Program: Engineering & Technology

Theoretical mechanics

- Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction.
- Kinematics of a point; translational and rotational motion of a rigid body.
- Velocity and acceleration at points of a rigid body and with complex motion.
- Differential equations of motion of a material point.
- General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.

Resistance of materials and fundamentals of materials science

- Types of deformations: elastic and plastic deformation.
- Strength, rigidity, structural stability.
- External forces (loads) - classification. Internal forces.
- The section method.
- Articulated-movable bearing, articulated-fixed bearing, rigid termination.
- Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending.
- The study of stress-strain state.
- Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.
- Complex resistance.
- State diagrams of various metals.
- Fundamentals of heat treatment of metals and alloys.
- The main types of functional organic and inorganic materials.
- Hybrid and composite materials.
- Tools and methods for diagnostics and testing, research and quality control of films, materials, coatings, blanks, semi-finished products, products.

Thermodynamics and the basics of heat and mass transfer

- Entropy and its basic properties. The second law of thermodynamics. Statistical interpretation of the second law of thermodynamics.
- The coefficient of performance (COP) of the heat engine. The Carnot cycle. Efficiency of the Carnot cycle. The Carnot theorem.

- Steam-turbine and gas-turbine cycles. Rankine cycle, the Brighton cycle.
- The crystalline state of the substance. Crystal lattices. Physical types of crystal lattices. The heat capacity of crystals. The Dulong-Petit law.
- Liquid state of the substance. Surface tension. Free energy. Capillary pressure.
- Phase equilibriums and transformations. Phase balance. Evaporation and condensation. Melting and crystallization. The Clapeyron-Clausius equation. Triple point.
- Boundary problems of thermal conductivity. The boundary conditions are 1,2 and 3 type. Initial conditions.
- Stationary heat conduction problems in flat, cylindrical and spherical walls with internal heat sources.
- The main laws of convective heat transfer during natural and forced circulation of the coolant. The Bio-Fourier Conjecture. The Newton-Richman law.
- Radiation heat transfer.
- The equation of heat balance.

Fundamentals of electrical engineering, electronics and automation

- Basic concepts of the circuit theory. Idealized passive and active elements.
- The system of equations of electrical equilibrium.
- Simplest linear circuits with harmonic effects.
- Methods for calculating complex electrical circuits.
- Quadripoles.
- Transients in circuits with lumped parameters.
- Electrical conductivity of semiconductors.
- Physical processes in the p-n junction.
- Semiconductor diodes.
- Bipolar transistors.
- Field effect transistors.
- The principles of constructing amplifying circuits.
- Amplification stages on bipolar transistors.
- Amplifier cascades on field effect transistors.
- Amplification cascades on operational amplifiers (op amps).
- Basic elements of digital electronics.
- The circuitry of logic elements.
- Sequential circuits.
- Combination schemes storage devices.

- Digital-to-analog and analog-to-digital converters.

Nuclear technology

- The nuclear model of an atom. Atomic spectra. Alpha particle scattering experiments. The Rutherford formula.
- The nuclear model of the atom. Postulates of Bohr.
- Heat capacity of crystals. Oscillation spectrum of the crystal lattice.
- Elements of the physics of the atomic nucleus. The composition of the atomic nucleus. Atomic number and mass number. Isotopes. Dimensions of the atomic nucleus. Mass and binding energy. Mass defect. Radioactivity. Types of radioactive processes. The law of decay.
- Elements of particle physics. Types of interaction and classes of elementary particles. Particles and antiparticles.
- The main isotope separation methods
- The main properties of nuclear fuel, the concept of critical mass.
- Chain nuclear fission reaction
- The main types of nuclear power plants NPP

Recommended textbooks

Theoretical mechanics

1. Hamill, Patrick (2014). A Student's Guide to Lagrangians and Hamiltonians. Cambridge University Press.
2. Hand, Louis; Finch, Janet (1998). Analytical Mechanics. Cambridge University Press.
3. Kibble, T. W.; Berkshire, F. H. (2004). Classical Mechanics. Imperial College Press.
4. Kleppner, Daniel; Kolenkow, Robert (1973). An Introduction to Mechanics. McGraw-Hill.
5. Marion, Jerry; Thornton, Stephen (2003). Classical Dynamics of Particles and Systems (5th ed.). Brooks Cole.
6. Morin, David (2005). Introduction to Classical Mechanics: With Problems and Solutions. Cambridge University Press.
7. Taylor, John (2005). Classical Mechanics. University Science Books.

Resistance of materials and fundamentals of materials science

1. Ashby, Michael; Hugh Shercliff; David Cebon (2007). Materials: engineering, science, processing and design (1st ed.). Butterworth-Heinemann.
2. Askeland, Donald R.; Pradeep P. Phulé (2005). The Science & Engineering of Materials (5th ed.). Thomson-Engineering.
3. Callister, Jr., William D. (2000). Materials Science and Engineering – An Introduction (5th ed.). John Wiley and Sons.
4. González-Viñas, W. & Mancini, H.L. (2004). An Introduction to Materials Science. Princeton University Press.
5. Mathews, F.L. & Rawlings, R.D. (1999). Composite Materials: Engineering and Science. Boca Raton: CRC Press.
6. Walker, P., ed. (1993). Chambers Dictionary of Materials Science and Technology. Chambers Publishing.

Thermodynamics and the basics of heat and mass transfer

1. M. M. Abbott and H. C. van Ness, 1989, Thermodynamics with Chemical Applications, Second Edition.
2. Schaum's Outline Series in Engineering, McGraw-Hill, New York.
3. T. L. Bergman, A. S. Lavine, F. P. Incropera, and D. P. DeWitt, 2011, Fundamentals of Heat and Mass.
4. C. Borgnakke and R. E. Sonntag, 2012, Fundamentals of Thermodynamics, Eighth Edition, John Wiley, New York.
5. Y. A. C¸engel andM. A. Boles, 2014, Thermodynamics: An Engineering Approach, Eighth Edition, McGraw-Hill, Boston.
6. J. R. Howell and R. O. Buckius, 1992, Fundamentals of Engineering Thermodynamics, Second Edition, McGraw-Hill, New York.
7. C. Kittel and H. Kroemer, 1980, Thermal Physics, Second Edition, Freeman, San Francisco.
8. L. D. Landau and E. M. Lifshitz, 2000, Statistical Physics, Part 1, Volume 5.
9. P. M. Morse, 1969, Thermal Physics, Second Edition, Benjamin, New York.

Fundamentals of electrical engineering, electronics and automation

1. Electric energy : its generation, transmission, and use by Laithwaite, E. R. (Eric Roberts), 1921- Freris, L. L.
2. FACTS controllers in power transmission and distribution by Padiyar, K. R.
3. Electric power : generation, transmission and efficiency by Lefebvre, Clément M.
4. Basic electronics theory by Horn, Delton T.
5. Basic electronics theory--with projects and experiments by Horn, Delton T.
6. Analogue and digital electronics for engineers : an introduction by Ahmed, H. Spreadbury, P. J.
7. The science of electronics. Digital by Floyd, Thomas L. Buchla, David M.
8. Analog and digital electronics : a first course by Beards, Peter H., 1932.

Nuclear technologies

1. Nuclear Energy (Murray). Pergamon, 1993.
2. Fundamental Aspects of Nuclear Reactor Fuel Elements (Olander). NTIS, 1976.
3. Introduction to Nuclear Engineering (Lamarsh). Prentice Hall, 2001.
4. Nuclear Power Plant Engineering (Rust). Haralson Pub. Co., 1979.
5. Nuclear Reactor Engineering (Glasstone), 4th ed. Chapman and Hall, 1994.
6. Nuclear Reactor Physics (Stacey). Wiley, 2007.
7. Radiation Detection and Measurement (Knoll), 3rd ed. Wiley, 2000.