

Essential notions required by students who wish to apply to ParisTech

Mathematics

Elementary logic and Algebra:

Propositional calculus, quantifiers. Arguments ad absurdo, by recursion.

Set and function terminology, sets \mathbb{N} , \mathbb{Z} and \mathbb{Q} : arithmetic and combinatorics,

Polynomials: Euclidian division.

Properties of the set \mathbb{R} :

Interval, neighbourhood, upper bound. Sequences and series: limit (Cauchy criterion), rate of convergence, recursion $u_{n+1} = f(u_n)$. Numerical functions of the real variable: limits and continuity, differentiability, finite increments formula, monotony and inverse functions, Taylor formulas and inequalities, finite expansions, usual functions.

The field of complex numbers, usual complex functions (exponentials ...).

Linear algebra :

Vector spaces, linear maps, basis and dimension. Matrices, determinants, linear systems. Eigenvalues and eigenvectors, characteristic polynomial, diagonalization. Application to differential systems and equations.

Analysis :

Rational functions and their decomposition, Computation of primitives: integral defined on a closed bounded interval, numerical methods. Taylor formula with integral remainder. Vector valued function of the real variable in \mathbb{R}^2 and \mathbb{R}^3 (excluding metric properties). Parametric curves in \mathbb{R}^2 or \mathbb{R}^3 . First and second order linear differential equations. Path integral.

Numerical series :

Functions of the real variable: sequences and series of functions, entire series, applications to Fourier series. Simple, absolute, uniform and normal convergences. Integrals over a real interval, integrals depending on a parameter. Examples and applications (Fourier, Laplace).

Numerical and vectorial analysis :

Differential calculus: multivariable functions. Partial derivatives and linear tangent application. Taylor formula of order 2: application to local extrema. Multiple integrals (functions of 2 or 3 variables). Computation via successive integrations and change of variables formula.

Finite dimensional euclidean spaces :

Scalar products, norms, orthonormal basis and orthonormalization. Adjoint, hermitian, unitary and normal operators. Introduction to the space L^2 . Orthonormal basis in L^2 , Legendre polynomials, basis of trigonometric functions. Applications to Fourier series. Fourier transformation : Plancherel equality.

Physics

International Unit System, Dimensional analysis.

Mechanics

Kinematics: trajectories, velocity, acceleration, motion of rigid bodies, change of reference frame.

Newtonian dynamics: first, second and third laws, inertial and non-inertial reference frames, conservation laws, forces and potentials, gravitational field, central forces, small oscillations.

Fluids: pressure, hydrostatics, Euler and Lagrange variables of a continuum, continuity equation, Euler equation of motion.

Thermodynamics

First law, internal energy, work, heat. Reversible and irreversible processes, second law, Carnot cycles. Equations of state, change of phase, ideal gases, chemical potentials, chemical reactions, equilibrium equations, affinity.

Electricity and magnetism

Electrostatics: electric charge, Coulomb's law, electric field, potential, Gauss' law, equilibrium of conductors, capacitance.

Magnetostatics: magnetic field, Ampère's laws, Faraday's law of induction.

Electric currents: electric current, Ohm's law, conductivity, Kirchhoff's laws, time varying currents, free and forced oscillations, condensers, inductance, complex impedance, resonant circuits.

Maxwell equations, Lorentz force, plane electromagnetic waves, radiation, light waves, reflexion, refraction, Huyghens principle, diffraction, interference phenomena.

Atomic and molecular physics

Quantum mechanics: Planck's law, Bohr's atom, de Broglie's relation, uncertainty principle, wave function, Schrödinger's equation, stationary states, quantization of energy.

Structure of matter: hydrogen atom, periodic table of the elements, molecules, solid state, elementary statistical physics.

TEST PROCEDURE

1)WRITTEN TEST

it is composed of 95 questions or statements. Each is followed by 5 suggested answers or completions. You will have to select the right one in each case and then mark the corresponding space on the answer sheet placed at the end of the test.

The scientific fields covered by the test are:

- Elementary mathematics : questions 1 to 30
- Advanced mathematics: questions 31 to 45
- Mechanics: questions 46 to 65
- Thermodynamics and chemistry: questions 66 to 75
- Information Sciences and technologies: questions 76 to 95

You will have 2h30 for answering, in order of priority:

- the Elementary mathematics
- the questions the most related to your speciality
- the other questions

We know it is impossible to answer all the questions, but the test is made to test the general scientific knowledge of the students. Carefully note that you will get one point for a right answer but a negative $1/4$ point for a bad one. So do not answer randomly.

Calculators and electronic dictionary or other devices are not allowed during this test.