



Water Harmony
Erasmus+

WATER HARMONY ERASMUS+

Generic curricula
of 6 water courses



Co-funded by the
Erasmus+ Programme
of the European Union



Water Harmony
Erasmus+

GENERIC CURRICULA

Version 2

Revised 13-Nov-16

based on inputs from the Project Meeting in Poland

Water resources management

Water treatment

Wastewater treatment

Industrial wastewater treatment

Innovation and entrepreneurship

Academic writing

Co-funded by the
Erasmus+ Programme
of the European Union



Water resources management

Lecture 1. Availability of water

- global, regional and national status
- Water cycle and water balance
- Water scarcity
- Drivers – for scarcity and solutions

Lecture 2. The Water Resources System

- Water users
- Water quality and quantity issues
- Ground water management & use
- Surface water management & use
- Rainwater harvesting
- Desalination
- Water reuse
- Remediation of water resources
- Pollution issues

Lecture 3. Hydrology

- Hydrologic processes
- Importance and application of hydrology in env eng and water management
- Hydro-meteorological basics of water balance
- basics of hydrodynamics and hydrostatics
- Storm water and floods

Lecture 4. Water Governance

- Stakeholders
- Decision making process
- Transboundary water resources
- Water conflicts

Lecture 5. Water and Environmental Law

- Right to water
- Need for sharing & sound management
- Legal basis including EU directives
- Water use and discharge permits
- Conflict Management and Negotiations

Lecture 6. Water Economics

- Relation to global and national economics
- Value of water

- Financing water resources (and supply)

Lecture 7. Managing resources

- Meeting needs in urban areas and rural areas
- Water Resources Planning
- Protection of water
- Water in agriculture
- Water Harvesting
- Water reuse and recycling

Lecture 8. Water quality monitoring

- Need
- Sampling of water
- Tools: lab, online

Lecture 9. Water Systems Modelling

- Use of modelling tools
- Water Resources Planning
- GIS and remote sensing
- Demand management
- Pollution abatement

Lecture 10. Special issues

- Adaptation to Climate Change
- Climate resilience of water resources and infrastructure
- Cost of adaptation?

Lecture 11. Integrated Water Resources Management

- Introduction
- Principles
- Examples

Water supply

Lecture 1: Introduction to water supply (should be a summary taken from the WRM course)

- Water – a scarce resource and Water Resources Management
- Access to safe drinking water: national and global concern
- Needs and users of water
- Water conflicts among users
- Transboundary water conflicts
- Point and diffuse pollution
- Integrated water resources management

Lecture 2. Water sources and pollution

- Ground water and surface water
- Seawater and reuse of wastewater
- Natural sources of pollution
- Pollution from domestic wastewater
- Agriculture as a pollution source: pesticides and nutrients
- Industrial pollution: heavy metals and toxic compounds
- Other sources: surface runoff, leachates, etc

Lecture 3: Status and needs

- Need for treatment: health, legal and aesthetic
- Legal aspects: national, regional and international practices
- Water quality monitoring

Lecture 4: Water chemistry

- Chemistry of water
- Chemical equilibriums relevant for water and water treatment
- RedOx reactions
- Reaction kinetics

Lecture 5: Planning of water supply

- Introduction and definitions
- Planning of water supply systems
- Basis of volume-design period, Design population, Design demand, Peaking factors, etc
- Sustainability of water supply system
- Residuals management

Lecture 6: Water intakes and distribution systems

- Water intakes: lakes, rivers and ground water
- Pipe materials and design
- Pumping designs

- Network design
- Surges in networks
- Leakage detection

Lecture 7: Water treatment – introduction

- History of water treatment
- Definitions: mechanical, biological and chemical processes
- Basics of reactor designs: CSTR vs PFR
- Removal of microorganisms
- Removal of particles
- Removal of NOM and other organic matter
- Removal of inorganic matter (Mn, Ferric, Nitrites, Fluoride, Arsenic etc)
- Removal of hardness
- Corrosion control
- Control of biofilms in distribution systems

Lesson 8: Filtration

- Theory of filtration
- Slow sand filters
- Rapid and multi-media filters
- Filtration breakthrough
- Process configurations

Lesson 9: Coagulation

- Coagulation mechanisms
- Coagulants and coagulation chemistry
- Process configurations

Lesson 10: Membrane processes

- Definitions: MF, UF, NF, RO
- Technological configurations
- Membrane fouling
- Desalination and reuse

Lesson 11: Adsorption

- Principles of adsorption
- Adsorbents: PAC and GAC
- Area of usage
- Process configurations

Lesson 12: Ion exchange

- Principles of ion exchange

- Ion exchange resins
- Area of usage
- Process configuration
- Regeneration

Lesson13: Biological processes

- Biological processes in water supply
- Area of usage
- Process configurations

Lesson 14: Disinfection

- Microorganisms required to be inactivated
- Chlorination, residual chlorine
- Ozonation
- UV
- Disinfect ion by-product

Lesson 15: Combined processes

- Requirements for removal of multiple pollutants
- Examples of treatment plants: flow sheets and removal efficiencies
- Factors to consider when combining unit processes

Lesson 16: Residuals management

- Production of residuals: quantities and qualities
- Sludge treatment methods
- Reuse

Lesson 17: Utility management

- Management of a treatment plant
- Surveillance and control
- Water quality and process monitoring
- Models and simulation programs
- Reporting

Lesson 18: Operation and maintenance

- Challenges in operation and maintenance (O&M)
- Identification of problems, reasons and trouble-shooting

Lesson 19: Economics in water treatment

- Investment costs
- O&M costs
- Costing of WWTPs

Lesson 20: Impact of climate change

- Influence of quantities
- Influence on qualities
- Adaptation measures

Lesson 21: technological trends

- Physical footprint
- Carbon footprint
- Technological trends

Other related activities:

- Visits to WTPs
- Lab exercise
- Term papers/project work

Wastewater treatment / Wastewater engineering

Lecture 1: What is wastewater

- Origin of wastewaters: domestic and industrial
- Quantities of ww produced from various sources
- Qualities of ww produced from various sources

Lecture 2: Status and needs

- National, regional and international status of wastewater treatment
- Challenges with wastewater: environmental, health and aesthetic aspects
- Legal aspects: national, regional and international practices

Lecture 3: Water chemistry

- Basic chemistry
- Chemical equilibriums
- Oxidation reactions
- Reaction kinetics
- Oxygen depletion, Eutrophication and other influences on water quality

Lecture 4: Wastewater management

- Black and grey wastewater
- Storm water
- Collection and transport of wastewater
- Decentralized vs centralized systems
- Environmental microbiology
- Residuals management

Lecture 5: Micro pollutants

- Origin and fate of micro pollutants (existing and emerging)
- Impact on environment and human health
- Legal aspects
- Fate and removal during treatment processes

Lecture 6: Wastewater treatment – introduction

- History of ww treatment
- Definitions: primary, secondary and tertiary treatment
- Definitions: mechanical, biological and chemical processes
- Removal of particles, phosphates, nitrogen, organic matter etc
- Examples of unit processes and process combinations
- Design approaches in wastewater treatment

Lecture 7. Wastewater transport – basics

- Sewer functions
- Storm water management and floods
- Leakages and sewer renewal
- Sewer design in general
- Sewer modelling tools

Lesson 8: Mechanical processes

- Screening and comminution
- Sand and grit removal
- Sedimentation
- Flotation
- Filtration
- Membrane processes

Lesson 9: Chemical processes - coagulation

- Coagulation mechanisms
- Coagulants and coagulation chemistry
- Process configurations

Lesson 10: Chemical processes - other

- Chemical oxidation
- Ammonia stripping
- Disinfection of ww

Lesson 11: Biological processes

- Characterization of processes
- Suspended and attach growth processes
- Aerobic and anaerobic processes
- Kinetics
- Removal of organic matter

Lesson 12: Biological processes for nutrient removal

- Nitrification
- Denitrification
- Biological phosphates removal
- Process configurations

Lesson 13: Combined processes

- Requirements for removal of multiple pollutants
- Examples of treatment plants: flow sheets and removal efficiencies
- Factors to consider when combining unit processes

Lesson 14: Decentralized wastewater treatment

- The need and status
- Septic tanks and basic solutions
- Source separation
- Small scale WWT plants
- Wetlands
- Advanced systems

Lesson 15: Industrial wastewater

- Qualities and quantities
- Treatment requirements
- Specific process combinations

Lesson 16: Residuals management

- Production of residuals: quantities and qualities
- Sludge treatment methods
- Sludge as a resource

Lesson 17: Reuse and recycling

- Reuse of wastewater
- Recovery of nutrients from sludge
- Energy production

Lesson 18: Utility management

- Management of a treatment plant
- Surveillance and control: sampling and analysis and statistical methods
- Water quality and process monitoring
- Models and simulation programs
- Reporting

Lesson 19: Operation and maintenance

- Utility management
- Challenges in operation and maintenance (O&M)
- Identification of problems, reasons and trouble-shooting

Lesson 20: Economics in wastewater treatment

- Investment costs
- O&M costs
- Costing of WWTPs

Lesson 21: Project planning

- Planning stages
- Basis of volume-design period, Design population, Design demand, Peaking factors, etc

- Sustainability of wastewater systems
- Design basics
- Design tools

Lesson 22: Impact of climate change

- Influence of quantities
- Influence on qualities
- Adaptation measures

Lesson 23: Industrial trends

- Physical footprint
- Carbon footprint
- Technological trends

Other related activities:

- Visits to WWTPs
- Lab exercise
- Term papers/project work

Industrial wastewater management

Lecture 1: Water and wastewater in industries

- Process water: quantities and qualities
- Wastewater: sources of pollution
- Wastewater: quantities and qualities
- Environmental, health and legal aspects

Lecture 2: Water treatment needs

- Industries with specific water quality requirements: typical industrial branches
- Sources of water (lakes, rivers, ground water and reused)
- Challenges with quantities

Lecture 3: Legal aspects

- Legislations
- EU directives
- Permit authorities
- Discharge permits
- Discharge fees and fines

Lecture 4: European tools

- IPPC directive: Integrated Pollution Prevention and Control
- Mandatory and specific conditions
- Obligations to access to information
- BAT- Best Available Technologies
- BREFF- Best available techniques reference document

Lecture 5: Water treatment methods

- Mechanical
- Chemical
- Biological
- Disinfection
- Removal of taste, colour and odour
- Modification of hardness, pH etc

Lecture 6: Industrial wastewater

- Types of industrial wastewater
- Pollution loads and quantities from typical industries
- Problems associated with various industrial wastewater

Lecture 7: Wastewater management strategies

- Polluter Pays Principle
- Cleaner technology vs end-of-pipe
- Principles of cleaner technology
- Principles of end-of-pipe concepts: centralized vs decentralised
- Discharge options: direct, treated, untreated to sewers, pre-treated to sewers

Lecture 8: Wastewater treatment (could be 3-6 lectures)

- Components in wastewater and treatment options
- Removal of solids
- Removal of dissolved inorganic substances
- Removal of dissolved organic substances

Lecture 9: Selected industries: basics on quality, challenges and processes

- Dairies
- Food processing
- Tanneries
- Dying
- Breweries
- Slaughterhouses
- Pulp and paper
- Metal processing
- Chemical industries

Lecture 10: Residuals management

- Reuse of water
- Sludge as a resources
- Recovery of resources
- Recovery and production of energy

Lecture 11: Analysis and surveillance

- Legal requirements
- Sampling techniques
- Analytical methods (most used)
- Online monitoring
- Statistical methods in analysis

Innovation and entrepreneurship

Lecture 1: Introduction to innovation

- Definitions
- Basic research to innovation
- Creativity and innovation
- Dynamics of technological innovation
- Industrial implications of technological innovation
- Competitive implications of market and technology dynamics

Lecture 2: Introduction to entrepreneurship

- Definitions
- Commercialisation of research results
- Entrepreneurship fundamentals
- Entrepreneurship as an economic and social phenomenon
- Entrepreneurship and Academia
- What is social entrepreneurship?

Lecture 3: Innovation and entrepreneurship examples

- Innovation policy, innovation systems, and context.
- Entrepreneurship and small business development: concept, theory, definition.
- National and Regional innovation policy
- Innovation and Entrepreneurship around the world

Lecture 4: Exploring and creating innovation

- Overview of best practices: Creating an innovation mind-set
- Developing an innovation strategy
- Igniting innovation within universities
- Instilling a leadership strategy to create a culture of innovation
- Using Innovation to create customer value
- Bringing innovation to life in an organization

Lecture 5: Developing an entrepreneur in you

- Identifying new opportunities – from intentions to actions
- An entrepreneurs' passion and characteristics
- The psychology of entrepreneurship
- Communicating your ideas – from elevator pitch to business plan
- Entrepreneur's decision making tactics and persistence
- Balance in merit from academic publications and entrepreneurship
- The Founder's Dilemma

- The Entrepreneurial Exit

Lecture 6: The Entrepreneurial Organization

- Developing your Company:
- Origin and circulation of ideas: idea processing from new idea to a new firm
- Firm development stages
- Market research and competitive analysis; market segmentation
- Revenue models and pricing, sales and distribution strategy

Lecture 7: Business development

- Firm Development Instruments and tools
- The Business Plan
- The Executive Summary
- The Business Plan Presentation
- The Investor Pitch
- Legal & tax aspects of the new venture
- Innovative structures of entrepreneurial organizations
- Innovation in water industry- examples/case studies

Lecture 8: Safeguarding your ideas, innovations and rights

- The intellectual property system, Industrial property
- Non-Disclosure Agreements
- Copyright and related rights. Non-traditional intellectual property objects
- patenting and pattern description
- product design and prototype development
- Protection of rights to inventions and utility mode
- Alternatives to patenting
- Sharing of ownership, user and commercial rights in academia

Lecture 9: Financing innovation and commercialization

- Innovation, entrepreneurship and economic growth; Innovation as economic resource
- Economic constraints of start-up firms
- Financing Aspects of Entrepreneurship
- Financial aspects of entrepreneurship
- Financing mechanisms during firm life
- Introduction venture capital investments; Venture cycle, VC performance
- Innovative financing instruments: crowd financing
- Economic policy in innovation and entrepreneurship – Policy design models
- Technology Transfer tools

Academic writing and presentations

Lecture 1: Introduction: ourselves as writers

- Barriers to writing and good writing practices
- Principles of critical reading and self-critical writing
- Writing strategies

Lecture 2: Structuring a manuscript

- IMRAD (introduction, methods, results, and discussion) standard components of a publishable research manuscript
- Argue - how to argue and develop a thesis statement
- Tables and Figures - how to make your writing understood

Lecture 3: Writing styles

- Clarity - six principles of clear writing
- Cohesion - how to make your writing fluid
- Punctuation - how to make your writing accurate
- Concision & Precision - how to make your writing tight and right

Lecture 4: Analysing texts

- Giving feedback as critical friends
- Writing with style

Lecture 5: Publishing

- How to find a suitable publication
- Preparing papers for submission
- What do the editors expect? How do reviewers review?
- The peer-reviewed system
- Plagiarism control
- Formatting styles and requirements
- Experiences of submitting papers to academic journals

Lecture 6: Products

- Publications (peer-reviewed/not, notes etc)
- Thesis
- Brochures
- Popular-scientific publications
- Presentations
- Newspapers and other media (web, tv, radio)

Lecture 7: Improving your publication

- Concision & Precision - how to make your writing tight and right

- Thesis - summing up the principles for a thesis

Lecture 8: Feedback and conclusions

- Feedback session, to review progress on the papers and discuss reflections on academic writing.
- Follow up work