Entrance examination topics

Info-Bionics Engineering MSc

Biology

2. DNA, gene, chromosomes, genome. Replication and cell division.
5. Regulation of gene expression in pro- and eukaryotes. Genetic engineering.
7. Outline of the nervous system and its function in living organisms.
8. Cellular information uptake, processing, storing and response
9. Characterization of the cell types found in nervous tissue, common and distinctive traits compared to the structure and function of other somatic cells
10. The electrical activity of neurons, action potential, EPSP and IPSP
11. Types of nerve fibers, conduction of nerve impulses in the central and peripheral nervous system
12. Types and functions of glial cells
15. Types of neurotransmitters, their synthesis, use and degradation, amines and peptide type neurotransmitters
16. Non-synaptic interneuronal contacts and retrograde signal transmission
17. Types and function of receptors. The structure and role of the muscle spindle.
18. Types and mechanisms of effectors, structure and role of the motor endplate
Recommended literature:

Chemistry

1. The periodic table of the elements. Properties of nuclei, isotopes, electronic structure, quantum numbers, the Bohr-Sommerfeld model

2. Properties of atoms, electronegativity, atomic radius, ionization energy, formation of bonds, bonding models, valence, molecular orbital theory, hybridization, VSEPR theory, features of chemical bonds, primary and secondary bonds

3. Compounds, stoichiometry, classification of compounds, important compounds of the abundant elements, case studies

4. States of matter, gases, kinetic gas theory, gas laws, fluids, surface tension, cohesive forces. Solid state, crystal structures, changes in states, phase diagrams

5. Chemical equilibria, acid-base reactions and theories: Arrhenius-Ostwald, Bønsted-Lowry, Lewis, HSAB


7. Thermodynamics: main laws, heat, entropy, enthalpy (reaction enthalpy), Gibbs free energy (equilibrium processes), electrochemistry (reactions on a boundary surface)

8. Classification and nomenclature of organic compounds


10. Classification of organic reactions, acidity and basicity of organic compounds, nucleophilicity and electrophilicity, energy profile of reactions, kinetic and thermodynamic control. Factors determining reactivity: inductive, steric and mesomeric effects


12. Oxo compounds: aldehydes and ketones, tautomerism, carboxylic acids and their derivatives, carbohydrates and heterocyclic compounds.

13. Amino acids and proteins, protein folding, primary, secondary and tertiary structure, cooperativity
14. Nucleosides, nucleotides and nucleic acids, their structure and biological function

15. Enzymes: fundamentals of enzyme catalysis, basic mechanisms, examples

16. Bioenergetics: role and production of ATP, completion of energetically unfavorable reactions in the cells

17. Lipids, biological membranes and transport mechanisms

**Recommended literature:**

**Physics**

1. Inductive way to Maxwell equation sand the Maxwell equations

2. Kirchhoff equations

3. Transmission lines

4. Linear antennas and antenna arrays

5. Motion of charge carriers in electromagnetic

6. Basics of quantum mechanics

7. Quantum statistics

8. Elements of solid state physics

9. Basics of semiconductor physics

10. Quantum optics and quantum electronics

**Recommended literature:**

**Electronics**

2. Generation of circuit equations, the solution of the DC equation. Thévenin and Norton theorems

3. Solution of the circuit equations in time domain, circuit simulator programs.


5. Analysis of linear circuits in frequency domain, Bode diagrams.

6. Basics of nonlinear circuits, Boolean circuit, amplifiers and chaotic circuits

7. Some problems of Boolean circuit design, speed, power, area, low power systems, DeMorgan-theorem, disjoint normal form.

**Recommended literature:**

**Computer Science**

1. Representation of information
2. ALU (its components, functions)
3. Arithmetic operational units
4. Digital building blocks (register, ALU, MUX, encoders)
5. Process of instruction execution
6. Control units
7. Memories (types, properties)
8. Input / Output units, buses
9. RISC and CISC computer architectures
10. Basic data types (Stack (LIFO), Queue (FIFO), Priority Queue, Lists). Representation, implementation and operations.
11. Data storage and retrieving (Heap, Binary search tree, B-tree, Hash table)


16. Components and tasks of database management systems


Recommended literature:

- Topics 1-9
  - L. Howard Pollard, Computer design, and architecture, Prentice Hall; 1st edition (July 1, 1997), ISBN: 9780131672550

- Topics 10-12

- Topics 13-14

- Topics 15-17