MINISTRY OF EDUCATION AND TRAINING
CAN THO UNIVERSITY

SOCIALIST REPUBLIC OF VIETNAM
Independence - Freedom - Happiness

SUBJECT OUTLINE DETAILS

1. Subject: Organic Chemistry I

- Code: CH251C

- Credits: 3

- Hours: 45 hours

2. Management Unit:

- Department: Chemistry

- Faculty: The Colledge of Natural Sciences

3. Prerequisites: CH151C Priciples of Chemistry I and CH152C Priciples of Chemistry II

4. Subject objectives:

4.1. Knowledge:

The chemistry of hydrocarbons: Alkanes, Cycloalkanes, Alkenes, Alkadienes, Alkynes and Arenes introduces the concept of structure, bonding, and reactivity of hydrocarbons, isomerism and stereochemistry, reaction mechanism and also their physical, chemical properties, nomenclature and preparations.

Use the modern spectroscopy methods: MS, NMR, UV-Vis, IR, …to determine the structures of organic compounds in different fields such as: chemistry, biology, food, drugs, environment,…

Understanding about effects of organic chemistry to social and environment.

4.2. Skill:

4.2.1. Hard skills

Understanding of important role of organic chemistry to country's development.

Use the modern spectroscopy methods: MS, NMR, UV-Vis, IR, …to analysis chemicals.

Suggest and build the research models in chemistry to support and solve the problems related to chemistry.

4.2.2. Soft skills

- Help students find their way to the chemical and biology library easily and their ability to refer or, and generally does indepth reasearch into the topic they are interested in.

Enable working independently or in team and self-study in their lives.

4.3. Attitude:

Construction students have a healthy and civilized lifestyle. To respect the law. Loyalty to the country always.

To have an inquiring mind, the will to work for progress**,**

Good team work, good attitude, cordial spirit, cooperation with colleagues in the work.

Strictly observe discipline and more dissemination on environmental issues, mobilization of citizen's contribution for and improvement of citizens' participation in environmental protection, increase the citizen's environmental awareness.

5. Brief description of subject content:

The chemistry of hydrocarbons: Alkanes, Cycloalkanes, Alkenes, Alkadienes, Alkynes and Arenes introduces the concept of structure, bonding, and reactivity of hydrocarbons,

isomerism and stereochemistry, reaction mechanism and also their physical, chemical properties, nomenclature and preparations.

Use the modern spectroscopy methods: MS, NMR, UV-Vis, IR, …to determine the structures of organic compounds.

Understanding about effects of organic chemistry to social and environment.

6. Subject content structure:

6.1. Theory

	Content	Hours	Objectives
Chapter 1.	**Alkanes and Their Stereochemistry** 1.1. Functional Groups 1.2. Alkanes and Alkane Isomers 1.3. Alkyl Groups 1.4. Naming Alkanes 1.5. Properties of Alkanes 1.6. Conformations of Ethane 1.7. Conformations of Other Alkanes	**3**	4.1.1;
Chapter 2.	**Cycloalkanes and Their Stereochemistry** 2.1. Naming Cycloalkanes 2.2. Cis–Trans Isomerism in Cycloalkanes 2.3. Stability of Cycloalkanes: Ring Strain 2.4. Conformations of Cycloalkanes 2.5. Conformations of Cyclohexane 2.6. Axial and Equatorial Bonds in Cyclohexane 2.7. Conformations of Monosubstituted Cyclohexanes 2.8. Conformations of Disubstituted Cyclohexanes 2.9. Conformations of Polycyclic Molecules	3	4.1.1;
Chapter 3.	**Stereochemistry at Tetrahedral Centers** 3.1. Enantiomers and the Tetrahedral Carbon 3.2. The Reason for Handedness in Molecules: Chirality 3.3. Optical Activity 3.4. Pasteur's Discovery of Enantiomers 3.5. Sequence Rules for Specifying Configuration 3.6. Diastereomers 3.7. Meso Compounds 3.8. Racemic Mixtures and the Resolution of Enantiomers 3.9. A Review of Isomerism 3.10. Chirality at Nitrogen, Phosphorus, and Sulfur 3.11. Prochirality 3.12. Chirality in Nature and Chiral Environments	**3**	4.1.1;
Chapter 4.	**An Overview of Organic Reactions** 4.1. Kinds of Organic Reactions 4.2. How Organic Reactions Occur: Mechanisms 4.3. Radical Reactions 4.4. Polar Reactions 4.5. An Example of a Polar Reaction: Addition of HBr to Ethylene	**3**	4.1.1;

4.6.	Using Curved Arrows in Polar Reaction Mechanisms		
4.7.	Describing a Reaction: Equilibria, Rates, and Energy Changes		
4.8.	Describing a Reaction: Bond Dissociation Energies		
4.9.	Describing a Reaction: Energy Diagrams and Transition States		
4.10.	Describing a Reaction: Intermediates		
4.11.	A Comparison Between Biological Reactions and Laboratory Reactions		
Chapter 5.	**Alkenes: Structure and Reactivity**	3	4.1.1;
5.1.	Industrial Preparation and Use of Alkenes		
5.2.	Calculating Degree of Unsaturation		
5.3.	Naming Alkenes		
5.4.	Cis–Trans Isomerism in Alkenes		
5.5.	Alkene Stereochemistry and the E,Z Designation		
5.6.	Stability of Alkenes		
5.7.	Electrophilic Addition Reactions of Alkenes		
5.8.	Orientation of Electrophilic Additions: Markovnikov's Rule		
5.9.	Carbocation Structure and Stability		
5.10.	The Hammond Postulate		
5.11.	Evidence for the Mechanism of Electrophilic Additions: Carbocation Rearrangements		
Chapter 6.	**Alkenes: Reactions and Synthesis**	**3**	4.1.1;
6.1.	Preparing Alkenes: A Preview of Elimination Reactions		
6.2.	Halogenation of Alkenes: Addition of X_2		
6.3.	Halohydrins from Alkenes: Addition of HOX		
6.4.	Hydration of Alkenes: Addition of H_2O by Oxymercuration		
6.5.	Hydration of Alkenes: Addition of H_2O by Hydroboration		
6.6.	Reduction of Alkenes: Hydrogenation		
6.7.	Oxidation of Alkenes: Epoxidation and Hydroxylation		
6.8.	Oxidation of Alkenes: Cleavage to Carbonyl Compounds		
6.9.	Addition of Carbenes to Alkenes: Cyclopropane Synthesis		
6.10.	Radical Additions to Alkenes: Chain-Growth Polymers		
6.11.	Biological Additions of Radicals to Alkenes		
6.12.	Reaction Stereochemistry: Addition of H_2O to an Achiral Alkene		
6.13.	Reaction Stereochemistry: Addition of H_2O to a Chiral Alkene		
Chapter 7.	**Alkynes: An Introduction to Organic Synthesis**	**3**	4.1.1;
7.1.	Naming Alkynes		
7.2.	Preparation of Alkynes: Elimination Reactions of		

	Dihalides		
7.3.	Reactions of Alkynes: Addition of HX and X_2		
7.4.	Hydration of Alkynes		
7.5.	Reduction of Alkynes		
7.6.	Oxidative Cleavage of Alkynes		
7.7.	Alkyne Acidity: Formation of Acetylide Anions		
7.8.	Alkylation of Acetylide Anions		
7.9.	An Introduction to Organic Synthesis		
Chapter 8.	**Organohalides**	3	4.1.1;
8.1.	Names and Properties of Alkyl Halides		
8.2.	Preparing Alkyl Halides from Alkanes: Radical Halogenation		
8.3.	Preparing Alkyl Halides from Alkenes: Allylic Bromination		
8.4.	Stability of the Allyl Radical: Resonance Revisited		
8.5.	Preparing Alkyl Halides from Alcohols		
8.6.	Reactions of Alkyl Halides: Grignard Reagents		
8.7.	Organometallic Coupling Reactions		
8.8.	Oxidation and Reduction in Organic Chemistry		
Chapter 9.	**Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations**	**6**	4.1.1;
9.1.	The Discovery of Nucleophilic Substitution Reactions		
9.2.	The S_N2 Reaction		
9.3.	Characteristics of the S_N2 Reaction		
9.4.	The S_N1 Reaction		
9.5.	Characteristics of the S_N1 Reaction		
9.6.	Biological Substitution Reactions		
9.7.	Elimination Reactions: Zaitsev's Rule		
9.8.	The E2 Reaction and the Deuterium Isotope Effect		
9.9.	The E2 Reaction and Cyclohexane Conformation		
9.10.	The E1 and E1cB Reactions		
9.11.	Biological Elimination Reactions		
9.12.	A Summary of Reactivity: S_N1, S_N2, E1, E1cB, and E2		
Chapter 10.	**Structure Determination: Mass Spectrometry and Infrared Spectroscopy**	**3**	4.1.2.
10.1.	Mass Spectrometry of Small Molecules: Magnetic-Sector Instruments		
10.2.	Interpreting Mass Spectra		
10.3.	Mass Spectrometry of Some Common Functional Groups		
10.4.	Mass Spectrometry in Biological Chemistry: Time-of-Flight (TOF) Instruments		
10.5.	Spectroscopy and the Electromagnetic Spectrum		
10.6.	Infrared Spectroscopy		
10.7.	Interpreting Infrared Spectra		
10.8.	Infrared Spectra of Some Common Functional Groups		

Chapter 11.	**Structure Determination: Nuclear Magnetic Resonance Spectroscopy**	**3**	4.1.2.
11.1.	Nuclear Magnetic Resonance Spectroscopy		
11.2.	The Nature of NMR Absorptions		
11.3.	Chemical Shifts		
11.4.	13C NMR Spectroscopy Signal Averaging and FT–NMR		
11.5.	Characteristics of ^{13}C NMR Spectroscopy		
11.6.	DEPT ^{13}C NMR Spectroscopy		
11.7.	Uses of ^{13}C NMR Spectroscopy		
11.8.	^{1}H NMR Spectroscopy and Proton Equivalence		
11.9.	Chemical Shifts in ^{1}H NMR Spectroscopy		
11.10.	Integration of ^{1}H NMR Absorptions: Proton Counting		
11.11.	Spin–Spin Splitting in ^{1}H NMR Spectra		
11.12.	More Complex Spin–Spin Splitting Patterns		
11.13.	Uses of ^{1}H NMR		
Chapter 12.	**Conjugated Compounds and Ultraviolet Spectroscopy**	**3**	4.1.1., 4.1.2.
12.1.	Stability of Conjugated Dienes: Molecular Orbital Theory		
12.2.	Electrophilic Additions to Conjugated Dienes: Allylic Carbocations		
12.3.	Kinetic versus Thermodynamic Control of Reactions		
12.4.	The Diels–Alder Cycloaddition Reaction		
12.5.	Characteristics of the Diels–Alder Reaction		
12.6.	Diene Polymers: Natural and Synthetic Rubbers		
12.7.	Structure Determination in Conjugated Systems: Ultraviolet Spectroscopy		
12.8.	Interpreting Ultraviolet Spectra: The Effect of Conjugation		
12.9.	Conjugation, Color, and the Chemistry of Vision		
Chapter 13.	**Benzene and Aromaticity**	**3**	4.1.1., 4.1.2.
13.1.	Sources and Names of Aromatic Compounds		
13.2.	Structure and Stability of Benzene		
13.3.	Aromaticity and the Hückel $4n + 2$ Rule		
13.4.	Aromatic Ions		
13.5.	Aromatic Heterocycles: Pyridine and Pyrrole		
13.6.	Polycyclic Aromatic Compounds		
13.7.	Spectroscopy of Aromatic Compounds		
Chapter 14.	**Chemistry of Benzene: Electrophilic Aromatic Substitution**	**3**	4.1.1.,
14.1.	Electrophilic Aromatic Substitution Reactions: Bromination		
14.2.	Other Aromatic Substitutions		
14.3.	Alkylation and Acylation of Aromatic Rings: The Friedel–Crafts Reaction		

14.4. Substituent Effects in Substituted Aromatic Rings
14.5. An Explanation of Substituent Effects
14.6. Trisubstituted Benzenes: Additivity of Effects
14.7. Nucleophilic Aromatic Substitution
14.8. Benzyne
14.9. Oxidation of Aromatic Compounds
14.10. Reduction of Aromatic Compounds
14.11. Synthesis of Polysubstituted Benzenes

7. Teaching method:

- Traditional teaching styles combined with learning, solving excercises and teaching activities
- Learner roles involve in researching on the real problems, discussing in group, generating new ideas, promote their ability and their soft-skill as communication skill, presentation skill, computer skill, etc.
- Teacher roles active teaching methods make students attracted into learning activities actively based on the organization and instruction of lecturers.
- The role of instructional materials: use multimedia, computer-assisted teaching are an approach to teaching and learning in which computer technology is used as an aid to the presentation, reinforcement, lecturer design,…

8. Duties of student:

Students have to do the following duties:

- present at least 80% theoretical hours
- finish the group and personal given exercises with accessing.
- take midterm exam
- take final exam
- organize and implemen self-study activities.

9. Assessment of student learning outcomes:

9.1. Assessment

Evaluating student's study following cumulative results of credits.

No.	Point components	Rules and Requirement	Weights	Objectives
1	Present	Present/absent hours	10%	4.3
2	Mark on solved exercises	Solved/given exercises	10%	4.2.1; 4.2.4; 4.3
3	Mark on solved exercises of group	- Report/represent/... - Contributed	5%	4.2.2; 4.2.5; 4.2.6; 4.3.
4	Mark on midterm exam	- Writing/multiple choice/ (30 min)	15%	4.1.1 to 4.1.4; 4.2.1
5	Mark on final exam	- Writing/multiple choice/ (60 min) - Present at least 80% theoretical hours - Compulsary to take exam	50%	4.1; 4.3; ...

9.2. Grading

- Grading components and final test scores will be marked on a scale of 10 (0 to 10), rounded to one decimal place.
- Subject score is the sum of all the components of the evaluation multiplied by the corresponding weight. The subject score is marked on a scale of 10 and rounded to one

decimal place, then is converted to A-B-C-D score and score on a scale of 4 under the academic provisions of the University.

10. Materials:

Materials information	Code number
[1] **Organic chemistry** / John McMurry.- 6th ed..- Belmont, CA.: Brooks/Cole-Thomson Learning, 2004.- xxix, [1758 p.] ; ill. (some col.), 26 cm, 0534389996.- 547/ M168 **Chi tiết** **MFN:** 116779	
[2] **Organic chemistry** / Susan McMurry.- Australia: Thomson, 2004.- 868 p., 27 cm (Study guide and student solutions manual for John McMurry's), 0534409342.- 547/ M979 **Chi tiết** **MFN:** 100852	
[3] Schaum's outline of theory and problems of **organic chemistry** / Herbert Meislich, Haward Nechamkin, Jacob Sharefkin.- 3rd ed..- New York: McGraw-Hill, 1999.- 469 p., 27 cm (Schaum's outline series), 007134165X.- 547/ M499 **Chi tiết** **MFN:** 65533	

11. Self-study Guide:

Week	Content	Theory (hours)	Practice (hours)	Students' duties
1	**Chapter 1: Alkanes and Their Stereochemistry** **Chapter 1.** 1.1. Functional Groups 1.2. Alkanes and Alkane Isomers 1.3. Alkyl Groups 1.4. Naming Alkanes 1.5. Properties of Alkanes 1.6. Conformations of Ethane 1.7. Conformations of Other Alkanes	3	0	Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 3.1 to 3.7, Chapter 3, - in the reference book 3 from page 50 to page 68. Every chapter describes individual functional groups. As you study each functional group, make sure that you understand the structure and reactivity of that group.
2		3	0	- Review the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 4.1 to 4.9, Chapter 4 - in the reference book 3 from page 162 to page 188. - Group (4-5 students) working: students

				have to solve the new excercises, 4-5 problems in Chapter 4 of the reference book 1
3	**Chapter 3. Stereochemistry at Tetrahedral Centers** 3.1. Enantiomers and the Tetrahedral Carbon 3.2. The Reason for Handedness in Molecules: Chirality 3.3. Optical Activity 3.4. Pasteur's Discovery of Enantiomers 3.5. Sequence Rules for Specifying Configuration 3.6. Diastereomers 3.7. Meso Compounds 3.8. Racemic Mixtures and the Resolution of Enantiomers 3.9. A Review of Isomerism 3.10. Chirality at Nitrogen, Phosphorus, and Sulfur 3.11. Prochirality 3.12. Chirality in Nature and Chiral Environments	3	0	- Review the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 5.1 to 5.12, Chapter 5 - in the reference book 3 from page 69 to page 86. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 5.1-5.25 in Chapter 5 of the reference book 1 - This crucial topic, so important for understanding biological chemistry
4	**Chapter 4. An Overview of Organic Reactions** 4.1. Kinds of Organic Reactions 4.2. How Organic Reactions Occur: Mechanisms 4.3. Radical Reactions 4.4. Polar Reactions 4.5. An Example of a Polar Reaction: Addition of HBr to Ethylene 4.6. Using Curved Arrows in Polar Reaction Mechanisms 4.7. Describing a Reaction: Equilibria, Rates, and Energy Changes 4.8. Describing a Reaction: Bond Dissociation Energies 4.9. Describing a Reaction: Energy Diagrams and Transition States	3		- Review the 5.1 - 5.5-7. sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 6.1 to 6.11, Chapter 6 - in the reference book 3 from page 31 to page 49. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 6.1-6.13 in Chapter 6 of the reference book 1

	4.10. Describing a Reaction: Intermediates 4.11. A Comparison Between Biological Reactions and Laboratory Reactions			
5	**Chapter 5. Alkenes: Structure and Reactivity** 5.1. Industrial Preparation and Use of Alkenes 5.2. Calculating Degree of Unsaturation 5.3. Naming Alkenes 5.4. Cis–Trans Isomerism in Alkenes 5.5. Alkene Stereochemistry and the E,Z Designation 5.6. Stability of Alkenes 5.7. Electrophilic Addition Reactions of Alkenes 5.8. Orientation of Electrophilic Additions: Markovnikov's Rule 5.9. Carbocation Structure and Stability 5.10. The Hammond Postulate 5.11. Evidence for the Mechanism of Electrophilic Additions: Carbocation Rearrangements	3	0	- Review the 6.1 - 6.6 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 7.1 to 7.11, Chapter 7 - in the reference book 3 from page 87 to page 117. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 7.1-7.21 in Chapter 7 of the reference book 1
6	**Chapter 6. Alkenes: Reactions and Synthesis** 6.1. Preparing Alkenes: A Preview of Elimination Reactions 6.2. Halogenation of Alkenes: Addition of X_2 6.3. Halohydrins from Alkenes: Addition of HOX 6.4. Hydration of Alkenes: Addition of H_2O by Oxymercuration 6.5. Hydration of Alkenes: Addition of H_2O by Hydroboration 6.6. Reduction of Alkenes: Hydrogenation	3	0	- Review the 7.3-7.9 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 8.1 to 8.13, Chapter 8 - in the reference book 3 from page 87 to page 117. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 8.1-8.21 in Chapter 8 of the reference book 1

	6.7. Oxidation of Alkenes: Epoxidation and Hydroxylation 6.8. Oxidation of Alkenes: Cleavage to Carbonyl Compounds 6.9. Addition of Carbenes to Alkenes: Cyclopropane Synthesis 6.10. Radical Additions to Alkenes: Chain-Growth Polymers 6.11. Biological Additions of Radicals to Alkenes 6.12. Reaction Stereochemistry: Addition of H_2O to an Achiral Alkene 6.13. Reaction Stereochemistry: Addition of H_2O to a Chiral Alkene carbonyl			
7	**Chapter 7. Alkynes: An Introduction to Organic Synthesis** 7.1. Naming Alkynes 7.2. Preparation of Alkynes: Elimination Reactions of Dihalides 7.3. Reactions of Alkynes: Addition of HX and X_2 7.4. Hydration of Alkynes 7.5. Reduction of Alkynes 7.6. Oxidative Cleavage of Alkynes 7.7. Alkyne Acidity: Formation of Acetylide Anions 7.8. Alkylation of Acetylide Anions 7.9. An Introduction to Organic Synthesis	3	0	- Review the 8.1-8.13 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 9.1 to 9.9, Chapter 9 - in the reference book 3 from page 140 to page 161. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 9.1-9.13 in Chapter 9 of the reference book 1
8	**Chapter 8. Organohalides** 8.1. Names and Properties of Alkyl Halides 8.2. Preparing Alkyl Halides from Alkanes: Radical Halogenation 8.3. Preparing Alkyl Halides from Alkenes: Allylic Bromination	3		- Review the 9.1-9.9 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 10.1 to 10.8, Chapter 10 - in the reference book 3 from page 118 to page 139.

	8.4. Stability of the Allyl Radical: Resonance Revisited 8.5. Preparing Alkyl Halides from Alcohols 8.6. Reactions of Alkyl Halides: Grignard Reagents 8.7. Organometallic Coupling Reactions 8.8. Oxidation and Reduction in Organic Chemistry			- Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 10.1-10.13 in Chapter 10 of the reference book 1
9	**Chapter 9. Reactions of Alkyl Halides: Nucleophilic Substitutions and Eliminations** 9.1. The Discovery of Nucleophilic Substitution Reactions 9.2. The S_N2 Reaction 9.3. Characteristics of the S_N2 Reaction 9.4. The S_N1 Reaction 9.5. Characteristics of the S_N1 Reaction 9.6. Biological Substitution Reactions 9.7. Elimination Reactions: Zaitsev's Rule 9.8. The E2 Reaction and the Deuterium Isotope Effect 9.9. The E2 Reaction and Cyclohexane Conformation 9.10. The E1 and E1cB Reactions 9.11. Biological Elimination Reactions 9.12. A Summary of Reactivity: S_N1, S_N2, E1, E1cB, and E2	6	0	- Review the 10.1-10.8 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 11.1 to 11.12, Chapter 11 - in the reference book 3 from page 118 to page 139. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 11.1-11.20 in Chapter 11 of the reference book 1
10	**Chapter 10. Structure Determination: Mass Spectrometry and Infrared Spectroscopy** 10.1. Mass Spectrometry of Small Molecules: Magnetic-Sector	3		- Review the 11.1-11.12 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 12.1 to

	Instruments 10.2. Interpreting Mass Spectra 10.3. Mass Spectrometry of Some Common Functional Groups 10.4. Mass Spectrometry in Biological Chemistry: Time-of-Flight (TOF) Instruments 10.5. Spectroscopy and the Electromagnetic Spectrum 10.6. Infrared Spectroscopy 10.7. Interpreting Infrared Spectra 10.8. Infrared Spectra of Some Common Functional Groups			12.8, Chapter 12 - in the reference book 3 from page 118 to page 139. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 12.1-12.10 in Chapter 12 of the reference book 1
11	**Chapter 11. Structure Determination: Nuclear Magnetic Resonance Spectroscopy** 11.1. Nuclear Magnetic Resonance Spectroscopy 11.2. The Nature of NMR Absorptions 11.3. Chemical Shifts 11.4. 13C NMR Spectroscopy Signal Averaging and FT–NMR 11.5. Characteristics of ^{13}C NMR Spectroscopy 11.6. DEPT ^{13}C NMR Spectroscopy 11.7. Uses of ^{13}C NMR Spectroscopy 11.8. ^{1}H NMR Spectroscopy and Proton Equivalence 11.9. Chemical Shifts in ^{1}H NMR Spectroscopy 11.10. Integration of ^{1}H NMR Absorptions: Proton Counting 11.11. Spin–Spin Splitting in ^{1}H NMR Spectra 11.12. More Complex Spin–Spin Splitting Patterns	3	0	- Review the 12.1-12.8 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 13.1 to 13.12, Chapter 13 - in the reference book 3 from page 230 to page 255. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 13.1-13.23 in Chapter 13 of the reference book 1

	11.13. Uses of ^{1}H NMR			
12	**Chapter 12. Conjugated Compounds and Ultraviolet Spectroscopy** 12.1. Stability of Conjugated Dienes: Molecular Orbital Theory 12.2. Electrophilic Additions to Conjugated Dienes: Allylic Carbocations 12.3. Kinetic versus Thermodynamic Control of Reactions 12.4. The Diels–Alder Cycloaddition Reaction 12.5. Characteristics of the Diels–Alder Reaction 12.6. Diene Polymers: Natural and Synthetic Rubbers 12.7. Structure Determination in Conjugated Systems: Ultraviolet Spectroscopy 12.8. Interpreting Ultraviolet Spectra: The Effect of Conjugation 12.9. Conjugation, Color, and the Chemistry of Vision	3	0	- Review the 13.1-13.12 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 14.1 to 14.9, Chapter 14 - in the reference book 3 from page 230 to page 255. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 14.1-14.15 in Chapter 14 of the reference book 1
13	**Chapter 13. Benzene and Aromaticity** 13.1. Sources and Names of Aromatic Compounds 13.2. Structure and Stability of Benzene 13.3. Aromaticity and the Hückel 4*n* + 2 Rule 13.4. Aromatic Ions 13.5. Aromatic Heterocycles: Pyridine and Pyrrole 13.6. Polycyclic Aromatic Compounds 13.7. Spectroscopy of Aromatic Compounds	3	0	- Review the 14.1-14.9 sections of the previous studied chapter of the reference book 1 - Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 15.1 to 15.7, Chapter 15 - in the reference book 3 from page 189 to page 204. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 15.1-15.12 in Chapter 15 of the reference book 1
14	**Chapter 14. Chemistry of Benzene: Electrophilic Aromatic Substitution**	3	0	- Review the 15.1-15.7 sections of the previous studied chapter of the reference book 1

	14.1. Electrophilic Aromatic Substitution Reactions: Bromination 14.2. Other Aromatic Substitutions 14.3. Alkylation and Acylation of Aromatic Rings: The Friedel–Crafts Reaction 14.4. Substituent Effects in Substituted Aromatic Rings 14.5. An Explanation of Substituent Effects 14.6. Trisubstituted Benzenes: Additivity of Effects 14.7. Nucleophilic Aromatic Substitution 14.8. Benzyne 14.9. Oxidation of Aromatic Compounds 14.10. Reduction of Aromatic Compounds 14.11. Synthesis of Polysubstituted Benzenes			- Student will study the theory carefully at home before going to the class with the Sections: - in the reference book 1 from 16.1 to 16.11, Chapter 16 - in the reference book 3 from page 205 to page 229. - Group (4-5 students) working: students have to solve the new excercises, 4-5 problems of 16.1-16.23 in Chapter 16 of the reference book 1

Can Tho, ……./……../20…

ON BEHALF OF RECTOR
DEAN/ DIRECTOR

HEAD OF DEPARTMENT