ENTRANCE EXAMINATION IN SPECIALTY FOR APPLICANTS ENTERING MASTER'S PROGRAMS OF PHYSTECH SCHOOL OF ELECTRONICS, PHOTONICS AND MOLECULAR PHYSICS

1. The structure of the atom and the periodic law.
2. The concept of a thermodynamic system. State functions and state parameters. Thermodynamically reversible processes. Equilibrium and non-equilibrium states and processes. The concept of energy, its types and work.
3. Work, inner energy, heat. The first law of thermodynamics. Internal energy and enthalpy of an ideal gas. Enthalpy change in chemical processes.
4. The concept of heat capacity. Heat capacity at constant volume and pressure. Relationship between C_V and C_P for an ideal gas (Mayer's ratio).
5. The second law of thermodynamics. Entropy (thermodynamic definition). Clausius inequality. Entropy of an ideal gas.
6. Reversible and irreversible processes. The law of increasing entropy. Non-equilibrium expansion of a gas into a void.
7. Classical theory of heat capacities. The law of uniform distribution of the energy of thermal motion over the degrees of freedom. Heat capacity of crystals (Dulong-Petit law).
8. Temperature dependence of the heat capacity C_V of gases. Excitation and freezing of degrees of freedom, characteristic temperatures.
9. Diffusion: Fick's law, diffusion coefficient, diffusion equation.
10. The subject of the study of electrochemistry. The difference between redox reactions and electrochemical ones.
11. The concept of the electrode system. Cathodic and anodic processes. Galvanic cell and electrolyzer.
12. Electricity. Joule-Lenz law. Charge. Coulomb's law. Passage of current through a conductor. Ohm's law.
13. Faraday's law. The physical meaning of the Faraday number. Using Faraday's Law in Electrolysis.
14. The concept of energy resources. Primary and secondary energy resources. Renewable resources.
15. Types of power plants and their main elements. Principles underlying the technological processes of various types of power plants.
16. Energy saving. Energy efficiency.

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2. James D. Patterson. Solid-State Physics. Introduction to the theory = Физика твердого тела: 3-е изд. / James D. Patterson, Bernard C. Bailey .— Switzerland : Springer Nature, 2018 .— ISBN 978-3-319-75322-5
3. Краткий курс термодинамики / В.Е. Белонучкин. — 2-е изд., перераб. и доп. — М.: МФТИ, 2010. — 164 с.
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Literature for the questions 10-13

1. Bagotsky V.S. Fundamentals of electrochemistry. 2nd ed. Wiley. 2006. 719 p.
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Literature for the questions 14-16

1. Encyclopedia of Sustainability Science and Technology Series, Second Edition / Ed.: Bronicki L.Y. Springer. 2018. ISBN 978-1-4939-7510-5
2. P. Mason. Power Stations and Electricity (Building the World). Wayland, 2019. ISBN-10 978-1526311238
3. Ph. Kiameh. Power Generation Handbook : Selection, Applications, Operation, Maintenance. McGraw-Hill Professional, 2002. ISBN 978-0071396042.
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