Reg No: BBBX08/20201



Faculty of Health, Science and Technology Physics

Syllabus

Natural Science, Prepatory Term

Course Code:	BBBX08
Course Title:	Natural Science, Prepatory Term Naturvetenskaplig bastermin
Credits:	30
Degree Level:	Preparatory
Progressive Specialis	sation: ()

Major Field of Study:

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2019-09-02, and is valid from the Spring semester 2020 at Karlstad University.

Prerequisites

General admission requirements plus upper secondary school level Mathematics 3b/3c, Physics 1, Chemistry 1, or equivalent

Learning Outcomes

The aim of the course is that students acquire knowledge equivalent to the requirements of the upper secondary school natural science programme (in Mathematics 3c and 4 plus Physics 2) and demonstrate adequate background knowledge for pursuing studies on the programmes in Computer Science, GIS, and Engineering, and in some natural science subjects and Mathematics programmes at Karlstad University.

Upon completion of the Physics module, students should be able to:

- plan and conduct experimental investigations on the basis of a given problem and report and interpret results orally and in writing,

- describe and analyse physical problems and treat them mathematically using adequate quantities, concepts, and models,

- give an account of the concepts force, work, energy in two dimensions, torque, and equilibrium, and use these concepts in calculations,

- describe electrical and magnetic fields, induction and some applications in these areas,

- describe and analyse mechanical and electromagnetic waves and treat them mathematically, including some applications in the area,

- describe, use, and explain Bohr?s atomic model,

- give an account of the structure of atoms, using the concepts of quantum physics and relevant experimental measuring methods,

- demonstrate insight into the theory of special relativity in terms of physical phenomena such as time dilation and length contraction,

- discuss the equivalence of mass and energy,

- give an account of ionised radiation, radioactive fallout, fission and fusion and use the mass energy equivalence for calculations in nuclear physics, and

- discuss environmental and ethical issues, especially in relation to nuclear physics.

Upon completion of the Mathematics module, students should be able to:

- handle polynomial and rational expressions and use power rules for logarithms,

- solve polynomial, power, exponential, and logarithm equations, inequalities, and linear equation systems,

- define the concept of derivative and use the definition to calculate the derivative of certain elementary functions,

- derive and use derivation rules for polynomial, power, exponential, and logarithm equations, composite functions, trigonometric functions, and product and quotient of functions,

- explain the connection between graph of a function and the first and second derivative of the function,

- use derivatives to solve maximum and minimum problems and carry out curve constructions,

- describe the basic properties of polynomial, power, and exponential equations, composite functions,

logarithm functions, and absolute value as a function and sketch their graphs,

- give an account of the concept differential equation,

- set up and interpret differential equations as models for simple everyday problems,

- determine primitive functions and calculate basic integrals,

- use algebraic and graphic methods to determine integrals,

- calculate area and rotation volumes using integrals,

- use the sine, cosine, and tangent functions to calculate the angles and lengths of right-angled triangles, and use the triangle theorems for arbitrary triangles,

- use the properties of the unit circle to define and derive trigonometric concepts and relations,

- handle trigonometric expressions, prove and use trigonometric formula,

- use algebraic and graphic methods to solve trigonometric equations,
- describe the basic properties of trigonometric functions and sketch their graphs,
- calculate with complex numbers notated in different forms including rectangular, polar, and power form,
- apply the factor theorem and solve polynomial equations with complex roots, and

- apply concepts and methods covered in the course in problem solving.

Content

The course comprises the following components:

Module 1: Physics, 7.5 ECTS cr

- mathematical treatment of motion and force in two dimensions, plus torque and equilibrium,

- electric charge, current, and voltage,
- basic understanding of the field concept in gravitation, electrostatics, and magnetism,

- application of the relation between electric field intensity, potential, and tension in simple situations,

charged particle movement in electric and magnetic fields, forces at work in electric and magnetic fields,

- induction and alternating current, and
- laboratory sessions on the above.

Module 2: Mathematics, 7.5 ECTS cr

- arithmetics for real numbers, factoring, root, equations, completion of the square, equation systems, inequalities, polynomials and rational expressions, absolute value,

- the concept of function,
- change quotient and derivative,
- derivation rules for polynomial, power, and exponential functions and applications,
- function studies using derivatives,
- curve construction and asymptotes,
- applications of derivative, extreme value problems,
- primitive functions and simple integrals,
- basic trigonometry in right-angled triangles,
- the unit circle, the triangle theorems for arbitrary triangles,
- trigonometric expressions and formulae,
- trigonometric equations,
- trigonometric functions and their graphs, and
- the radian concept.

Module 3: Physics, 7.5 ECTS cr

- harmonic oscillation, resonance, mechanical waves, acoustics,
- light, reflection, refraction, interference, diffraction, polarisation,
- Einsteins postulate, time dilation, and relative energy,
- the structure of atoms, connections between energy levels and atomic spectra, and the significance of the photon concept,
- the structure of the atom and the nucleus,
- absorption and emission of electromagnetic radiation, energy quantisation,
- wave particle duality,
- nuclear reactions, ionised radiation, and calculation of radioactivity,
- ethical and environmental issues related to radiation, and
- laboratory sessions on the above.

Module 4: Mathematics, 7.5 ECTS cr

- composite functions, logarithm functions, absolute value as a function

- derivation rules for trigonometric, logarithm, composite functions, product and quotient of functions, and applications,

- differential equations,
- differential equations as models for simple everyday problems,
- primitive functions and integrals,
- applications of integrals,
- rotation volumes,
- calculations with complex numbers,
- the complex number plane,
- complex numbers in rectangular, polar, and power form, and
- polynomial equations, polynomial division, the factor theorem.

Instruction is in the form of lectures, exercises, seminars, and laboratory sessions.

Reading List

See separate document.

Examination

Assessment is based on written exams, tests, hand-in assignments, reports, and laboratory presentations. The laboratory sessions are mandatory and part of the examination.

If students have a decision from Karlstad University entitling them to special pedagogical support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades

One of the grades Fail (U) or Pass (G) is awarded in the examination of the course (Dnr C2019/423).

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional information

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.

The course corresponds to the upper secondary science and technology programmes Physics 1 and 2 according to the 2011 curriculum and to Mathematics 3c and 4. On successful completion, the preparatory course qualifies for and guarantees admission to engineering or natural science programmes at Karlstad University.