MS ISEE Study track: Energy systems, Course Table: 2016/2017

1. **Year Aalto University:** Department of Mechanical Engineering, Mika Järvinen
2. **KTH:** Department of Energy Technology, Mark Howells

Study track focus and goals:

Background

Affordable access to essential services underpins development. Energy fuels many such services. The 'energy-system' harnesses resource, transforms it to energy carriers that are used in appliances and machinery to provide those services. In order to provide services to current and future generations, the 'energy-system' itself needs to be sustainable. This 'energy system' may impact and interact with the economy, the environment (including other physical resource or commodity systems) and society. The effects of this impact and interaction should also be sustainably managed. The energy decision maker is thus concerned with: (i) enabling appropriate, affordable and adequate service access; (ii) ensuring the energy-system can do so in a sustainable manner; and (iii) ensure that the broader interactions between systems do not compromise the planet's sustained development.

The goal of the program is to:

Expose the student to the context, role and process of energy systems analysis for medium to long term decision making; Have the student apply a range of standard energy modeling techniques to stereo-typical problems; Elucidate the role of energy modeling for Policy, technology, economic assessments; Have the student design, implement and apply a fully-fledged optimization energy systems model to a given assessment.

In the process, the student should be understand:

Why Energy Systems (rather than descrete energy technology) is important and how systems are analysed and modelled. The process of energy-environment-economic (3E) modeling: knowing why modelling is important, as well as who the stakeholders and decision makers are. - Introduction to the formulation of accounting, econometric, input-output, CGE and optimization modeling. Development of energy service and energy demand projections. Characterization of resources, technologies, economic, policy, and other elements to be considered within the modeling process. The role of scenarios and assumptions (forecasting, back casting etc…) and the importance of transparency. The relationship between modeling and action (policy / investment formulation / technology development). Typical model scopes, types and their application; Assessment of limitations and dealing with uncertainty.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
Aalto University		**KTH**	
EEN-E1050 Renewable Energy for Communities and Industry (5 ECTS), I	EEN-E3002 Power process simulation (5 ECTS) III	MJ2475 Theory & methodology of science in energy research (6 ECTS)	MJ210x Thesis , 30 ECTS
EEN-E2007 Energy, Environment and Emission Control (5 ECTS), II	EEN-E3001 Fundamentals of industrial energy engineering (5 ECTS), III	MJ2383 Energy system economics modeling and indicators for sustainable development (6 ECTS)	
EEN-E1010 Power Plants and Processes (5 ECTS), I-II	PHYS-E0483 Advances in New Energy Technologies (5 ECTS), III- IV	MJ2382 Energy data, balances and projections (6 ECTS)	
Ene-47.5130 Process Integration, Simulation and Optimization P (3 ECTS), I	31C01300 Energy and Environmental Economics (6 ECTS), V	MJ2440 Measurement techniques (3 ECTS)	
MS-E2140 Linear programming (5 ECTS), I	Elective courses from list2	MJ2409 Applied energy technology project course 9 (ECTS)	
Elective courses from list1			
= 30 ECTC	**= 30 ECTS**	**= 30 ECTS**	**= 30 ECTS**

Elective course list 1

- PHYS-E6572 Advanced Wind Power Technology (5 ECTS) (I-II) (alternate years, lectured in autumn 2016)
- PHYS-C6370 Fundamentals of New Energy Sources (5 ECTS) (I-II)
- EEN-E2005 Bioenergy I (5 ECTS) (I)
- EEN-E2006 Bioenergy II (5 ECTS) (II)

Elective course list 2

- EEN-E3004 District heating and cooling (5 ECTS) (V)
- PHYS-C1380 Multi-disciplinary energy perspectives (5 ECTS) (III-V)
- PHYS-E6570 Solar Energy Engineering (5 ECTS) (III- IV) (alternate years, lectured in spring 2016)
- CHEM-E5145 Materials for Renewable Energy P (5 ECTS) (III–V)
- EEN-E3005 Exercises in Energy Technology (5 ECTS) (IV-V)

Research areas for projects / master thesis

Responsible professor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
Mark Howells, KTH, Department of Energy Technology	Mika Järvinen, Aalto, Department of Mechanical Engineering Martti Larmi, Aalto, Department of Mechanical Engineering Risto Lahdelma, Aalto University, Department of Mechanical Engineering	Development of a local, national, regional or global energy assements. Focusing on relevant issues such as: The role of specific technologies or systems of technologies, the impact on the environment, system economics.

Degree requirements for admission process

A BSc degree corresponding to a minimum of 180 ECTS credits in the engineering field with clear background of energy, economics and mathematics. Applicants that are enrolled in an integrated five year degree with no bachelor level can also apply. Applicants must have sufficient knowledge of numerical methods and basic programming using e.g. MATLAB or a similar programming language. Furthermore, applicants must document that they have fulfilled the following minimum requirements during their previous studies:

- Mathematics: 20 ECTS including linear algebra, calculus and differential equations
- Thermodynamics and heat transfer: 5 ECTS
- Energy & Environment: 5 ECTS
- Statics and dynamics: 5 ECTS
- Fluid mechanics: 5 ECTS
- Industrial Economics: 5 ECTS