

WEEKLY CONTENTS OF MOOC SOLAR ENERGY

Week 1: Introduction to Solar Energy [1 Sep 2015]

Block 1.1 General Introduction to the Course and the edX Platform

- Lecture 1.1: Introduction to the Course
- Video: Introduction to the edX Platform
- Video: Courseware Accordion
- Video: Top-Level Navigation
- Video: Discussion
- Video: Summary

Pre-Questionnaire

Block 1.2 Energy Conversion

- Lecture 1.2: Energy Conversion I
- Practice Questions: PQ1.2.1-1.2.2
- Lecture 1.3: Energy Conversion II
- Practice Questions: PQ1.2.3-1.2.4

Block 1.3 Photovoltaics

- Lecture 1.4: Photovoltaics
- Practice Questions: PQ1.3.1-1.3.2

Block 1.4 History of Solar Energy

- Lecture 1.5: History of Solar Energy
- Discussion

Block 1.5 Status and Prospects of Solar Energy

- Lecture 1.6: Status and Prospects of Solar Energy
- Practice Questions: PQ1.5.1-1.5.2
- Discussion

Block 1.6 Solar Light

- Lecture 1.7: Solar Light I
- Practice Questions: PQ1.6.1
- Lecture 1.8: Solar Light II
- Practice Questions: PQ1.6.2-1.6.6
- Energy Price and Availability Survey

Assignment 1 [1 Sep 2015 - deadline: 22 Sep 2015]

- Instructions
- 1.1 Costs of PV Technology Generations: AQ1.1.1-1.1.3
- 1.2 Renewables in Global Electricity Supply Mix: AQ1.2.1-1.2.2
- 1.3 Power Spectral Density and Photon Flux: AQ1.3.1-1.3.2
- 1.4 PV Potential around the World: AQ1.4.1-1.4.4
- 1.5 PV System for the Smith Family: AQ1.5.1-1.5.6

Week 2: Working Principle of a Semiconductor Based Solar Cell [8 Sep 2015]

Block 2.1 How to Transform Light into Electricity

- Lecture 2.1: How to Transform Light into Electricity
- Practice Questions: PQ2.1.1-2.1.2

Block 2.2 Band Gap

- Lecture 2.2: Band Gap I - Electrons in Atoms
- Practice Questions: PQ2.2.1
- Lecture 2.3: Band Gap II - Electrons in Molecular Bonds
- Practice Questions: PQ2.2.2
- Discussion

Block 2.3 Charge Carriers

- Lecture 2.4: Excitation of Charge Carriers I
- Lecture 2.5: Excitation of Charge Carriers II
- Practice Questions: PQ2.3.1-2.3.3
- Lecture 2.6: Transport of Charge Carriers
- Practice Questions: PQ2.3.4-2.3.6

Block 2.4 Semiconductor Junction

- Lecture 2.7: Semiconductor Junction I - Basic Principles
- Practice Questions: 2.4.1-2.4.3
- Lecture 2.8: Semiconductor Junction II - The Solar Cell
- Practice Questions: 2.4.4-2.4.5
- Discussion

Assignment 2 [8 Sep 2015 - deadline: 6 Oct 2015]

- Instructions
- 2.1 Phosphorus Electron Configuration: AQ2.1.1
- 2.2 Conductivity in Semiconductors: AQ2.2.1
- 2.3 N-Doping of Silicon: AQ2.3.1
- 2.4 Minority Carrier Concentration: AQ2.4.1
- 2.5 Diffusion Current Density versus Drift Current Density: AQ2.5.1-2.5.2
- 2.6 Minority Carrier Lifetime: AQ2.6.1
- 2.7 P-N Junction: AQ2.7.1-2.7.6
- 2.8 Open-Circuit Voltage: AQ2.8.1

Week 3: Solar Cell Operation, Performance and Design Rules [15 Sep 2015]

Block 3.1 Solar Cell Operation

- Lecture 3.1: Solar Cell Operation
- Practice Questions: PQ3.1.1-3.1.2

Block 3.2 Solar Cell Performance

- Lecture 3.2: External Parameters of an Ideal Solar Cell
- Example: External Parameters of an Ideal Solar Cell
- Practice Questions: PQ3.2.1-3.2.4
- Lecture 3.3: Series and Shunt Resistance
- Example: Series and Shunt Resistance
- Practice Questions: PQ3.2.5-3.2.6

Block 3.3 Solar Cell Design Rules

- Lecture 3.4: Utilization of Band Gap Energy
- Practice Questions: PQ3.3.1
- Lecture 3.5: Spectral Utilization I - External Quantum Efficiency
- Practice Questions: PQ3.3.2-3.3.4
- Lecture 3.6: Spectral Utilization II - Shockley-Queisser Limit
- Practice Questions: PQ3.3.5-3.3.6
- Lecture 3.7: Light Trapping I - Absorption and Optical Losses
- Practice Questions: PQ3.3.7-3.3.8
- Lecture 3.8: Light Trapping II - Anti-Reflection and Trapping Methods
- Practice Questions: PQ3.3.9-3.3.11
- Example: Light Trapping - Rayleigh Film

Exam 1: Recap Week 1, 2 and 3 [15 Sep 2015 - deadline: 20 Oct 2015]

- Instructions
- 1.1 Drift of Charge Carriers: EQ1.1.1
- 1.2 Biased P-N Junction: EQ1.2.1
- 1.3 Open-Circuit Voltage: EQ1.3.1
- 1.4 Fill Factor and Efficiency: EQ1.4.1-1.4.2
- 1.5 Ideal I-V Curve: EQ1.5.1-1.5.4
- 1.6 Non-Ideal J-V Curve: EQ1.6.1-1.6.5
- 1.7 Absorption Coefficient: EQ1.7.1-1.7.4
- 1.8 Reflection in a Solar Cell: EQ1.8.1

Week 4: PV Technology Based on Crystalline Silicon [22 Sep 2015]

Block 4.1 Properties of Crystalline Silicon

- Lecture 4.1: Properties of Crystalline Silicon
- Practice Questions: PQ4.1.1-4.1.2

Block 4.2 Manufacturing of Crystalline Silicon

- Lecture 4.2: Manufacturing of Crystalline Silicon
- Practice Questions: PQ4.2.1-4.2.3

Block 4.3 Design Rules of Crystalline Silicon

- Lecture 4.3: Design Rules of Crystalline Silicon
- Practice Questions: PQ4.3.1-4.3.4

Block 4.4 High-Efficiency Concepts of c-Si Wafer Based Solar Cells

- Lecture 4.4: High-Efficiency Concepts of c-Si Wafer Based Solar Cells
- Practice Questions: PQ4.4.1-4.4.3

Block 4.5 From Solar Cells to Solar Modules

- Lecture 4.5: From Solar Cells to Solar Modules
- Practice Questions: PQ4.5.1-4.5.3

Assignment 3 [22 Sep 2015 - deadline: 8 Dec 2015]

- Instructions
- 3.1 Manufacturing of Polysilicon: AQ3.1.1
- 3.2 Finger's Resistance: AQ3.2.1
- 3.3 Surface Recombination at the Air/Silicon Interface: AQ3.3.1
- 3.4 Choosing the Silicon Layer Thickness: AQ3.4.1
- 3.5 Back Surface Field: AQ3.5.1
- 3.6 Effect of Bypass Diodes: AQ3.6.1-3.6.3

Week 5: Thin-Film PV Technologies [29 Sep 2015]

Block 5.1 III-V PV Technology

- Lecture 5.1: III-V PV Technology
- Practice Questions: PQ5.1.1-5.1.2

Block 5.2 Thin-Film Silicon PV Technology

- Lecture 5.2: Thin-Film Silicon PV Technology I
- Lecture 5.3: Thin-Film Silicon PV Technology II
- Practice Questions: PQ5.2.1-5.2.4

Block 5.3 CIGS PV Technology

- Lecture 5.4: CIGS PV Technology
- Practice Questions: PQ5.3.1

Block 5.4 CdTe PV Technology

- Lecture 5.5: CdTe PV Technology
- Practice Questions: PQ5.4.1-5.4.4

Block 5.5 Organic PV Technology

- Lecture 5.6: Organic PV Technology
- Practice Questions: PQ5.5.1-5.5.2

Assignment 4 [29 Sep 2015 - deadline: 8 Dec 2015]

- Instructions
- 4.1 Micromorph Module: AQ4.1.1
- 4.2 CIGS and CdTe Fabrication: AQ4.2.1
- 4.3 Triple Junction J-V Curve: AQ4.3.1
- 4.4 External Quantum Efficiency of a Tandem Cell: AQ4.4.1-4.4.6
- 4.5 Dye-Sensitized Solar Cell: AQ4.5.1-4.5.3

Week 6: Third Generation PV and Other Ways to Utilize Solar Energy [6 Oct 2015]

Block 6.1 Third Generation PV Technologies

- Lecture 6.1: Third Generation PV Technologies
- Practice Questions: PQ6.1.1-6.1.2
- Discussion

Block 6.2 Solar Thermal Technologies

- Lecture 6.2: Solar Thermal Energy I - Basic Principles
- Practice Questions: PQ6.2.1-6.2.3
- Lecture 6.3: Solar Thermal Energy II - Solar Thermal Heating
- Practice Questions: PQ6.2.4-6.2.7
- Lecture 6.4: Solar Thermal Energy III - Solar Thermal Power
- Practice Questions: PQ6.2.8-6.2.9

Block 6.3 Solar Fuel Technologies

- Lecture 6.5: Solar Fuels
- Practice Questions: PQ6.3.1-6.3.4
- Discussion

Exam 2: Recap Week 4, 5 and 6 [6 Oct 2015 - deadline: 8 Dec 2015]

- Instructions
- 2.1 Manufacturing of Monocrystalline Silicon: EQ2.1.1
- 2.2 Effect of Bypass Diodes: EQ2.2.1-2.2.3
- 2.3 Triple Junction Solar Cell: EQ2.3.1-2.3.8
- 2.4 Up Converters: EQ2.4.1-2.4.9
- 2.5 Solar Water Heating Systems: EQ2.5.1-2.5.6
- 2.6 Solar Fuels: EQ2.6.1-2.6.2

Week 7: PV Systems - Components and Concepts [13 Oct 2015]

Block 7.1 Introduction to PV Systems

- Lecture 7.1: Introduction to PV Systems
- Practice Questions: PQ7.1.1
- Discussion

Block 7.2 PV Modules in PV Systems

- Lecture 7.2: PV Modules I - Module Parameters, Orientation and Tilt
- Practice Questions: PQ7.2.1-7.2.2
- Lecture 7.3: PV Modules II - Temperature Dependency of PV Output
- Practice Questions: PQ7.2.3-7.2.4

Block 7.3 Maximum Power Point Tracking (MPPT)

- Lecture 7.4: Maximum Power Point Tracking
- Practice Questions: PQ7.3.1-7.3.3

Block 7.4 Inverters in PV Systems

- Lecture 7.5: Inverters in PV Systems
- Practice Questions: PQ7.4.1-7.4.2

Block 7.5 Storage in PV Systems - Batteries

- Lecture 7.6: Batteries I - Introduction
- Practice Questions: PQ7.5.1-7.5.2
- Lecture 7.7: Batteries II - Battery Parameters
- Practice Questions: PQ7.5.3-7.5.6
- Lecture 7.8: Batteries III - Charge Controllers
- Practice Questions: PQ7.5.7

Assignment 5 [13 Oct 2015 - deadline: 8 Dec 2015]

- Instructions
- 5.1 PV Modules: AQ5.1.1-5.1.2
- 5.2 Maximum Power Point Trackers: AQ5.2.1-5.2.2
- 5.3 Inverters: AQ5.3.1
- 5.4 Batteries: AQ5.4.1-5.4.5

Week 8: PV Systems - Applications and Design [20 Oct 2015]

Block 8.1 Stand-Alone PV Systems

- Lecture 8.1: Stand-Alone PV Systems
- Practice Questions: PQ8.1.1-8.1.3

Block 8.2 Grid-Connected PV Systems

- Lecture 8.2: Grid-Connected PV Systems
- Practice Questions: PQ8.2.1-8.2.2

Block 8.3 Economics of PV Systems

- Lecture 8.3: Economics of PV Systems
- Practice Questions: PQ8.3.1-8.3.2

Block 8.4 Environmental Considerations of PV Systems

- Lecture 8.4: Environmental Considerations of PV Systems
- Practice Questions: PQ8.4.1-8.4.3

Block 8.5 Final Thoughts

- Lecture 8.5: Final Thoughts

Exam 3: Recap Week 7 and 8 [20 Oct 2015 - deadline: 8 Dec 2015]

- Instructions
- 3.1 Modules in PV Systems: EQ3.1.1-3.1.2
- 3.2 MPPT Concepts: EQ3.2.1
- 3.3 Batteries in PV Systems: EQ3.3.1-3.3.6
- 3.4 Stand-Alone PV System: EQ3.4.1-3.4.6
- 3.5 Economics of PV Systems: EQ3.5.1
- 3.6 Environmental Considerations of PV Systems: EQ3.6.1-3.6.3