

**MASTER DEGREE  
“ENVIRONMENTAL ASSESSMENT AND INTEGRATED MANAGEMENT  
IN URBAN AREAS”**

**COURSE’S MAIN TOPICS**

**1. SUSTAINABLE DEVELOPMENT & ENVIRONMENTAL ASSESSMENT (4 credits)**

**1.1 Module: basic concepts of sustainable development**

The concept of sustainable development. Sustainability strategies: technological and socio-economic drivers and constraints. Environmental knowledge/information, social perception and political consensus. Urban growth as a sustainability issue at global and national/local scale. The design of environmental policy: the theory of externalities and public goods; evaluation of environmental damages. Policy objectives and instruments (standards, taxes, marketable pollution permits, liability regimes, voluntary agreements). Environmental ‘commons’ and models of cooperative governance. ‘International regimes’ for the global environment (conventions, protocols). European environmental policies from the EU to local level. The role of international agencies and technical bodies.

The DPSIR (Determinants-Pressures-State-Impacts-Responses) approach: measurement, modelling, and assessment. Simple and complex indicators. Strategic environmental assessment (SEA) of policies and programmes. Project appraisal and feasibility analysis. Financial analysis of investment projects. Risk analysis, cost benefit analysis, cost effectiveness analysis, multi criteria analysis. Environmental impact assessment (EIA): orientation, communication and participation. Case studies. Data collection, data quality control/assurance, data bases. The access to data: role of scientific communities, policy makers and the general public. The concept of science for policy.

**1.2 Module: basic environmental economics and policies**

Basic environmental economics – The market economy: efficiency and equity problems. Market imperfections: theory of externalities; public goods; monopolistic markets. Natural resource scarcity: the allocation of depletable and renewable resources. Local, regional, transboundary and global pollution problems: the optimal level of pollution; the Coase theorem and the role of the property rights; the Pigouvian approach. The economic evaluation of environmental damages.

The design of environmental policies - Criteria to be used in the definition of the environmental policies. Policy principles: polluter pays principle; user pays principle, precautionary principle, subsidiary principle. Economic and administrative instruments: standards, taxes, subsidies, marketable pollution permits, liability regimes, voluntary agreements and new environmental instruments. Information requirements for optimization policy. The economic impacts of the environmental policies – Micro and macro economic effects. Local and national economic issues: environmental fiscal reforms; employment and green jobs. International issues: trade impact.

## **2. CLIMATE CHANGE & COSTAL AREAS (2 credits)**

Overview of the underlying physical processes, the impacts and the mitigation of climate change together with policy debates surrounding current climate issues. Main elements of the scientific basis of climate change (without focusing on the mathematical background), main impacts of climate change on human and natural systems at the global level and at regional level, mitigation and stabilization scenarios. International climate change science and policy framework by focusing on the role, structure and debate of *IPCC (Intergovernmental panel on Climate Change)*, the *UNFCCC (UN Framework Convention on Climate Change)* and *Kyoto Protocol*.

Climate-dependent sea-level rise and its impacts on the natural environment and human society in the coastal zone. Inundation, exacerbation of flooding, beach erosion, salt water intrusion to rivers and groundwater aquifers. Mitigation of potential effects of climate change in coastal areas, appropriate responses, integrated approaches for the management of coastal ecosystems. Coastal ecosystems environmental, and socio-economic characteristics, Integrated Coastal Zone Management (ICZM). Vulnerability assessment, and climate change adaptation strategies development in coastal zones. Relevant case study examples.

## **3. AIR QUALITY (1 credit)**

The atmospheric pollutants and their impact on human health, ecosystems and cultural heritage: fine and coarse particulate matter, carbon monoxide, nitrogen oxides, sulphur oxides, volatile organic compounds, organic micropollutants, heavy metals. Emission factors, air concentrations and measurement techniques, evaluation of exposure indicators. Emission sources and source apportionment procedures, emission inventories, monitoring systems, mathematical models. Critical levels for the protection of human health and vegetation. Toxicology and epidemiology of air pollutants: acute and chronic effects. The regulations at international and national level. Guidelines, target and limit values. Statistical parameters. Risk assessment protocols. Short and long term policies at regional and urban level.

## **4. WATER MANAGEMENT & QUALITY (2 credits)**

The water cycle: surface water and groundwater. Groundwater reservoirs; hydro-geological balance; water flux in confined and unconfined aquifer; wells and groundwater flow to wells. Current problems of Hydrogeology in Urban Areas: groundwater quantity and quality. Groundwater quality: groundwater pollution related to the environmental and human impact, contaminant transport toward and in groundwater, groundwater monitoring. Groundwater remediation: guide line of remediation techniques . River quality: oxygen balance, river quality criteria, model based quality management. Lake and reservoir pollution and recovery: eutrophication, phosphorus balance, direct and indirect recovery actions.

Water uses: drinking and other human needs (agriculture, industry, water ecosystems, recreation and tourism). Water treatment technologies. Wastewater treatment technologies: urban and industrial wastewater treatments; wastewater reuse in agriculture: quality criteria and technological options for a safe reuse. Integrated Water Resources Management (IWRM) at the river basin scale. Dealing with multiple decision-makers, stakeholders and services (criteria and indicators). Planning and management actions as inter-sector combinations of interventions (time scales and design parameters). The role of modelling and optimization to support decision making. Principle of negotiations. IWRM in practice: example of integrated planning and management of quality and quantity.

## **5. ENVIRONMENTAL ECONOMICS (2 credits)**

The relation between environmental performance and competitiveness. The development of green technologies and techniques within companies. Techniques for environmental review and assessment and methods to determine the company most significant impacts: the Life-Cycle approach, Life-Cycle Assessment on products and processes, Green design. Green Marketing: eco-labels, Environmental Product Declarations, Environmental management systems, green advertising.

Policies and good practices for the management of environmental services at local level. Models and regulation of local public utilities: monopolistic versus competitive markets; the economic rationality of the privatisation processes; institutional aspects of privatisation. Financing public services : taxes and tariffs. The evaluation of the environmental policies – Financial analysis of investment projects; cost – benefit analysis; environmental impact assessment. Water services – Theoretical and policy background for water management. Water allocation criteria: principles and examples. Financing the water services: efficiency and affordability problems. Public and private management in the water industry. Urban transport – How to improve traffic conditions: supply and demand management. Traffic demand management and regulatory measures: traffic zone limits, parking tariffs, road pricing. Waste management policy instruments. Recycling policy: economic aspects.

## **6. ENVIRONMENTAL SOCIOLOGY ( 2 credits)**

*Urban poverty, quality of life, sustainable development.*

The nature and intensity of the relationship between space and individuals (economic development, poverty, vulnerability, social exclusion, crime), and between environmental and urban issues (mobility, risk management, cities degradation and regeneration). Conceptualization and measure of the relationship between space (both spatial and socio-economic) and multidimensional well-being/poverty. Concepts and measurement in multidimensional poverty analysis; multidimensional indicators of quality of life in urban area; urban poverty analysis and social sustainable development; poor individuals versus poor area: definition of effective poverty reduction strategies and programs.

*Citizens and enterprises: the Corporate Social Responsibility*

The Corporate Social Responsibility (CSR) as the integration into corporate strategy of social and environmental issues. Their role in both market and society. Influence of stakeholders on company's way to operate. Advantages from and obstacles to CSR following the win-win logic; contribution to both corporate competitive advantage and societal benefits. Policies and practices for assuming social and environmental responsibility in doing business. Overview of the developing field of CSR and integration of social and environmental challenges into company's typical activities, following the Porter's value chain model.

## **7. COMMUNICATION & EDUCATION (2 credits)**

The real State of the world. Communication & education. Case study: The Skeptical Environmentalist. Lomborg's book, media, information. How to communicate about the environment: scientific community, policy makers, authorities. Sustainable Education. Revisioning learning and change. The teaching of environmental sciences at college/university level. Environmental values and ethics. Multilateral approach. Individual and social perception of environmental issues. Role of family, school and political institutions into an environmental education. Foundations and Corporate Social Responsibility in, for, about sustainable education. Environmental awareness and school systems. Global warming. Educational approach at primary, middle and high school. Human prosperity and long life education.

## **8. SOLID WASTE & SOIL POLLUTION (2 credits)**

Waste production as a function of the consumptions level. Waste collection, waste management and technologies, prevention and remedial actions; waste management balance, waste destination (reutilization, recycle or disposal). Municipal and hazardous waste management: roles and responsibilities in urban waste management, territorial planning, waste analysis and characterization, waste integrated cycle, waste collection systems, plants and technologies, controlled landfills, combustion processes and thermal treatment plants, waste management balance. Contaminated sites management: environmental impact assessment, risk analysis and sites characterization, remediation of polluted sites, remediation of uncontrolled landfills.

## **9. TRANSPORT (1 credit)**

Public and private transport: social, economic and environmental costs. Strategies and tools for improving transport sustainability: instruments, policies, optimization tools and ICT. Transport policies evaluation: objectives, indicators, comparison techniques. Decision support systems (mobility data mining, methodological aspects, multicriteria decision aid). Planning and management of intermodal public transport systems to ensure accessibility. Design of non-conventional transport services (car-pooling, demand-responsive services, car-sharing, bike-sharing). Travel demand management measures: methodological, organizational, economic and acceptability issues. Regulation measures vs pricing schemes. The role of the mobility manager and the importance of the institutional framework. Intelligent transport systems: the use of ICT for passenger and freight transport. Advanced real-time traveller information systems: modelling and organizational aspects. Urban logistics: optimization models and organizational schemes. Case studies.

## **10. NOISE POLLUTION (1 credit)**

Basics of sound waves and hearing: sound waves, speed of sound, impedance, sound intensity, levels and spectra, reflection, absorption and transmission, descriptors. Noise sources in urban area and outdoor sound propagation: description of traffic noise, railway noise, airplane noise, industrial plants noise, yards noise and anthropic noise. Attenuation due to distance, excess attenuation (meteorological effects, ground effects). Noise analysis: acoustic comfort and human health, criteria and procedure for determining human response to noise in communities and Buildings. Outlines of regulations and Laws. Acoustic territory classification, evaluation of environmental impact, case studies. Field measurements and ratings: equipments, techniques, data analysis, laboratories. Prevention and mitigation: noise reduction (barriers, special asphalts), buildings insulations, materials and construction, basics on the use of noise prediction software, case studies.

## **11. ENERGY TECHNOLOGY (1 credit)**

Energy sources, energy carriers and final uses. State-of-the-art technologies for large-scale power generation: ultra-supercritical pulverised coal plants, advanced natural gas combined cycles, third+ generation nuclear reactors. Comparison in terms of cost of electricity, gaseous emissions and greenhouse gases. Modern technologies for distributed generation: fossil-fuelled micro-cogeneration (micro-turbines, fuel cells, internal and external combustion engines), tri-generation, and renewables (solar photovoltaic cells, biomass energy, wind turbines). Efficient modes to generate low temperature heat: cogeneration, district heating, geothermal heat pumps. Refrigerating machines: compression and absorption machines. Future trends for power generation: the “zero-emissions” technologies: renewables, nuclear and carbon capture and storage (CSS). The hydrogen vector: the various options for production, infrastructure and final uses. The “hydrogen+electricity” economy.

## **12. ENERGY POLICY (1 credit)**

Energy policy objectives will be discussed and analysed, taking into account ongoing international agreements such as Kyoto: productive efficiency; allocative efficiency; security of energy supply and sustainability, among others. The link between the energy sector and climate change: energy supply and final uses as sources of greenhouse gas emissions. Policy lessons for the deployment and diffusion of renewable energy sources, energy efficiency and low carbon technologies, focusing on urban areas. Economic and regulatory tools will be compared, looking both at market based mechanisms, such as emission trading, and regulatory mechanisms, such as technical standards and economic incentives. Case studies will be presented, with a focus on urban areas.

## **13. LAND PLANNING IN LARGE URBAN AREAS (2 credits)**

Cities as engines of economic development; their changes in structure and form. Planning strategies to steer processes of change in the contemporary city. Problems of planning in large urban regions.

The role of cities in the third millennium: from cities to mega-city regions. Urbanization processes in different parts of the world, their different characteristics, the problems that they propose. Cities in the "Knowledge economy" and in emerging countries; socio-economic and territorial trends, causes and consequences of urban transformations. The physical form of the city and related phenomena: sprawl, urban diffusion, network cities, a number of forms which are presenting different planning problems. The emerging forms of strategic planning which are specifically devised to overcome the traditional planning approach. Issues of theory and methods. Innovative experiences either in western countries and in China and India. The relationship with urban projects.

## **14. URBAN ECOLOGY (2 credits)**

The urban and sub-urban natural resources: ground- and surface water, soils, habitat suitable to host rare species and to promote plant and animal biodiversity. Functionality and evaluation of ecosystem services. Theory and examples of conservation and growth of natural resources and possible activities to reduce the current level of exploitation, in particular regarding the non-renewable energy sources.

Implementation and expansion of natural resources for anthropogenic purposes. Creation of sustainable green spaces for recreational activities within cities, particularly in remote areas and in zones of recent urbanization. Actions against the degradation of urban green spaces ("broken windows" theory) Relations between town and country: operations of rebalancing flows and interconnections in a model of spatial connectivity, consistent with an ecological network for large areas. Redevelopment of contact areas city-countryside. Possible case study: how to mitigate the environmental effects of the "rural rebound".

## **15. INTEGRATED RISK MANAGEMENT (1 credit)**

Single vs. integrated (multi-) risk, Social and individual risk. Economic risk evaluation. Natural hazards: hydrogeological, seismic, forest fires, etc. Technological hazards: industrial activities, transport of dangerous goods. Social risks: road accidents, work accidents, etc. Main European legislation. Territorial sensitivity: residential population, sensitive/critical densely "populated" infrastructures, sensitive/critical "non-populated" infrastructures, protected areas. Territorial resilience/coping capacity. Quantitative vs. qualitative risk analysis. Tools and models. Case histories. Social and institutional actors. Mitigation measures: short-/medium-/long-term; structural/non-structural. Land planning & integrated risk planning.

## **16. CITY AND AGRICULTURE: FOOD SUPPLY, SAFETY AND SECURITY (1 credit)**

Dynamic nature of food trade, food safety regulatory agencies, risk analysis to design regulation, the farm to table approach, Hazard Analysis and Critical Control Point (HACCP) system as a basis for new regulation of microbial pathogens in food, standards for many food safety hazards, new and more extensive regulation to handle newly identified hazards, market performance in food safety. Process standards for food quality - not safety - associated with production practices and geographic origin of food products, animal welfare or sustainability, labelling regulations to protect use of names of historic geographic origin or to indicate country of origin. Product differentiation, traceability, labelling and associated costs of monitoring and verification of production practices. Consumer risk preferences, consumer perceptions, and the role of non-science issues in regulatory decision making, Genetically Modified Organisms (GMOs) and labelling of foods produced through modern biotechnology.

## **17. CITY ENVIRONMENTAL GOVERNANCE: NEW TECHNOLOGIES, GOOD PRACTICES, THE CITY OF THE FUTURE (1 credit)**

Territorial and sector planning at regional and urban level, stakeholder engagement through agenda XXI and other public information and participation methodologies. Public governance models and instruments of policy implementation in the fields of air, water, waste, energy and mobility, with reference to specific city cases and good practices drawn from international experiences. Examples of technological innovation in environmental, energy and mobility systems (e.g., intelligent energy and transportation systems).

Policy evaluation tools, in particular environmental accounting and reporting through the use of city performance indicators. Planning and management of large events (in the context of EXPO 2010 and EXPO 2015). Local mitigation and adaptation strategies for global climate change, also through international cooperation processes of technology transfer (e.g., programmatic CDMs). Case studies held by public utilities and technical agencies representatives.