Admission requirements for enrollment in bachelor programs

The following is the list of educational outcomes which the applicant is expected to have achieved at the time of enrollment*

Mechanics

- Analyse motion in a straight line
  - Physically analyse the examples of uniform motion in a straight line
  - Physically analyse the examples of uniformly accelerated/decelerated motion along a straight line
- Apply Newton's first law
  - Apply the concept of Newton's 1st law
- Apply 2nd Newton's law
  - Apply simultaneous action of several forces on a body and display them using a force diagram
  - Physically analyse Newton's 2nd using examples of gravity, elastic force and frictional force
  - Physically analyse movement in the gravitational field (free fall, vertical, and horizontal shot)
- Apply Newton's 3rd law and the momentum conservation law
  - Apply the concept of Newton's 3rd law
  - Relate the impulse and the change of momentum
  - Apply the concept of the momentum conservation law
- Apply the energy conservation law
  - Physically analyse the energy conservation law
  - Physically analyse the concepts of energy and work
  - Physically analyse the concepts of power and efficiency
  - Physically analyse concepts of different forms of mechanical energy
- Analyse circular motion
  - Physically analyse examples of uniform circular motion
- Apply the law of gravity and analyse the motion of the Earth and celestial bodies
  - Physically analyse Newton's law of gravity
  - Physically analyse the motion of a satellite
- Apply the laws of fluid statics
  - Physically analyse pressure (hydrostatic, atmospheric, hydraulic)
  - Physically analyse buoyancy
  - Physically analyse the action of forces on a body immersed in a fluid
- Apply the laws of fluid dynamics
  - Physically analyse the motion of ideal fluids (equation of continuity and Bernoulli's equation)
- Apply the model of the particle structure of matter
  - Physically analyse the laws of thermal expansion of solid and liquid bodies (linear and bulk)
  - Explain the structure of matter, diffusion, Brownian motion, and physical states

Thermodynamics

- Analyse and apply ideal gas laws and molecular-kinetic gas model
  - Physically analyse the changes of state of an ideal gas (gas laws)
  - Physically analyse the molecular-kinetic theory of gases on the ideal gas model
- Analyse thermodynamic processes and systems
  - Physically analyse the concept of gas work, heat and internal energy
  - Physically analyse changes in physical states

- Physically analyse the operation of heat engines
- Physically analyse the first law of thermodynamics

Electromagnetism

- Explain electrostatic phenomena, apply concepts and laws of electrostatics
  - Physically analyse the basic concepts and laws of electrostatics
- Describe the electric field
  - Physically analyse the electric field
  - Physically analyse the motion of a charged particle in an electric field
  - Physically analyse the concept of capacitance and electrostatic quantities associated with a plate capacitor
  - Physically analyse the concept of electric voltage and electric potential
- Apply the laws of electrodynamics to an electrical circuit
  - Physically analyse the concept of electric current
  - Physically analyse the concept of electrical resistance
  - Physically analyse Ohm's law
  - Physically analyse the dependence of current, voltage and resistance in electrical circuits
  - Physically interpret work and power in an electrical circuit
- Describe the properties of magnets and analyse the connection between electric current and magnetism
  - Physically analyse the magnetic fields of permanent magnets
  - Physically analyse the magnetic field of electric current
- Analyse magnetic interaction and explain applications
  - Apply physical expressions for Ampere and Lorentz forces to examples
  - Analyse the motion of a charged particle in a magnetic field
- Analyse electromagnetic induction and applications
  - Physically analyse electromagnetic induction
  - Apply Faraday's law and Lenz's rule
  - Apply the basic physical quantities in expressions for alternating current
  - Compare properties of direct and alternating currents, apply the operating principles of electric generators, electric motors, and transformers, apply capacitive and inductive resistance

Vibration, waves and optics

- Analyse harmonic oscillations
  - Physically analyse the oscillation of a body on a spring
  - Physically analyse the oscillation of a mathematical pendulum
  - Physically analyse the oscillation in the LC oscillating circuit
  - Conceptually analyse forced and damped vibration
- Explains the creation of a wave and Analyse wave properties
  - Physically analyse the creation and propagation of a wave
  - Physically analyse properties of mechanical waves (reflection, refraction, interference)
- Analyse the wave properties of sound
  - Physically analyse the wave properties of sound
  - Physically analyse the formation of a standing wave
  - Physically analyses the examples of the Doppler effect
- Apply the laws of geometric optics

- Physically analyse the laws of light reflection and apply light reflection from a plane mirror
- Physically analyse the laws of light refraction and apply light refraction through plane-parallel plates and lenses

- Analyse the wave nature of light
  - Physically analyse the wave properties of light (diffraction, interference, polarisation, scattering)
- Explain the origin, properties and applications of electromagnetic waves
  - Physically analyse electromagnetic waves
  - Physically analyse the electromagnetic spectrum
- Analyse the wave-particle model of light and matter
  - Physically analyse the photoelectric effect
  - Physically analyse the wave-particle model of electromagnetic radiation and matter
- Analyse the atom model and energy spectra
  - Physically analyse the Bohr model of atoms
- Explain the model of the atomic nucleus and nuclear reactions
  - Physically analyse nuclear reactions
  - Physically analyse the principle of equivalence of mass and energy
- Analyse radioactive decay and describe the effects of ionising radiation on living organisms
  - Physically analyse the radiative decay law
  - Physically analyse types of ionising radiation and their effect on living organisms
- Describe and apply the basic ideas of the special theory of relativity (STR)
  - Physically analyse the STR concepts (time dilation, length contraction, relativistic energy, rest energy of a particle)
- Describe the model of creation and structure of the universe
  - Describe the model of the origin and structure of the universe

<u>In all sections, the student is expected to be able to “solve problems” which implies the following outcomes</u>

- visualise the problem situation
- identify problem-solving objectives
- select the necessary information and applicable physical principles
- construct a problem-solving plan
- qualitatively infer by applying physical concepts and laws
- mathematically model situations and calculate the necessary physical quantities
- evaluate physical situations
- interpret and apply different representations of physical quantities
- apply and convert measurement units
- evaluate the procedure and the result

<u>The following mathematical and experimental skills are expected in all sections:</u>

- Know the physical quantities and their SI units
  - apply symbols and SI units of measurement of physical quantities
  - distinguish between scalar and vector quantities
  - convert measurement units
  - use number notation with powers of 10
  - know and correctly use the decimal prefixes of measurement units (pico, nano, micro, milli, centi, deci, deka, hecto, kilo, mega)
- Apply elementary experimental skills
  - design simple experiments and measurements

- determine the mean value of the measurement results
- determine the maximum absolute measurement error
- state the measurement result with the associated error
- graphically show the interdependence of the measured quantities
- evaluate and interpret measurement results

- Apply basic mathematics knowledge in the context of physics
  - read the values of the quantities from the graph
  - draw a graph of the interdependence of two quantities based on the data
  - determine the slope of a line and interpret its meaning in the case of linear dependence of two quantities
  - use basic mathematical knowledge in physical problems:
    - use a pocket computer
    - use tables and diagrams
    - draw graphs from the given data
    - interpret graphs
    - convert decimal fractions to percentages and vice versa
    - determine mean values and interpret their meaning
    - transform a mathematical expression
    - solve a quadratic equation with one unknown
    - apply proportionality and inverse proportionality
    - add and subtract vectors
    - use trigonometric functions
    - use logarithmic and exponential functions
    - calculate the area and perimeter of triangles, circles and rectangles
    - calculate the area and volume of a cube, cylinder and sphere

<u>In the development of educational outcomes, the phrase "physical analysis" implies one or more of the following outcomes:</u>

1. solve problem situations of physical phenomena by applying exclusively physical concepts
2. numerically or algebraically solve problem situations by applying physical laws
3. graphically display tabulated data
4. connect graphic representations of physical phenomena
5. tabulate graphically displayed data
6. examine and analyse graphic representation and identify physical phenomena
7. establish a physical expression (mathematical formulation) based on a graph
8. establishes a physical expression (mathematical formulation) based on a table

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