

## Study Plan of ENREM Master Program

as at February 2009

**The International Master Program in Environment and Resources Management (ENREM)** is based on the two existing Master Programs of **the Multidisciplinary Postgraduate Program in Environmental Sciences (PMPCA)** of the Autonomous University of San Luis Potosí, Mexico (UASLP) and **the Institute for Technology and Resources Management in the Tropics and Subtropics (ITT)** of the Cologne University of Applied Sciences, Germany (CUAS).

During the first two semesters all participants study at the UASLP (Mexico) and during the third semester at the CUAS (Germany). The thesis research during the fourth semester is conducted in any Latin American country or in Germany. The graduation will take place at any of the two universities depending on the thesis subject and the tutor.

Module names in the list below are named either in Spanish or English, depending on the location in the respective semester.

## Semester 1, San Luis Potosí (August – December)

	Module Name
Core Module - Obligatory	Introducción a la estadística
Core Module - Obligatory	Desarrollo Sustentable
Core Module - Obligatory	Ecología
Core Module - Obligatory	Problemática y Gestión Ambiental

## Semester 2, San Luis Potosí (January - June)

	Module Name
Core Module - Obligatory	Seminario propuesta de tesis
Core Module - Obligatory	Seminario multidisciplinario
Elective	curso optativo PMPCA 1
Elective	curso optativo PMPCA 2
<i>Elective</i>	<i>curso optativo PMPCA 3</i>
Obligatory	Thesis Work

A list of all cursos optativos is available in Annex I

### Semester 3, Cologne (September – February)

	Module Name/Obligation
Core Module - Obligatory	Preparation MSc. Thesis
Elective	Elective Module 1
Elective	Elective Module 2
Elective	Elective Module 3
Elective	Elective Module 4
Elective	Elective Module 5 – Special Topics Seminar
	Thesis Work

A list of all Elective Modules offered by ITT in 3rd semester is available in Annex II

### Semester 4, (March – August)

	Module Name/Obligation
	Field Research (in Mexico, another Latin American Country or Germany, according to agreement with supervisors)
Obligatory	Thesis Work
Obligatory	Colloquium (Presentation and oral exam), either in San Luis Potosí or in Cologne

Thesis supervisors will be from PMPCA and ITT and have to be selected at the beginning of 2<sup>nd</sup> semester.

## ANNEX I

### List of PMPCA Cursos Optativos in 2<sup>nd</sup> Semester

In 2nd semester students have to choose 2 to 3 of these cursos.

Elective Area	Module Name
Prevención y Control	Técnicas en Caracterización de Minerales y Materiales
	Gestión Ambiental de Operaciones Minerometalúrgicas
	Restauración de Sitios Contaminados
	Fenómenos Interfaciales
Evaluación Ambiental	Atmósfera
	Hidrosfera y Medio Ambiente Terrestre
	Litósfera
	Impacto y Riesgo Ambiental
Recursos Naturales Renovables	Ecología de Agostaderos
	Ecología de Producción de Cosechas
	Etnobiología
	Manejo de Recursos Naturales en Zonas Secas
	Fisiología Animal Ambiental
	Ecología de Poblaciones y Comunidades
	Evaluación y Manejo de los Recursos Naturales Renovables
	Ecología de Agostaderos
Gestión Ambiental	Educación Ambiental
	Planeación y Ordenamiento
	Participación Social
	Sistemas de Manejo y Calidad Ambiental

Toxicología	Química Analítica Ambiental
	Bioestadística Aplicada y Epidemiología Ambiental
	Toxicología Ambiental
	Ecotoxicología
	Evaluación de Riesgos en Salud
Tópicos selectos*	Alternativas Ecológicas para Manejo de Plagas
	Historia Ambiental: Teoría y Praxis
	Naturaleza y Sociedad: Una Introducción ...
	Geoquímica Ambiental
	Fisicoquímica de las Aguas Naturales
	Química de la Interfase Solido-Agua
	Caracterización Fisicoquímica de la Fase Sólida Natural
	<i>Depending on student interests courses of ITT in the area of renewable energies might be offered in San Luis Potosí during 2<sup>nd</sup> semester</i>

\* La lista de cursos de tópicos selectos no es exhaustiva, pues dependerá sobre todo de los requerimientos de las líneas de investigación de estudiantes e investigadores.

Description of Module contents can be downloaded here:

<http://agenda.di.uaslp.mx/PMPCA/Infos/Docum/Forms/AllItems.htm?IdM=44>

(see “ PMPCA-Programa”)

## ANNEX II

### List of ITT Elective Modules offered in 3<sup>rd</sup> Semester

Students have to choose 4 of these modules. They are not restricted to choose modules from only one elective area. The module “Special Topics” is offered in each elective area and has to be selected.

Elective Area	Module Name
Urban and Regional Management	Integrated Planning II - Infrastructure and Services
	Integrated Planning III - Housing and Social Issues
	Regional Planning
	Urban and Regional Management
Land Use Management	Global change and food security
	Sector modeling and environmental Analysis
	Ecosystem Management and Nature Conservation
	Land Use and Water Resources
Water Resources Management	Water Policy and Legislation
	Urban Drainage, Sanitation and Public Health
	Water Supply and Demand Management
	Water System Analysis
	Flood and Drought Risk Management
	Dams, Channels and Hydropower
	Watershed Management
Water Resources Planning	
Renewable Energies Management	Integrated Energy Planning
	Wind and Water Energy Generating Systems
	Biomass and Bioenergy
	Energy Efficiency and the Environment/ LCA
In all Elective Areas	Special Topics Seminar

## ANNEX III

### Description of ITT Modules offered in 3<sup>rd</sup> Semester

Name of Module	Thesis Preparation	Course Code	MPM
Learning Goals / Outcome			
Content	<ol style="list-style-type: none"> <li>1. Research planning steps               <ol style="list-style-type: none"> <li>1.1. State of the art</li> <li>1.2. Background and justification</li> <li>1.3. Problem statement</li> <li>1.4. Hypothesis and objectives of the work</li> <li>1.5. Data demands and Information sources</li> <li>1.6. Methods and procedures</li> <li>1.7. Expected results</li> <li>1.8. Scientific presentations (II)</li> </ol> </li> <li>2. Master thesis checklist and planning document               <ol style="list-style-type: none"> <li>2.1. Each student provides a detailed plan for the field research and analysis methods he/she will follow in the master thesis. An intensive dialogue with the tutors and thesis supervisors accompanies this process</li> </ol> </li> </ol>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Research proposal (80 %)</li> <li>▪ Oral presentation (20 %)</li> </ul>		
Module Coordinator	Prof. Dr. H. Gaese, NN		
Involved lecturers	All professors of the ITT		

Name of Module	<b>Integrated Planning 2: Infrastructure and Services</b>	Course Code	RI2
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Describe and analyse in principle an urban economic system</li> <li>▪ Understand the technical principles and markets of urban infrastructure</li> <li>▪ Conceptualize access and barriers to infrastructure services</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Economic sectors, Formality and informality               <ol style="list-style-type: none"> <li>1.1. Secondary, tertiary, quaternary sector</li> <li>1.2. Production, Services (e.g. tourism)...</li> </ol> </li> <li>2. Urban disparities, poverty etc.</li> <li>3. Urban Infrastructure</li> <li>4. Water and wastewater systems</li> <li>5. Energy supply systems</li> <li>6. Waste management</li> <li>7. Traffic systems</li> <li>8. Demand-side concepts</li> <li>9. Integrated resource planning principles</li> </ol>		
(Potential) Submodules	1/3 Urban economies 2/3 Urban infrastructures		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentations</li> <li>▪ In Course exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Presentation (20%)</li> <li>▪ In course exercises (20%)</li> <li>▪ Short essay (term paper) or final exam (60%)</li> </ul>		
Recommended Reading	Kessides, J. (2004): Reforming Infrastructure: Privatization, Regulation, and Competition  Medina, M. (1997): Informal Recycling and Collection of Solid wastes in Developing Countries: Issues and Opportunities  Misztal, B. (2000): Informality: Social Theory and Contemporary Practice		
Module Coordinator	Prof. Dr. J. Hamhaber		
Lecturers	Prof. Dr. M. Sturm		

Name of Module	<b>Integrated Planning 3: Housing and Social Issues</b>	Course Code	RI3
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Explain the principles of urban real estate markets</li> <li>▪ Elaborate on urban social issues and fragmentation and segregation structures and processes</li> <li>▪ Analyse the structural patterns and demography of a given population</li> <li>▪ Identify the stakeholders in decision making and urban resource allocation</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Urban fragmentation, demography and Migration Poverty, Risks, Vulnerability and Livelihoods</li> <li>2. Settlement structures and housing types Housing concepts and planning issues</li> <li>3. Urban renewal Low-cost housing, upgrading, resettlement</li> <li>4. Land ownership and real estate markets Legal issues of migration, settlement, tenancy</li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentations</li> <li>▪ In Course exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Presentation (20%)</li> <li>▪ Course participation (20%)</li> <li>▪ Short essay (term paper) (30%)</li> <li>▪ Short final exam (30%)</li> </ul>		
Recommended Reading	UN Habitat (2007): State of the World's population UNFPA (2007): State of the worlds cities Barnes, Krutilla (2005) The urban household energy transition Gugler (2000) World Cities beyond the West Wheeler, Beatley (2004): the sustainable urban development reader		
Module Coordinator	Prof. Dr. J. Hamhaber		
Lecturers	MEng. S. Sandholz		

Name of Module	Regional Planning	Course Code	RPL
Learning Goals / Outcome	<p>After completion of this module the participants will be able to</p> <ul style="list-style-type: none"> <li>▪ Understand the planning hierarchy and apply it</li> <li>▪ Comprehend the fundamental opportunities and challenges of rural spaces in the tropics and subtropics</li> <li>▪ Analyse the urban-periurban-rural gradient</li> <li>▪ Elaborate on regional (rural) development theories and their relation to regional development policies (and ODA history)</li> <li>▪ Conceptualise the role of society, communities and agents</li> <li>▪ Conceptualise and analyse social vulnerability and risk in rural and urban areas</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Planning Principles and Procedures Planning levels and scales / hierarchies / plan types</li> <li>2. Settlement patterns / centrality / basic functions</li> <li>3. Regional economies Regional economic development theories Specific economies and industries (tourism...)</li> <li>4. Rural planning procedures and concepts (also ODA concepts)</li> <li>5. Political Ecology and related theories/concepts</li> </ol>		
Teaching methods	<ul style="list-style-type: none"> <li>▪ Lectures</li> <li>▪ Short presentation with term paper</li> <li>▪ Course Exercises</li> </ul>		
Assessment method	<ul style="list-style-type: none"> <li>▪ Presentation (20%)</li> <li>▪ Course Participation (30%)</li> <li>▪ Short essay on course exercise topics (term paper) (50%)</li> </ul>		
Recommended Reading	<p>Behera, M.C. (ed., 2006): Globalizing Rural Development</p> <p>Dalal-Clayton, B., Dent D., Dubois, O (2002): Rural Planning in Developing Countries</p> <p>Lynch, K. (2005): Rural-Urban Interaction in the Developing World</p> <p>McGregor: The Peri-Urban Interface</p>		
Module Coordinator	Prof. Dr. J. Hamhaber		

Name of Module	Urban and Regional Management	Course Code	RUM
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Analyse and describe postmodern urban form and processes</li> <li>▪ Transfer postmodern concepts to emerging Southern cities</li> <li>▪ Choose from policy portfolios available</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Postmodern framework and Urban Governance               <ol style="list-style-type: none"> <li>1.1. Government and Governance</li> <li>1.2. Actors and Stakeholders</li> <li>1.3. Globalisation and local response</li> <li>1.4. Postmodern regulation and accumulation regimes</li> </ol> </li> <li>2. Urban and Regional Management               <ol style="list-style-type: none"> <li>2.1. Economic management: policies, urban and regional marketing</li> <li>2.2. Locational choice theories and new relational economic geography (FDI, SME, Clusters, Networks...)</li> <li>2.3. Competition and Cooperation</li> <li>2.4. Adapted management strategies (urban quarter, regional, rural management)</li> </ol> </li> </ol>		
(Potential) Submodules	Mandatory module – subdivisions not planned 1 SWS Postmodern Framework 2 SWS Urban and Regional Management		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture and Guest Lectures</li> <li>▪ Short presentations</li> <li>▪ In Course exercises: (Case Study Analysis)</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Presentation (20%)</li> <li>▪ Course participation (20%)</li> <li>▪ Short essay (term paper) (60%)</li> </ul>		
Recommended Reading	Bathelt, H., Glückler, J. (2004): Relationale Wirtschaftsgeographie Castells, M. (2005) Spaces of Flows, space of places Levy (2007) Governance Reform Sanyal, B. (2005): Planning Cultures Van Dijk (2006): Managing Cities in Developing Countries Zukin, S. (2005): Cultures of Cities		
Module Coordinator	Prof. Dr. J. Hamhaber		
Lecturers	MEng. S. Sandholz		

Name of Module	Global Change and Food Security	Course Code	LCF
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Understand the driving forces of global change</li> <li>▪ Analyse the adaptation processes of global change on land use and food supply</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Driving forces of global change and adaptation processes</li> <li>2. Population growth, global climate change and food security (2 ECTS)               <ol style="list-style-type: none"> <li>2.1 Demographic trends, supply and demand on energy, food, materials</li> <li>2.2 Tradeoffs between ecosystem services, food security and economic growth</li> <li>2.3 Interactions between food systems and global environmental change.</li> <li>2.4 Impacts of climate change on food production and supply.</li> <li>2.5 Food system, resilience vulnerability.</li> <li>2.6 Scenarios of future climate and its impact on agricultural production.</li> <li>2.7 Adaptation to climate change in agriculture, forestry and fisheries</li> <li>2.8 Agriculture as source and sink of greenhouse gases. Possible strategies to reduce emissions from agriculture</li> </ol> </li> <li>3. Food market (3 ECTS)               <ol style="list-style-type: none"> <li>3.1 Globalization of markets</li> <li>3.2 Agricultural trade: Agricultural trade liberalization, the multilateral trading system, etc.</li> <li>3.3 International agreements (Doha Development Agenda, etc)</li> <li>3.4 Environmental Cost-Benefit Analysis (ECBA)</li> </ol> </li> <li>4. Analysis of the present and future food supply in selected countries (case studies)</li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Case Studies</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Written/oral exam</li> <li>▪ Presentation or report</li> </ul>		
Module Coordinator	Prof. Dr. H. Gaese		
Lecturers	Prof. Dr. S. Schlüter, Dr. J.C. Torrico		

Name of Module	Land Use and Water Resources	Course Code	LWR
Learning Goals / Outcome			
Content	<ol style="list-style-type: none"> <li>1. Land use and water resources interactions               <ol style="list-style-type: none"> <li>1.1 Land use change impacts on water resources quantity</li> <li>1.2 Impacts of agriculture on water resources, land use change impacts on hydrology</li> <li>1.3 Droughts and desertification, role of climate change</li> <li>1.4 Hydrological, meteorological and agricultural draughts and adaptation mechanisms; desertification: causes, consequences and mitigation</li> <li>1.5 Diffuse pollution: physical, hydrological, biological, and chemical processes</li> <li>1.6 Export of pollutants from agricultural and urban watersheds and its impacts on water resources; Theory, concepts, monitoring and modelling</li> <li>1.7 Control of diffuse pollution: farming methods, fertilization, buffer strips etc.</li> </ol> </li> <li>2. Agricultural water management               <ol style="list-style-type: none"> <li>2.1 Rainfed agriculture. Optimisation potential of agricultural water use; rainwater harvesting and storage, soil water management</li> <li>2.2 Irrigation and drainage: technologies and management</li> <li>2.3 Sources of irrigation water (reservoir, groundwater, surface water); conveyance (earth and concrete channels, pipelines); surface, sprinkler, drip technologies.</li> <li>2.4 Irrigation management: crop water demands, scheduling, water allocation, economic aspects, institutional aspects.</li> <li>2.5 Water use efficiency and water productivity                   <ul style="list-style-type: none"> <li>• Field efficiency versus basin efficiency</li> <li>• Physical efficiency vs. water productivity</li> <li>• Implications for agricultural water management</li> </ul> </li> </ol> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Input lectures</li> <li>▪ Peer to peer teaching</li> <li>▪ Field trip based teaching</li> <li>▪ Problem based learning / case studies</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Examination (30%)</li> <li>▪ Written assignment with presentation (50%)</li> <li>▪ Lab and field visit reports (20%)</li> </ul>		

<p>Recommended Reading</p>	<p>Calder, I. 1999 The Blue Revolution. Land use and IWRM. FAO irrigation and drainage papers 40, 44 and 45 FAO website on desertification. <a href="http://www.fao.org/desertification/">http://www.fao.org/desertification/</a> IWMI / Calder I. 1998 SWIM paper 3 Water Resource and Land Use Issues IWMI 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute. Lisa K. Al-Amoodi, Pamm Kasper, R. J. Lascano (Editor), R. E. Sojka 2007. Irrigation of Agricultural Crops, Second Edition. American Society of Agronomy; Crop Science Society of America; Soil Science Society of America Ritter, W.F. and A. Shirmohammadi, A. 2001. Agricultural Nonpoint Source Pollution- Watershed Management and Hydrology. Lewis Publishers, Washington, D.C., 342p. SIWI 2001 Water Harvesting for Upgrading of Rainfed Agriculture - Problem Analysis and Research Needs Y. Villacampa Esteve, C. A. Brebbia, D. Prats Rico. 2008. Sustainable Irrigation Management, Technologies and Policies II</p>
<p>Module Coordinator</p>	<p>Prof. Dr. H. Gaese</p>
<p>Lecturers</p>	<p>Prof. Dr. E. Salgado, Dr. L. Ribbe, Dr. U. Nehren, Prof. Dr. S. Schlüter</p>

Name of Module	Ecosystem Management and Nature Conservation	Course Code	LEC
Learning Goals / Outcome			
Content	<ol style="list-style-type: none"> <li>1. Ecosystems: their values and uses               <ol style="list-style-type: none"> <li>1.1. Ecosystem functions, goods and services</li> <li>1.2. Quantifying ecosystem services (Provisioning services, regulating services, cultural services); close link to environmental economics! (travel cost method, hedonic pricing, contingent valuation etc)</li> <li>1.3. Case studies: forests, mangroves, flood plains, deltaic systems, wetlands</li> </ol> </li> <li>2. Biodiversity               <ol style="list-style-type: none"> <li>2.1. Biodiversity and its value</li> <li>2.2. Biodiversity in different eco-zones: case studies (rainforests, dry lands, flood plains, wetlands, etc.)</li> <li>2.3. Evolution of biodiversity and human impact (deforestation, fragmentation, etc.)</li> <li>2.4. Sustainable use and benefit sharing of biological diversity</li> <li>2.5. Indigenous communities and biodiversity, traditional knowledge</li> <li>2.6. Biodiversity in cultural landscapes (including agricultural biodiversity and forest biodiversity)</li> <li>2.7. Urban biodiversity</li> <li>2.8. Biodiversity and climate change</li> <li>2.9. The problem of invasive species</li> </ol> </li> <li>3. Ecosystem management:               <ol style="list-style-type: none"> <li>3.1. Concepts, approaches and applications (including organic farming, ecotourism, sustainable forestry etc)</li> <li>3.2. Nature conservation strategies (including protected areas, biosphere reserves, world heritage sites)</li> <li>3.3. Combining the management of cultural and natural heritage</li> <li>3.4. The global dimension: species and endemism hotspots, hotspots of biodiversity, priority areas for conservation</li> <li>3.5. Case studies</li> </ol> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Field trip based teaching</li> <li>▪ Problem based learning / case studies</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Written/oral exam</li> <li>▪ Presentation or report</li> </ul>		
Recommended Reading			

Module Coordinator	Prof. Dr. Gaese
Lecturers	Dr. U. Nehren, Dr. L. Ribbe, MEng. S. Sandholz

Name of Module	Land Use and Water Resources	Course Code	LWR
Learning Goals / Outcome			
Content	<p>3. Land use and water resources interactions</p> <ul style="list-style-type: none"> <li>3.1 Land use change impacts on water resources quantity</li> <li>3.2 Impacts of agriculture on water resources, land use change impacts on hydrology</li> <li>3.3 Droughts and desertification, role of climate change</li> <li>3.4 Hydrological, meteorological and agricultural draughts and adaptation mechanisms; desertification: causes, consequences and mitigation</li> <li>3.5 Diffuse pollution: physical, hydrological, biological, and chemical processes</li> <li>3.6 Export of pollutants from agricultural and urban watersheds and its impacts on water resources; Theory, concepts, monitoring and modelling</li> <li>3.7 Control of diffuse pollution: farming methods, fertilization, buffer strips etc.</li> </ul> <p>4. Agricultural water management</p> <ul style="list-style-type: none"> <li>4.1 Rainfed agriculture. Optimisation potential of agricultural water use; rainwater harvesting and storage, soil water management</li> <li>4.2 Irrigation and drainage: technologies and management</li> <li>4.3 Sources of irrigation water (reservoir, groundwater, surface water); conveyance (earth and concrete channels, pipelines); surface, sprinkler, drip technologies.</li> <li>4.4 Irrigation management: crop water demands, scheduling, water allocation, economic aspects, institutional aspects.</li> <li>4.5 Water use efficiency and water productivity <ul style="list-style-type: none"> <li>• Field efficiency versus basin efficiency</li> <li>• Physical efficiency vs. water productivity</li> <li>• Implications for agricultural water management</li> </ul> </li> </ul>		
(Potential) Submodules	<ul style="list-style-type: none"> <li>▪ Submodule 1: 1,5 SWS</li> <li>▪ Submodule 2: 1,5 SWS</li> </ul>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Input lectures</li> <li>▪ Peer to peer teaching</li> </ul>		

	<ul style="list-style-type: none"> <li>▪ Field trip based teaching</li> <li>▪ Problem based learning / case studies</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>▪ Examination (30%)</li> <li>▪ Written assignment with presentation (50%)</li> <li>▪ Lab and field visit reports (20%)</li> </ul>
Recommended Reading	<p>Calder, I. 1999 The Blue Revolution. Land use and IWRM.          FAO irrigation and drainage papers 40, 44 and 45          FAO website on desertification. <a href="http://www.fao.org/desertification/">http://www.fao.org/desertification/</a>          IWMI / Calder I. 1998 SWIM paper 3 Water Resource and Land Use Issues          IWMI 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute.</p> <p>Lisa K. Al-Amoodi, Pamm Kasper, R. J. Lascano (Editor), R. E. Sojka 2007. Irrigation of Agricultural Crops, Second Edition. American Society of Agronomy; Crop Science Society of America; Soil Science Society of America</p> <p>Ritter, W.F. and A. Shirmohammadi, A. 2001. Agricultural Nonpoint Source Pollution- Watershed Management and Hydrology. Lewis Publishers, Washington, D.C., 342p.</p> <p>SIWI 2001 Water Harvesting for Upgrading of Rainfed Agriculture - Problem Analysis and Research Needs</p> <p>Y. Villacampa Esteve, C. A. Brebbia, D. Prats Rico. 2008. Sustainable Irrigation Management, Technologies and Policies II</p>
Module Coordinator	Prof. Dr. H. Gaese
Lecturers	Prof. Dr. E. Salgado, Dr. L. Ribbe, Dr. U. Nehren, Prof. Dr. S. Schlüter

Name of Module	Water Policy and Legislation	Course Code	WPL
Learning Goals / Outcome			
Content	<ol style="list-style-type: none"> <li>1. Introduction               <ol style="list-style-type: none"> <li>1.1. Defining Terms. Governance, Policy and Legislation, Law, Regulation etc</li> <li>1.2. Objectives of and need for water policies and legislation; relation to values of water, scarcity, allocation and pollution problems</li> <li>1.3. Principles of effective water governance (transparency, equity, coherence, inclusive, accountable, efficient, responsive)</li> <li>1.4. Theoretical concepts of multi-level governance, good governance, the rule of law, participatory approaches and international relations theories</li> </ol> </li> <li>2. Water Policy               <ol style="list-style-type: none"> <li>2.1. International policy frameworks and recommendations 8GWP, World Bank, ADB etc)</li> <li>2.2. National water policies; relation with other sector policies: agriculture, energy, tourism, health, etc.; Water and Development</li> <li>2.3. Water sector analysis (comparative analysis of water sector approaches and reforms), policy formation and reform (policy cycle)</li> <li>2.4. Case studies of national water related sector and cross sector policies (Australia, South Africa, Brazil, Chile, Vietnam, Jordan);</li> <li>2.5. IWRM and water policy (vertical lines vs horizontal integration), EU Water Policy.</li> </ol> </li> <li>3. Water Resources Legislation               <ol style="list-style-type: none"> <li>3.1. Water law in history</li> <li>3.2. Water as a public and private good; water rights, entitlements</li> <li>3.3. Role of the state in water management</li> <li>3.4. National water legislations                   <ol style="list-style-type: none"> <li>3.4.1. Protection of supplies</li> <li>3.4.2. Rules and roles for sanitation</li> <li>3.4.3. Rules for allocation; preferences and priorities</li> <li>3.4.4. Monitoring, registration, recording, information management and sharing</li> <li>3.4.5. Water quality legislation</li> <li>3.4.6. Comprehensive legal frameworks (EU WFD, Clean Water Act, Australian WQM Policy and Legislation etc)</li> </ol> </li> <li>3.5. Special regulations and mechanisms regarding control and enforcement</li> <li>3.6. Corruption in the water sector; regulations related to tender, contract, procurement processes (example South Africa etc), professional service providers (PSP).</li> </ol> </li> </ol>		

	<ol style="list-style-type: none"> <li>4. Water institutions and administration             <ol style="list-style-type: none"> <li>4.1. Institutional roles and landscapes</li> <li>4.2. Performance, management and reform of institutions</li> <li>4.3. International networks and global institutions</li> <li>4.4. Stakeholder processes and participation</li> </ol> </li> <li>5. Financing and incentive structures             <ol style="list-style-type: none"> <li>5.1. Loans,</li> <li>5.2. Grants,</li> <li>5.3. Equity capital</li> </ol> </li> <li>6. International water legislation and transboundary water management             <ol style="list-style-type: none"> <li>6.1. Principles of international water law</li> <li>6.2. Helsinki rules and United Nations Convention on the Law of Non-Navigational Uses of International Watercourses</li> <li>6.3. Major water and environmental disputes and cases; negotiation theory, and dispute resolution</li> <li>6.4. Case studies of transboundary legislation and management</li> </ol> </li> <li>7. Tools             <ol style="list-style-type: none"> <li>7.1. GWP toolbox</li> <li>7.2. Policy and environmental assessment tool and checklist</li> <li>7.3. DPSIR strategic analysis, decision making matrix</li> <li>7.4. Ex-post analysis of existing laws and regulations</li> </ol> </li> </ol>
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lectures</li> <li>▪ Case studies</li> <li>▪ Individual work of students on case studies</li> <li>▪ Plenum presentation</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>▪ Short test (20 %)</li> <li>▪ Written assignment (60 %)</li> <li>▪ Oral presentation (20 %)</li> </ul>
Recommended Reading	<p>Australian Government. Department of the Environment. 1994 ff. National Water Quality Management Strategy Australia  <a href="http://www.environment.gov.au/water/quality/nwqms/index.html">http://www.environment.gov.au/water/quality/nwqms/index.html</a></p> <p>Caponera, D , 2007. Principles of Water Law and Administration, 2nd edition. Taylor and Francis, London</p> <p>FAO 1995, Reforming water resources policy: a guide to methods, processes and practices, FAO Irrigation and Drainage Paper 52, Rome, Italy, 1995. (ISBN 92-5-103506-7) also: <a href="http://www.fao.org/docrep/V7160E/V7160E00.htm">http://www.fao.org/docrep/V7160E/V7160E00.htm</a></p> <p>FAO 2001. Socio-Economic and Gender Analysis Programme. Field Level Handbook.</p> <p>GWP, Policy Brief 6. How to integrate IWRM and national development plans</p> <p>GWP: TEC Paper no.12 "Water Financing and Governance"</p> <p>IUCN, 2008 Rule: Reforming Water Resources Governance</p>

IWMI (International Water Management Institute). 2003. "Development of effective water-management institutions". Final Report, Volumes I - V, 30 June 2003. Colombo, Sri Lanka: International Water Management Institute.

IWMI 2005 Community-Based Water Law and Water Resource Management Reform in Developing Countries  
[http://www.iwmi.cgiar.org/Publications/CABI\\_Publications/CA\\_CABI\\_Series/Community\\_Law/protected/](http://www.iwmi.cgiar.org/Publications/CABI_Publications/CA_CABI_Series/Community_Law/protected/)

Johnsson, Rosa Maria Formiga; Kemper, Karin 2005. Institutional and policy analysis of river basin management : the Alto-Tiete river basin, Sao Paulo, Brazil. World Bank Research Paper no. 3650

Le Moigne, G., Subramanian, A., Xie, M., and Giltner, S., A Guide to the Formulation of Water Resources Strategy, World Bank Technical Paper No. 263, Washington, USA, 1994 <BR>(ISBN 0-8213-3038)

Saleth, R. Maria, and Ariel Dinar 2008. Quantifying institutional impacts and development synergies in water resource programs : a methodology with application to the Kala Oya basin, Sri Lanka

Saleth, R. Maria, and Ariel Dinar. 2004. The Institutional Economics of Water: A Cross-Country Analysis of Institutions and Performance. Edward Elgar Publishing

South African Government. a) AN ASSESSMENT OF THE WATER POLICY PROCESS IN SOUTH AFRICA (1994 to 2003) (WRC Report number TT232/04) and B) White Paper on National Water Policy for South Africa.

Towards Sustainable Water Resources Management, A Strategic Approach European Commission, Belgium.  
[http://europa.eu.int/comm/development/publicat/water/en/frontpage\\_en.htm](http://europa.eu.int/comm/development/publicat/water/en/frontpage_en.htm)

Transparency International. 2008. Global Corruption Report. Corruption in the water sector. <http://www.transparency.org/publications/gcr>

World Bank 1999. Evaluating Water Institutions and Water Sector Performance, Volume 1

World Bank, Water Resources Management, a World Bank Policy Study, 1993 (ISBN 0-8213-2636-8)

World Bank's 2003 Water Resources Sector Strategy.

Module Coordinator

NN

Lecturers

Dr. L. Ribbe, Prof. Dr. J. Roehrig, Prof. Dr. S. Schlüter, Prof. Dr. J. Hamhaber

Name of Module	Urban Drainage, Public Health and Sanitation	Course Code	WDH
Learning Goals / Outcome	<p>After completion of this module the participants will be familiar with:</p> <ul style="list-style-type: none"> <li>▪ The issues of public health</li> <li>▪ Waste water drainage and treatment</li> <li>▪ Appropriate techniques for drainage and treatment</li> </ul> <p>.They are able to:</p> <ul style="list-style-type: none"> <li>▪ Assess these techniques</li> <li>▪ To dimension drainage systems and waste water treatment plants</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Public health 1 SWS               <ol style="list-style-type: none"> <li>1.1. Water borne diseases</li> <li>1.2. Water supply and public health</li> <li>1.3. Sewage disposal and public health</li> <li>1.4. Water reuse and public health</li> </ol> </li> <li>2. Environmental aspects of wastewater 0,25 SWS               <ol style="list-style-type: none"> <li>2.1. Quality issues in watercourses</li> <li>2.2. Quality demands for treated wastewater (regulations)</li> </ol> </li> <li>3. Wastewater composition and quantity 0,25 SWS               <ol style="list-style-type: none"> <li>3.1. Domestic wastewater</li> <li>3.2. Industrial wastewater</li> <li>3.3. Storm water</li> </ol> </li> <li>4. Wastewater collection 1 SWS               <ol style="list-style-type: none"> <li>4.1. Decentralised systems</li> <li>4.2. Centralised systems (separate , combined)</li> <li>4.3. Design (hydraulics)</li> <li>4.4. Construction (pipe materials)</li> <li>4.5. Damages and rehabilitation</li> </ol> </li> <li>5. Wastewater treatment 1 SWS               <ol style="list-style-type: none"> <li>5.1. Mechanical treatment (screening, grit removal, sedimentation)</li> <li>5.2. Biological treatment (anaerobic; aerobic: activated sludge trickling filters)</li> <li>5.3. Nutrient removal (P,N)</li> <li>5.4. Disinfection</li> <li>5.5. Ponds and wetlands</li> <li>5.6. Decentralised and centralised treatment</li> <li>5.7. Wastewater reuse</li> <li>5.8. Process selection</li> </ol> </li> <li>6. Treatment, reuse and disposal of sludge 0,5 SWS               <ol style="list-style-type: none"> <li>6.1. Solids sources and characteristics</li> </ol> </li> </ol>		

	<p>6.2. Regulations for reuse and disposal</p> <p>6.3. Treatment</p>
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lectures with inputs of basic knowledge</li> <li>▪ Assignment with presentation to special subjects</li> <li>▪ Lab exercises with short reports</li> <li>▪ Field visits with a short report.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>▪ Examination (40%)</li> <li>▪ Assignment with presentation (20%)</li> <li>▪ Lab reports (20%)</li> <li>▪ Report of field visits (20%)</li> </ul>
Recommended Reading	
Module Coordinator	Prof. Dr. M. Sturm
Lecturers	Guest lecturer for public health

Name of Module	Water Supply and Demand Management	Course Code	WSD
Learning Goals / Outcome	<p>After completion of this module the participants will be familiar with:</p> <ul style="list-style-type: none"> <li>▪ Issues of water catchments</li> <li>▪ Drinking water quality and water treatment</li> <li>▪ Water distribution</li> <li>▪ Water demand management</li> <li>▪ Appropriate techniques for catchment, treatment and distribution.</li> </ul> <p>They are able to:</p> <ul style="list-style-type: none"> <li>▪ Assess these techniques</li> <li>▪ Dimension waterworks and distribution networks</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Water catchment 1 SWS <ul style="list-style-type: none"> <li>Ground water (definitions, hydraulic, wells, groundwater recharge, protection)</li> <li>Surface water (types, rivers, lakes)</li> <li>Water harvesting (definition, types)</li> <li>Sea water</li> <li>Water reuse (definition, types)</li> </ul> </li> <li>2. Drinking water quality 0,5 SWS <ul style="list-style-type: none"> <li>Parameters (microbiological, chemical)</li> <li>Water quality standards (WHO-Guidelines)</li> </ul> </li> <li>3. Water treatment 1 SWS <ul style="list-style-type: none"> <li>Overview</li> <li>Air stripping and aeration (gas transfers, techniques)</li> <li>Coagulation processes (colloids, flocculation, coagulation)</li> <li>Sedimentation and flotation (mechanisms, Stokes, reactors)</li> <li>Filtration (mechanisms, slow filters, rapid filters)</li> <li>Adsorption of organic compounds (theory, activated carbon)</li> <li>Disinfection (physical, chemical)</li> <li>Desalination (Dr. Braun)</li> </ul> </li> <li>4. Water distribution 1 SWS <ul style="list-style-type: none"> <li>Water demand, water losses</li> <li>Systems ( decentralised, centralised)</li> <li>Water transport (pipes, valves....)</li> <li>Pumping ( hydraulic, types, characteristics)</li> <li>Storage (types, dimensioning)</li> </ul> </li> <li>5. Water demand management 0,5 SWS</li> </ol>		

Teaching methods	<ul style="list-style-type: none"> <li>▪ Lectures with inputs of basic knowledge</li> <li>▪ Assignment with presentation to special subjects</li> <li>▪ Lab exercises with short reports</li> <li>▪ Field visits with a short report.</li> </ul>
Assessment method	<ul style="list-style-type: none"> <li>▪ Examination (40%)</li> <li>▪ Assignment with presentation (20%)</li> <li>▪ Lab reports (20%)</li> <li>▪ Report of field visits (20%)</li> </ul>
Recommended Reading	
Module Coordinator	Prof. Dr. M. Sturm

Name of Module	Dams, Rivers, Channels and Hydropower	Course Code	WDC
Learning Goals / Outcome	<p>After completion of this module the participants will be familiar with:</p> <ul style="list-style-type: none"> <li>▪ The various components of water systems</li> <li>▪ The main items in the system to convey water from the source to the demand points</li> <li>▪ Implication of constructing dams on environment, socially, economy, and dam's important technical issues</li> <li>▪ The two different conveyors, especially the gravity free flow through open channels</li> <li>▪ The hydraulic and economic aspects of hydropower</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Basics in fluid mechanics and the important applications in hydraulics for the two different flows; free flow by gravity and pressurised flow 1SWS</li> <li>2. Construction of Dams to create reservoirs and the main technical issues such as location, geological conditions, types, shapes, dimensions, materials 0,5 SWS</li> <li>3. Implications of constructing dams on environment 0,5 SWS</li> <li>4. Comparison between open flow and pressurised systems and selection of type to suit the condition of site starting from source to demand points 0,5 SWS</li> <li>5. River Engineering, sediment control and free flow by gravity through open channels, shape and most economical section of hydraulically efficient flow and practical construction, different flow types due to bed profile and gradients, water losses through seepage out of the channel section and the importance of the lining using different materials 0,5 SWS</li> <li>6. Hydraulic structures required along the channels system, different intakes, the cross structures such as aqueducts and siphons to cross channels, drains or roads, and to control flow through barrages 0,5 SWS</li> <li>7. Hydropower, potential to generate electricity, turbines 0,5 SWS</li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lectures with inputs of basic knowledge</li> <li>▪ Assignment with presentation to special subjects</li> <li>▪ Lab exercises with short reports</li> <li>▪ Field visits with a short report.</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Examination (40%)</li> <li>▪ Assignment with presentation (20%)</li> <li>▪ Lab reports (20%)</li> <li>▪ Report of field visits (20%)</li> </ul>		
Recommended Reading			
Module Coordinator	Prof. Dr. M. Sturm		

Name of Module	Floods and Drought Risk Management	Course Code	WFD
Learning Goals / Outcome	<p>After completion of this module the participants will be familiar with:</p> <ul style="list-style-type: none"> <li>▪ The various components of water systems</li> <li>▪ The main items in the system to convey water from the source to the demand points</li> <li>▪ Implication of constructing dams on environment, socially, economy, and dam's important technical issues</li> <li>▪ The two different conveyors, especially the gravity free flow through open channels</li> <li>▪ The hydraulic and economic aspects of hydropower</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Introduction <ul style="list-style-type: none"> <li>Hydrological extremes, variability of hydrology and climate, statistical description</li> </ul> </li> <li>2. Floods <ul style="list-style-type: none"> <li>Definition and types of floods</li> <li>Causes of floods: hydrological risks and climate change</li> <li>Vulnerability and flood damage analysis (socio-cultural, economic, environmental aspects)</li> <li>Mitigation and adaptation strategies (evaluation and comparison of different measures)</li> <li>Flood risk management</li> <li>Floods forecasting and warning systems</li> <li>Flood management programmes and project management</li> <li>Modelling and GIS applications</li> <li>Case studies</li> </ul> </li> <li>3. Droughts <ul style="list-style-type: none"> <li>Definitions and types of droughts</li> <li>Meteorological droughts</li> <li>Hydrological droughts</li> <li>Agricultural droughts</li> <li>Impacts of droughts on rainfed and irrigated agriculture, forestry, grassland, ecosystems</li> <li>Adaptation strategies and drought risk management (farm level, regional, national level; infrastructure, legal, policy options)</li> <li>Land use systems and drought management</li> <li>Case studies</li> </ul> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lectures with inputs of basic knowledge</li> <li>▪ Assignment with presentation to special subjects</li> <li>▪ Lab exercises with short reports</li> </ul>		

	<ul style="list-style-type: none"> <li>▪ Field visits with a short report.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>▪ Examination (40%)</li> <li>▪ Assignment with presentation (40%)</li> <li>▪ Report of field visits (20%)</li> </ul>
Recommended Reading	
Module Coordinator	Prof. Dr. J. Roehrig
Lecturers	Prof. Dr. J. Roehrig, Dr. L.Ribbe

Name of Module	<b>Water System Analysis</b>	Course Code	WSA
Learning Goals / Outcome			
Content	<ol style="list-style-type: none"> <li>1. The role of systems analysis on water resource management</li> <li>2. Decision under alternatives, multicriteria decision making</li> <li>3. Optimization</li> <li>4. Stochastic modelling</li> <li>5. Modelling uncertainty</li> <li>6. Sensitivity analysis</li> <li>7. Adaptive management systems</li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Theory</li> <li>▪ Individual project on tools for water resources management</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Individual project presentation and oral defence</li> </ul>		
Recommended Reading			
Module Coordinator	Prof. Dr. J. Roehrig		

Name of Module	Watershed Management	Course Code	WSM
Learning Goals / Outcome			
Content	<p>Based on case studies the following topics are covered:</p> <ol style="list-style-type: none"> <li>1. Inventory of the watershed <ul style="list-style-type: none"> <li>Description of water cycle, water availability and quality over space and time</li> <li>Topography, soils and land uses</li> <li>Economic activities which depend on water (agriculture, domestic and industrial water supply, hydropower etc.)</li> <li>Ecological aspects related to water resources (wetlands, riparian zones, lakes, coastal areas, protection areas etc.)</li> </ul> </li> <li>2. Water management and legislation <ul style="list-style-type: none"> <li>Conflicts over water resources, stakeholders involved</li> <li>Laws and institutions related to water resources allocation and protection</li> </ul> </li> <li>3. Driving forces / external factors <ul style="list-style-type: none"> <li>National water policy, economic development of the region/country</li> <li>Climate change, populations growth and other present or future developments</li> </ul> </li> <li>4. Problems and solutions <ul style="list-style-type: none"> <li>Describing the central issues and problems in the watershed (case studies cover issues of floods, droughts, irrigation, urban and industrial water supplies)</li> <li>Developing and describing possible solutions to the problems</li> <li>Valuating and comparing solutions under economic, environmental, societal and cultural aspects.</li> </ul> </li> <li>5. Implementing solutions <ul style="list-style-type: none"> <li>Integrated planning approaches, participation, awareness, capacity development etc.</li> <li>Considerations for the implementation of solutions, recommendations related to organizational and legal issues.</li> </ul> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Cases studies presented by the lecturers</li> <li>▪ Group work of students</li> <li>▪ Presentations to the plenum</li> </ul>		
Assessment Method			
Recommended Reading	<p>Debarry, PA. 2004. Watersheds: Processes, Assessment and Management. Wiley</p> <p>EPA 2006. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. United States Environmental Protection Agency, Office of Water,</p>		

	Nonpoint Source Control Branch, Washington, DC 20460 Heathcote IW. 1998. Integrated Watershed Management: Principles and Practice. Wiley.
Module Coordinator	NN
Lecturers	Prof. Dr. J. Roehrig, Dr. L.Ribbe

Name of Module	Water Resources Planning	Course Code	WRP
Learning Goals / Outcome			
Content	<p>In planning implementation and monitoring reference is made to three different levels:</p> <ol style="list-style-type: none"> <li>1. National level</li> <li>2. Watershed level</li> <li>3. Project level</li> </ol> <p>Since the watershed level is subject of module "13" here the national and particularly the <b>project level</b> is emphasised.</p> <p>The students will work case studies and apply tools (like GIS, modelling, system analysis, economic valuation etc) which they learnt in previous models</p> <ol style="list-style-type: none"> <li>1. Planning process               <ol style="list-style-type: none"> <li>1.1. Problem scoping</li> <li>1.2. Analysis and assessment methods, eia/sea</li> <li>1.3. Objectives and indicators definitions</li> <li>1.4. Development of measures                   <ol style="list-style-type: none"> <li>1.4.1. Strategies and options definition</li> <li>1.4.2. Options prioritization and selection</li> </ol> </li> <li>1.5. Documentation of planning results</li> </ol> </li> <li>2. Planning of water projects (Planning of water projects: case studies):               <ol style="list-style-type: none"> <li>2.1. Dam construction</li> <li>2.2. River restoration</li> <li>2.3. Waste water treatment plant</li> <li>2.4. GIS, information systems projects</li> </ol> </li> <li>3. Implementation, monitoring and evaluation               <ol style="list-style-type: none"> <li>3.1. Controlling project implementation</li> <li>3.2. Monitoring evaluation</li> </ol> </li> </ol>		

Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lectures with inputs of basic knowledge</li> <li>▪ Assignment with presentation to special subjects</li> <li>▪ Lab exercises with short reports</li> <li>▪ Field visits with a short report.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>▪ Individual project presentation and</li> <li>▪ oral defence</li> </ul>
Recommended Reading	
Module Coordinator	Prof. Dr. J. Roehrig

Name of Module	Integrated Energy Planning	Course Code	EIP
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Understand the energy production chain and related management concepts</li> <li>▪ Apply multi-criteria decision making, modelling and other DS tools</li> <li>▪ Use their knowledge on energy policy and law related to energy market decisions</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Energy planning               <ol style="list-style-type: none"> <li>1.1. Energy production chain</li> <li>1.2. Supply side vs. demand side management SSM / DSM</li> <li>1.3. Integrated Resource Planning IRP</li> </ol> </li> <li>2. Energy policy and law               <ol style="list-style-type: none"> <li>2.1. Trans- and international actors</li> <li>2.2. International agreements and contracts and Development Cooperation</li> <li>2.3. Environmental governance: e.g. Emission trading</li> <li>2.4. National and transnational energy policies and institutions</li> <li>2.5. Principles of Energy law</li> <li>2.6. Institutions of the energy sector</li> </ol> </li> <li>3. Decision making and planning tools               <ol style="list-style-type: none"> <li>3.1. Information systems and DSS</li> <li>3.2. Modelling and scenarios</li> <li>3.3. Environmental and Social Impact Assessment Methods</li> </ol> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentation w/ term paper</li> <li>▪ Course Exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Short Presentation</li> <li>▪ Course participation</li> <li>▪ Term paper or exam</li> </ul>		
Recommended Reading	Kessides (2005): Reforming Infrastructure Lantsberg (2005): Sustainable Urban Energy Planning Lovins, Hennicke (1999): Voller Energie		
Module Coordinator	Prof. Dr. I. Stadler Prof. Dr. J. Hamhaber		
Lecturers	Prof. Dr. I. Stadler Prof. Dr. J. Hamhaber Dr. Fishedick		

Name of Module	Wind and Water Energy Generating Systems	Course Code	EWW
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Understand wind resources assessment</li> <li>▪ Perform energy yield predictions of wind turbines</li> <li>▪ Understand the operation of wind turbines</li> <li>▪ To understand the operation of hydro power stations</li> <li>▪ Perform energy yield predictions of hydro power plants</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Wind energy               <ol style="list-style-type: none"> <li>1.1. Aerodynamics</li> <li>1.2. History of wind power</li> <li>1.3. Types of wind turbines</li> <li>1.4. Nacelle, power train, gear, breaks, etc.</li> <li>1.5. Electrical Systems for wind turbines</li> <li>1.6. Control aspects</li> <li>1.7. Power and energy yield of wind turbines</li> <li>1.8. Planning and operation of wind turbines</li> <li>1.9. Net coupling</li> <li>1.10. Control and safety engineering</li> <li>1.11. Environmental effects</li> <li>1.12. Wind park planning</li> </ol> </li> <li>2. Hydro-electricity               <ol style="list-style-type: none"> <li>2.1. Hydropower</li> <li>2.2. Micro and Pico hydro power</li> </ol> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentation w/ term paper</li> <li>▪ Course Exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Short Presentation</li> <li>▪ Course participation</li> <li>▪ Term paper or exam</li> </ul>		
Recommended Reading	Erich Hau: Windkraftanlagen, Springer Verlag Emil Mosonyi. Wasserkraftanlagen, Springer Verlag European Wind Atlas		
Module Coordinator	Prof. Dr. Stadler		

Name of Module	Biomass and Bioenergy Systems	Course Code	EBB
Learning Goals / Outcome	After completion of this module the participants will be able to <ul style="list-style-type: none"> <li>▪ Give an overview of available biomass resources</li> <li>▪ Understand the resource potential</li> <li>▪ Explain the conversion technologies</li> <li>▪ Understand biomass market potential</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Natural energy and biomass</li> <li>2. Biomass engineering (Liquid fuels, vegetable oils, biomass gas fuels, solid fuels)</li> <li>3. Bioconversion</li> <li>4. Energy crops</li> <li>5. Green manures</li> <li>6. Biomass feedstock</li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentation w/ term paper</li> <li>▪ Course Exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Short Presentation</li> <li>▪ Course participation</li> <li>▪ Term paper or exam</li> </ul>		
Recommended Reading			
Module Coordinator	NN		
Lecturers	Prof. Dr. C. Rieker, Dr. J.C. Torrico, NN		

Name of Module	Energy Efficiency and the Environment / LCA	Course Code	EEE
Learning Goals / Outcome	<p>After completion of this module the participants will be able to</p> <ul style="list-style-type: none"> <li>▪ Connect energy use, energy efficiency and environmental effects</li> <li>▪ Evaluate energy systems (options) on the base of their life cycle performance</li> <li>▪ Incorporate efficiency and environmental impact into energy systems decision making</li> </ul>		
Content	<ol style="list-style-type: none"> <li>1. Environment               <ol style="list-style-type: none"> <li>1.1. Energy consumption and climate change</li> <li>1.2. Renewable energies and energy saving strategies for climate protection (CO<sub>2</sub>, emission reduction, energy input and output, future strategies)</li> <li>1.3. Evaluation of emissions from defined and diffusive sources from industry, trade, residential areas and traffic</li> <li>1.4. Assessment and evaluation of air quality and impact studies (EIA)</li> <li>1.5. Feasibility studies (for introduction of innovative technologies in environmental control and process operations)</li> <li>1.6. Climate protection and reduction of greenhouse gases</li> <li>1.7. Environmental impact assessment</li> </ol> </li> <li>2. Efficiency               <ol style="list-style-type: none"> <li>2.1. Efficiency in traffic and transport</li> <li>2.2. Efficiency in building, planning</li> <li>2.3. Efficiency in production</li> </ol> </li> <li>3. Life cycle assessment               <ol style="list-style-type: none"> <li>3.1. Cumulated demand of energy</li> <li>3.2. Resources for material used in renewable energy systems</li> <li>3.3. Methods to recycle material of renewable energy systems</li> <li>3.4. Environmental impact during production or use of renewable energy systems</li> </ol> </li> </ol>		
Teaching Methods	<ul style="list-style-type: none"> <li>▪ Lecture</li> <li>▪ Short presentation w/ term paper</li> <li>▪ Course Exercises</li> </ul>		
Assessment Method	<ul style="list-style-type: none"> <li>▪ Short Presentation</li> <li>▪ Course participation</li> <li>▪ Term paper or exam</li> </ul>		

<p>Recommended Reading</p>	<p>Articles in 'Energy' and 'Energy Policy' (e.g. Graus, Vogt, Worrell (2007))</p> <p>Hartart, Schaffer, Giegrich (2008): Ressourceneffizienz im Kontext der Nachhaltigkeit. – Nomos</p> <p>World Energy Council, 2007: Energy Efficiency Policies around the World: Review and Evaluation</p> <p>ISO 14040 (2000). Environmental Management - Life Cycle Assessment - Principles and Framework. ISO/FDIS/TC207SC514040/1997(E).</p> <p>ISO 14041 (2000). Environmental Management - Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.</p> <p>ISO/TC207/SC5/DIS 14041. ISO 14042 (2000). Environmental Management - Life Cycle Assessment - Life Cycle Impact Assessment.</p>
<p>Module Coordinator</p>	<p>Prof. Dr. W. Wiesner</p>

Program website: [www.enrem-master.info](http://www.enrem-master.info)

PMPCA website: <http://ambiental.uaslp.mx/pmpca>

ITT website: [www.tt.fh-koeln.de](http://www.tt.fh-koeln.de)