

COURSE OUTLINE

DAY 1

Photovoltaic Systems

1. Introduction

- Global warming and in sustainable development
- Energy strategies and the role of renewable energy.
- Potential of solar energy
- Development of photovoltaic systems and support mechanisms

2. Solar Radiation

- Extra-terrestrial and terrestrial solar spectrum.
- Components of solar radiation
- Solar components' geometry
- Location survey parameters and site assessment

3. Photovoltaic Cells and Modules

- Model of photovoltaic cells.
- I-V and P-V characteristics and maximal power point
- Influence of solar radiation and cell temperature to PV characteristics
- PV modules and arrays.
- Effect of shading and use of bypass and blocking diodes
- Types of solar cells and manufacturing of cells and modules

DAY 2

Photovoltaic Systems

4. Photovoltaic Inverters

- Types of photovoltaic systems
- Inverters for grid-connected systems
- System topology (central, string, multi-string)
- Inverters for stand-alone
- Energy storage, types of batteries and characteristics
- Inverters for hybrid systems

5. Photovoltaic System Design

- Photovoltaic mounting structures
- Balance of system components
- Planning and design parameters of grid connected PV systems
- Planning and design parameters of standalone PV systems
- Planning and design parameters of hybrid PV systems

6. Investment and Operation

- Soiling and degradation
- Operation and maintenance
- Financial aspects of PV systems

DAY 3

Solar Thermal Systems

1. Introduction – solar energy and principles of harvest
 - General characteristics
 - Solar radiation at Earth
 - Harvesting techniques
2. Application of Solar Thermal Systems
3. Types of solar thermal collectors
 - Flat plate
 - Evacuated tube collectors
 - Comparison of flat plate and evacuated tube solar collector
 - Concentrating solar collectors
 - Façade solar collectors
 - Air solar collectors
4. Solar Thermal Systems
 - Types
 - Active solar thermal systems
 - Combined solar systems
 - Solar cooling
5. Components and Specifics
 - Connection
 - Stagnation
 - Accumulation
 - Heat exchangers
 - Hydraulic characteristics

DAY 4

Photovoltaic Thermal Collectors - PVT

1. Introduction of PVT
 - PV-only and solar thermal-only installations
 - Temperature characteristics issues of PVs
 - Efficiency issues of solar thermal collectors
 - PVT systems as a general solution
2. Characteristics of PVT collectors
 - PVT collectors provide both power and thermal energy.
 - Application of PVT hybrid collector
3. Testing of PVTs
 - Relevant monitoring parameters
 - Test results from World verified institutions Dimensioning PVT Systems
 - PVT only systems
 - Combined PVT with Heat Pumps
 - Combined PVT with adsorption chillers
 - Other practical examples
5. Overview of PVT Systems and References

DAY 5

Solar Systems Sustainability and Innovations

1. Sustainability trends

- Climate target goals (2030/2050) and RES (solar) applications
- Solar energy utilization in the context of the global initiative for carbon neutral world (2050) -Planetary health, climate changes, clean energy (human health issues and biodiversity)
- Environmental – social – economic aspects of clean energy (solar) utilization

2. Innovation trends in solar energy sector

- Novel types of materials in solar energy devices,
- Progress towards a more sustainable future – recyclability, circular economy, circularity by design, LCA (Life Cycle Analysis)
- Climate-smart actions and products
- Innovative solutions in solar devices
- Anti-soiling (low soiling) applications
- Thermo-conductive connectors/adhesives

3. Solar energy in NZEB (nearly zero energy buildings)

- Novel trends in NZEB and construction sector with RES utilization
- Active facades with installed PV modules and PVT collectors

Case studies: EU R&D projects for solar energy utilization in NZEB

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