General Information	
Academic subject	Energy management in agriculture
Degree course	SAAT
Curriculum	
ECTS credits	6
Compulsory attendance	no
Language	italian

Subject teacher	Name Surname	Mail address	SSD
	Antonio pantaleo	Antonio.pantaleo@uniba.it	

ECTS credits details			ETCs
Basic teaching activities	24 hours		3
Practics	42 hours		3

Class schedule	
Period	Second semester
Year	1st year
Type of class	24 hours teaching – 42 hours practics

Time management	
Hours	156
In-class study hours	66
Out-of-class study hours	90

Academic calendar	
Class begins	March 2021
Class ends	June 2021

Syllabus	
Prerequisites/requirements	Physics, maths
Expected learning outcomes (according to Dublin Descriptors) (it is recommended that they are congruent with the learning outcomes contained in A4a, A4b, A4c tables of the SUA-CdS)	*Knowledge and understanding* o Management of energy consumption of agricultural secgtor and agricultural farms and technologies to match demand with renewable energy sources in agricultural, forestry and food sectors *Applying knowledge and understanding* o Know how for sizing and management of energy conversion systems to match heat and power demand of agricultural farms, with fossil and renewable energy sources, and know how for management of consumption and energy costs of agricoltural sector *Making informed judgements and choices* Capability to carry out cost-benefit analyses of energy investments for optimal management of costs and energy consaumption of agricultural and food processing sector o … *Communicating knowledge and understanding* Ability to describe the main renewable energy sources fundamentals, characteristics of biomass fuels and energy efficiency options for agricoltural sector o …. *Capacities to continue learning* o Capability to learn the fundamentals of energy conversion processes from fossil and renewable energy, and in particular biomass, wind, solar energy o … o … The results of the expected learning, in term of knowledge and ability, are listed in the Annex A of the Didactic Regulation of the Bachelor Course (expressed by the European descriptors of the study title).

Contents	The course provides fundamental background on thermodynamics, heat exchange, mass and energy balances, cost-benefit analyses of investments in energy sector; bioenergy supply chains, with specific focus on agricultural and forestry biomass resources, both from dedicated crops and by-products; analysis of biomass fuel properties, treatment, energy conversion processes for heat and power; focus on mechanical processes for biomass treatment and upgrade, thermochemical conversion processes, biochemical conversion processes for biogas production, solar energy, wind energy; analysis of energy bills, energy costs and main technologies for energy efficiency; assessment of case studies and best practices in agricultural sector
Course program	
Bibliography	CIGR handbook of agricoltural engineering, ASABE, Vol 5
Notes	**Examples of websites** www.iea.org; www.gse.it www.energiadallegno.it www.aiel.it
Teaching methods	Lectures with slides in ppt with theoretical background and case studies For students enrolled to the year of course when teaching is carried out, there is the possibility to undertake a partial exam during the course, which is an oral test on teaching carried out during the first months. The evaluation of student capabilities is carried out on the basis of the rules and criteria defined in annex A of the Didactic Regulation of the Bachelor Course
Assessment methods (indicate at least the type written, oral, other)	Oral with case studies discussion and quantitative exercises on mass/energy balances and cost/benefit analyses

Evaluation criteria (Explain for each expected learning outcome what a student has to know, or is able to do, and how many levels of achievement there are.	• *Knowledge and comprehension ability*
	  ○ Quantify the energy demand of agricultural farms on the basis of the assessment of fuel consumption, energy costs and typology of loads/end users
	  ○ …
	• *Knowledge and applied comprehension ability*
	  ○ Carry out cost-benefit analyses of investments for on site production of renewable energy for agricultural farms and quantify the economic profitability of energy efficiency measures ton save energy consumption in the production processes
	  ○ …
	• *Autonomy of judgement*
	  ○ Carry out biomass energy potentials analysis and economic profitability analyses of energy investments in agricultural sector; capability to quantify the economic, energetic and environmental impacts of the different technological solutions to match the energy demand
	  ○ …
	• *Communication skills*
	  ○ Capability to describe the main renewable energy sources, the main technologies for energy efficiency, describe the main processes for heat exchange and energy transformation
	  ○ …
	• *Learning ability*
	  ○ Capability to understand technical datasheets of energy technologies adopted for energy generation and carry out sizing and selection of best energy conversion technologies to match the energy demand of agricultural and food processing sectors
	  ○ …
	  ○

Further information	**Visiting hours** .

Subjects	ETC	hours		
		ETC	Th-Pr	
Contents and objectives of the course; energy sources classification and energy balances; energy markets; energy consumption in agricolturak sector		0.25	2	-
Fundamentals of energetics: energy, power, thermodynamic principles, heat exchange, latent and sensible heat, specific heat, practice on heath exchange and mass/energy balances		0.5	2	3,5
Energy conversion and fundamentals on thedrmodynamic cycles: Rankine, Joule, Diesel, Otto		0.25	2	-
Bioenergy conversion chains: energy crops. Classification, energy potentials analysis, land suitability, logistics, collection options, energy-environmental analyses		0,5	1	5,25
Bioenergy conversion chains: agricoltural and forestry byproducts. Classification, energy potentials assessment, collection and transport technologies, energy-envoronmental and economic analyses		0,5	1	5,25
Classification and chemical-physical properties of lignocellulosic biomass: sizing, moisture, volumetric mass, heating value, ashes content, elementary chemical composition, measurenent techniques and technical standards		0,5	2	3,5
Bioenergy chains for lignocellulosic biomass: drying, densification,, pelletizing, storage, energy and mass balances		0,5	2	3.5
Thermochemical processes: combustion, gasification, pyrolysis, torrefaction; technologies, operating modes, conversion efficiency, mass and energy balances, environmental emissions, agricoltural reuse of ashes and biochar		0,5	2	3.5
Biochemical processes: anaerobic digestion for biogas and biomethane; technologies, efficiencies, mass and energy balances, digestors sizing, agronomic use of digestate		0,5	2	3.5
Oleagineous crops for vegetable oils and biodiesel production, row materials, crops yield, estraction processes, energy-economic analyses and mass-energy balances; small and large scale plants; sugar and starch biomass chains for bioethanol		0,25	2	
Solar energy for thermal applications: technologies, energy yield, cost analysis, optimal layout, energy production and economic profitability in agricultural farms		0,5	1	5,25

Solar energy for electricity: photovoltaic technologies, energy yield, cost analysis, optimal layout, energy production and economic profitability in agricultural farms	0,5	1	5,25
Wind energy generation: fundamentals, wind resource analysis, energy yield assessment, economic profitability of small scale wind farms for agricoltural sector, environmental impact analysis	0,25	1	1,75
Heat pumps: fundamentals, efficiency and COP, applications in agriculture, economic analyses	0,25	2	0
Energy costs analyses: electricity and natural gas bills, saving options, main energy efficiency investments for agricoltural farms	0,25	1	1,75
TOTAL	6	24	42