

## Farm scale Utilization of Biobased By-products, 10 ECTS credits

### General information

The course is open **18.3.-31.5.2019**

### Target group

The course is targeted to domestic students from the sectors of agriculture, bioeconomy and forestry and for international exchange students studying in the field of natural resources.

### Learning outcomes

The student recognizes the sources and the possibilities of domestic agricultural, forest-based and industrial by-products. He/she is able to calculate the energy and utilization potential of the biomasses and is able to determine the scale of the processing unit. The student is able to define environmentally sound ways to recycle the residues of the process.

**Introduction to course units:** (you can choose 1 to 5 course)

### 1 Sources and Potentials of Different Biomass By-products (4 ECTS Credits)

Lecturer in charge: Jyrki Kataja, JAMK

### Learning Outcomes

The student understands the concept of the biomass by-products. The student knows the main principles of calculating of the regional biomass and by-product potentials in Finland. After the course, the participants are able to utilize the available calculation software for dimensioning the inputs and outputs of the heating and biogas plants.

### Course Contents

- The by-products of different biomasses
- Calculating of a regional biomass and by-product potential
- Planning the use of the end-products of the biomass utilization in a region

### Student Workload in Hours

- virtual study 20 h
- virtual assignments 30 h
- independent study 56 h

### 2A Biogas Production in Farm Scale (3 ECTS Credits)

Lecturers in charge: **Pekka Alho and Anna Hallvar, Turku AMK**, Mikko Aalto, OAMK and Jaakko Tukia, JAMK

### **Learning Outcomes**

The student understands, what kinds of biomass can be utilized as raw material for biogas production, how and with what kind of technology biogas is produced and how it can be utilized for energy production. The student recognizes environmental impacts of production and usage of biogas. The student realizes the positive impact of the energy utilization of local raw materials for local economy.

### **Course contents**

Overview on properties of biogas and natural gas. The basic processes of biogas production.

### **Student workload in hours**

- virtual study 20 h
- virtual assignments 30 h
- independent study 56 h

## **2B Farm Scale Energy Production from Solid Biofuels (3 ECTS credits)**

Lecturer in Charge: Laura Vertainen, JAMK

### **Learning Outcomes**

The students know the basic concepts of the energy sector and the basics of energy production in the rural areas. They can determine the amount of energy needed for the production of warm water and the heating of premises of a real farm, and they can select suitable solid biomass heating equipment for energy production. They can estimate the energy consumption structures of different farms. They are able to calculate the potential of available biomass by-products for energy production on farm and small-scale district heating scales and the possibilities of solar energy on farm-scale.

### **Course contents**

- energy consumption structure on farms
- energy production potential of available solid biomass by-products
- heating systems for solid biomass and solar energy
- designing and planning farm and district scale heating system

### **Student workload in hours**

- virtual study 15 h
- virtual assignments 30 h
- Independent study 35 h

**3A Biochar: Pyrolysis of Biomass (3 ECTS credits)** Adding value into biomass by pyrolysis (Biochar production)

Lecturer in Charge: Annakaisa Elo, HAMK

### **Learning Outcomes**

The student will learn the concept and basic properties of pyrolysis method and biochar. The student will learn which biomass side streams could be used for biochar production, will understand the pyrolysis process and will know alternative pyrolysis methods to produce biochar. The student will learn to evaluate how the raw material and production method will affect the quality and applications of biochar. The student will get a practical guidance how to produce biochar by himself with a simple home scale pyrolysis method and will be introduced to various practical applications for biochar.

### **Course contents**

Overview of the concept, properties, environmental aspects and applications of biochar. Evaluation of the side streams suitable for pyrolysis. Introduction to various pyrolysis methods and the effect of biomass and process into the quality and applications of biochar. The methods to modify the properties of biochar (e.g. nutrient activation). The practical applications of biochar, especially in farming and horticulture.

### **Student workload in hours**

- virtual study 20 h (webinars, videos)
- virtual assignments 30 h
- independent study 56 h

**3B Plant Nutrients from Biobased By-products (3 ECTS credits)**

Lecturer in Charge: Ulla Heinonen, JAMK

### **Learning Outcomes**

The student understands the importance of plant nutrients and the adverse effects of heavy metals on plant growth and soil. The student understands the role of organic matter from the point of view of the health of the soil. The student recognizes the side streams suitable for fertilization, gets acquainted with their properties and is able to analyze their usefulness in plant production.

### **Course contents**

Plant nutrients, organic matter and heavy metals, from the point of view of the need for balanced growth of plants. The side streams suitable for fertilization, the effects of their composition and quality on their usability.

**Student workload in hours**

- virtual assignments 30 h
- webinars 6 h
- independent (includes potentially pair or group work) study 44 h