Faculty of Health, Science and Technology
Chemistry

Syllabus

Molecular biotechnology with applications C

Course Code:	KEGC11
Course Title:	Molecular biotechnology with applications C *Molekylär bioteknik med tillämpningar C*
Credits:	15
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has at least 60 credits in first-cycle course/s as entry requirements (G2F)

Major Field of Study:
KEA (Chemistry)
KTA (Chemical Engineering)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2017-02-14, and is valid from the Autumn semester 2017 at Karlstad University.

Prerequisites
Admission to the Master of Science programme in chemical engineering at Karlstad University, with at least 90 ECTS credits programme courses attended and at least 75 ECTS cr completed, or courses in chemistry 90 ECTS cr attended with at least 75 ECTS cr completed, including basic courses in biochemistry, molecular biology, or equivalent of at least 7.5 ECTS cr.

Learning Outcomes
The aim of the course is that students further develop the basic knowledge in biochemistry and molecular biology required to understand biotechnical processes that include the growth of microorganisms and the technical use of enzymes or other biomolecules.

Upon completion of the course, students should be able to:
- explain the conditions for the most important reactions in the energy conversion and energy supply of cells based on chemical thermodynamics and, when appropriate, organic-chemical reaction mechanisms,
- describe reaction paths in the biosynthesis of a selection of building blocks for biomolecules, and apply organic-chemical reaction mechanisms and chemical thermodynamics to explain their conditions,
- describe the expression of genes in prokaryotes, including different mechanisms for regulating gene expression, and give examples of how knowledge of expression and regulatory mechanisms can be applied in the expression of cloned genes,
- describe protein biosynthesis in prokaryotes,
- explain basic concepts relating to protein folding and stability based on kenetic and thermodynamic considerations,

- describe the use of bioreactors in the production of different types of biomolecules, including recombinant proteins and the use of genetically modified micro organisms,
- describe different separation methods used in the purification of biomolecules and apply separation methods in the design of purification processes,
-give an account of the chemical basis of enzyme catalysis and apply chemical kinetics to describe enzyme catalysis,
- describe the most important mechanisms for the regulation of enzyme activities,
- analyse the use of enzymes or other biomolecules in technical processes, with regard to process and economic conditions,
- plan, conduct and report laboratory investigation in one or several areas treated in the course.

Content
-Different types of respiration and photosynthesis, including related ATP-synthesis and the thermodynamic link between redox reactions, membrane transport reactions and phosphate transporter reactions
-Fermentations and substrate level phosphorylation, including reaction mechanistic and thermodynamic aspects
-Biosynthetical reaction paths: gluconeogenesis, pentose phosphate pathway and the Calvin cycle, citric acid cycle in its biosynthetic role and glyoxylate cycle, biosynthesis of fatty acid, steroides and terpenes, survey of the biosynthesis of amino acids and some examples of the reactions involved and survey of nucleotide metabolism.
-Prokaryote gene expression and protein biosynthesis.
-Thermodynamic and kinetic aspects on protein stability and folding.
-Cultivation and growth of micro organisms in bio reactors and control of process conditions
-Legal framwork for genetically modified micro organisms.
-Separation processes for the purification of av bioreactor products
-Exemples of processes for the production of small molecules and processes for the production of recombinant proteins in bioreactors.
-The chemical basis for enzyme catalysis.
-Steady-state kinetics: Michaelis-Menten equation and the kinetic description of reversible inhibition of enzymes.
-Use of enzymes in liquid or immobilised forms in technical processes in the paper and pulp industry, production of biofuel and production of groceries.
-Hand-in assignments and laboratory work, see under Examination.

Reading List
See separate document.

Examination
Assessment is based on a written exam, mandatory hand-in assignments and participation in mandatory laboratory sessions and lab reports according to special guidelines and within limited timeframes.

Grades
One of the grades Distinction (VG), Pass (G), or Fail (U), is awarded in the examination of the course. Engineering students are awarded on of the grades Distinction (5), Some Distinction (4), Pass (3), or Fail (U).

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 courses KEGC11 and KEAD11 cannot be included in the same degree programme.

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