Sveučilište u Zagrebu Agronomski fakultet
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Energetic Utilization of Biomass and Biofuel (296604)

Nositelj kolegija

prof. dr. sc. Neven Voća

Opis kolegija

Chapters regarding bioenergy production in agriculture and processing industry will be elaborated in this module. This will include chapters dealing with collecting, techniques and technologies of biomass production for electric and thermal energy production purpose. Possibilities of raw material collecting, techniques and technologies of all generations of biofuels production and their usage in internal-combustion engines instead of mineral origin fuels will also be elaborated. Manure and liquid manure sanation will be oriented onto biogas production for electric and thermal energy production purpose. Organic waste sanation from agriculture and processing industry will be a special chapter with emphasis on highly hazardous organic waste sanation. All production types will be monitored from the aspect of environment protection and legislatives and regulatives of EU and Republic of Croatia.

ECTS: **6.00**

E-učenje: **R1**

Sati nastave: 60
Predavanja: 40
Laboratorijske vježbe: 16
Seminar: 4

Izvođač predavanja

- prof. dr. sc. Neven Voća

Izvođač vježbi

- dr. sc. Jona Šurić

Izvođač seminara

- dr. sc. Anamarija Peter

Ocjenjivanje

Dovoljan (2): 60-69 %
Dobar (3): 70-79 %
Vrlo dobar (4): 80-89 %
Izvrstan (5): >90%

Vrsta kolegija

- Graduate studies / MS Courses taught in English (Izborni kolegij, 1. semestar, 1. godina)

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Opće kompetencije

The course enables the understanding of basic process of renwable energy sources production in agriculture.
Students receive the necessary theoretical knowledge of biomass and biofuel production in agriculture.

Oblici nastave

- Lectures
- Auditory Exercises

  observation and discussion of the production of biomass and biogass
- Seminars

  a panel discussion on the selected biofuel production

Ishodi učenja i način provjere

Ishod učenja	Način provjere
Explain models of production and use of biofuels in agriculture and systematize biofuels from agricultural biomass in compering to the type of raw material and production technology.	Participating in the discussions, assignments during class - seminar, written and oral exam
Identify opportunities of using agricultural biomass as solid biofuel for energy production and to describe the possibility of using liquid biofuels produced from agricultural biomass.	Participating in the discussions, assignments during class - seminar, written and oral exam
Identify opportunities for the production of biogas from agricultural waste and residues.	Participating in the discussions, assignments during class - seminar, written and oral exam
Enumerate the possibility of producing new-generation biofuels and compare waste management technologies.	Participating in the discussions, assignments during class - seminar, written and oral exam
Establish disposal technologies for hazardous waste in agriculture.	Class assignments, seminar
Assess the possibility of applying the concept of biorefinery.	Participating in the discussions, assignments during class - seminar, written and oral exam
Argue the importance of the use of biomass, biofuels and the waste of agricultural production on environment.	Seminar

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Način rada

Obveze nastavnika

The teacher use the material provided in content items, checks lessons learned and evaluate the students knowledge and skills acquired through seminars, laboratory exercises, written and oral exam. All teaching materials are organized and available in Moodle system; forum for communication with students; Calendar of major events for college; information related to the course; tasks for the establishment of knowledge at a particular module; instructions for the use of teaching materials with separate units, lectures and evaluation of student assignments, written examinations, conducting oral examinations.

Obveze studenta

Attending lectures, laboratory exercises and seminars is required, students must participate in learning in the course through the system for e-learning. Students during the first two weeks of classes should be sure to log into the system for e-learning Moodle within students can use presentations and other materials. Terms for the exam are regularly attended lectures and exercises and written seminar.

Polaganje ispita

Elementi praćenja	Maksimalno bodova ili udio u ocjeni	Bodovna skala ocjena	Ocjena	Broj sati izravne nastave	Ukupni broj sati rada prosječnog studenta	ECTS bodovi
2. partial exam	20	0-60 61-70 71-80 81-90 91-100	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)	20	20	1
3. partial exam	20	0-60 61-70 71-80 81-90 91-100	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)	20	65	2
Oral exam	40	0-60 61-70 71-80 81-90 91-100	Nedovoljan (1) Dovoljan (2) Dobar (3) Vrlo dobar (4) Izvrstan (5)		20	2
1. partial exam	20	61-70	Sufficient	20	20	1

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Elementi praćenja	Opis	Rok	Nadoknada
Seminar	Theme for seminar paper is set up at the beginning of the semester for each student individually. The written work is submitted for review at least a week before exposure. The corrected thesis must be submitted in the presentation. Presentations of seminar papers beginning in the 14th week of the semester according to the agreed schedule.	1 week 13. week 14. week	
Partial exam 1	It covers the first part of the program modules: biomass of agricultural origin, preparation of biomass for energy efficiency, first-generation biofuels.	4. week	
Partial exam 2	It includes second part of the module: the production of first generation biofuels, biodiesel and ethanol, the production of second-generation biofuels, BTL and alcoholic second-generation biofuels, biofuels third and fourth generation.	10. week	
Partial exam 3	It includes third part of the module: biogas production, classification and management of organic waste from the agricultural and food production.	15. week	
Oral exam	Oral exam consisting of five questions; theory and fact, analytical skills, critical thinking, creativity and social responsibility.		

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Tjedni plan nastave

1. Fossil energy resources and their utilization in agriculture L - Fossil energy resources classification: oil, coke, natural gas, nuclear energy; production and consumption of fossil fuels. Fossil fuel utilization in agricultural production.
2. Definition of renewable energy sources (RES). Using RES in agriculture. L - RES classification: sun, wind, geothermal energy sources and hydroelectric energy. Production and utilization of energy from sun and wind in agricultural production.
3. Using RES in agriculture. Biomass classification and preparing of biomass for efficient energy generation. L - Production and utilization of geothermal energy and influence of hydroelectric energy production on agriculture. Definition and characteristics of agricultural and forest biomass and their energy potential; utilization systems of biomass for energy generation.
4. Biomass classification and preparing of biomass for efficient energy generation. 1st generation of biofuels. P, L - Technical and technological characteristics for biomass preparation and utilization in energy generation. Classification of 1st generation of biofuels and their contribution to environmental protection and agricultural production.
5. Production and utilization of biodiesel fuel. L - Technological processes in biodiesel fuel production from different raw materials. Possibilities of biodiesel fuel utilization.
6. Production and utilization of alcoholic biofuels. L - Technological processes in alcoholic biofuels production from different raw materials. Ethanol, buthanol and methanol utilization.
7. Chemical procedures in 1st generation biofuels production. Biogas production and utilization. P, L - Procedures in biodiesel fuel production from raw oil; procedures in alcoholic biofuels production from sugar and starch. Anaerobic fermentation of different organic waste form agriculture.
8. Biogas production and utilization. Methods for classification and utilization of organic waste from agriculture. L - Definition of biogas facilities and classification of cogeneration plant for electric and thermal energy production. Classification and sanation of organic waste by their categorisation.
9. 2nd generation of biofuels. Pre-treatments in biofuel production from lignocellulosic biomass. L, P - Classification of 2nd generation of biofuels and their contribution to environmental protection and agricultural production. Definition and classification of pre-treatments in 2nd generation biofuels production.
10. Production and utilization of BtL fuel. L - Technology and raw material in BtL fuel production. BtL fuel utilization in agricultural production.
11. Production and utilization of alcoholic biofuels from lignocellulosic biomass. L - Production of ethanol, buthanol and methanol from lignocellulosic biomass. Utilization of ethanol, buthanol and methanol from lignocellulosic biomass in agricultural production.
12. Production of biohydrogen fuel from lignocellulosic biomass. 3th generation of biofuels. L - Biohydrogen production methods from biomass. Classification of 3th generation of biofuels and their contribution to environmental protection and agricultural production.
13. 4th generation of biofuels. Biorafinery. L - Classification of 4th generation of biofuels and their contribution to environmental protection and agricultural production. Biorafinery concept definition.
14. Field work. F - Visiting facilities for biofuel production in Croatia.
15. Seminar. S - Seminar themes in agreement with every student.

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Obvezna literatura

1. Mittelbach M.; Remschmidt, C. (2004): Biodiesel – the compprehensive handbook, Book, Graz, Austrija
2. Deublein, D.; Steinhauser, A. (2008): Biogas from Waste and Renewable Resources, Book, Wiley, Germany
3. Soetaert, W. (2008): Biofuels, Book, Wiley, Germany
4. Minteer, S. (2006): Alcoholic fuels, Book, Taylor and Francis

Preporučena literatura

1. Stout, B.A. (1990): Handbook of energy for world agriculture, Book, Elsevier Science, SAD.
2. Kamm, B.; Gruber, P.; Kamm, M. (2006): Biorafineries – Industrial processes and products, Wiley, Germany
3. Dewulf, J.; Van Langenhove, H. (2007): Renewables Based Technology, Book, Wiley, SAD.
4. Stout, B.A. (1990): Handbook of energy for world agriculture, Book, Elsevier Science, SAD.

Sličan kolegij na srodnim sveučilištima

- University of Wageningen, Holland,; MS study, Biosystems engineering, course Biological Processes in Resource Recovery
- Humboldt State University, USA, MS study Environmental Resources Engineering, course Renewable Energy Power Systems
- Stanford University, USA, MS study Earth, Energy, and Environmental Sciences, course Research in Earth, Energy, and Environmental Science
- University of Ghent, Belgium, MS study Rural Development and Agricultural Economics, course Climate and Energy Management

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