

MS ISEE Study Track: Solar Cell Systems and Materials

Course Table: 2016/2017

1. **Year DTU:** Department of Energy Conversion and Storage, Head of Section Luise Theil Kuhn
2. **Year NTNU:** Faculty of Natural Science and Technology, Department for Material Science and Engineering Associate Professor Marisa Di Sabatino Lundberg

Study track focus and goals:

The overall goal of the study track is to educate MSc level candidates with theoretical knowledge and practical competence, qualified to a professional career in the PV industry, or for PhD level studies in the field. The study track focuses on the fundamental principles behind- and the application and development of- photovoltaic materials and/or devices, and systems. The students will, based on bachelor background, have the opportunity to choose between a physics direction and a materials science direction.

In the first year at DTU, a broad basis in energy systems, technology and economics will be offered to all students. The fundamentals of solar energy harvesting are provided, in addition to basic courses in semiconductor physics and materials synthesis.

In the second year at NTNU, depending on study line/direction, advanced courses in solid state physics, optics etc. will be offered to students in the physics direction. For students in the materials science direction, courses covering process metallurgical, electro-chemical and chemical methods to synthesize semiconducting and light harvesting PV materials are offered. In addition, courses in PV Si-materials processing such as crystallization, wafering and passivation are available. The year at NTNU contains a 15 ECTS project, in addition to the 30 ECTS MSc project. Depending on project and MSc direction, course choice will be recommended by project supervisor.

Course Table

1. Semester	2. Semester	3. Semester	4. Semester
Technical University of Denmark (DTU) Search the course number (i.e.42002)		Norwegian University of Science and Technology (NTNU) Search for courses	
<i>Modelling and Analysis of Sustainable Energy Systems Modelling using Operations Research, 42002, 5 ECTS</i>	<i>Chose 30 ECTS of Elective courses list 1 (Physics line) or 2 (Materials line)</i>	<i>Elective course list 3 (Physics line) or Elective course list 4 (Materials line) 7.5 ECTS</i>	<i>TFY 4915 Solar Cell Systems and Materials, Master's Thesis 30 ECTS (Physics line) or TMT 4915 Solar Cell Systems and Materials, Master's Thesis 30 ECTS (Material line)</i>
<i>Energy Economics, Markets and Policies, 42003, 10 ECTS</i>		<i>Elective course list 3 (Physics line) or Elective course list 4 (Materials line) 7.5 ECTS</i>	
<i>Feasibility Studies of Energy Technologies 42004, 5 ECTS (recommended) or Energy and Sustainability 28870, 5 ECTS,</i>		<i>TFY 4530 Solar Cell Systems and Materials Specialization Project 15 ECTS (Physics line), or TMT 4520 Solar Cell Systems and Materials, Specialization Project 15 ECTS (Material line)</i>	
<i>Analytical Imaging of Energy Materials by Electron Microscopy, 47311, 5 ECTS</i>			
<i>Light emitting diodes and photovoltaics for energy applications, 34540, 5 ECTS, or 11128 Development of solar energy systems, 5 ECTS</i>			
= 30 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1 - Physics line, DTU

- **Spring:** Solar heating systems, 11117, 10 ECTS
- **Spring:** Experimental Surface Physics, 10304, 10 ECTS
- **Spring:** Nanophotonics, 34051, 10 ECTS*

*Requires Bachelor in Physics

Elective course list 2 - Materials line, DTU

- **Spring:** Applied Inorganic Chemistry, 47303, 5 ECTS
- **Spring:** Electrochemistry, 47305, 5 ECTS
- **Spring:** Catalysis and Sustainable Chemistry, 26510, 10 ECTS
- **Spring:** Emerging Energy Technologies, 31778, 5 ECTS
- **Spring:** Functional Materials, 47319, 5 ECTS
- **Spring:** Ceramic Science and Engineering, 47304, 10 ECTS
- **Spring:** Electronic Structure Methods in Material Physics, Chemistry and Biology, 10302, 10 ECTS

Elective course list 3 - Physics line, NTNU

Depending on background, one can for example choose:

- **Fall:** TFE4145 Semiconductor Physics and Electronic Devices, Introduction 7.5 ECTS
- **Fall:** TFY4300 Energy and environmental Physics 7.5 ECTS
- **Fall:** FY3114 Functional Materials 7.5 ECT
- **Fall:** TFY4255 Materials Physics 7.5 ECT
- **Fall:** TMT4322 Solar Cells and Photovoltaic Nanostructures 7.5 ECTS

Elective course list 4 – Materials direction NTNU

- **Fall:** TMT4330 Resources, energy and environment 7.5 ECTS
- **Fall:** TMT4326 Refining and Recycling of Metals 7.5 ECTS
- **Fall:** TMT4322 Solar Cells and Photovoltaic Nanostructures 7.5 ECTS

Research areas for projects / master thesis

NTNU, Responsible prof., department	DTU, Second supervisor, department	Research area Topic (P= Physics line, M=Materials line)
Gabriella Tranell Merete Tangstad <i>Department of Material Science and Engineering</i>	<i>Possible second supervisor, university, department (someone in chemical engineering)</i>	<u>Si feedstock (M)</u> <i>Si production and SoG-Si Refining</i>
Marisa Di Sabatino Lundberg Lars Arnberg Eivind Johannes Øvrelid <i>Department of Material Science and Engineering</i>	<i>Possible second supervisor, university, department</i>	<u>Crystallization (M)</u> <i>Material properties Characterization Wafering</i>
Mari-Ann Einarud Fride Vullum-Bruer <i>Department of Material Science and Engineering</i>	<i>Possible second supervisor, university, department</i>	<u>Wet chemistry/sol gel (M)</u> <i>TCO, nanoparticles Intermediate band materials</i>
Turid W. Reenaas Ursula Gibson Randi Holmestad Ton Helvoort Morten Kildemo Mikael Lindgren Ingve Simonsen, <i>Department of Physics</i>	<i>Possible second supervisor, university, department</i>	<u>Thin film/third generation solar cells (P)</u> <i>Intermediate band solar cells Thin film/Intermediate band solar cells TEM characterization TEM characterization Optical characterization Optical characterization Modeling light/matter interaction</i>
Bjørn-Ove Fimland Helge Weman <i>Department of Electronics and Telecommunications</i>	<i>Possible second supervisor, university, department</i>	<u>III-V solar cells (P)</u> <i>Nanowire and intermediate band solar cells Nanowire solar cells</i>