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Organic Chemistry

أ.د. باسل عبدالمهدي صالح

- 1) ^1H NMR spectroscopy for organic compounds
- 2) Mass spectroscopy for organic compounds
- 3) Perkin Reaction
- 4) Michael addition
- 5) Wittig reaction
- 6) Riemer-Timann Reaction
- 7) Mannich Reaction
- 8) pyridine
- 9) Indole
- 10) Quinoline
- 11) R and S configuration

References:

1. دليل الى ميكانيكية التفاعلات العضوية ترجمة فاضل كمونة
2. Advance organic chemistry by Cary and Sundberg
3. Introduction in heterocyclic chemistry by Acheson

2

Analytical Chemistry

أ.د. علي عبدالرزاق عبدالواحد

- 1) Atomic Absorption Spectrometry (AAS)
- 2) Separation Techniques (Simple Extraction, Cloud Point Extraction, Solid Phase Extraction)
- 3) Chromatography (GC, LC, HPLC)

References:

1. An Introduction to Analytical Atomic Spectrometry by L. Ebdon.
2. Spectrochemical Analysis by Atomic Absorption and Emission 2nd Edition by L.H.J. Lajunen and P. Perämäki.
3. Chemical Analysis 2nd Edition by Francis Rouessac and Annick Rouessac.

3 Physical Chemistry

أ.د. مؤيد عبدالعالي حسين

Part one: Thermodynamic.

1. First law of thermodynamic:
 - a) State Functions.
 - b) Types of systems.
 - c) Types of heat capacity and their relations.
2. Second law of thermodynamic:
 - a) Entropy.
 - b) Helmholtz and Gibbs free energies.
 - c) The relation between first and second laws.
3. Third law of thermodynamic.
4. The chemical potentials of liquids:
 - a) Ideal solutions.
 - b) Ideal dilute solutions.
5. Chemical equilibrium:
 - a) The value of the sign of Gibbs free energy.
 - b) The equilibrium constant.
 - c) The Van't Hoff equation.

Part Two: Electrochemistry.

1. Types of electrolytes:
 - a) The Deby-Hückel limiting law.
 - b) The conductance and conductivity.
 - c) Ion mobility.
2. Electrochemical cells:
 - a) Half reactions and electrodes.

- b) The Nernst equation.
 - c) The relation between E and ΔG .
 - d) Concentration cells.
3. Standard potentials:
- a) The measurement of standard potentials.
 - b) The calculation of reaction constants.
4. Applications of standard potentials:
- a) The electrochemical series.
 - b) Solubility constant.
 - c) Determination of pH.

Part Three: Kinetic chemistry.

- 1. Monitoring the progress of a reaction.
- 2. The rate of reaction.
- 3. Reaction order.
- 4. The determination of the rate law:
- 5. Integrated rate laws.
 - a) First order reactions.
 - b) Second order reactions.
- 6. Half-lives.
- 7. Reactions approaching equilibrium:
 - a) First order reactions close to equilibrium.
- 8. The temperature dependence of reaction rates:
 - a) The Arrhenius parameters.
- 9. Consecutive elementary reactions:
 - a) The variation of concentrations with time.
 - b) The rate determining step.
 - c) The steady-state approximation.

10. The collision theory.
11. The activated complex theory.

Part Four: Quantum Chemistry.

1. Black body radiation.
2. The particle character of electromagnetic radiation.
3. The wave character of particles.
4. The Schrödinger equation.
5. The normalization of wave function.
6. Quantum mechanical principles:
 - a) The information in a wave function.
 - b) The probability density.
 - c) Eigen values and Eigen functions.
 - d) Operators.
 - e) The uncertainty principles.
7. A particle in a box.
8. The rigid rotator.
9. The harmonic oscillator.
10. The hydrogen atom.
11. The Deby-Hückel limiting law.

Part Five: Molecular Spectroscopy.

1. Pure rotation spectra.
2. Linear rotator.
3. Centrifugal distortion.
4. Rotational transitions.
5. Nuclear statistics and rotational states.

6. The vibrations of diatomic molecules.
7. Molecular vibrations.
8. Anharmonicity.
9. Vibration-rotation spectra of diatomic molecules.
10. The Frank-Condon principle.

11. Nuclear Magnetic resonance (NMR) :

- a) The technique.
- b) The energies of nuclei in magnetic fields.
- c) The chemical shift.
- d) The fine structures (The systems).
- e) The magnitudes of coupling constants.
- f) The origin of spin-spin coupling.
- g) Pulse techniques in NMR.
- h) The magnetization vector.
- i) The effect of static field.
- j) The effect of radiofrequency field.
- k) Time and frequency domain spectra.
- l) Spin relaxation.
- m) Spin echoes.
- n) The nuclear Overhauser effect.

12. Two dimensional NMR:

13. Electron Spin Resonance (ESR) :

- a) The g-value.
- b) Hyper fine structure.
- c) The effects of nuclear spin.
- d) The origin of hyperfine interaction.

Part Six: Statistical.

1. Statistical thermodynamics:
 - a) Configurations and weights.
 - b) Instantaneous configurations.
 - c) The dominating configuration
 - d) The Boltzmann distribution.
 - e) The molecular partition function.
2. The canonical partition function:
 - a) The dominating configurations.
 - b) The thermodynamic information in the partition function.
 - i. The entropy.
 - ii. The entropy of monoatomic gas.
 - iii. The internal energy.
 - iv. The enthalpy.
 - v. The Gibbs energy.

References:

1. P.W.Atkins, Physical Chemistry, 6th edition, Oxford University press, (2001).

4 Inorganic Chemistry

أ.د. عادل علي عبدالحسن

Part one: periodic table.

1. Electronic configuration.
2. Electronegativity, electron affinity, metallic properties
3. Term symbol.

Part Two: Reactivity

1. Hard and soft acid and base
2. Reactivity as a thermodynamic view
3. Reactivity as a kinetic view
4. Oxidation Reduction reactions

Part Three: Coordination Chemistry

1. Coordination theories.
2. MOT diagrams.
3. Magnetic susceptibility.
4. Electronic and charge transfer spectra.

Part four: Symmetry

- 1- Symmetry elements.
- 2- Point group.

References:

1. Advanced inorganic chemistry by Haregray
2. General chemistry
3. Symmetry and group theory by Vincent.
4. Principals of inorganic chemistry by Mahdi Naji Al-zecom

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Biochemistry

أ.د. داود سلمان علي

1. Vitamins (define, classification)
2. Hormones (define, classification)
3. Nucleic acid
4. Protein synthesis

References :

1. Lehninger Principles of Biochemistry 4th Edition by David L. Nelson (Author), Michael M. Cox (Author).
2. Harper's Illustrated Biochemistry, 28th Edition

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Polymer Chemistry

أ.د. صلاح شاکر هاشم

1. Free Radical Polymerization
2. Cationic Polymerization
3. Anionic Polymerization
4. Living/Controlled Radical Polymerization
5. Condensation Copolymerization
6. Addition Copolymerization
7. Mechanical Properties of Polymers
8. Thermal Properties of Polymers

References:

1. Principle of Polymerization by Odian.
2. Introduction to Polymer Science and Chemistry by Manas Chanda.

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