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Syllabus of lectures in organic chemistry

Academic year 2025/2026, summer semester

1. **Carboxylic acids.** Classification and nomenclature. Methods for synthesis of carboxylic acid, Perkin's reaction (mechanism). Acidity of carboxylic acids; substituents and acid strength. More important representatives of mono-, di- and polycarboxylic acids. Carboxylic acid salts. Preparation of halogenated acids – *Hell-Volhard-Zelinsky* reaction. **2 hours**
2. **Functional derivatives of carboxylic acids.** Esters, acyl halides, anhydrides, amides, hydroxamic acids, nitriles – structure, the most important methods of preparation, reactivity and properties. **2 hours**
3. **Acetoacetic and malonic esters**. Synthesis (mechanism of *Claisen* condensation). Applications of acetoacetate and malonic ester in organic synthesis – alkylation, *Knoevenagel* and *Michael* reactions (mechanism). Halogenated acids – *Reformatsky's* reaction. **2 hours**
4. **Oxy and oxo acids.** Important representatives. Stereoisomerism in oxy acids (lactic acid, malic acid, tartaric acid). Synthesis of salicylic acid. Decarbonylation and decarboxylation, lactides, lactones and polyesters. **1 hour**
5. **Natural esters.** Waxes, fats and phospholipids – composition, properties and biological role. Concept of prostaglandins. Surface-active substances (surfactants) – classification. **1 hour**
6. **Terpenes and steroids**. Classification, biosynthesis, isoprene rule. Examples of mono-, di- and tetraterpenes (carotenoids). Steroids – cholesterol, vitamin D, bile acids, corticosteroids, and sex hormones. **1 hour**
7. **Monosaccharides.** Classification, nomenclature and representatives of trioses, tetroses, pentoses and hexoses. Cyclic forms of monosaccharides – *Haworth* projections. Stereoisomerism - anomers, epimers, mutations. Chemical properties – glycoside formation, reaction with amino compounds, oxidation and reduction, chain extension and shortening. **2 hours**
8. **Disaccharides and polysaccharides.** Reducing and non-reducing disaccharides. Polysaccharides – structure and biological role of cellulose, starch and glycogen. Cellulose derivatives with practical application. Polysaccharides containing uronic acids and amino sugars. **2 hours**
9. **Aliphatic and aromatic amines.** Classification and structure. Methods of preparation (from ammonia and amines, by reduction, by molecular rearrangements, etc.). Link between structure and basicity (pK_b). Salt formation, N-alkylation and N-acylation. *Mannich* reaction (mechanism), *Hofmann* and *Cope* elimination. Diazonium salts – production and chemical properties (*Zandmayer* reaction and coupling). **2 hours**

10. **Amino alcohols and amino phenols.** More important representatives – aminoethanol, choline, acetylcholine, ephedrine, adrenaline and noradrenaline. Drugs derived from 3-amino-1,2-propanediol (β-blockers). **1 hour**
11. **Amino acids, peptides, and proteins.** Proteinogenic amino acids – classification and representatives. Formation of 2,5-dioxopiperazines, lactams, and polyamides. Methods for studying primary structure of proteins. Strategies of protein synthesis. Secondary, tertiary and quaternary structure of proteins, biological importance. **2 hours**
12. **Five-membered aromatic heterocyclic compounds.** Pyrrole, furan and thiophene. *Knorr* pyrrole synthesis. Structure and reactivity – comparison of chemical properties. Indole - *Fischer* synthesis, indole derivatives of biological significance. **2 hours**
13. **Six-membered heterocyclic compounds.** *Hantzsch* pyridine synthesis. Chemical properties – basicity, salt formation, nucleophilic substitution reactions (*Chichibabin* reaction). Tautomerism – pyridones. Pyridine derivatives of biological significance – nicotinamide, nicotine, vitamin B_6. **2 hours**
14. **Heterocyclic compounds fused with benzene.** The *Skraup* synthesis of quinoline and the *Bischler-Napieralski* synthesis of isoquinoline. Quinoline and isoquinoline alkaloids – examples. Acridine, benzazepines. **2 hours**
15. **Five-membered heterocyclic compounds with two heteroatoms.** Oxazoles, thiazoles and diazols – nomenclature and general characterization. Derivatives with biological activity. Pyrazolone derivatives, synthesis of antipyrine. **2 hours**
16. **Six-membered heterocyclic compounds with two heteroatoms.** Oxazines, thiazines and diazines – nomenclature and general characteristics. Lactam-lactim tautomerism in pyrimidine hydroxyl derivatives. Derivatives with biological activity – barbiturates, pyrimidine bases, nucleosides and nucleotides. **2 hours**
17. **Fused heterocyclic compounds**. Purines and pteridines – nomenclature and general characteristics. Purine nucleic acid bases, DNA and RNA structure, purine alkaloids. Derivatives with biological activity – folic and folinic acid, alloxazine and isoaloxazine, riboflavin. **2 hours**

2.02.2024 Prepared by: .....

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