Modernising Undergraduate Renewable Energy Education: EU Experience for Jordan
TEMPUS Project Number 530332
Princess Sumaya University for Technology
Report on DEV2.2
"Selection of Pilot Courses and Labs"

Introduction

According to DEV2.2 of MUREE project which foresees the updating and improving of contents for 4 state-of-the art courses and then the delivering, accrediting and adapting to add value to the existing programme at PSUT and all Jordanian universities, partners of MUREE, the following report has been prepared. As indicated in the proposal, among 4 courses, 1 course will be taught in other beneficiary universities at university requirements and 1 at faculty level. Sapienza, as leader of WP 2, coordinates all activities for the elaboration of syllabus and courses' contents. DEV2.2 foresees the identifying of 4 pilot courses, the e-learning course and the labs, in traditional and remote way.

Pilot Courses

During the last meeting in Graz, 10-11th of April 2013, MUREE partners have approached the topic of "Selection of Pilot Courses and Labs, starting from the Report on Labour Market needs, elaborated by JUST. The following pilot courses have been chosen, 4 for in presence learning and 2 for distance learning:

1. Energy Conversion (in presence)
2. Renewable Energy Systems (in presence and in distance learning)
3. Photovoltaic (in presence and in distance learning)
4. Solar Thermal Energy (in presence)
5. Wind Energy (in presence)
6. Electric machines and drive (in presence)

Some Jordanian Partners have declared to have part of listed courses in the university curricula and internal expertise for didactic. The experience of these partners is the starting point for the development of the new and updated programmes and materials. In according with what decided during the meeting, the development of each course is carries on by one Jordanian partner, as leader, and Jordanian and European partners as collaborators. The following table shows Jordanian partners which have in the university curricula the chosen courses, European partner involved in the development of updated version, Jordanian leader and other partners which support the elaboration of didactic materials and syllabus.

Course name	PSUT	UJ	MUTAH	HU	JUST	EU	Leaders from Jordan	Partners	Persons involved
Energy conversion	✓	✓	✓	✓		Sapienza	**UJ**	PSUT, MUTAH	Katiuscia, Ahmad + Odah
RE systems	✓	✓	✓	✓		Sapienza	**HU**	PSUT, UJ, MUTAH	Katiuscia, Bashan +Ahmad +Handri + Khasw
PV	✓	✓	✓	✓	✓	UCY	**PSUT +HU**	UJ, MUTAH , HU, JUST	Maria, Issa, Mohamet +Monsoon
Solar Energy (thermal)		✓	✓		✓	TU Berlin	**MUTAH**	UJ, JUST	Jens, Ayman M + Kais
Wind energy			✓		✓	TU Berlin	**JUST**	MUTAH	Jens, Suhil, Maiteh
Electric machines	✓			✓	✓ RE in	TU Graz	**PSUT**	HU, JUST	Annette, Ayman F, Klaus

and drive					electr onics				

Leader's DEVs:

- Driving the elaboration of course for which is leader,
- Provide European partner(s) information for the development of the definitive contents in according to the National and University needs.

Main activities for DEV2.2:

1. Jordanian and European partners work together in the elaboration of courses' syllabus;
2. Jordanian partners verify the syllabus and send to European partners the definitive version;
3. Jordanian partners elaborate a course description and all the information for the request of accreditation;
4. European partners send a general curriculum content and expect feedback from Jordanians on making the course customized to their needs, and send more help back;
5. Jordanian partners request the development of detailed course material, and ask each EU partner to send what they have;
6. EU universities request Jordanians to send them the program of their courses they given.

All the activities are managed by Sapienza and TUG in collaboration with all Jordanian partner universities.
HU will include in the report the technical specifications for the e-learning courses.

Laboratories

In addition to the 6 updated courses, 2 labs, and 4 remote labs and an educational solar/wind station have to be established. Following the indication of DEV2.3:

- TUB and UCY are responsible for the design of traditional labs;
- UNED and HU are responsible for the design of e-learning courses and remote labs;
- UCY and PSUT are responsible for the design of the station.

Traditional Laboratory

PSUT Power and Energy traditional labs intend to demonstrate explain and relate the link between the renewable energy and the actual electric power systems and machines. Being able to demonstrate the fundamental characteristics and capabilities of the power electronics devices, allows the student to understand the operation of the converters used to integrate between the renewable energy sources and the power systems, contributing into a better understanding of what so called the 'Smart Grid', as well the use of these converter devices for efficient driving and controlling of the electric motors and generators. The equipment to be purchased and topics to be covered for the electric machines and power electronics lab space, in order to achieve the desired objectives above:

- Performance Characteristics of motors
  - Single phase induction motor
  - Three-Phase induction motor
  - Reluctance motor
- Power Electronics Converters :
  - DC Choppers.
  - AC inverters.
  - Frequency Converters
  - Servo-Drives

The labs will offer students the chance to investigating the characteristics, and operational states of power systems that integrate renewable energy with conventional generation methods and its transmission and distribution as well. Furthermore, determination of the different power systems parameters of transmission lines and substations of the grid associated with the power quality metering standards. The labs will explain and demonstrate some modern energy management systems making use of SCADA systems and smart energy metering devices. Also, it will introduce students to the coordination and communication between the protective equipment installed over the 'Smart Grid', as well as the fundamental characteristics of this protection equipment.

The equipment to be purchased and topics to be covered for the electric machines and power electronics lab space, in order to achieve the desired objectives above:

- Power systems & Protection:
- Double bus bar systems characteristics.
- Transmission lines parameters.
- Smart Grid Software.
- SCADA.
- Power Protection Relays. (Differential & Overcurrent)

The power systems laboratory will include transmission lines, substations models; able to demonstrate a model of a smart grid, as well with the protection devices of that system. UNED and HU to include in the report all information on remote labs they have at the moment. UCY and PSUT to include in the report all information on the station they have at the moment.

Remote labs

Equipment for remote labs established will be installed in HU, PUST, JUST, MUTAH:

(i) Wind and solar power trainer setup: teach students characteristics of solar panels and wind power generators,

(ii)Alternative energy trainer: theory of generating power from solar, wind, fuel cells,

(iii) Power quality trainer: analysis tools,

(iv) Solar tracking control trainer.

Action Plan

The following action plan is based on the deadline of MUREE project and intends to support the achievement of the deliverables:

Deliverables	Partners involved	Deadline [dd/mm/yyyy]
Dev 2.3 - Detailed Design of Pilot Courses	All partners	15/08/2013
– Comments and suggestions concerning the courses	All partners	30/08/2013
– Final Version of the report and syllabus	Sapienza/TUG	03/09/2013
– List of topics for which didactic materials are missed	Jordanian Partners	06/09/2013
– Elaboration of missed Didactic materials	All partners	27/9/2013
Dev 2.4 – Accreditation of New Curricula	Jordanian Partners	15/04/2014
Dev 2.5 – New Curricula for RE Courses	All partners	15/10/2014
Dev 2.6 – Labs and Educational Station on RE	All partners	15/10/2014
Dev 2.7 – Monitoring and Feedback Methodology and Reports	Sapienza	15/12/2014

Annex I
Title of pilot course: **Energy Conversion**
Credits: Three-credit hour course
Pre-requisites: …
Level: Junior-senior level

Contents:
[UoJ Proposal]
1. Energy classification, resources and utilization.
2. Principal fuels for energy conversion.
3. Production of thermal energy.
4. Fossil fuel systems.
5. Environmental impact of power plant operation.
6. Production of electrical energy (by direct energy conversion).
7. Wind energy.
8. Solar energy.
9. Geothermal energy.
10. Energy storage and conservation.

Detailed contents:
[Sapienza's Proposal]
1. Introduction to the energy problem (X hours)
Energy cycle, energy classification, energy sources
Difference between conventional and renewable sources
Classification of primary and secondary sources
Energy balance of the Heart

2. Conventional Systems (X hours)
Principal fuels for energy conversion
Classification of fluid machines
Classification of the energy conversion plants
Main thermodynamic cycles
Steam Power
Gas turbine
Nuclear fission and fusion
Vapour compressor
Absorption refrigeration

3. Direct Conversion (X hours)
Thermionic power conversion
Thermoelectric effect (Seebeck effect, Peltier effect, Thomson effect)
MHD – Magnetohydrodynamic

4. Renewable Energy Systems (X hours)
Wind energy
Photovoltaic cells
Solar concentration
Solar thermal technology (Low, medium and High temperature)
Geothermal energy
Hydrogen and fuel cells
Biomass and Biofuel

Note:
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Text Book:

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Additional references:

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Practical:

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Title for pilot course: **Renewable Energy Systems**
Three-credit hour course
Pre-requisites: ….
Level: Junior-senior level

Contents:
1. Introduction
2. Photovoltaic
3. Solar Thermal
4. Wind
5. Biomass/fuel
6. Hydropower
7. Geothermal

Detailed contents:
1. Introduction (3 hours)
Energy situation in Jordan
Energy situation in the world
Renewable energy sources

2. Photovoltaic (11 hours)
Introduction
Fundamentals of solar radiation
Solar radiation measurements and availability
Sun path description and calculations
Silicon
Solar cells
Components
Panels
Inverters
Solar charge controller
Solar batteries
Loads
Theory
Photovoltaic systems
On- and Off-grid
Trackers and non-trackers
Modules and arrays
Efficiency and MPP
I-V curves under standard test conditions
Temperature, insolation, and shading impacts
Smart grid
Design
Economics
Software

3. Solar Thermal (13 hours)
Introduction
Structure
Operation
Components and Theory
Flat-plate collectors
Air-based collectors
Vacuum-tube collectors

Parabolic troughs
Heliostats
Thermal systems (free and forced circulations)
Solar cooling
Solar power plants
Thermal performance
Design
Economics
Software

4. Wind (10 Hours)
Introduction
Wind energy sources
Wind turbine types
Wind turbine operation
Wind farms
Power coefficient
Components
Rotors
Blades
Gearboxes
Wind Turbine generators
Measurements and controllers
Charges
Theory
Impart of tower height
Rotor efficiency
Speed control
Grid-connected wind turbine
Performance calculations
Design
Economics
Software

5. Biomass/fuel (8 hours)
Origin
Fundamentals
Availability
Characteristics
Biofuels
Products

6. Hydropower (4 hours)
Introduction
Turbines
Plants
Theory
Hydraulic analysis
Turbine speeds
Energy transfer in turbines

7. Geothermal (4 hours)
Introduction
Theory

Resources
Geothermal energy systems
Geothermal heat pumps

Note:
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Text Book:
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Additional references:
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Practical:
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Title for pilot course: **Photovoltaic Systems**
Three-credit hour course
Pre-requisites: Electronics I (semiconductor materials, diodes, transistors, feedback circuits)
Level: Junior-senior level

Contents:
1. Introductory overview
2. The solar resource
3. Semiconductor physics
4. Solar cells
5. PV array and modules
6. PV systems
7. Distributed versus centralized solar PV generation, BOS design, Intro to smart-grid for PV systems
8. Recent advances and challenges in PV systems:
Addressing continued challenges: concerns with high penetration, grid stability, cost, dust, high temperature, reliability, intermittency, and dynamically instable energy.
Introduction to BIPV, energy management and energy policy and regulations
9. Practical challenges that need to be addressed ... PV installations

Detailed contents
1. Introduction overview (3 hours)
Overview of Energy
Environmental and Social threats
Energy Crisis
Solar Potential
Photovoltaic applications and market potentials
Photovoltaic energy in Jordan

2. The solar resource (6 hours)
The solar spectrum
The earth's orbit
Altitude angle of the sun at Solar Noon
Solar position at any time of day
Sun path diagrams for shading analysis
Clear sky direct-beam radiation
Total clear sky insolation on a collecting surface

3. Semiconductor physics (6 hours)
Intro
Basic semiconductor physics
A generic PV cell
From cells to modules to arrays
The PV I-V curve under STC
Impacts of temperature and insolation on I-V curves
Shading impacts on I-V curves

4. Solar cells (8 hours)
Solar cell structure
Collection probability
Spectral response
Photovoltaic Effect
Operation parameters
Effect of Parasitic resistance
Effect of temperature

Effect of Irradiance
Solar Cell - Manufacturing
Introduction to major PV technologies
Introduction to manufacturing of solar cells
I-V curves for loads
Stand alone and Grid-connected systems and economics

5. PV modules and array (5 hours)
PV system analysis
Module performance
PV interconnection effects
Reasons for underperformance

6. PV systems (10 hours)
PV markets and driving forces
PV systems
PV system performance
PV system design and sizing ... components
PV tracking systems
PV performance
Energy prediction
PV Business – Manufacturing Costs

7. Distributed solar PV generation (6 hours)
Distributed (DG) versus centralized solar PV generation
BOS design
Intro to smart grids: advanced metering infrastructure AMI
Micro-grids

8. Recent advances and challenges in PV systems (4 hours)
Challenges of high penetration, dynamic pricing – cost issues,
Introduction to BIPV,
Energy management
Policy

9. Practical challenges that need to be addressed ... PV installations (3 hours)

Note:
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Text Book:
1] M. Green, "Solar Cells, Operating Principles, Technology and System Applications", NSW, December 1998.
[2] C. Honsberg, S. Bowden, "Photovoltaic Devices", Part 1, UNSW, 1998.
[3] J. Singh, "Semiconductor Devices, Basic principles", John Willey & Sons, Inc., 2001.
[4] M.S. Tyagi, "Introduction to semiconductor materials and devices", John Willey & Sons, Inc., 1991.

Additional references:
[1] E. Lorenzo, "Solar Electricity, Engineering of Photovoltaic Systems", Institute of Solar Energy, Polytechic Univesity of Madrid, April 1994.

Practical:
PV cell characterization

Title for pilot course: **Wind Energy**
Three-credit hour course
Pre-requisites: Fluid Mechanics, Electric machine, Energy Conversion
Level: Junior-senior level

Contents:
1. Introductory overview
2. Wind Characteristics and Resources
3. Aerodynamics of Wind Turbines
4. Wind energy conversion systems
5. Performance of wind energy conversion systems
6. Electrical Aspects of Wind Turbines
7. Wind Turbine Control
8. Economics of wind energy

Detailed contents:

1. Introduction overview (X hours)
Modern Wind Energy Convertors

2. Wind Characteristics and Resources (X hours)
General Characteristics of the Wind Resource
Characteristics of the Atmospheric Boundary Layer
Wind Data Analysis and Resource Estimation
Wind Turbine Energy Production Estimates Using Statistical Techniques
Wind Measurements and Instrumentation
Overview of Available Resource Assessment Data

3. Aerodynamics of Wind Turbines (X hours)
One-Dimensional Momentum Theory and the Betz Limit
Ideal Horizontal Axis Wind Turbine with Wale Rotation
Airfoils and General Concepts of Aerodynamics
Momentum Theory and Blade Element Theory
Blade Shape for Ideal Rotor without Wake Rotation
General Rotor Blade Shape Performance Prediction
Blade Shape for Optimum Rotor with Wake Rotation
Generalized Rotor Design Procedure
Simplified HAWT Rotor Performance Calculation Procedure
Effect of Drag and Blade Number on Optimum Performance
Advanced Aerodynamic Topics

4. Wind energy conversion systems (X hours)
Wind electric generators: Tower, Rotor, Gear box, Power regulation, Safety brakes, Generator
Wind farms

5. Performance of wind energy conversion systems (X hours)
Power curve of the wind turbine
Energy generated by the wind turbine; Weibull based approach and Rayleigh based approach
Capacity factor
Matching the turbine with wind regime
Performance of wind powered pumping systems
Wind driven piston pumps
Wind driven roto-dynamic pumps
Wind electric pumping systems

6. Electrical Aspects of Wind Turbines (X hours)

Overview
Basic Concepts of Electric Power
Power Transformers
Electrical Machines
Power Converters

7. Wind Turbine Control (X hours)
Overview of Wind Turbine Control Systems
Typical Grid-connected Turbine Operation
Supervisory Control Overview and Implementation
Dynamic Control Theory and Implementation

8. Economics of wind energy (X hours)
Factors influencing the wind energy economics
Site specific factors
Machine parameters
Energy market
Incentives and exemptions
The 'present worth' approach
Cost of wind energy
Initial investment
Operation and maintenance costs
Present value of annual costs
Benefits of wind energy
Net present value
Benefit cost ratio
Pay-back period

Note:
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Text Book:
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Additional references:
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Practical:
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Title of pilot course: **Introduction to Electric Machines and Drives**
Credits: Three-credit hour course
Pre-requisites: …
Level: Junior-senior level

Contents:
1. Motivation
2. Review: Electromagnetics and Energy Conversion
3. Review: AC Systems and Three-Phase Circuits
4. Basics of AC Machines
5. Synchronous Machines: Steady State
6. Induction Motors: Steady State
7. Converter Power Electronics: Basic Theory, Devices
8. AC Inverter Basics: VSI, Modulation
9. Adjustable Speed Drives: Basics
10. Field oriented control (Special case: Field Oriented Control of Induction Motors)
11. Adjustable Speed Drives: Volts/Hz Control
12. Adjustable Torque Drives: Basics
13. Synchronous machine control
14. Application-Specific Selection of Machine-and-Drive Systems

Detailed contents:

1.Motivation (1 hr)
Load types and characteristics
Practical issues of machine and drive selection

2.Review: Electromagnetics and Energy Conversion (2 hrs)
Ampere's law
Faraday's law
Gauss's magnet law
Magnetic circuits: electrical-magnetic analogy
Magnetic flux
Soft magnetic materials
Inductors and transformers
Forces: Lorentz and Reluctance
DC machine

3.Review: AC Systems and Three-Phase Circuits (2 hrs)
AC voltages and currents
Complex numbers and phasor concepts
Why three-phase?
Harmonics
Per-unit system

4.Basics of AC Machines (4 hrs) (Spend more time on fundamentals)
Elementary AC machines- air-gap MMF- flux- voltage waveforms
Distributed stator windings
Elementary rotor-stator coupling
Three-phase operation

5.Synchronous Machines: Steady State (1 hr+2hrs as time permits)
Synchronous machine types- smooth rotor- salient pole- permanent magnet
Circuit models and vector diagrams
Capability curves

6.Induction Motors: Steady State (1hr+2hrs as time permits)
Induction machine types- wound rotor- "squirrel cage" rotor

Circuit models
Definition of slip
Torque-speed curves

7. Converter Power Electronics: Basic Theory, Devices (3 hrs)
Review of circuit fundamentals
Basic converters: AC-DC, DC-DC, DC-AC, AC-AC
Higher focus on DC-DC, and DC-AC. Mention buck and boost converters
Device characteristics and capabilities

8. AC Inverter Basics: VSI, Modulation (3 hrs)
Basic inverter system
Voltage source inverter (VSI)
Modulation techniques
Pulse width modulation (PWM)
Practical considerations

9. Adjustable Speed Drives: Basics (3 hrs)
Basic adjustable speed drive systems
Review: DC machine:
9. Speed control
10. Torque control
11. Cascaded control
12. Field weakening
Varying voltage
Motor and drive selection

10. Field oriented control (Special case: Field Oriented Control of Induction Motors) (4 hrs)
Revisit IM model
Physical representation of induction machine fields
Basic IM vector drive
Rotor flux orientation
Field weakening
Induction machine torque-slip control

11. Adjustable Speed Drives: Volts/Hz Control (1 hr)
Concepts of constant flux and torque
Operation at constant torque or power
Low speed operation
Basic Volts-per-Hertz system
Drive limitations

12. Adjustable Torque Drives: Basics (1 hr)
Ideal adjustable torque systems

13. Synchronous machine control (2 hrs)
Synchronous machine control (notably PM machines)

14. Application-Specific Selection of Machine-and-Drive Systems (1 hr)
Specific drives to suit application
Case study

Note:
If time permits, go back and talk more about steady state synchronous machines and induction machines (up to **4 hrs**)

Text Book:

Introduction to Electric Machines and Drives;T. M. Jahns, T. A. Lipo, and D. W. Novotny.

Additional references:
"Electric Drives" and "Advanced Electric Drives" by Ned Mohan

Practical:
Experiments on speed control of synchronous Machines, Induction Machines, and Reluctance Machines

Title for pilot course: **Solar Thermal Systems**
Three-credit hour course
Pre-requisites: thermodynamics
Level: Junior-senior level

Contents:

1. Fundamentals
2. Design and installation
3. Fields of application
4. Concentrating solar power

Detailed contents:

1. Fundamentals

Physics:
Basics in thermodynamics
Heat transfer (conduction, convection, radiation)
Basics in fluid mechanics
Components:
Solar Collectors
o DEV, function and characteristic values
o Collector types
o Flow type and hydraulic characteristics
Solar Storage Unit
o Function and Requirements
o Types of construction and advanced storage technologies
Heat Exchangers
o Function and requirements
o Construction types
Collector Loop:
Types of systems
Heat transfer fluids and characteristics
Pumps and accessories

2. Design and Installation

System design and configuration
○ Design of households' size water and space heating systems
○ Feasibility assessment, site survey
○ Energy consumption assessment
○ Collector array angles and orientation
○ Combination with other fossil and renewable energy sources
○ Calculating output
○ Economics
○ Loads and applicable building regulation (wind speeds, snow etc.)
○ Dimensioning of collectors, storage units and collector loop
○ Pipe dimensioning, hydraulic configuration and pressure losses
System Installation
○ Selection of components and assembling
○ Collector Mounting
○ Assembly on a sloped roof
○ Rigging on a flat roof
○ Building integration
○ Inspection and testing of the system
○ Operation and Maintenance
○ Monitoring system performance
○ Possible malfunctions and trouble shooting

3. Fields of Application for Solar Thermal Systems

Basics of Solar Thermal technologies:

- Functionality
- Required conditions
- Efficiencies
- Characterization

Motivation, potential und market development for Solar Thermal Systems

Kinds of solar thermal collectors

- Temperature ranges
- Basics radiation
- Physics for collectors
- Basics of power generation

Applications in the residential sector

- Space/water heating and cooling
- Cooking
- Drying

Industrial applications -

- Process Heat
- Desalination
- Drying
- Preheating

Solar assisted heat networks: Local and district heating.

Energy storing possibilities

4. Concentrating Solar Power

Conventional Steam Power Plant technology

- Fundamentals in thermodynamics of steam power plants
- Conventional steam power plants

CSP

- Overview on different CSP technologies, system types, solar and hybrid systems, pros and cons of
- Different technologies, market overview and market situation
- Investigation of suitable areas; criteria for site selection and selection process
- Storage systems for different power plant technologies
- Cooling technologies
- Other fields of application
- Tendering procedures
- Operation and maintenance
- Risk analysis
- Political framework conditions for CSP
- Economics of CSP

Note:

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Text Book:	**Publisher**	**Author**
Passive Cooling of Buildings (Best (Buildings Energy and Solar Technology))	Routledge	M. Santamouris
Heating and Cooling of Buildings: Design for Efficiency (McGraw-Hill Series in Mechanical Engineering)	MC Graw Hill	Jan F. Kreider
Energy Performance of Residential Buildings: A Practical Guide for Energy Rating and Efficiency	Earthscan	M Santamouris

Solar Cooling Handbook: A Guide to Solar Assisted Cooling and Dehumidification Processes: A Guide to Solar Assisted Cooling and Dehumification Processes	Springer	Hans Martin Hennings
Solar Cell Technology and Applications	CRC Press	A.R. Jha
Solar Installations: Practical Applications for the Built Environment	James & James	Lars Andren
Solar Energy: Fundamentals, Design, Modelling And Applications	Narosa	G.N. Tiwari
Time to Shine: Applications of Solar Energy Technology	Wiley	Michael Grupp
Energy: Management, Supply and Conservation	Butterworth-Heinemann	Clive Beggs
The Future for Renewable Energy 2: Prospects and Directions	James & James	EUREC
Thermal Energy Storage: Systems and Applications	Wiley	Ibrahim Dincer
Flexible Solar Cells	Wiley	Mario Pagliaro
Solar Energy Storage: A Combat of Energy Crisis: Photochemical Conversion and Storage of Solar Energy	Lambert	Arsi Ameta
Solar house : a guide for the solar designer	Elsevier	Terry Galloway
Planning and installing solar thermal systems	DGS	DGS

Additional references:
None

Practical:
Project oriented teaching recommended. Provide the students with a DEV (develop a solar cooking station for instance).

Annex II
Form for courses' accreditation
COURSE OUTLINE

Course Title:	
Course Coordinator:	

I. COURSE DESCRIPTION

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…………………………………………………….
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…………………………………………………….

II. REQUIRED BACKGROUND OR EXPERIENCE

Prerequisites by course:

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Prerequisites by topic:

1. ………
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2. ………
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3. ………
…………………………….
4. ………
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5. ………
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6. ………
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Postrequisites:

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III. EXPECTED OUTCOMES

Students will be expected to develop the following skills/understanding upon the successful completion of the course. They will be able to:

1. ………
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2. ………
…………………………….
3. ………
…………………………….
4. ………
…………………………….
5. ………
…………………………….
6. ………
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IV. TEXTBOOK(S) AND READINGS
1…………. [Title, Editor, author(s), cost]
2…………. [Title, Editor, author(s), cost]
3…………. [Title, Editor, author(s), cost]
4…………. [Title, Editor, author(s), cost]

VII. COURSE OUTLINE
The following topics will be covered in this course:

	Topics	**Number of Hours**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		