidants (vitamins, albumin, flavonoids, poliphenols). (4 student's presentations). Q	dr. B. Piekarska	room 5
					Gr.C,D		Dr. M. Wróbel	CH
	Tu	12.00-13.45	Lec 23	2	Whole class	**Carbohydrate metabolism II.** Gluconeogenesis. Relationships between oxidative pathways of glucose metabolism and synthesis of glucose from various low molecular weight metabolites. Cori cycle. Alanine cycle.	dr. M. Wróbel	LH
		14.00-15.30	sem 10	2	Gr. E,F	**Reactive oxygen species (ROS).** The tetraelectron reduction of the molecular oxygen (O_2). ROS – examples, synthesis in vivo, Fenton reaction. Metabolic and toxic effects of ROS. Oxidative stress. Enzymatic and nonenzymatic defence of organism against ROS:SOD, glutathione and its role (peroxidase, reductase system), catalase, anioxidants (vitamins, albumin, flavonoids, poliphenols). (4 student's presentations). Q	dr. H. Jurkowska	room 5
					Gr.G,H		dr J. Dulińska-Litewka (k) x2	room 8
					Gr. I,J		Dr. M. Wróbel	CH
	Th	14.15-15.45	Lec 24	2	Whole class	**Carbohydrate metabolism III**. Glycogen, glycogenolysis and glycogenogenesis. Futile cycles. Regulation of glycogen degradation and synthesis. Tissue specificity of carbohydrates metabolism.	dr. M. Wróbel	LH
	Fr	10.00-13.00	Lab 11	4	Gr. E	**Laboratories.** "From gene to protein" – part 4.	dr. D. Gil	Lab 1
					Gr. F		Dr. K. Kocemba	Lab 2
					Gr. G		dr Halina Jurkowska	Lab 3
					Gr. H		dr A. Bentke	Lab 4
22nd week Mar 6-10	Mo	12.15-13.45	sem 11	2	Gr. A,B	**Lipids.** Classification, naming and functions of lipids. Fatty acids. Simple lipids – triacylglicerols, waxes. Phospholipids: glycerol and sphingophospholipids. Glycolipids. Cholesterol and derivatives (bile acids, hormones). Glycolipids. Isoprenoids – dolicholes, lipid soluble vitamines, coenzyme Q. (4 student's presentations) Q	dr D. Ciołczyk-Wierzbicka	Room 5
					Gr.C,D		dr S. Olszowski	CH
	Tu	12.00-13.45	Lec 25	2	Whole class	**Lipid metabolism I**. Digestion and absorption of lipids from intestinal tract. Lipoproteins and transport of lipids in organism. Central role of fatty acyl-CoA in intracellular lipids metabolism. Oxidation of saturated and unsaturated fatty acids. Ketone bodies.	dr. P. Laidler/dr.J. D-L	LH
		14.00-15.30	sem 11	2	Gr. E,F	**Lipids.** Classification, naming and functions of lipids. Fatty acids. Simple lipids – triacylglicerols, waxes. Phospholipids: glycerol and sphingophospholipids. Glycolipids. Cholesterol and derivatives (bile acids, hormones). Glycolipids. Isoprenoids – dolicholes, lipid soluble vitamines, coenzyme Q. (4 student's presentations) Q	dr D. Ciołczyk-Wierzbicka	r. 5
					Gr.G,H		dr S. Olszowski	r. 8
					Gr. I,J		dr B. Stopa(k) x2	CH
	Th	14.15-15.45	Lec 26	2	Whole class	**Lipid metabolism II.** Synthesis of saturated fatty acids. Fatty acids synthase in lower and higher organisms. Regulation of oxidation and synthesis of palmitoyl-CoA. Elongation and desaturation of fatty acids. Microsomal electron transport - cytochrome b5.	dr. P. Laidler/dr.J. D-L	LH
	Fr	10.00-13.00	Lab 12	4	Gr. E	**Laboratories.** "From gene to protein" – part 4.	dr D. Ciołczyk-Wierzbicka	Lab 1
					Gr. F		dr B. Ostrowska	Lab 2
					Gr. G		dr D. Gil	Lab 3
					Gr. H		dr. A. Bentke	Lab 4
23rd week Mar 13-17	Mo	10.00-13.00	Lab 12	4	Gr. I	**Respiratory chain.**	dr J. Dulińska-Litewka	lab 3
					Gr. J		dr. B. Piekarska	lab 4
	Tu	12.00-13.45	Lec 27	2	Whole class	**Lipid metabolism III.** Synthesis of cholesterol and other steroids. Microsomal electron transport - cytochrome P450. Arachidonic acid and synthesis of eicosanoids. Cyclooxygenation and lipooxygenation - prostaglandines and leukotrienes. Diseases related to lipid metabolism.	dr. P. Laidler/dr.J. D-L	LH
		14.00-15.30	Sem 12	2	Gr. E,F	**Lipoproteins.** (4 student's presentations)	dr. B. Piekarska	Room 5
					Gr.G,H		dr J. Dulińska-Litewka	Room 8
					Gr. I,J		dr. M. Wróbel	CH
	Fr	10.00-13.00	Lab	4	Gr. A	**Respiratory chain.**	dr J. Dulińska-Litewka	Lab 1

			12		Gr. B		dr. B. Ostrowska	Lab 2
					Gr. C		dr K. Kocemba	Lab 3
					Gr. D		Dr A. Bentke	Lab 4
24th Mar 20-24	Mo							
		12.15-13.45	Sem 12	2	Gr. A,B	**Lipoproteins.** (4 student's presentations)	dr. B. Piekarska	room 5
					Gr.C,D		Dr. M. Wróbel (k) x 2	CH
	Tu	12.00-13.45	Lec 28	2	Whole class	**Amino acid metabolism I.** Digestion of proteins and absorption of amino acids from intestinal tract. Cystinuria. Metabolic fates of amino acid nitrogen. Transdeamination and urea synthesis. Connections between urea and Krebs cycles. Defects in the urea cycle enzymes. Ammonia toxicity.	Prof. P. Laidler/dr. M. Wróbel	LH
	Th	14.15-15.45	Lec 29	2	Whole class	**Amino acid metabolism II.** Conversion of amino acids C-skeletons to Krebs cycle intermediates. Gluco- and ketogenic amino acids. Endogeneous and exogeneous amino acids. Synthesis of endogeneous amino acids. Folic acid and metabolism of one carbon units. Vitamin B12. Homocystinuria.	Prof. P. Laidler/dr. M. Wróbel	LH
	Fr	10.00-13.00	Lab 13	4	Gr. A	**Glycolysis.**	Dr. A. Bentke	Lab 1
					Gr. B		Dr. H. Jurkowska(k)x3	Lab 2
					Gr. C		Dr. B. Piekarska	Lab 3
					Gr. D		Dr. B. Ostrowska	Lab 4
25th week Mar 27-31	Mo	10.00-13.00	Lab 13	4	Gr. I	**Glycolysis.**	dr D. Ciołczyk-Wierzbicka	lab 3
					Gr. J		Dr B. Ostrowska	lab 4
	Tu	12.00-13.45	Lec 30	2	Whole class	**Amino acid metabolism III.** Metabolism of chosen amino acids: methionine, tryptophan, phenylalanine, tyrosine, branched-chain amino acids. Amino acids as precursors of signal molecules. Inherited diseases of amino acid metabolism: methylmalonyl-CoA mutase deficiency, phenylketonuria, alkaptonuria, albinism, maple syrup urine disease (MSUD).	Prof. P. Laidler/dr. M. Wróbel	LH
		14.00-15.30	sem 13	2	Gr. E,F Gr.G,H Gr. I,J	**Heme.** Biosynthesis, degradation, jaundice, porphyrias. (3 student's presentations) Q	Dr B. Piekarska (k) x 2	Room 5
							dr K. Kocemba	Room 8
							dr. M. Wróbel	CH
	Th	14.15-15.45	Sem 13	2	Gr. A,B	**Heme.** Biosynthesis, degradation, jaundice, porphyrias. (3 student's presentations) Q	Dr. B. Piekarska	LH
					Gr.C,D		dr. M. Wróbel	CH
	Fr	10.00-13.00	Lab 13	4	Gr. E	**Glycolysis.**	Dr. A. Bentke	Lab 1
					Gr. F		Dr. H. Jurkowska(k)x3	Lab 2
					Gr. G		Dr. B. Piekarska	Lab 3
					Gr. H		dr J. Dulińska-Litewka	Lab 4
26th week Apr 3-7	Mo							
		12.15-13.45	Rec 5	2	Gr. A,B	**Review.** Carbohydrates and lipids.	dr. B. Piekarska	Room 5
					Gr.C,D		Dr. M. Wróbel	CH
	Tu	12.00-13.45	Lec 31	2	Whole class	**Purine and pyrimidine nucleotides metabolism I.** Metabolic functions of nucleotides. Synthesis of purine and pyrimidine nucleotides de novo. Salvage pathway of synthesis of nucleotides. Degradation of purines and pirimidines. Regulation of purines and pyrimidines metabolism.	dr. B. Piekarska	LH
		14.00-15.30	rec 5	2	Gr. E,F	**Review.** Carbohydrates and lipids.	Dr. B. Piekarska	Room 5
					Gr.G,H		dr J. Dulińska-Litewka	Room 8
					Gr. I,J		dr. M. Wróbel	CH
	Th	14.15-15.45	**Ex. 3**	2	Whole class	**Test 3.** Oxidative phosphorylation, TCA, carbohydrates and lipids metabolism.	dr. M. Wróbel dr. B. Piekarska	CH LH
	Fr	10.00-13.00	Lab 14	4	Gr.E	**Free radicals.**	dr K. Kocemba	Lab 1
					Gr. F		dr D. Ciołczyk-Wierzbicka	Lab 2

					Gr. G		dr. D. Gil	Lab 3
					Gr. H		dr J. Dulińska-Litewka	Lab 4
27th week Apr 10-11 Mo-Tu	Tu	12.00-13.45	Lec 32	2	Whole class	**Purine and pyrimidine nucleotides metabolism II.** Synthesis of deoxyribonucleotides. Nucleotide coenzyme synthesis. Regulation of purine and pyrimidines metabolism. Discussion on selected topics related to nucleotide metabolism.	dr. B. Piekarska	CH
		14.00-15.30	rec 6	2	Whole class	**Discussion on Exam 3.**	dr. M. Wróbel	CH
Apr 17-21						EASTER		
28th week Apr 24-28	Mo	10.00-13.00	Lab 14	4	Gr. I	**Free radicals.**	Dr D. Gil	Lab 3
					Gr. J		Dr A. Bentke	Lab 4
	Tu	12.00-13.45	Lec 33	2	Whole class	**Nutrition.** Macronutrients and dietary fibers. Vitamins. The minerals - calcium and phosphorus, iron magnesium, zinc, cooper and manganese, iodine, selenium. Nutrient and energy balance; control of energy balance. Disturbances of energy balance.	dr. B. Piekarska	CH
		14.00-15.30	rec 7	2	Gr. E,F	**Recitation.** Review of amino acid and nitrogenous compound metabolism.	Dr B. Piekarska	Room 5
					Gr.G,H		dr J. Dulińska-Litewka	Room 8
					Gr. I,J		Dr M. Wróbel	CH
	Th	14.15-15.45	rec 7	2	Gr. A,B	**Recitation.** Review of amino acid and nitrogenous compound metabolism.	dr. B. Piekarska	Room 8
					Gr. C,D		Dr M. Wróbel	CH
	Fr	10.00-13.00	Lab 14	4	Gr. A	**Free radicals.**	dr K. Kocemba	Lab 1
					Gr. B		Dr H. Jurkowska	Lab 2
					Gr. C		dr D. Gil (k) x 3	Lab 3
					Gr. D		dr. A. Bentke	Lab 4
29th Week May 4-5 Th-Fr	Mo							
	Th	**16.00**-17.45	**Exam 4**	2	Whole class	**Test 4.** Metabolism of amino acid and nitrogenous compounds.	dr. M. Wróbel dr B. Piekarska	CH LH
30th week May 8-12	Mo	12.15-13.45	Sem 14	2	Gr. A,B	**Case II.** Reperfusion injury after hypoxia. Metabolism of heart muscle. (!Note supplementary materials on the website).	Dr B. Piekarska	Room 5
					Gr. C,D		Dr. D. Gil	CH
	Tu	12.00-13.45	Rec 8			**Discussion on Exam IV.**	dr. M. Wróbel	CH
		14.00-15.30	Sem 14	2	Gr. E,F	**Case II.** Reperfusion injury after hypoxia. Metabolism of heart muscle. (!Note supplementary materials on the website).	Dr B. Piekarska	Room 5
					Gr.G, H		dr J. Dulińska-Litewka	Room 8
					Gr. I, J		Dr D. Gil	CH
	Th	14.15-15.45	Lec 34	2	Whole class	**Intercellular communication - hormones.** Chemistry of hormones. Polypeptide and amino acids derivative hormones and their receptors. Signal transduction. G proteins. Secondary messengers. Steroid hormones and their receptors. Intracellular effects of hormone action.	dr. M. Wróbel	LH
31st week May 15-19	Mo	12.15-13.45	sem 15	2	Gr A, B	**Detoxication in organism**. The role of liver in detoxication processes. Biotransformations. Cytochrome P_{450} electron transport systems. **Case III** The effect of ethanol on metabolism. (!Note supplementary materials on the website). Q (3 student's presentations)	Dr B. Ostrowska (k) x 2	Room 5
					Gr C, D		dr. M. Wróbel	CH
	Tu	12.00-13.45	Lec 35	2	Whole class	**Metabolic interrelationships I.** Overview of major metabolic pathways, key junctions and control sites. Metabolic profiles of individual tissues - brain, muscle, liver, adipose tissue, red blood cells.	dr. M. Wróbel	LH
		14.00-15.30	sem 15	2	Gr.E, F	**Detoxication in organism**. The role of liver in detoxication processes. Biotransformations. Cytochrome P_{450} electron transport systems. **Case III.** The effect of ethanol on metabolism. (!Note supplementary materials on the website). Q (3 student's presentations)	Dr B. Ostrowska	Room 5
					Gr.G,H		dr J. Dulińska-Litewka	Room 8
					Gr. I, J		dr. M. Wróbel	CH

	Th	14.15-15.45	Lec 36	2	Whole class	**Metabolic interrelationships II.** Hormonal regulation of fuel metabolism. Intracellular effects of hormone action. Metabolic interrelationships of tissues in various nutritional and hormonal states.	dr. M. Wróbel	LH
32nd week May 22-26	Mo	12.15-13.45	Lec 37	2	Whole class	**Biochemistry of disease I.** Oncogenic transformation of a cell. Oncogenes, suppressor genes and growth factors.	dr. P. Laidler	LH
	Tu	12.00-13.45	Lec 38	2	Whole class	**Biochemistry of disease II.** Cancer invasion and metastasis. Cell membrane proteins and components of signal transduction and inhibition of their activity.	dr. P. Laidler	LH
33rd week May 29 - Jun 2	Mo	12.15-13.45	Rec 9	2	Whole class	**Review**. Metabolism of carbohydrates, lipids and proteins. Metabolic interrelationships.	dr. M. Wróbel	CH
34th week Jun 5-9								
9.06	Fr	11.45-14.45	Ex.5	4	Whole class	**Final Exam**	Dr M. Wróbel Dr. B. Piekarska	CH LH