

## DEPARTMENT OF WATER RESOURCES ENGINEERING

The Department of Water Resources Engineering was formerly one of the five divisions in the Department of Civil Engineering which had offered some basic courses in hydraulic, hydrology and water resources engineering to the undergraduate students in civil, environmental and survey engineering. The division had also offered a graduate program specialized in water resources engineering leading to the Master of Engineering Degree since 1971 and to the Doctor of Engineering Degree since 1984. At the end of 1991, the Department of Water Resources Engineering was established to reflect growing concern of Chulalongkorn University in the field of water resources development and management which nowadays, has become one of the nation's most critical problems.

The Department offers programs leading to the Master and Doctor of Engineering degrees in Water Resources Engineering. Works are directed toward research and professional development in areas such as hydrology and hydrologic engineering; hydraulic engineering; irrigation engineering; groundwater; coastal engineering; and water resources planning and management. Students who wish to continue their study in water resources engineering should have completed the equivalent of the undergraduate majoring in civil engineering or water resources engineering, or other related fields with adequate background in civil engineering.

### HEAD :

Anurak Sriariyawat, Ph.D. (Nottingham)

### ASSOCIATE PROFESSORS :

Sucharit Koontanakulvong, D.Agr. (Kyoto)  
Saree Chanyotha Ph.D. (Arizona)  
Tuantan Kitpaisalsakul, D.Eng. (AIT)

### ASSISTANT PROFESSORS :

Aksara Putthividhya, Ph.D. (U. of Michigan)  
Anurak Sriariyawat, Ph.D. (Nottingham)

### LECTURERS :

Busawan Bidorn, Ph.D. (FSU)  
Piyatida Ruangrassamee Ph.D. (MIT)  
Pongsak Suttinon D.Eng (Kochi UT)  
Supattra Visessri Ph.D. (ICL)

### NAME OF THE DEGREE

: Master of Engineering  
: M.Eng.

## ADMISSION

An applicant must hold a Bachelor's Degree in Civil Engineering, Irrigation Engineering, Water Resources Engineering or equivalent and also meet the requirements of the Graduate School.

## DEGREE REQUIREMENTS

The candidate is required to complete at least a total of 36 credits, of which 24 credits shall be graduate course work. These 24 credits course work shall consist of 12 credits of required courses and 12 credits of approved elective credits. The grade point (GPA) must not be less than 3.00, Plus 12 credits of thesis and satisfactorily pass an oral examination.

## COURSE REQUIREMENTS

### 1) Required Courses 12 credits

2112602	Hydroinformatics I	1(0-3-1)
2112605	Hydrology and Hydraulic Laboratory	1(0-3-1)
2112611	Engineering Fluid Mechanics	3(3-0-9)
2112614	Hydraulics of Open Channels	3(3-0-9)
2112631	Hydrological Processes	3(3-0-9)
2112698	Seminar in Water Resources Engineering	1(0-3-1)

### 2) Elective Courses

At least 12 credits must be chosen from the following courses with the approval of the advisor and in accordance with the approved student's plan.

2112501	Computer Application in Water Resources Engineering	3(3-0-9)
2112503	Irrigation Engineering	3(3-0-9)
2112504	Water Resources Systems Design	3(3-0-9)
2112505	Water Resources Planning and Management	3(3-0-9)
2112541	Introduction to Groundwater Contamination	3(3-0-9)
2112542	Probability and Time Series Analysis for Infrastructure Data	3(3-0-9)
2112543	Water Resources and Environmental Project management	3(3-0-9)
2112601	Digital Methods in Water Resources Engineering	3(3-0-9)
2112603	Hydroinformatics II	3(3-0-9)
2112604	Advanced Topics in Hydroinformatics for Water Resources Engineering	3(3-0-9)
2112615	Erosion and Sedimentation	3(3-0-9)
2112617	Hydraulic Design	3(3-0-9)
2112633	Advanced Hydrology	3(3-0-9)
2112634	Statistical Hydrology	3(3-0-9)
2112635	Stochastic Processes in Hydrology and Hydraulics	3(3-0-9)
2112636	Urban Hydrology	3(3-0-9)
2112637	Flood Plain Hydrology	3(3-0-9)
2112641	Groundwater Hydrology	3(3-0-9)

2112642	Flow Through Porous Media	3(3-0-9)
2112643	Modelling of Subsurface Flow	3(3-0-9)
2112644	Groundwater Exploration and Development	3(3-0-9)
2112661	Coastal Engineering	3(3-0-9)
2112662	Port and Harbour Engineering	3(3-0-9)
2112663	Coastal Process and Protection	3(3-0-9)
2112664	Estuaries Hydraulics	3(3-0-9)
2112671	Systems Analysis for Large-Scale Systems	3(3-0-9)
2112672	Water Resources Systems Engineering	3(3-0-9)
2112674	Water Management	3(3-0-9)
2112681	Engineering for Water Disaster Mitigation	3(3-0-9)
2112691	Special Studies in Water Resources Engineering	3(3-0-9)
2112692	Advanced Topics in Water Resources Engineering	3(3-0-9)

3) **Thesis**

2112811 Thesis 12 credits

**NAME OF THE DEGREE**

: Doctor of Engineering  
: D.Eng.

**ADMISSION**

An applicant must hold a Master Degree in Civil/Water Resources Engineering or equivalent with GPA above 3.25, passes an English examination and also meet the requirements of the Graduate School.

**DEGREE REQUIREMENTS**

An acceptable dissertation of not less than 48 credits, together with 12 credits in the primary area plus 2 credits in seminar (S/U), is required for the Doctoral Degree.

A student who has fulfilled the requirements of the program with a period of study no more than 10 regular semesters and satisfactorily pass an oral examination, will be awarded the Degree of Doctor of Engineering.

**COURSE REQUIREMENTS**

1) <i>Required Courses (S/U) 2 credits</i>		
2112798	Seminar in Water Resources Engineering II	1(0-3-1)
2112799	Seminar in Water Resources Engineering III	1(0-3-1)
2112894	Doctoral Dissertation Seminar	S/U
2112897	Qualifying Examination	S/U
2) <i>Elective Courses 12 credits</i>		
2112601	Digital Methods in Water Resources Engineering	3(3-0-9)
2112603	Hydroinformatics II	3(3-0-9)

2112604	Advanced Topics in Hydroinformatics for Water Resources Engineering	3(3-0-9)
2112615	Erosion and Sedimentation	3(3-0-9)
2112617	Hydraulic Design	3(3-0-9)
2112633	Advanced Hydrology	3(3-0-9)
2112634	Statistical Hydrology	3(3-0-9)
2112635	Stochastic Processes in Hydrology and Hydraulics	3(3-0-9)
2112636	Urban Hydrology	3(3-0-9)
2112637	Flood Plain Hydrology	3(3-0-9)
2112641	Groundwater Hydrology	3(3-0-9)
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2112664	Estuaries Hydraulics	3(3-0-9)
2112671	Systems Analysis for Large-Scale Systems	3(3-0-9)
2112672	Water Resources Systems Engineering	3(3-0-9)
2112673	Economics of Water Resources Systems	3(3-0-9)
2112674	Water Management	3(3-0-9)
2112681	Engineering for Water Disaster Mitigation	3(3-0-9)
2112691	Special Studies in Water Resources Engineering	3(3-0-9)
2112692	Advanced Topics in Water Resources Engineering	3(3-0-9)

3) *Dissertation*

2112828 Dissertation 48 credits

**COURSE DESCRIPTIONS IN WATER RESOURCES ENGINEERING**

**2112210 Water/Soc 3(3-0-6)**

Importance of Water Resources; Context and roles of water resources in society, environment, and community; water cycle, surface water, precipitation, surface runoff, stream flow, erosion surface, water quality, saltwater/intrusion, groundwater, groundwater storage, groundwater abstraction, land subsidence groundwater quality groundwater contamination, remediation for contaminated groundwater, water supply water supply production proun, water distribution system, village water supply system, wastewater, paramenters, treatment technologies, water resources situation in the society, flood drought climate change and impacts, transboundary water resources problems, flood and drought mitigation measures, structural measures, dam/reservoir, rainfall harvesting water drainage system, water reuse program, non-structural measures, forecasting and warning system, conjunctive use of surface and groundwater; laws and regulations

**2112341 Hydrology 2(2-0-4)**

*Condition: Prerequisite 2112346*

Hydrologic cycles; precipitation; infiltration; rainfall –runoff and river gauging; hydrographs; reservoirs; evaporation; evapotranspiration; flood forecasting; flood routing; groundwater; measurement of hydrologic and meteorological parameters.

**2112342 Principles of Hydrology 3(3-0-6)**

*Condition: Prerequisite 2112346*

Hydrologic cycles; precipitation; infiltration; runoff rainfall and river gaging; hydrographs; reservoirs; evaporation; evapotranspiration; flood forecasting; flood routing; groundwater; measurement of hydrologic and meteorological parameters, ; application in water resources projects; demonstration of infiltration, runoff hydrographs; and groundwater flow.

**2112343 Hydrology for Surveying Engineering 3(3-0-6)**

Hydrologic cycle and processes; precipitation; streamflow and hydrograph analyses; infiltration soil water and groundwater movement; measurement of hydrologic and hydro-meteorological parameters; rainfall-runoff relationship; statistical and probabilistic analyses of hydrologic data; introduction to water management; hydrological applications of GIS/Hydro-informatics..

**2112344 Hydraulic Laboratory I 1(0-3-0)**

*Condition : Prerequisite 2112346*

Experimental measurement of fluid pressure; principles of fluid flow through orifices and weirs ; momentum forces; measurement of flow in pipe, flow in open channel and unsteady flow.

**2112346 Hydraulics I 3(3-0-6)**

*Condition : Prerequisite 2103213*

Properties of fluid statics; dynamics and kinematics of fluid flow; energy equations in steady flow; momentum and dynamic forces in fluid flow; similitude and dimensional analysis; flow of fluid in pipes; open channel flow; fluid flow measurement; unsteady flow.

**2112440 Hydraulic Engineering 3(3-0-6)**

*Condition : Prerequisite 2112341 or 2112342 and Senior Standing*

Open channel flow; flow in pressure conduits; water hammer; reservoirs; sediment transport in streams; reservoir sedimentation; dams; spillways; gates; tunnels; penstocks; turbines; hydraulic models; design of channels; groundwater and hydraulics of well; surface drainage.

**2112501 Computer Application in Water Resources Engineering 3(3-0-9)**

Application of computer in solving water resources problems; program development or application of available packages to solve assigned water resources problems.

**2112503 Irrigation Engineering 3(3-0-9)**

Land grading and field layout; irrigation water requirements; water application techniques; water conveyance, control and acquisition.

**2112504 Water Resources Systems Design 3(3-0-9)**

*Condition : Prerequisite 2112346*

Introduction to water resources engineering; application of hydraulic and hydrology to related water system projects; reservoirs; pipe system and pump; design of water distributed system and urban drainage design.

**2112505 Water Resources Planning and Management 3(3-0-9)**

*Condition : Prerequisite 2112341 or 2112342 OR 2112343*

Water resources and rainfall characteristics in Thailand; principles of water resources planning and management; water resources system modeling; role in planning and management; problem-based water resources management; concepts in probability and statistic modeling in hydrological waters; river basin models for water resources planning and management; climate change and hydrological uncertain issues.

**2112541 Introduction to Groundwater Contamination 3(3-0-9)**

Fundamentals of subsurface flow and transport; Relation of groundwater flow to geologic structure; man-made contamination and their impacts of subsurface environment; Behavior of chemicals in subsurface environment; Management of contaminated groundwater; Movement of contaminants through groundwater and their eventual fate; Fate of Contaminants in saturated and unsaturated groundwater aquifers.

**2112542 Probability and Time Series Analysis for Infrastructure Data 3(3-0-9)**

Probabilistic concepts and quantitative methods that are useful for water resources and infrastructure data analysis; random variables and their properties; hypothesis testing; analysis of trends; Fourier transformation; characterization of data in the time domain; characterization of data in the frequency domain; correlation among variables; simulation of random variables; linear regression and time series models; Theory and use of MATLAB programming language to import raw data construct simulation models analyze data and present the results.

**2112543 Water resources and environmental project management 3(3-0-9)**

*Condition : Consent of Faculty*

The importance of water resources and environment in infrastructural development, water quantity and water quality aspects in infrastructural development, the projects principles of infrastructure planning in developing countries, appropriate and sustainable technologies for water

and sanitation projects, technical, socio-cultural, public health, and economic factors important to planning and design of water and sanitation systems that unique in the city critical factors that are often unique to a major water resources and environmental project : the uncertainty lappen in water resources and environmental cleanup projects and process of environmental laws.

**2112601 Digital Methods in Water Resources Engineering 3(3-0-9)**  
*Condition : Prerequisite 2112501 or Consent of Faculty*

Digital computer methods in solving problems in water resources engineering; selected problems in the areas of hydrology, groundwater, hydraulics, coastal engineering and water resources systems simulation and management.

**2112602 Hydroinformatics I 3(3-0-9)**

Introduction to information and communication technologies (ICTs) in water resources; integration of hydraulics, hydrology and environmental engineering; assimilation of measured data; concept of the geographic information system; GIS applications in water resources engineering; social dimension of the problems of water management; decision support tools.

**2112603 Hydroinformatics II 3(3-0-9)**

Drainage basin form and process; geomorphologic approach; physically-based catchment modeling; development of numerical schemes; modeling and forecasting of hydrological systems; database management system; risk analysis and mitigation; decision making process; applications of information and communication technologies (ICTs) to water and related resources management.

**2112604 Advanced Topic in Hydroinformatics for Water Resources Engineering 3(3-0-9)**  
*Condition : Prerequisite 2112603 or Consent of Faculty*

Analysis, design, installation and operation of combined measuring and numerical-modeling schemes; dynamic and mobile river systems; introduction to flood- and other early warning systems; introduction to real-time water management systems; contemporary issues in hydroinformatics.

**2112605 Hydrology and Hydraulic Laboratory 1(0-3-1)**

Experimental verification of advanced principles of hydrology and hydraulics; usage of various hydrological and hydraulic measurement devices; preparation for field laboratory/field measurement.

**2112611 Engineering Fluid Mechanics 3(3-0-9)**

Advanced topics in theoretical fluid mechanics and hydrodynamics including mechanics of ideal fluids and viscous fluids; incompressible and

compressible flow; one-two-and three-dimensionall flows.

**2112614 Hydraulics of Open Channels 3(3-0-9)**

Continuity, energy and momentum principles applied to steady and unsteady flow in open channels, channel controls, transitions, flood routing, and models.

**2112615 Erosion and Sedimentation 3(3-0-9)**  
*Condition : Prerequisite 2112614*

Form of erosion and methods of control; sediment properties and their measurement; initiation of sediment movement; transportation and deposition of sediment by flowing water; bed load and suspended load movement; sediment discharge formulas; river behavior and control.

**2112617 Hydraulic Design 3(3-0-9)**  
*Condition : Prerequisite 2112614*

Analysis of flow behavior through various types of hydraulic structures such as spillway, stilling basin, energy dissipator, gates, outlet works, open channel, pressure conduit, transitions and flow measurement structure. Consideration and procedures for hydraulic design.

**2112631 Hydrological Processes 3(3-0-9)**

The hydrologic cycle; atmospheric moisture; precipitation; streamflow; infiltration; evaporation and evapotranspiration; groundwater and well hydraulics; hydrograph analysis; analysis and synthesis of hydrological processes; water quality; mathematical models and simulation in hydrology.

**2112633 Advanced Hydrology 3(3-0-9)**  
*Condition : Prerequisite 2112631 or Consent of Faculty*

Transport phenomena in hydrology and meteorology; flood routing and overlandflow theory; linear and nonlinear analysis of rainfall-runoff system; conceptual and digital models for hydrologic processes.

**2112634 Statistical Hydrology 3(3-0-9)**  
*Condition : Prerequisite 2112631 or Consent of Faculty*

Basic statistical characteristics of hydrological data; probability and distributions; parameters estimation techniques; linear and non-linear equations and coefficients estimation; maximum probable values.

**2112635 Stochastic Processes in Hydrology and Hydraulics 3(3-0-9)**  
*Condition : Prerequisite 2112631 or Consent of Faculty*

Basic characteristics of time series; time series analysis and synthesis; prediction and forecasting.

**2112636 Urban Hydrology 3(3-0-9)**

*Condition : Prerequisite 2112631 or  
Consent of Faculty*

Effects of urban on hydrological processes; urban drainage system and flood protection design; mathematical modelling and simulation for design and management.

**2112637 Flood Plain Hydrology 3(3-0-9)**

*Condition : Prerequisite 2112631 or  
Consent of Faculty*

Nature and origin of flood; rainfall-runoff analysis; flood routing; flood surface profile analysis; flood plain modelling and simulation; flood forecasting and flood protection measures.

**2112641 Groundwater Hydrology 3(3-0-9)**

*Condition : Prerequisite 2112631 or  
Consent of Faculty*

Occurrence of groundwater; basic principles of flow through porous media; hydrology of aquifers; well hydraulics; numerical and analog models for aquifer analysis; discussion on special topics such as salt-water intrusion, water quality, artificial recharge, land subsidence and groundwater basin management.

**2112642 Flow Through Porous Media 3(3-0-9)**

*Condition : Prerequisite 2112641 or  
Consent of Faculty*

Kinematics and dynamics of fluids in saturated porous and fractured media; introduction to free surface, unsaturated, and multiphase flows.

**2112643 Modelling of Subsurface Flow 3(3-0-9)**

*Condition : Prerequisite 2112641 or  
Consent of Faculty*

Finite difference and finite element methods for subsurface fluid flow and mass or energy transport simulation; applications to aquifers, unsaturated soils, seepage through earth dams.

**2112644 Groundwater Exploration and Development 3(3-0-9)**

*Condition : Prerequisite 2112641 or  
Consent of Faculty*

Review of geologic and hydrologic formation of groundwater; techniques and interpretation of field survey; data collection and analysis; water quality; groundwater exploration and construction of well; large-scale development of groundwater; simulation model of wellfields; determination of groundwater yield; analysis and management of groundwater basin; case studies.

**2112661 Coastal Engineering 3(3-0-9)**

*Condition : Prerequisite 2112611 or  
Consent of Faculty*

An introductory course to coastal engineering; basic wave theories; wave mechanics-refraction, diffraction, reflection and breaking; wave generation and forecasting; wave forces on structures; longshore current and sediment transport; field

survey; coastal process and protection; design of coastal structure; hydraulic model.

**2112662 Port and Harbour Engineering 3(3-0-9)**

*Condition : Prerequisite 2112661 or  
Consent of Faculty*

Review of wave mechanics and wave forecasting; functions of ports and harbors; various types of coastal structures for ports and harbours; analysis and design of structures; planning of ports and harbours; economics and environmental consideration, case studies.

**2112663 Coastal Process and Protection 3(3-0-9)**

*Condition : Prerequisite 2112661 or  
Consent of Faculty*

Review of wave mechanics and generation process; wave forecasting; coastal process; mechanics of sediment transport; coastal protection works; beach and land reclamation; economics and environmental consideration; case studies.

**2112664 Estuaries Hydraulics 3(3-0-9)**

*Condition : Prerequisite 2112661 or  
Consent of Faculty*

Estuary phenomena and its problems in hydraulic aspect; tidal phenomena; tidal dynamics; tidal computation; density current; water pollution; mixing and dispersion process; and withdrawal of water from estuaries zone.

**2112671 Systems Analysis for Large-Scale Systems 3(3-0-9)**

An introduction to system concept and methodologies; nature of large-scale public projects; socio-economic evaluation; identification of objectives and alternatives; systems modelling; optimization techniques; simulation; applications to the design and management of large-scale projects.

**2112672 Water Resources Systems Engineering 3(3-0-9)**

*Condition : Prerequisite 2112671 or  
Consent of Faculty*

Application of system analysis in water resources planning, design and operation; simulation modelling; deterministic and stochastic approaches; reservoir design and operation; optimization for multipurpose water resources system; design and management of urban water resources; river basins and groundwater aquifers. Determination of optimal operating rules and planning strategies. Current and proposed methods for feasibility studies of water resources development projects.

**2112673 Economics of Water Resources Systems 3(3-0-9)**

*Condition : Prerequisite 2112671 or  
Consent of Faculty*

Discounting techniques for public works planning; socio-economic evaluation in water resources development and pollution control; benefit-cost analysis; allocation of joint-costs in

multipurpose development; design and risk analysis; applications to planning and management of flood control, drainage, water supply, hydropower, irrigation, water quality control, recreation and navigation.

**2112674 Water Management 3(3-0-9)**  
*Condition : Prerequisite 2112671 or Consent of Faculty*

Water requirements for agriculture, industries, communities and environmental; economic, social and political criteria in water resources allocations; water resources allocation techniques and optional allocations.

**2112681 Engineering for Water Disaster Mitigation 3(3-0-9)**  
*Condition : Consent of Faculty (S/U)*

Introduction to water disaster resilience, causes and mitigation of flood disaster, basic concept of designing flood mitigation and beach erosion protection, risk in hydrologic, hydraulic and coastal engineering, field trip to water disaster prone areas.

**2112691 Special Studies in Water Resources Engineering 3(3-0-9)**

Special problems in water resources engineering with emphasis on research work and independent study.

**2112692 Advanced Topics in Water Resources Engineering 3(3-0-9)**

A special course offering the advanced topics on the current research and development in water resources engineering. (offered under special circumstance)

**2112698 Seminar in Water Resources Engineering 1(0-3-1)**

Discussion of special topics related to advanced water resources engineering; analysis of data and conclusion; presentation of reports.

**2112798 Seminar in Water Resources Engineering II 1(0-3-1)**

Discussion of special topics related to advanced research works in water resources engineering; analysis of data and conclusions; presentation of reports.

**2112799 Seminar in Water Resources Engineering III 1(0-3-1)**

*Condition : Prerequisite 2112798 or Consent of Faculty*

Discussion of special topics related to advanced research works in water resources engineering; analysis of data and conclusions presentation of reports.

**2112811 Thesis 12(0-0-0)**

**2112828 Dissertation 48(0-0-0)**

**2101894 Doctoral Dissertation Seminar 0(0-0-0) (S/U)**

**2112897 Qualifying Examination 0(0-0-0) (S/U)**