

SYLLABUS

of the lecture course in organic chemistry for students in pharmacy – second year, 3rd semester, academic 2026/2027

- 1. Introduction.** Presentation of organic compounds and organic reactions. Homolytic and heterolytic processes, electrophiles, and nucleophiles. Types of ionic reactions – substitution, addition, elimination, rearrangements (examples). **2 h**
- 2. Electronic effects in organic molecules.** Localized and delocalized chemical bonds - examples of systems with delocalized bonds. Induction effect. Mesomeric (resonance) effect. Resonance theory – canonical structures, hybrid structure, resonance energy. Methods for studying the mechanism of organic reactions. **2 h**
- 3. Alkanes and cycloalkanes.** Basic principles of IUPAC nomenclature for open chain and cyclic compounds; fused and spiro compounds. Preparation of alkanes. Halogenation – mechanism of radical substitution reactions (S_R); reactivity and selectivity. Nitration and sulfochlorination. Stability and specific reactions of cycloalkanes. Cracking, petroleum products. **2 h**
- 4. Stereochemistry – Part I.** Conformational isomerism. Perspective and *Newman* projections. Conformation analysis of ethane and butane. Cyclohexane – "chair" and "boat" conformations, equatorial and axial substituents. Conformation analysis of substituted cyclohexanes. Conformations of polycyclic compounds. Conformation and biological activity. **2 h**
- 5. Stereochemistry - Part II.** Enantiomers and σ -diastereomers. Optical activity and chirality of molecules – examples of asymmetry in organic molecules. Absolute and relative configuration. *Fischer* projection formulas, D, L-configuration. *Kang-Ingold-Prelog* system (R, S-nomination system). Enantiomers and biological activity. Sigma -diastereomers. **3 h**
- 6. Alkenes and cycloalkenes.** π -diastereomeric alkenes. Preparation – mechanism and stereochemistry of β -elimination reactions (E2 and E1). *Zaytsev's* rule, *Hoffman's* rule – examples. Additional reactions of alkenes – hydrogenation, halogenation, addition of hydrogen halides, water, and other reagents. Mechanism and stereochemistry of electrophilic addition (A_E) reactions. Oxidation of alkenes, ozonolysis. Examples of alkenes polymerization. **3 h**
- 7. Alkynes and dienes.** Preparation and properties of alkynes. *Kucherov* reaction, keto-enol tautomerism. Acidity of alkynes, alkynides as bases and nucleophiles. Preparation of 1,3-dienes. 1,2- and 1,4-addition to conjugated dienes – kinetic and thermodynamic control of the reaction. *Diels-Alder* reaction, diene synthesis (examples). **2 h**

8. Arenes. Criteria for aromaticity, *Hückel's* rule. Benzene and benzene homologues. Chemical properties of benzene and its derivatives – mechanism of electrophilic substitution reactions (S_E), energy diagram. Nitration, sulfonation, halogenation, *Friedel-Crafts'* alkylation and acylation. Radical substitution, oxidation, and reduction of arenes. **2 h**

9. Effect of substituents on reactivity and orientation in electrophilic aromatic substitution. Activating and deactivating substituents, o-, m- and p-direction. Stability of the corresponding arenium ions (σ -complexes) in o-, m- and p-substitution. Influence of two or more substitutes. Biphenyls, fused arenes; naphthalene sulfonation. **2 h**

10. Alcohols, diols, and thioalcohols. Industrial and laboratory methods for preparation. Chemical properties of alcohols – mechanism and stereochemistry (*Walden* inversion, racemization) of the nucleophilic substitution (S_N) reactions; dehydration, etherification, esterification. Laboratory and biological oxidation of alcohols. Periodate oxidation of diols. Properties of thioalcohols. **4 h**

11. Phenols. Acidity of phenols, influence of substitutes in aromatic ring. Natural sources of phenols, industrial production of phenols. Electrophilic substitution in the benzene ring. Competitive acylation and alkylation reactions in the benzene ring and the phenol group. Laboratory and biological oxidation of phenols. Concept of polyphenols. **2 h**

12. Aldehydes and ketones. Classification and nomenclature. Industrial and laboratory synthetic methods – ozonolysis of alkenes, hydration of alkynes, oxidation of alcohols. *Gattermann-Koch* and *Reimer-Tiemann* reaction. *Friedel-Crafts* acylation of aromatic compounds. Chemical properties – mechanism of nucleophilic addition (A_N) and addition – elimination ($A_N + E$) reactions. Reactions with *Grignard* reagents. Aldol condensation and crotonylation (mechanisms of the reactions). *Cannizzaro* reaction. Oxidation and reduction of carbonyl compounds. Quinones. **4 h**

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