

### Section 1. Mathematics and Programming

1. Systems of linear algebraic equations. The Kronecker-Capelli theorem. General solution of a system of algebraic equations.
2. Matrices. Matrix rank, matrix product rank, transposed matrix rank. The determinant of the matrix.
3. A random variable and its distribution function. Joint distribution of random variables. Distribution of the sum of independent random variables.
4. Mathematical expectation and variance of a random variable, their properties.
5. A definite integral and its properties. Integrability of a continuous function. The Newton-Leibniz formula.
6. Computer architecture: von Neumann architecture, Harvard architecture.
7. High-level programming languages. Variables, arrays, conditions, loops. Functions. Recursion.
8. Programming language (e.g. C++, Java, C#, Python): how compilation, interpretation, execution occurs.
9. Programming language (e.g. C++, Java, C#, Python): syntax basics, built-in types, arrays and structures, functions, working with dynamic memory.
10. Programming language (e.g. C++, Java, C#, Python): classes and OOP.

### Section 2. Chemical systems

1. Complex chemical systems (e.g. biological cell).
2. Self-organized systems.
3. General aspects of thermodynamics. Equilibrium and nonequilibrium phase transitions.
4. Mechanical and thermodynamic equilibrium.
5. Nonlinear chemical reactions.
6. The first law of thermodynamics. Internal energy. Enthalpy. The consequences of the first law of thermodynamics.
7. Gibbs free energy.
8. The content and formulation of the second law of thermodynamics. Reversible and irreversible processes.
9. Entropy. Change in entropy in some processes: during phase transformations, during Heating system, in chemical reaction.
10. Application of the first law of thermodynamics to chemical processes. Hess's Law. Calculation Thermal effects of chemical reactions based on Hess's law. Dependence of the thermal effect on temperature. Kirchhoff's equation.

### RECOMMENDED RESOURCES

1. Graham R., Knuth D., Patashnik O. Concrete Mathematics: A Foundation for Computer Science.
2. Diez D.M., Cetinkaya-Rundel M., Barr C.D. OpenIntro Statistics. 4th edition. OpenIntro, 2019.
3. Shriver & Atkins Inorganic chemistry, 5th edition.
4. Atkins' physical chemistry, 11th edition.
5. Organic chemistry, J. Clayden, N. Greeves, S. Warren.