Required knowledge in Physics

NB: General concepts as energy conservation and momentum conservation laws are a must for the test.

1 Newtonian mechanics

The laws of mouvement of a point with mass m submitted to external forces must be known, in one, two and three dimensions. The core Newton laws must be mastered by the candidates : the principle of inertia, the principle of action and reaction, the fundamental equation of dynamics, as well as the angular momentum theorem, the kinetic energy theorem. Notions of non-inertial frames and forces referred to as *inertia* forces are pre-supposed (in particular, in the case of linear acceleration and uniform rotation frames). In some cases, the symmetry of the applied forces can be used to solve the problems. Basics knowledge of newtonian mechanics applied to ideal fluid, as the Archimedes force, must be know by the candidates.

2 Mechanics of solids

Within this syllabus, the mechanics of solids deals only with rigid bodies (non-deformable solids). Additionally, only solids rotating about a fixed axis are a possible examination topic. Inertia tensors are not required. The expression of the kinetic energy of a solid as a sum of a translational term of its centre of mass and of a rotational term with respect to the centre-of-mass reference frame should be known.

3 Thermodynamics: perfect gaz, reversible thermodynamical cycle

The usual thermodynamics functions as internal energy, entropy, enthalpy, free energy, free enthalpy, as well as their differentials must be known. The heat capacities at constant volume and at constant pressure equal the partial derivatives of internal energy and of enthalpy with respect to the temperature must also be known by the candidates. The definitions of extensive and intensive variables, as well as of thermodynamic equilibrium must be known. The gaz will be considered as perfect, and the equation $PV = nRT$ must be mastered. The entropy for perfect gaz as function of volume, pressure and temperature must also be known. The three principles of thermodynamics must be known. The reversible thermodynamical cycles must also be know.

4 Geometrical optics and wave optics

4.1 Geometrical optics

The concept of light rays, reflection and refraction by a plane mirror and the Snell – Descartes' laws, must be known. The applicants should know what spherical mirrors and lenses are, as well as the conjugation and magnification relationships.

4.2 Wave optics

The concept of an optical path as well as the interference between two totally coherent waves must be known. Also to know are: diffraction at infinity, diffraction by a rectangular slit, diffraction at infinity by two slits (Young's slits) and by a row of slits. The calculation of the diffraction pattern for a circular (or any other more complex form) slit is excluded from the syllabus.

5 Electromagnetism

Coulomb's law, the concept of electric field, electrostatic field E, current circulation and flow under static electric field, Gauss' theorem and symmetry properties of the electric field must be known. The magnetic field B, the symmetry properties of B, the circulation of the magnetic field on a closed curve as well as the flux of magnetic field must be mastered by the candidates. The candidates must also know the the Maxwell equations as well as the Poisson equation.

6 Electronics

Electric voltage, Kirchoff's laws of knots and meshes, electrical current, Ohm's law and the superposition theorem must be known. The physical bases of operation of the basic circuit components: resistor, capacitor, induction coil, are required. Their impedances in a sinusoidal regime must be known, as well as the transient regime of charging and discharging a capacitor. The candidates must also know the basic examples of RC, RL, LC and RLC circuits, as well as circuits with operational amplifiers and transistors. Candidate must also kwon the boolean logic.

7 Quantum mechanics

Candidates must master the concept of hamiltonian, and must know the Schrödinger equation, as well as how to solve it in the majority of simple cases, when the potential energy is constant and in the case of the harmonic oscillator. The eigen energies and eigen vectors of the hamiltonian in the case of standard potential energy like quantum well, harmonic oscillator and Coulomb potential must be know. The candidates must also master the concetp of wave function, together with its meaning and its physical properties.