

## Entrance tests

### Mathematics of computations

1. The Taylor formula, the remainder term forms, the decomposition of elementary functions.
2. Intervals of monotonicity, extrema, convexity, inflections and asymptotes of functions.
3. Differential, partial derivatives, directional derivative, gradient of a function of several variables.
4. Jacobian and the change in variables in the functions of several variables.
5. Implicit function theorems.
6. Convergence of numerical series, Cauchy's mutual convergence criterion, convergence tests.
7. Uniform convergence of functional sequences and series, tests for convergence, theorem on the passage to the limit.
8. Theorems on continuity, termwise integration and differentiation of functional series.
9. Formal power series, radius of convergence, Cauchy-Hadamard formula.
10. Topological spaces, their continuous mappings; compactness.
11. Metric spaces, completeness, the principle of contracting mappings.
12. Lebesgue measure, properties of measurable functions, Egorov's theorem.
13. The Lebesgue integral and its properties, the passage to the limit under the Lebesgue integral sign.
14. Hilbert spaces, orthogonal systems of functions, complete systems, completeness criterion.
15. Bessel's inequality and Parseval's equality in Hilbert spaces.
16. Convergence of Fourier series in a Hilbert space.
17. Linear spaces, basis, theorem on the bases of finite-dimensional spaces, dimension.
18. The matrix rank theorem, its consequences.
19. Systems of linear equations, theorems on the general solution of homogeneous and inhomogeneous systems.
20. Bilinear and quadratic forms in linear spaces, reduction of quadratic forms to normal form, inertia law.
21. Linear mappings in linear spaces, eigenvectors and eigenvalues, their properties.
22. The Jordan form of the matrix of a linear operator, Jordan's theorem, the Churkin algorithm.
23. Linear Fredholm equations of the second kind, Fredholm's theorems.
24. First-order differential equations, the theorem of existence and uniqueness for the solution of the Cauchy problem.
25. Linear systems of differential equations, Vronsky's determinant.
26. Method of variation of arbitrary constants.
27. Linear differential equation systems with constant coefficients;
28. Lyapunov stability and asymptotic stability.
29. Stability of linear systems, the theorem on stability in the first approximation.
30. Second-order linear partial differential equations, their classification.
31. The Dirichlet problem for the Laplace equation.
32. The independent Bernoulli trials, the Moivre-Laplace theorem.
33. The law of large numbers.
34. The central limit theorem.
35. Exact and iterative methods for solving systems of linear equations.
36. Numerical methods for solving non-linear equations and systems.
37. Interpolation polynomial in the Newton and Lagrange forms.
38. The method of least squares.
39. Numerical differentiation and numerical integration.
40. Numerical solution of ordinary differential equations.
41. Grid methods for solving problems in mathematical physics.