Karlsruhe Institute of Technology

HECTOR SCHOOL
OF ENGINEERING AND MANAGEMENT

Executive Master Program Energy Engineering & Management

KIT – University of the State of Baden-Württemberg
and National Research Center of the Helmholtz Association

In cooperation with:

ESADE
Ramon Llull University

eit
KIC InnoEnergy

Master Program Schedule

The Master Programs are designed for working professionals. Intermittent periods of lectures are scheduled to allow participants to continue with demanding careers while acquiring new skills.

The programs lasts over a period of 18 - 20 months. They are divided into ten intensive modules of 14 days, each alternating with monthly breaks. The programs are completed with a masters thesis.

The primary goal of our programs is to enable young professionals to take a holistic approach when managing highly interdependent processes.

Leadership for engineers in today's fast changing and complex environment does imply technological and organizational responsibilities as well as requires economical accountability and Human Resource Management know-how.

The engineering emphasis is laid on five Modules adapted to each specialization. The lectures provide insight into the newest research topics and convey current and state of the art methodology necessary to master the scope of innovative technologies.

The following timetable shows the schedule for the Master Intake 2013. Current programs are also available depending on open places.

March 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
				01	MM 1	
04	05	06	07	08	09	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

April 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
01	02	03	04	05	06	07
08	09	10	11	12	MM 2	
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

May 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
		01	02	03	04	05
06	07	08	09	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	EM 1	
27	28	29	30	31		

June 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
					01	02
03	04	05	06	07	08	09
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
01	02	03	04	05	EM 2	
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						01
02	03	04	05	06	MM 3	
09	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

October 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
	01	02	03	04	05	06
07	08	09	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

November 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
				01	EM 3	
04	05	06	07	08	09	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

December 2013

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						01
02	03	04	05	06	07	08
09	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

January 2014

Mon	Tue	Wed	Thu	Fri	Sat	Sun
		01	02	03	MM 4	
06	07	08	09	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February 2014

Mon	Tue	Wed	Thu	Fri	Sat	Sun
					01	02
03	04	05	06	07	08	09
10	11	12	13	14	EM 4	
17	18	19	20	21	22	23
24	25	26	27	28		

March 2014

Mon	Tue	Wed	Thu	Fri	Sat	Sun
					01	02
03	04	05	06	07	08	09
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	EM 5	
31						

April 2014

Mon	Tue	Wed	Thu	Fri	Sat	Sun
	01	02	03	04	05	06
07	08	09	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May 2014

Mon	Tue	Wed	Thu	Fri	Sat	Sun
			01	02	03	04
05	06	07	08	09	MM 5	
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Master Thesis
(company project):
June - December 2014

MM Management Modules

EM Engineering Modules

Energy Engineering & Management

The use of energy has been a key in the development of the human society by helping it to control and adapt to the environment. Managing the use of energy is inevitable in any functional society. In the industrialized world the development of energy resources has become essential for agriculture, transportation, waste collection, information technology and communications that have become prerequisites of a developed society. The increasing use has also brought with it a number of serious problems, some of which, such as global warming, present potentially grave risks to the world.

In the near future, more than seven billion people worldwide will need to be supplied with energy. Industry and universities are challenged to develop innovative concepts for a safe, economically efficient, sustainable and environmental friendly energy supply.

Consumption of energy resources has typically an effect on the environment. Many electric power plants burn coal, oil or natural gas in order to generate electricity for energy needs. While burning these fossil fuels produces a readily available and instantaneous supply of electricity, it also generates air pollutants and increases global warming by emission of CO2. The large-scale use of renewable energy technologies could mitigate or eliminate a wide range of environmental and human health impacts of energy use and support a long term sustainable energy availability. Renewable energy technologies include biofuels, solar heating and cooling, hydroelectric power, solar power, water- and wind power.

Since the sustainable availability of energy has become a significant factor in the performance of economy of societies, management of energy resources has become very crucial. Energy management involves utilizing the available energy resources more effectively, that is with minimum incremental costs. Many times it is possible to save energy without incorporating fresh technology by simple management techniques. Most often energy management is the practice of using energy more efficiently by eliminating energy wastage or to balance justifiable energy demand with appropriate energy supply.

The Executive Master Program Energy Engineering and Management targets to pave the way for an independent and sustainable energy system enabling a climate-neutral and sustainable energy supply. Therefore it aims to enable the participants to successfully achieve commercialisation of innovations, i.e. new products, services and business ideas in the fields of Energy Technology and Energy Management. The program aspires to develop ideas and people - and thus an innovative and entrepreneurial culture - to warrant a new industrial wave based on energy technologies and services. The program is part of the Knowledge Innovation Centre InnoEnergy and therefore supports the aims of the European Union to achieve a climate-neutral and sustainable energy supply.

Prof. Dr.-Ing. Hans-Jörg Bauer
Head of Institute of Thermal Turbomachinery, KIT
Program Director EEM

Prof. Dr.-Ing. Mathias Noe
Head of Institute of Technical Physics, KIT
Program Director EEM

Content Management Modules

The aim of the 5 Management Modules (MM) is to provide profound knowledge and understanding of the fundamental concepts which are essential for every successful manager.

MM 1: Accounting & Controlling

Accounting focuses on measuring, processing and communicating information. In this course the concepts of both financial and managing accounting are covered, providing a powerful framework which supports participants in making successful business decisions. Particular emphasis is placed upon the implementation of new technologies in the current business environment and the analysis of real world business cases and relevant business practices.

MM 2: International Project Management

International Project Management is a key to the world of business. In order to become fully acquainted with this important discipline the module aims to help the participants to understand the objectives of project management and scheduling, to learn how to analyse planned projects and to control project execution. Particular attention is paid to the construction of project networks and Gantt charts, heuristic solution procedures and rescheduling as well as the completion of temporal and resource-constrained project scheduling computations. Modelling, planning and scheduling, which arise in a great variety of practical situations, are also emphasized.

MM 3: Finance & Marketing

This module is comprised of two of the most important issues in management: Fundamentals of Finance and Marketing. The former addresses two fundamental financial questions, which are central to corporate and private investment: how to raise capital and how to invest it. Marketing focuses on creating optimal interaction between interest groups (e.g. company and customers, authorities and citizens, political parties and voters).

MM 4: Corporate Innovation & Entrapreneurship (ESADE, Spain)

The module presents advanced techniques in modeling and analyzing stochastic systems and strategic decision problems as well. The module will enable the participants to get a better understanding of stochastic phenomena, and, in particular, to use this knowledge in making decisions under uncertainty, where uncertainty can arise either from "nature" or from playing against conscious opponents ("strategic uncertainty").

MM 5: Law & Contracts

This module comprises both economics and legal sections. In the economics section, a groundwork is laid through introducing decision theory, expected utility, risk and ambiguity, bargaining and basic incentive theory. In addition, fundamental problems regarding world economics are discussed, for example stagnation and economic growth, unemployment and international division of labor, and harmonization of the international monetary system. The legal section is divided into lectures about the law of business organizations and lectures about international patent, trademark and copyright law.

Content Engineering Modules

EM 1 Renewables: Introduction & Scope of EEM, Energy Systems | Introduction Technical Thermodynamics | Fluid Mechanics| Wind & Water Power | Solar Power & Geothermal

EM 2 Thermal Energy Conversion: Technical Combustion/ Heat & Mass Transfer | Thermal Power Plants inc. Coal & Gas Power Plants | Turbo Machinery | Carbon Capture & Storage | Energy from Biomass

EM 3 Electricity Generation & Energy Storage: Power Generators | Photovoltaics | Batteries & Fuel Cells | Hydrogen Technology | Mechanical Energy Storage

EM 4 Smart Networks & Energy Distribution: Introduction to Power Systems/ High Voltage Engineering | Components of Power Systems | Transmission & Distribution | Smart Grids & Emerging Technologies | Building Performance in Smart Grids

EM 5 Energy Economics: Energy Markets | European Network Regulation | Energy Systems Analysis | Energy Efficiency (Supply & Demand Side) | Integration of Energy Systems & eMobility

EM1 Renewables

Introduction & Scope of EEM, Energy Systems

The overarching goal is to make the participants acquainted with the overall principles and challenges related to the energy supply of a modern society. It sets the scene for the subsequent courses and is mainly intended to give a general overview rather than a very deep knowledge about the energy system and its details.

Introduction Technical Thermodynamics

The objective of this course is to provide the fundamentals of thermodynamics needed in the other courses of this module.

Fluid Mechanics

The course imparts an introduction into the basics of Fluid Mechanics. Fluid flow phenomena occur in many fields of technical processes and products. The most processes in energy techniques are based on fluid flow problems. To understand the function of energy converting systems and machinery, e.g. turbomachinery, water-/wind power systems, combustion engines and combustion systems, Fluid Mechanics is the key competence.

Wind & Water Power

Wind Power: The goal is to provide the participants a view of the wind energy sector with different approaches: economical, business and technical. The economic and business views are general enough. The technical view includes a general introduction to all the subsystems of a wind turbine and a wind farm, making special emphasis on electrical engineering subsystems and discussing the key technological points to be developed in the near future. The introduction to HOMER software enables the basic economic estimation of the performance of a wind farm.

Water Power: aims on giving a broad perspective about the role of hydropower in the world and the future trends. The course describes the main types of hydropower units and the participants will understand how they operate. They'll also gain an understanding of the basics of the transfer of hydraulic energy into mechanical energy. A physical understanding of the different phenomena that take place during the operation of these machines (i.e. cavitation) is provided and a global perspective about ocean energy and the main types of machines used in this area is given. A final objective is to know how machines are monitored and the maintenance practices.

Solar Power & Geothermal

Solar Power: The main goal of this course is to provide the participants with a profound technical knowledge on the capabilities and constraints thermal solar energy is offering. The focus is rather to provide the tools for a physical understanding of the key aspects of the solar thermal energy rather to aim at the different economic aspects which vary considerably between the different countries and individual preferences. In this view the lecture provides an insight in the crucial physical aspects of thermal solar energy such as optics and optic concentration (including error sources), material sciences, thermodynamics and energy conversion, and the associated engineering sciences, which enables a technical realization of the solar energy.

Geothermal: The mail goal of this course is to understand the basic concepts behind geothermal energy from nm scale processes to a sustainable use of energy.

EM 2: Thermal Energy Conversion

Technical Combustion/ Heat & Mass Transfer

Based on the explanation of the fundamental concepts and observed phenomena in combustion, this lecture studies the experimental analysis and the mathematical description of laminar and turbulent flames. The lecture aims at delivering the fundamentals of the physical and chemical processes governing combustion particularly with regard to a deeper understanding of technical combustion systems (e.g. engines, turbines, furnaces ...).

Thermal Power Plants inc. Coal & Gas Power Plants

The goal of this two days lecture is to show realistic examples of major components of the power plants to illustrate the theoretical background learned in the lecture before. Qualitative explanations will help to understand why each component is designed as such and will indicate technical challenges.

Turbo Machinery

The participants will learn to apply their knowledge acquired in the generic courses to a complex technical system. They will be enabled to analyze the performance of a turbo machine and its potential application in present and future energy systems.

Carbon Capture & Storage

The main goal of this course is to understand the basic concepts behind CCS from nm scale processes to climate change.

Energy from Biomass

This course provides an overview about the potential of biomass conversion to energy, processes and technical systems for biomass conversion to energy and chemical energy carriers, status of commercialization of the different technologies, legal aspects, and ecological and economical aspects.

EM 3: Electricity Generation & Energy Storage

Power Generators

Course contents are: Induction law, dqO transformation, phasor representation, equivalent circuit of synchronous generator, infinite bus system model, excitation system, synchronization, load shedding, pole slipping, steady state and transient operation.

Photovoltaics

Which role can PV play in an energy scenario and what are the specifics? The course objective is to understand the basic principle of a solar cell and to apply the physical background to real existing solar cell concepts, the technology of different kind of solar module technologies from a production point of view, and To have an overview of system components and applications of real existing solar generators

Batteries & Fuel Cells

The participants will become familiar with the basic concepts of electrochemical energy storage and the design of efficiently working batteries. They will become acquainted with the available state-of-the-art fuel cell technologies and their efficiencies, understand and appreciate the involved opportunities and limitations.

Hydrogen Technology

The cross-cutting issue of hydrogen as an energy carrier and the concept of a hydrogen economy are introduced. The chemical and physical properties of hydrogen are explained. Details of established and high potential future technologies for production, storage, distribution, and energy applications besides fuel cells are given. Systems like hydrogen driven cars, refueling stations, and energy storage applications are characterized with their efficiencies and costs.

Power Electronics

The lecture shows the fundamental principle of power electronics, which consists in switching voltages with nearly ideal transistors and integrating them to currents by inductors which then additionally can be integrated by capacitors to other voltages. Frequency converters additionally convert the frequency.

EM 4: Smart Networks & Energy Distribution

Introduction to Power Systems/ High Voltage Engineering

The main goal of this lecture is to teach the basics for understanding the following lectures on power system components and transmission and distribution. These lectures require a minimum understanding on, structure of power systems, definitions and knowledge on electrical insulation.

Components of Power Systems

This lecture gives a general technical overview about the components of power grids on a high level. The relevant fundamentals of specifications and quality aspects of network components should be present. The working principles of the components as well as their interconnections are described.

Transmission & Distribution

The role and functions of electric power networks are introduced. In addition to basic technical understanding of networks, the lecture addresses issues such as network topologies, network calculation methods, components and concepts of network technology, effects of neutral point treatment, principles of power system protection, and typical units of a network operator.

Smart Grids & Emerging Technologies

Smart grids: The objective of this course is to provide some insights on the special impact of an increasing number of electric vehicles on energy distribution and power system management. In particular, it will address the need for an intelligent use of information and communication systems, tools, and services for building and managing a reliable smart power grid which moves from demand-oriented management to supply-oriented demand management.

Emerging Technologies: The lecture contains the basics of superconductivity for engineers and a state-of-the-art overview about superconducting materials and their characteristics. For the most relevant superconducting applications in power systems the function and the state-of-the-art are given.

Building Performance in Smart Buildings

The course provides an overview on buildings' energy consumption and standards. It shows the role of buildings in the energy system/ and in smart grids and interrelations between thermal and electrical performance. Potential of different active and passive components with regard to load management are adressed. Finally the relevance of scale with regard to building modeling is shown.

EM 5: Energy Economics

Energy Markets

The course provides participants with a basic comprehension of the different markets within the energy sector with a strong focus on the electricity sector. The participants will be enabled to assess different market designs with their advantages as well as limits and shortcomings.

European Network Regulations

Participants shall learn the basic aims and possibilities as well as the problems and limits of regulation. A central goal is to achieve an understanding of regulation as an incentive system under problems of severe asymmetric information. After the course, participants should be able reflect critically the different regulatory principles and practices applied in practice.

Energy Systems Analysis

The course provides participants with a basic comprehension of the different approaches in energy system analysis and their applications. Furthermore, it provides the participants will the skills necessary to apply selected approaches as well as to understand and critically reflect their limits and shortcomings.

Energy Efficiency (Supply & Demand Side)

The course treats the basics of modern principle-agent theory and the principles governing the functioning of contracts within and across firms. The specific problems that arise in a framework of incomplete information are addressed. The course provides the tools and methods to deal with the incentive problems that arise from informational asymmetries by analyzing the optimal contract design. Other topics are the problem of truthful preference revelation, the Grovemechanisms, incomplete contracts and tournaments. Moreover, market forms such as internet auctions, and especially the phenomenon of "late bidding" are analyzed.

Integration of Energy Systems & eMobility

The objective of this lecture is to give participants an overview of current research topics in the context of energy efficiency and electric mobility as well as the necessary basic methodologies in this context.

Your Notes:

Keyfacts of our Master Programs

HECTOR School Master Programs

Energy Engineering & Management (EEM)
Embedded Electronic Systems Engineering (ESE)
Financial Engineering (FE)
Green Engineering Mobility (GME)
Management of Product Development (MPD)
Production & Operations Management (POM)
Service Management & Engineering (SME)

Academic Degree

Upon successful completion of the Master Program participants will be awarded a Master of Science (M.Sc.) degree of the Karlsruhe Institute of Technology (KIT).

Language

The programs are taught in English. Foreign students are encouraged to take advantage of supplementary courses (for example German language classes).

Program Structure

The programs are run on a part-time basis with a program duration of 18 months. They are divided into 10 teaching units of 2 weeks, so called modules. The Masters Thesis (4-6 months) is designed as an industrial project supervised by the KIT.

Admission Requirements

- First university degree: e.g., Bachelor, Diploma (Uni/FH/BA)
- 3 years of relevant work experience with according references
- TOEFL score of at least 100 ibt-based or equivalent test
- Optional: GMAT, GRE or HECTOR School Assessment

Cost

Tuition fees for one entire Master Program are 30.000 €.

Service

The Master Programs are embedded into the environment of the International Department GmbH which also provides services like extra-curricula lectures, excursions as well as an attractive living and working environment.

Program Start

Intake 2013:	March 04, 2013
Intake 2014:	September 2014

Program starts are every 18 month in March/September. For individual solutions (e.g. schedules) please contact our program consultance.

Accreditation is currently in progress.
Results are available in April 2012.

ASIIN

PEOPLE | POTENTIAL | PERSPECTIVE









HECTOR SCHOOL
OF ENGINEERING AND MANAGEMENT

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