Course Title	Sustainable Energy Resources	
Course Code	MEE 510	
Course Type	Compulsory	
Level	Masters (2 nd Level)	
Year / Semester	1 st year / Fall Semester	
Teacher's Name	DrIng. Paris A. Fokaides, Dr. Nicholas Christofides	
ECTS	10 Lectures / week 3 Laboratories/week 0	
Course Purpose	In the history of mankind renewable energies have for a long time been the	
	primary possibility of generating energy. This only changed with industrial	
	revolution when lignite and hard coal became increasingly more important.	
	Later on, also crude oil gained importance. Offering the advantages of easy	
	transportation and processing also as a raw material, crude oil has become	
	one of the prime energy carriers applied today. Moreover, natural gas used	
	for space heating and power provision as well as a transportation fuel has	
	become increasingly important, as it is abundantly available and only requires	
	low investments in terms of energy conversion facilities. Yet, the utilisation of	
	fossil energy carriers involves a series of undesirable side effects which are	
	less and less tolerated by industrialised societies increasingly sensitised to	
	possible environmental and climate effects at the beginning of the 21st	
	century.	
	Against this background, this course aims at presenting the physical and	
	technical principles of the main possibilities of utilising fossil and renewable	
	energies. In this context, firstly the main characteristics of the available energy	
	streams are outlined. Subsequently, the technologies of heat provision from	
	passive and active solar systems, ambient air, shallow geothermal energy as	
	well as energy from biomass, deep geothermal sources are presented. Also	
	the processes of electricity generation from solar radiation (photovoltaic and solar thermal power plant technologies), wind energy, hydropower and	
	geothermal energy are addressed.	
	For the main possibilities of renewable energies utilisation, in addition,	
	parameters and data are provided which allow for an economic and	
	environmental assessment of the discussed options. The assessment thus	
	enables a better judgment of the possibilities and limits of the various options	
	of utilising renewable sources of energy	
Learning	By the end of the course, students must be able to:	
Outcomes		

1. Analyze methodological approaches with regard to the key figures, which are characteristic for the individual sustainable energy resources application 2. Describe most important technologies for exploiting fossil energy carriers for the provision of heat and electricity 3. Demonstrate the main characteristics of renewable and fossil energy resources 4. Distinguish between passive and active solar thermal systems 5. Assess the utilization of passive solar energy by the use of the building envelope as absorber 6. Design simple solar thermal systems for domestic hot water and space heating with the use of flat plate collectors 7. List the main technologies for power production using concentrated solar panels 8. Analyze the main technical properties of photovoltaic systems and design a small-scale grid connected system 9. Evaluate alternative utilization routes for biomass to biofuel conversion 10. Calculate the wind potential of selected sites and the energy yield based on given wind turbine power curves 11. Describe the operation of a shallow geothermal system and the operation of a ground coupled heat pump Prior taught experience on energy resources Corequisites 10. Introduction Energy system Energy consumption Applications of renewable energies Conventional energy provision systems Power generation technologies 	vehicie vehicie vehicie <th>h are characteristic for the individual sustainable energy urces application</th>	h are characteristic for the individual sustainable energy urces application
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 Renewable energy sources 	- Bala	

Solar radiation --Wind energy - Run-of-river and reservoir water supply - Photosynthetically fixed energy Geothermal energy. -**3 Utilisation of Passive Solar Energy** Principles -Technical description. _ -Definitions System components -- Functional systems **4 Solar Thermal Heat Utilisation** - Principles **Technical description** -Collectors -Collector components - Further system elements _ Heat store -Energy conversion chain and losses System design concepts -- Applications Economic and environmental analysis -**5 Solar Thermal Power Plants** - Principles -Solar tower power stations - Parabolic trough power plants Dish/Stirling systems -

- Solar updraft tower power plant
- Solar pond power plants

6. Photovoltaic Power Generation

- Principles
- Energy gap
- Conductors, semiconductors and insulators
- Photovoltaic effect
- Technical description
- Photovoltaic cell and module

-	Further system components
-	Grid-independent systems
-	Grid-connected systems
-	Economic and environmental analysis
7. Bio	omass Utilization
-	Principles
-	Biomass Resources
-	Biochemical and thermochemical biomass to biofuels conversion
	routes
-	Mechanical biomass to biofuels conversion routes
-	Technical description
- 1	Biomass boilers and combustors
-	Further system components
-	Space heating systems
-	Industrial heating systems
-	Biogas power generation systems
-	Biofuels in the transportation sector
-	Economic and environmental analysis
8. Wi	nd Power Generation
-	Principles
-	Technical description
-	Wind turbine design
-	System elements
- 1	Rotor, Gearbox, Generator
-	Wind direction yaw mechanism
-	Energy conversion chain, losses and characteristic power curve
-	Wind parks
-	Grid-independent applications
-	Economic and environmental analysis
9 Hyc	Iroelectric Power Generation
-	Principles
-	Technical description
-	Schematic layout
-	Categorisation and construction types
-	Low-head plants
	System components

	 Isolated and grid operation
	 Energy conversion chain, losses, and power curve
	- Economic and environmental analysis
	10. Utilisation of Ambient Air and Shallow Geothermal Energy
	- Principles
	 Heat pump principle
	 Technical description
	 Heat source systems for shallow geothermal energy utilisation
	 Closed systems
	 Open systems
	- Heat pump
	 System configurations
	 Economic and environmental analysis
Teaching	The teaching methodology of this course will be based on lecturing,
Methodology	demonstrating and collaborating.
	- Lecture notes, comprising of the fundamentals of each module of the
	course will be prepared and presented in class on a weekly basis. The
	notes will introduce the major concepts and will focus on specific
	learning outcomes of the course.
	- Demonstration activities including the solution of worked examples in
	class on a weekly basis, as well as laboratorial work will also be
	employed. For each fundamental concept, at least one worked
	example will be solved during lectures. The laboratory work will cover
	all major topics of the course, allowing the students to personally
	relate to the presented knowledge.
	- Collaborating teaching through classroom discussion and debriefing
	will also be encouraged during lectures.
	Besides from the notes taken by students in class, all of the course material
	will be made available through the class website and also through the
	eLearning platform. The instructor will also be available to students during
	office hours or by appointment in order to provide any necessary tutoring.
Bibliography	Textbook: Kaltschmitt, M., Streicher, W., & Wiese, A. (Eds.). (2007).
	Renewable energy: technology, economics and environment. Springer
	Science & Business Media.
	References:

	1. Electric Machinery Fundamentals, 5 edition, Stephen J. Chapman,
	McGraw Hill, 2011
	2. K. Mertens, Photovoltaics: Fundamentals, Technology and Practice,
	Wiley-Blackwell, 2014
	3. K. Mertens, Photovoltaics: Fundamentals, Technology and Practice,
	Wiley-Blackwell, 2014
	4. Solar Energy International, Photovoltaics: Design and Installation Manual,
	New Society Publishers, 2004
Assessment	Students will be assessed through:
	- A midterm test at the 7 th week of the course
	- A personal assignment which will be handed out at the beginning of
	the semester (week 2) and will be collected by completion of semester
	(week 12).
	- A final test at the end of the semester, in which all material will be
	examined.
	The weights of the course assessment are as follows:
	Assignment: 20%
	Midterm Exams: 20%
	Final Exams: 60%
Language	English and Greek