

**MASTER OF SCIENCE IN HYDROLOGY AND WATER RESOURCES**

<b>AGE 845</b>	<b>Methods and Techniques of Hydrology</b>
<b>Course content (including topics)</b>	Probability and statistics: analysis of hydrological events, special probability distributions for hydrological problems, statistical hypothesis and significance tests. Hydrological data series and fitting of probability distributions, frequency analysis of gauged and ungauged catchments. Time series analysis. Regression and Correlation techniques. Numerical methods; finite difference and finite elements. Models in hydrology. Classification of models and principles of model building; deterministic and stochastic approaches; linear and non-linear model approaches and lumped versus distributed models of catchment processes. Use of ready made packages on microcomputers including selected surface and ground water computer models. Catchment research, experimental design and sampling procedures. Runoff formation; temporal and spatial variability.
<b>AGE 846</b>	<b>Ground Water Hydrology</b>
<b>Course content (including topics)</b>	Occurrence and spatial distribution. Types of aquifers; physical properties: porosity, permeability, storage, hydraulic conductivity and transmissivity. Darcy's law. Flow in aquifers and well hydraulics. Ground Water Movement: Darcy's law: Coefficient of Permeability. Laboratory Measurement of Permeability. Field measurement of Permeability Ground water investigations. Flow in aquifers and well hydraulics. Steady Flows to Wells in an unconfined and confined aquifer. Unsteady Flow to a well. Non equilibrium Equation for Pumping Tests. Well Flow Near Aquifer Boundaries. Ground water recharge, regional geohydrology, Salt water intrusion: Occurrence of Salt Water Intrusion. Prevention and Control of Salt Water Intrusion; Ground water quality and aquifer management.
<b>AGE 847</b>	<b>Hydrometry and Surface Water Hydrology</b>
<b>Course content (including topics)</b>	Hydrometric network. Instrumentation of established networks: gauges, weirs and flumes. Streamflow measurements: current meters methods, chemical methods and rating curves. Precipitation measurements, Interception, Infiltration and flow measurements, hydrograph analysis and flood routing. Soil erosion and sediment transport measurements: suspended sediments and bed load sampling; Streamflow measuring methods and development of rating curves; Hydrograph analysis and flood routing; Ground Water observations; Water quality

	measurements
<b>AGE 848</b>	<b>Hydraulics, Drainage Basins &amp; Applied Hydrology</b>
<b>Course content (including topics)</b>	Introduction to fluid mechanics; continuity, momentum and energy equations. Open channel flow: classification, uniform and gradually varied flow, backwater curves, scouring, sediment transport and deposition. Geomorphological principles: Drainage patterns, density and basin relief. Drainage basins. Hydrologic mapping: network, runoff, rainfall, evaporation, groundwater, erosivity and flood prone areas. Rainfall frequency maps. Hydrologic design. Man's impact on hydrological processes. Flood forecasting: data needs, routing techniques and control measures.
<b>AGE 849</b>	<b>Assessment and Management of Water Resources</b>
<b>Course content (including topics)</b>	Water resource planning data: demand, estimation of available surface and ground water supplies, losses and water balance computations. Watershed management and conservation of catchment areas. Legal and economic aspects of water resources and protection of water resources quality. Reservoir planning and operation. Urban water management, supply and sanitation. Drainage basin development. Environmental Impact Assessment. Environmental sound water management. Systems approach to water management and National Master water plans. Estimation of water resources and water supply for regions
<b>AGE 850</b>	<b>Hydrological Data Management and Processing</b>
<b>Course content (including topics)</b>	Observation networks, times of observation and methods of observations. Primary data processing, storage/retrieval using microcomputers. Interpretation and quality analysis. Types of hydrologic data: surface water, ground water and quality. Data requirements for hydrological modelling: input data; historical, real time data, data for testing and verifying models, data for operational use by models. Remote sensing and aerial photography in hydrology. GIS application in hydrology. Methods used in hydrological data processing and suitability of records for various uses.
<b>AGE 851</b>	<b>Agricultural Hydrology</b>
<b>Course content</b>	Crop water requirements and their computations. Irrigation water requirements

<b>(including topics)</b>	and scheduling. Low flow analysis and drought forecasting, soil erosion in agricultural lands and its prediction. Techniques of soil conservation and maintenance of agricultural roads. Swamp reclamation and drainage. Irrigation from base flow, reservoirs, lakes and ground water. Drainage of irrigated fields. Soil physical and chemical properties.
<b>AGE 852</b>	<b>Environmental Aspects of Hydrology</b>
<b>Course content (including topics)</b>	Water Chemistry and analysis: physical and chemical processes in natural waters; pH, hardness and salinity. Water pollution in aquatic environments and their effects. Water quality criteria for different uses and water quality monitoring, sampling and analysis. Ecosystems and aquatic ecology and biological effects of dissolved matter and practical aspects of biological water quality. Eutrophication of standing water bodies and oxygen depletion. Waste water treatment: basic concepts, treatment and industrial waste waters. Erosion and soil loss: forms of erosion and quantification of soil loss. Coastal hydrology: deltas, estuaries, coastal lagoons and their economic significance; salinity of ground water and intrusion of salt water into an estuary. Lowland development of river basins. On-stream and off-stream storage. Environmental aspects of floods, erosion and road drainage. Droughts and drought management. Climate change variations. Nuclear tracer techniques in surface and ground water hydrology. International river basins and legal aspects. Lakes and reservoir systems. Hydrologic problems in tropical environments.
<b>AGE 853</b>	<b>Hydrology of Arid and Semi Arid Lands (ASALS)</b>
<b>Course content (including topics)</b>	Hydrological processes and water balance. Ground water, surface water and their spatio-temporal variations. Agriculture, water requirements and water harvesting in the ASALS. Flash floods in ASAL catchments. The problem of salinization and ground water pollution.
<b>AGE 854</b>	<b>Ecohydrology</b>
<b>Course content (including topics)</b>	Ecosystem concept and ecology. Wetlands and their interaction between flood plains and river systems. Surficial ecohydrological processes. Fresh water ecotones. Forest hydrology. Ecohydrology in sustainable water management. Effects of hydraulic processes on biotic communities and water quality. Nutrient loads and flood peaks on biotic communities. Vulnerability of aquatic

	ecosystems. Case studies.
<b>AGE 855</b>	<b>Urban Hydrology</b>
<b>Course content (including topics)</b>	Precipitation in urban areas. Intensity-duration –frequency relationships. Urban runoff and flooding, storm water drainage. Design storm and runoff computation. The rational method. Urban geomorphology and erosion. Ground water in urban areas. Waste water collection in sewer systems and waste water management. Water quality and storm water models. Solid waste management in urban areas. Cities in vulnerable areas. Case studies