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| **Title and Code** of the subject: **Applied Chemistry,** MTMAL7003A | **ECTS Credit Points: 4** |
| **Type** of the subject: **compulsory** | |
| **Ratio of theory and practice** (credit %)  50 % theoretical, 50 % practical | |
| **Type and number of classes per semester**: 28 hours lecture + 28 hours practice per **semester = 56**  Number of teaching hours per week : 2 (lecture) + 2 (practice) = 4 | |
| **Type of exam**: **colloquium** | |
| **Subject in the curriculum**: **1st semester.** | |
| **Preliminary requirements: none** | |

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| **Summary of content - theory**: |
| Course objectives:  Main goal is to deepen chemical knowledge such as groups of bio-macromolecules and their roles, detailed mechanisms of reactions in animal and human organisms. Strengthen the basics of physiological processes. The main differences between biomolecules and inorganic compounds, the role of bio-catalysers (enzymes), vitamins and hormones will be discussed. Main chemical processes of fixing electromagnetic radiations by plants, as the basics of the life, groups of energy collecting and storing compounds, biosynthesis and decomposition of polysaccharides, lipids and proteins, Szent-Györgyi – Krebs cycle, Krebs–Henseleit-cycle, glyoxylic cycle and their energy balance will be introduced. Understanding signal- and regulation mechanisms of living organisms at an advanced level will be part of the course.  1st week: Object of applied chemistry, the relationship of biochemistry with other sciences. Major features components and structures of living organisms. Role of water and inorganic ions in biological systems. Molecular organization of the living cells, comparison of biomolecules with the molecules of lifeless nature  2nd week: Main organic compounds and their monomers I.: Carbohydrates. Mono-, di- and oligosaccharides. Reducing and non-reducing disaccharides. Lactose intolerance: reason, symptoms and healing  3rd week: Main organic compounds and their monomers II. Proteins. Alfa-amino acids, their structure and functional groups. Chirality of amino acids. Essential, conditionally essential and non-essential amino acids  4th week: Main organic compounds and their monomers IV.: Nucleic acids. Nucleobases, nucleotides. Deoxyribonucleic acid (DNA). Ribonucleic acids (RNA) and their role – messenger ribonucleic acids (mRNA), transfer ribonucleic acids (tRNA), ribosomal ribonucleic acids (rRNA). Nucleoside triphosphates (ATP, UTP, GTP)  5th week: Vitamins – Reference Daily Intake (RDI). Hypervitaminosis, hypovitaminosis and avitaminosis. Sources of vitamins. Antivitamins – avidin in the row eggs.  6th week: Hormones of the pancreas. Hormones of the ovary. Hormones of the testes. Tissue hormones: Gastrointestinal hormones. Plant growth stimulating and retarding hormones (phytohormones)  7th week: Metabolic processes. The connection of the living beings and their environment. The connection of the photosynthesising- and the heterotrophic living beings, the biological cycles of C, H, O and N. Carbohydrate metabolism. The biosynthesis of carbohydrate of the photosynthesising organisms  8th week: The „direct oxidation” of the glucose (The pentose phosphate pathway). Fermentation processes, the pathways of fermentation. Alcoholic fermentation, lactic acid fermentation. The processes taking place in the stomach of ruminants  9th week: Glycogen metabolism (synthesis, breakdown). Cori-cycle (Lactic acid cycle). The biosynthesis of fatty acids. The synthesis of the glycerol. The synthesis of triglycerides. The biosynthesis of phosphor-glycerides. The biosynthesis of carotenoids and steroid skeleton lipids  10th week: Ketogenesis. The catabolism of steroids. The cholesterol, bile acids. Carbohydrate synthesis from lipids: glyoxylate cycle  11th week: The biosynthesis of protein. The transcription processes. The translation (initiation, elongation, termination). Biosynthesis of essential amino acids. The biosynthesis of threonine and methionine  12th week: The fate of proteins put on by diet in the heterotrophic living beings. The nutritional quality of protein. Biological value (BV), Chemical score, Net protein utilization (NPU), Protein efficiency ratio (PER), Protein digestibility  13th week: Protein turnover. Nitrogen secretion of mammals. Synthesis of urea (carbamide). Krebs–Henseleit-cycle. Nitrogen secretion of birds and reptiles. Synthesis of uric acid. Disturbances of amino acid metabolism, phenylketonuria (PKU). Some hereditary amino acid metabolisms disturbance. Disorders of nucleic acid metabolism. The biochemical bases of the function of skeletal muscle  14th week: Fermentation. The application of the fermentation in the food industry. The biochemical processes of the germination of cereals. The steps of the germination. Cellular respiration. The respiration of fruits and vegetables. The ripening of the fruits |
| **Summary of content - practice**: |
| Skills to be learnt:  Deepening theoretical knowledge by solving some practical exercises, discussing the lectures’ material. Basic practical knowledge on the really wide range of possibilities of the Applied Chemistry.  1st week: Molecular organization of the living cells, classification of the living beings according to a metabolism type  2nd week: Structure, shape, digestibility and main physiological role of polysaccharides: starch, cellulose and glycogen  3rd week: Main organic compounds III.: Lipids. Essential and conditionally essential fatty acids, omega-3 fatty acids. Structure and role of vaxes, triglycerides, phospholipids, sphingolipids and glycolipids. Steroid compounds  4th week: Bioactive compounds I.: Vitamins. Lipid-soluble vitamins (vitamins A, D, E, K). Water soluble vitamins (vitamins B1, B2, B3, B5, B6, B9, B12, H, C)  5th week: Bioactive compounds II.: Hormones. Role of hormones. Hormones of hypophyzis. Hormone of pineal gland: Melatonin. Hormones of thyroid gland. Parathyroid hormone. Hormones of the adrenal gland. Hormones of the adrenal cortex. Hormones of the adrenal medulla  6th week: Bioactive compounds III.: Bio-catalysers. Role and structure of enzymes. Factors influencing enzyme activity: activators, inhibitors and destructors, temperature, pH-values, enzyme and substrate concentrations  7th week: The light-dependent reactions (Hill-reaction). The dark reactions (Calvin-cycle). Catabolic processes, Carbohydrate catabolism. The breakdown stages of glycose  8th week: The fate of absorbed volatile fatty acids. Gluconeogenesis. The backward pathway of the glycolysis  9th week: The breakdown of lipids. The ß-oxidation of saturated fatty acids. Pathway for catabolism of odd-numbered fatty acid carbon chain. Energy yield from fatty acid oxidation  10th week: The metabolism of protein. The nitrogen uptake by plants. Biological nitrogen fixation. Nitrate reduction in the plant. Incorporation of ammonium ion. The origin of the carbon backbones of the amino acids. Transamination  11th week: The biosynthesis of lysine, arginine, leucine, isoleucine, valine, phenylalanine tryptophan and histidine  12th week: The balance of proteins. Lack of protein in nutrition. The digestion of proteins. What is the function of protease? The common features of amino acid degradation pathways. Biogenic amines and their functions  13th week: Factors influencing the quantity and quality of urine. Ion exchange in the tubules of kidneys. The gastric juice and separation. The mechanism of the hydrochloric acid production of the stomach. The essence of Davenport theory of gastric acid production  14th week: Non enzymatic browning (NEB). Enzymatic browning (EB). The biochemistry of meat ripening. The influence of the ripening processes of the meat. The processes in the muscular tissue after slaughtering. The influence of the ripening processes of the meat. Changes of colour through the meat processing |
| ***Compulsory literature:***  Klaus Urich (1994): Comparative Animal Biochemistry. Springer Verlag, Berlin, Heidelberg. ISBN-13: 978-3-642-08181-1. doi.org/10.1007/978-3-662-06303-3  ***Optional literature:***  Klaus Urich (1990): Vergleichende Biochemie der Tiere. Gustav Fischer Verlag, Jena. ISBN-13: 978-3437204401 |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge**   Students learn about the general and specific characteristics of Applied Chemistry, their boundaries, their directions of development, and their attachment to related subjects.   1. **Ability**   Theoretical aspects of Applied Chemistry and related terminologies can be used in innovative ways to solve the actual problems.   1. **Attitude:**   Student has a strong professional identity and professionalism that she/he can take for professional and wider social community.   1. **Autonomy and responsibility:**   Student sees the importance of general and special Applied Chemistry knowledge so that it can formally incorporate into their further university studies and at the end of their studies. Students will be able to autonomously and responsibly use the knowledge acquired in the course of their work in a deliberate manner. |

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| **Responsible lecturer:**  **Assoc. Professor Dr. habil. Imre Vágó, CSc, deputy head of Institute** |
| **Other lecturer:** - |
| **Form of examination:**  **Oral (preferred) and/or written** (only if the subject is signed) |
| **Requirement(s) to get signature:**  Attendance at lectures is not compulsory, but highly recommended! Participation at practice is compulsory. Attendance both at lectures and practice classes will be recorded by the teacher. Being late is counted as an absence. Tolerable maximal absence rate is 30 %. In case of further absences, a medical certificate needs to be presented.  In the frame of practice, as an individual activity, all of the students have to complete and present to the other students two power point presentations. The theme of it will be jointly decided by the student and the lecturer. Form and content of presentations will be discussed by the group members, and will be accepted or denied. The denied presentation must be repeated. Requirement to get signature is, two accepted .ppt-presentations. |

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| **Exam questions:** |
| 1st week: What is the object of biochemistry? What is the meaning of the following: Biochemistry is an interdisciplinary science? Which are the most important features of the living matter? What are the roles of water and inorganic anions in the biological system? How can living organism according to their type of metabolism be classified? How can carbohydrates be classified? What are the similarities and the differences in the following monosaccharides: glucose, fructose, ribose, ribulose? What does reductive sugars expression mean?  2nd week: How can disaccharides be classified? What kind of biological functions polysaccharides have? What are the monomer units of starch, pectin, chitin and inulin? What are the similarities and the differences between amylose and amylopectin? What are essential amino acids? What kind of bonds stabilise the spatial structure of proteins? How can proteins be classified? What are the biological functions of proteins?  3rd week: What kind of substances are lipids? How can lipids be classified? What are the biological functions of phospholipids and neutral fats? What are the differences of neutral fats and oils? How can nucleic acid be classified by their biological functions? What are the similarities and the differences between the primary and secondary functions of DNA and RNA? What are the biological functions of nucleoside-triphosphates?  4th week: What are the concepts of vitamin, provitamin? What do the next expressions mean: hypo- and hypervitaminosis? How can vitamins be classified? How can vitamins expound their effects? Which vitamins are sensitive to light, heat, acidity?  5th week: What kind of role do hormones play in the function of living organisms? What kinds of glands are producing hormones? How can hormones be classified? What does the fact mean that hormonal regulation has hierarchical order?  6th week: What are the similarities and the differences between hormones and tissue hormones? What kinds of phyto-hormones do you know? What is the task of the enzymes in the living organism? What parts does an enzyme consist of? What is the function mechanism of enzymes? What groups do enzymes have? What is the connection between enzymes and vitamins? What influences the function of the enzymes?  7th week: What is the connection of a living being and its environment? What is the essence of photosynthesis? What are the stages of photosynthesis? What are the products of light reactions? What does the expression of photophosphorylation mean? Where are the products of light reactions used?  What are the stages of the catabolism of glucose and what are the places of these reactions in the cell? What are the reactions of glycolysis? What are the products of the Szent-Györgyi – Krebs (citric acid) cycle? Where is produced and how much energy is recovered from the entire oxidative catabolism of mole of glucose?  8th week: What is the importance of pentose phosphate cycle? What kind of circumstances take place in the fermentation processes? What kind of fermentation processes do you know? What determines which fermentation process takes place? What are the similarities and the differences between the processes taking place in the silo and the first stomach? What is the essence of gluconeogenesis? Where and why does this process take place?  9th week: Where is the glycogen synthesized and what is the initial substrate of glycogen synthesis? What is the central enzyme of the catabolism process of glycogen? What substances are necessary to the biosynthesis of fatty acids? What is the equation of the biosynthesis of palmitic acid? What are the functions of phospholipids? What is the intermediary compound of the biosynthesis of cholesterol? How does the catabolism of fat begin and what enzyme catalyses this process? What does β-oxidation pathway mean?  10th week: What is the process of ketogenesis? What are ketone bodies? What is the role of cholesterol in the human body and where is it formed? What is the role of glyoxylate cycle and what is the difference between glyoxylate cycle and Szent-Györgyi – Krebs cycle? How can plants take up nitrogen? What is nitrogen fixation? What is transamination process?  11th week: Describe the biosynthesis of protein; transcription (initiation, elongation, termination); translation (initiation, elongation, termination); the biosynthesis of essential amino acids; the biosynthesis of threonine and methionine; the biosynthesis of lysine, arginine; the biosynthesis of leucine, isoleucine, and valine; the biosynthesis of phenylalanine and tryptophan; the synthesis of histidine.  12th week: What are the fates of proteins in the human body? How can you determine the quality of proteins? What does Negative nitrogen balance mean? What kind of diseases might the lack of protein in nutrition cause? Review the process of the breakdown of proteins! What kind of protein-digesting enzymes do you know? What are biogenic amines and what are their significances? What is the function of protease? Review the catabolism of carbon skeleton of amino acids in the tricarboxylic acid cycle!  13th week: What process is called protein turnover? What is the major end-product of nitrogen metabolism in mammals and where is it synthesized? Review the Krebs-Henseleit-cycle (carbamide cycle)! How can birds and reptiles excrete nitrogen? What is phenylketonuria? What kind of disorders do you know in the nucleic acid metabolism? From what kind of chemical processes do muscles obtain energy for their function? What kind of factors influence the quantity and quality of the urine? What is gastric juice  14th week: What is fermentation in food processing used for? What are the steps of germination? Review the main factors influencing the velocity of cellular respiration! What makes a seed breathe faster? Review the biochemical processes going during the ripening of fruits! What does non-enzymatic browning mean? What is enzymatic browning and how does it affect food products? Review the biochemistry of meat ripening! How does the colour of the meat change through the processing of meat, what is the biochemical reason of this? |