Faculty of Health, Science and Technology
Physics

Syllabus

Wave Physics and Electric Circuits

Course Code:	FYGA17
Course Title:	Wave Physics and Electric Circuits *Vågfysik och elteknik*
Credits:	7.5
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has less than 60 credits in first-cycle course/s as entry requirements (G1F)

Major Field of Study:
FYA (Physics)
MTA (Mechanical Engineering)
TKA (Engineering Physics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2018-08-29, and is valid from the Spring semester 2019 at Karlstad University.

Prerequisites
Foundation Course in Mathematics 7.5 ECTS cr, Calculus and Geometry 7.5 ECTS cr, and Experimentation and Data Analysis 7.5 ECTS cr, or equivalent.

Learning Outcomes
Upon completion of the course, students should be able to:

Module: Wave Physics
- give an account of the different models for describing light: the wave, the radiation and the foton model and their applicability,
- identify and analyse light and sound reflection and refraction in everyday phenomena and reconstruct reflection and refraction based on the radiation model,
- explain refraction using the wave model and apply the model in different contexts,
- identify wave properties such as wavelength, frequency and phase and apply the properties to wave phenomena,
- identify and mathematically describe wave phenomena such as interference and diffraction and apply them in different contexts,
- apply central wave concepts to simple physical problems, formulate the problem mathematically, calculate a result and critically assess the order of magnitude of the result,
- apply knowledge of wave behaviour and particle behaviour to describe the wave-particle duality and estimate its consequences for physical phenomena.

Module: Electric Circuits

- give an account of basic concepts in circuit theory,
- give an account of potential energy and potential of charged particles in electric fields and of the forces affecting the particles,
- apply the basic circuit theory concepts in the description and analysis of simple electric circuits,
- give an account of the basic concepts required to understand alternating current calculations and the complex method (the jw-method),
- perform calculations with the jw-method and draw phasor diagrams for simple networks with resistors, capacitors and inductors,
- connect and measure current and voltage in simple electric circuits.

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

Module: Wave Physics, 3 ECTS cr
Descriptions of plane, circular and spherical waves, and mechanical and electromagnetic waves.
Wave properties: wavelength, frequency and phase.
Reflection, superposition, standing waves, double slits experiments, interference, diffraction grating, single slit diffraction, refraction and dispersion.

Module: Electric Circuits, 4.5 ECTS cr
Basic concepts:
Electric charge, Coulomb's law, force between charges and definition of electric field.
Potential, voltage, current, resistance, conductance and Ohm's law. Power and energy.
Brief introduction to Gauss' law, electric flux density, permittivity and dielectric materials, magnetic field, Ampere's law, magnetic flux density, permeability and magnetic materials, Faraday's law and induction.
Parallel-plate capacitors, capacitance and the relation to electric fields.
Inductors, inductance and the relation to magnetic fields.
Complex quantities: Phasors, impedance and admittance.

Calculations:
Series connections, Kirchhoff's voltage law and voltage division.
Parallel connections, Kirchhoff's current law and current division.
Voltage source. Ideal sources and models of real sources with inner resistance.
Node-voltage analysis, superposition, and zeroing of sources.
Two-terminal theorem and simplified equivalent calculation models.
The complex method (the jw-method).
RLC-circuit with series and parallel resonance.

Laboratory work:
Performing simple laboratory experiments measuring currents and voltages.

Reading List
See separate document.

Examination
Assessment is based on written exams and laboratory reports. Laboratory attendance is mandatory.

Grades
One of the grades U (Fail), 3 (Pass), 4 (Pass with Some Distinction), or 5 (Pass with Distinction) is awarded in the examination of the course for engineering programmes. Other students are awarded a grade on the scale U (Fail), G (Pass), or VG (Distinction).

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.