UNIVERSITATEA DE ŞTIINŢE AGRICOLE ŞI MEDICINĂ VETERINARĂ CLUJ-NAPOCA
Facultatea de Agricultură
Calea Mănăştur 3-5, 400372, Cluj-Napoca, România
Tel: 0264-596.384, Fax: 0264-593.792
www.usamvcluj.ro

USAMV form 0107040110

SUBJECT OUTLINE

1. Information on the programme

1.1. Higher education institution	**University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca**
1.2. Faculty	**Agriculture**
1.3. Department	III – Environment and Plant Protection
1.4. Field of study	Environmental Engineering
1.5. Cycle of study[1]	Bachelor
1.6. Specialization/ Study programme	**Environmental Engineering**
1.7. Form of education	Full time

2. Information on the discipline

2.1. Discipline name	**Non-conventional Energy Sources**							
2.2. Course coordinator				Senior Researcher I. Valentin PETRESCU-MAG				
2.3. Seminar/ laboratory/ project coordinator				Senior Researcher I. Valentin PETRESCU-MAG				
2.4. Year of study	IV	2.5. Semester	II	2.6. Evaluation type	summative evaluation	2.7. Discipline status	Content[2]	DS
							Compulsoriness[3]	DI

3. Total estimated time (teaching hours per semester)

3.1. Hours per week – full time programme	**4**	**out of which: 3.2. lecture**	**2**	**3.3. seminar/ laboratory/ project**	**2**
3.4.Total number of hours in the curriculum	**40**	**out of which: 3.5. lecture**	**20**	**3.6. seminar/laboratory**	**20**
Distribution of the time allotted					**hours**
3.4.1. Study based on books, textbooks, bibliography and notes					**10**
3.4.2. Additional documentation in the library, electronic platforms and field experiences					**10**
3.4.3. Preparing seminars/ laboratories/ projects, subjects, reports, portfolios and essays					**6**
3.4.4. Tutorials					**2**
3.4.5. Examinations					**2**
3.4.6. Other activities					
3.7. Total hours of individual study	**30**				
3.8. Total hours per semester	**78**				
3.9. Number of credits[4]	**3**				

4. Prerequisites (if applicable)

4.1. curriculum-related	Ecology, Meteorology and Climatology, Hydrology and Hydrogeology, Wind Engineering.
4.2. skills-related	Team communication skills, organization, use of the internet as a resource.

5. Conditions (if applicable)

5.1. for the course	Room equipped with computer, video projector. A correct academic conduct is required throughout the duration of the lecture. No other activities are tolerated during the lecture, mobile phones must be switched off.
5.2. for the seminar/ laboratory/ project	Room equipped with computer, video projector and blackboard. Good academic conduct is required throughout the duration of the work. Seminar room / laboratory with specific of the teaching process.

6. Cumulated specific competences

Professional competences	1. Knowledge, understanding, explanation and interpretation. Knowledge, understanding of the essential aspects related to unconventional energies and the principles of their use 2. Instrumental-applicative - Formation of specific skills for understanding the main particular aspects related to unconventional energies. Formation of problem analysis capacity. 3. Attitudes - the manifestation of positive attitudes that help to investigate the aspects related to the aspects of the use of unconventional energies in the field of environmental engineering.
Transversal competences	The application of the rules of rigorous and efficient work, the manifestation of responsible attitudes towards the scientific and didactic field, for the optimal and creative exploitation of its potential in specific situations, respecting the principles and norms of professional ethics. Effective and effective conduct of team activities. Efficient use of information sources and communication and training resources.

7. Discipline objectives (based on the cumulated specific competences)

7.1. General objective	Knowledge of the types of unconventional energies and their potential, as well as of the existing technologies for exploiting renewable energy resources
7.2. Specific objectives	Understanding by students of the nature and causes of energy crises. Acquisition of knowledge regarding the potential, management and use of unconventional energies, with a lower impact on the environment, for the operation of classical installations. Acquiring knowledge regarding the impact of renewable energy systems on the environment.

8. Content

8.1. COURSE **Number of hours – 20**	Teaching methods	Observation
1. Current and prospective situation of energy sources. The potential of renewable energy resources	Lecture	1 lecture = 2 hours. 2 hours
2. Solar energy. The characteristics of solar energy. Thermal analysis of solar collectors. Flat collectors. Collectors with radiation concentration and sun tracking. Thermal analysis of collectors. The thermal efficiency of the plan collector.	Lecture	2 hours
3. Applications of solar collectors. Water heating systems: thermo-siphon system (passive), storage system with collectors (passive), direct flow systems (active), indirect water heating systems (active).	Lecture	2 hours
4. Air systems. Heating and cooling of buildings (heat pumps). Industrial heating processes. Solar desalination plants. Thermal solar power station. Solar ovens. The solar tower.	Lecture	2 hours
5. Wind power. Theoretical potential. Capture systems (installations). Specificity of wind energy. Design and execution of wind turbines with horizontal and vertical axis. Uses of wind energy.	Lecture	2 hours
6. Hydraulic energy. Hydropower potential. Types of turbines (impulse, reaction). Technological solutions for micro-hydroelectric plants. Economic, social and environmental problems.	Lecture	2 hours
7. Biomass. Biomass resources. Potential and availability. Conversion of biomass into energy.	Lecture	2 hours
8. Thermochemical processes: combustion (combustible properties of biomass, calorific value, pollutant emissions, problems related to the burning of biomass in boilers, co-burning of biomass with coal, combustion plants), gasification, pyrolysis.	Lecture	2 hours
9. Biochemical processes: fermentation, anaerobic digestion, composting. Mechanical extraction.	Lecture	2 hours
10. Geothermal energy. Types of geothermal resources. Exploration of geothermal resources. Fluid survey, extraction and distribution. Use of geothermal resources. Environmental impact of geothermal energy.	Lecture	2 hours
11. Hydrogen energy. Production of hydrogen from renewable resources. Hydrogen storage, transport and distribution.	Lecture	2 hours
12. Combustion batteries. Applications of fuel cells.		

8.2. PRACTICAL WORKS Number of hours – 20	Teaching methods	Observation
	Theoretical presentation of practical works	1 lab work (2 hours/work)
1. Work instructions and norms of the labor safety technique and PSI in the profile laboratories.	Exposure and verification of PSI knowledge	2 hours
2. Economic technical calculation for a solar water heating installation	Application of notions theoretical based on provided databases	2 hours
3. Determining the functional characteristics of a planar solar collector	Discussions and debates.	2 hours
4. Economic technical calculation for a biomass heating plant	Exposition.Discussions and debates.	2 hours
5. Electricity generation using a horizontal axis wind turbine	Exposition.Discussions and debates.	2 hours
6. Technical-economic calculation for a micro-hydroelectric plant	Exposure. Exercise Discussions and debates	3 hours
7. Analysis of the organic Rankine cycle for the recovery of geothermal energy	Demonstration. Exercise testing	3 hours
8. Economic technical calculation for a combustion cell	Exercise testing	2 hours
9. Verification of knowledge	Evaluation	2 hours

Compulsory bibliography:

1.Petrescu-Mag I. V., 2014. *Energii neconvenționale.* Note de curs.
2. Nițu, V., Pantelimon, L., Ionescu, C., 1985. *Energetică generală și conversia energiei*, Ed. Didactica si Pedagogica, Bucuresti.
3. Ilie V., s.a., 1984. *Utilizarea energiei vintului*, Ed. Tehnica, Bucuresti.
4. Danescu Al. s.a., 1987*Utilizarea energiei solare*, Ed. Tehnica.
5. Ilina M., Bandrabur C., 1987 Oancea N., *Energii neconventionale utilizate in instalatiile din constructii*, Ed. Tehnica.

Optional bibliography:

1. Bitir-Istrate I., Minciuc E., 2003.*Valorificarea biogazului pentru producerea energiei electrice si termice*, Ed. Cartea Universitara, Bucuresti.
2. Tanasescu, F.T., 1986. *Conversia energiei. Tehnici neconventionale*, Ed. Tehnica, Bucuresti.
3. Duffie, J. A., Beckman, W. A,. 1991. *Solar Engineering of Thermal Processes*, 2nd. Ed., J. Wiley & Sons, New York, USA.
4. http://www.gvec.net - global wind energy council
5. http://www.evea.org - european wind energy association

9. Corroborating the discipline content with the expectations of the epistemic community representatives, of the professional associations and of the relevant employers in the corresponding field

The content of the discipline is in accordance with what is studied in the discipline of unconventional energies in other university centers in the country and abroad.
The content and structure of the course are aspects adapted to the needs of the students and the demands of the labor market.
At the same time, the specific knowledge of the course constitutes a starting point towards the higher level of preparation, represented by the doctoral programs.

10. Evaluation

Type of activity	10.1. Evaluation criteria	10.2. Evaluation type	10.3. Percentage of the final grade
10.4. Course	It follows the student's ability to make logical connections between concepts, as well as his overall view on the subject.	E	70%
10.5. Seminar/Laboratory	The correctness of the answers to the questions. The entire activity carried out at the practical works is quantified.	VP	30%
10.6. Minimum performance standards			
Mark 5 is awarded following the individual evaluation of each subject, which must obtain note 5 individually; The final average will be a simple arithmetic resulting from the final mark at the Laboratory periodic verification. 60% knowledge of the information obtained from the hours of practical work.			

1 Cycle of studies - choose one of the three options: Bachelor/Master/Ph.D.
2 according to the educational plan
3 Discipline status (compulsoriness) - choose one of the options – **DI** (compulsory discipline) **DO** (optional discipline) **DFac** (facultative discipline).
4 One credit is equivalent to 25-30 hours of study (teaching activities and individual study).

Filled in on
04.09.2019

Course coordinator
Şef lucr. Dr. I Valentin PETRESCU-MAG

Laboratory work/seminar coordinator
Şef lucr. Dr. I Valentin PETRESCU-MAG

Approved by the department on
05.092019

Head of the Department
Prof. univ. Dr. Ioan G. OROIAN