HYDROLOGICAL MODELLING (3 ECTS)

Fall semester, 2021-2022

Cooordinator	College of Technology
Credits	3 ECTS
Lecturers	**Trần Văn Tỷ, Huỳnh Vương Thu Minh**
Level	Master
Host institution	Can Tho University
Course duration	30 hours

Summary

In this 3 ECTS course, students will be provided systematically about the basic concepts of modeling and the process of building and simulating applied mathematical modeling. Expertise in math modeling currently applied in the field of hydrology and problems related to water resource use in the Mekong Delta, Vietnam and around the world.

Target student audiences

Master in Hydraulics Engineering

Prerequisites

Required courses (or equivalents): NO

Aims and objectives

- Students grasp common mathematical modeling processes and concepts
- Knowledge of basic concepts and calculation methods of all kinds of hydrological problems.
- Applying mathematical model to hydrological problems related to exploitation use, water resource management such as calculation of flow characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management in the original country.

Authentic Tasks:

Desired learning outcomes:

By the end of the course, successful students will:

Knowledge	• Understand the concept and process of building general mathematical models • Applying the mathematical model to the hydrological problem related to the exploitation and management of water resources such as calculating the flow characteristics, hydrological forecasts, calculating balance and planning the use of water resources., flood prevention planning, integrated management in the whole country. • Apply random and statistical models to the analysis of hydrological data.

Skills	• Skills to simulate hydrostatic math models • Proficient skills in using some computational software • Self-study and research skills
Attitude / capacity of autonomy and responsibility	• Active, willing to learn and self-study • Has a positive attitude in research

Overview of sessions and teaching methods

The course will make most of interactive and self-reflective methods of teaching and learning and, where possible, avoid standing lectures and presentations.

Learning methods

- Project Based Learning
- Literature review
- Stakeholder analysis / customer consultation

Literature

[1] Tran Van Ty, Huynh Vuong Thu Minh, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ.

[2] CT. Haan, HP. Johnson and DL. Brakensiek, 2003. Mô hình toán thủy văn lưu vực nhỏ (Người dịch: Nguyễn Thanh Sơn).

[3] Đặng Văn Bảng, 2001. Bài giảng Mô hình toán thủy văn, Khoa Thủy văn môi trường, Trường Đại học Thủy lợi.

[4] Lê Văn Nghinh, 2008. Giáo trình cao học Thủy lợi: Mô hình toán thủy văn. NXB Xây dựng.

[5] Lê Văn Nghinh, 2003. Tính toán thủy văn thiết kế. NXB Nông nghiệp.

[6] Maidment, David R. Handbook of Hydrology, 1993. New York, USA, McGraw-Hill Book company.

[7] Mark Ole and David Luketina, 2003. Hydrological Modelling - Lecture notes. AIT. Thailand.

[8] Huynh Vuong Thu Minh, Giáo trình Thủy Văn Công Trình – NXB Đại học Cần Thơ, 2010.

[9] Hair Jr, J.F. Multivariate Data Analysis Joseph F. Hair Jr. William C. Black Barry J. Babin Rolph E. Anderson Seventh Edition.

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities (15 hours of theory and 5 hours of group presentations)			
Teaching theory in class	Students are provided with general math modeling processes and concepts. Applying mathematical	Join the class	15 hours/ 4 Topic

	model to hydrological problems related to exploitation use, water resource management such as calculation of flow characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management in the original country. Apply random and statistical models to the analysis of hydrological data		
Class discussion is moderated	Discuss each case of the lesson	Join classes and prepare for discussions	2 hours
Exercises in class, practical homework Lesson 1. HEC-HMS model Lesson 2. Artificial intelligence network model ANN Lesson 3. Statistical analysis	Completed individually	Join classes and prepare for assignments	5 hours
Reading and discussion of assigned papers for preparation for lectures	Depending on the number of academies and topics, groups of exercises will be appropriate	Class participation, creative and active contribution to discussion	3 hours
Presentation group	Depending on the number of academies and topics, the group will group the appropriate presentation	Quality group exercises and individual presentations	5 hours
Independent work (10 hours)			
Working group: - Contribution to group case studies projects - Contribute to the preparation and delivery of personalized presentations - Contribute to web application		Quality group exercises and individual presentations	5 hours
Course group exercises			
Presentation group		Quality group exercises and	5 hours

		individual presentations	
Total			

Course outline

Week	Topics
Week 1&2	Topic 1: The deterministic model
Week 3&4	Topic 2: Random pattern
Week 5&6	Topic 3: Random pattern
Week 7&8	Topic 4: Statistical analysis in Hydrological calculation
Week 9-11	Practice Lessons 1. HEC-HMS model
Week 12-13	Practice Lessons 2. Artificial intelligence network model ANN
Week 14-15	Practice Lessons 3. Statistical analysis

Course Schedule

Topic 1: Hydrological model concept	
Learning objectives	General and applied knowledge related to hydrographic model
Learning outcomes	Students are provided with general math modeling processes and concepts.
Student deliverables	Exercise:
Topic materials	Lesson [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ [8] Hair Jr, J.F. Multivariate Data Analysis Joseph F. Hair Jr. William C. Black Barry J. Babin Rolph E. Anderson Seventh Edition. [5] Maidment, David R. Handbook of Hydrology, 1993. New York, USA, McGraw-Hill Book company. [6] Mark Ole and David Luketina, 2003. Hydrological Modelling - Lecture notes. AIT. Thailand.
Outline	1.1. The concept of the mathematical model 1.2. Classification of math models 1.3. The process of implementing the mathematical model
Topic 2: Deterministic model (5t)	
Learning objectives	General knowledge of basic concepts and calculation methods of all kinds of hydrological problems.
Learning outcomes	Students are provided with general math modeling processes and concepts. Applying mathematical model to hydrological problems related to exploitation use, water resource management such as calculation of flow characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management

	in the original country.
Student deliverables	Exercise:
Topic materials	Lesson [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ [8] Hair Jr, J.F. Multivariate Data Analysis Joseph F. Hair Jr. William C. Black Barry J. Babin Rolph E. Anderson Seventh Edition. [5] Maidment, David R. Handbook of Hydrology, 1993. New York, USA, McGraw-Hill Book company. [6] Mark Ole and David Luketina, 2003. Hydrological Modelling - Lecture notes. AIT. Thailand.
Outline	1.1. Flow formation process 1.2. Types of deterministic models 1.3. Rational model 1.4. Time / Area method 1.5. Kinetic wave model 1.6. Unit flood model 1.7. Cognitive model
Topic 3. Random pattern (5t)	
Learning objectives	General and applied knowledge related to hydrographic model.
Learning outcomes	Students are provided with general math modeling processes and concepts. General knowledge of basic concepts and calculation methods of all kinds of hydrological problems.
Student deliverables	Exercise:
Topic materials	Lesson [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ [2] Đặng Văn Bảng, 2001. Bài giảng Mô hình toán thủy văn, Khoa Thủy văn mội trường, Trường Đại học Thủy lợi. [3] Lê Văn Nghinh, 2008. Giáo trình cao học Thủy lợi: Mô hình toán thủy văn. NXB Xây dựng. [7] Huỳnh Vương Thu Minh, Giáo trình Thủy Văn Công Trình – NXB Đại học Cần Thơ, 2010. [5] Maidment, David R. Handbook of Hydrology, 1993. New York, USA, McGraw-Hill Book company. [6] Mark Ole and David Luketina, 2003. Hydrological Modelling - Lecture notes. AIT. Thailand.
Outline	1.1. Calculate randomness in hydrology 1.2. Synthesize and analyze data series 1.3. Artificial intelligence network
Topic 4. Statistical analysis in Hydrological calculation (5t)	

Learning objectives	General and applied knowledge related to hydrographic model.
Learning outcomes	Students are provided with general math modeling processes and concepts. General knowledge of basic concepts and calculation methods of all kinds of hydrological problems.
Student deliverables	Exercise:
Topic materials	Lesson [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ [2] Đặng Văn Bảng, 2001. Bài giảng Mô hình toán thủy văn, Khoa Thủy văn mội trường, Trường Đại học Thủy lợi. [3] Lê Văn Nghinh, 2008. Giáo trình cao học Thủy lợi: Mô hình toán thủy văn. NXB Xây dựng. [4] Lê Văn Nghinh, 2003. Tính toán thủy văn thiết kế. NXB Nông nghiệp. [7] Huỳnh Vương Thu Minh, Giáo trình Thủy Văn Công Trình – NXB Đại học Cần Thơ, 2010.
Outline	1.1. Hydrological analysis according to design frequency 1.2. Analysis of linear and nonlinear correlation 1.3. Multivariate analysis
Practice Lessons 1. HEC-HMS model (10t)	
Learning objectives	Teamwork, presentation and reporting skills. General evaluation and analysis skills.
Learning outcomes	Applying mathematical model to hydrological problems related to exploitation use, water resource management such as calculation of flow characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management in the original country.
Student deliverables	Exercise:
Topic materials	Lesson - Documentation simulation by HEC-HMS [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ
Outline	1.1. Set up the model 1.2. Edit / test the model 1.3. Forecast
Practice Lessons 2. Artificial intelligence network model ANN (5t)	
Learning objectives	Teamwork, presentation and reporting skills. General evaluation and analysis skills.
Learning outcomes	Applying mathematical model to hydrological problems related to exploitation use, water resource management such as calculation of flow

	characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management in the original country.
Student deliverables	Exercise:
Topic materials	Lesson - Documentation simulation by ANN [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ
Outline	1.1. Set up the model 1.2. Edit / test the model 1.3. Forecast
Practice Lessons 3. Statistical analysis (5t)	
Learning objectives	Teamwork, presentation and reporting skills. General evaluation and analysis skills.
Learning outcomes	Applying mathematical model to hydrological problems related to exploitation use, water resource management such as calculation of flow characteristics, hydrological forecasting, balance calculation and water resource use planning, flood prevention planning, integrated management in the original country.
Student deliverables	Exercise:
Topic materials	Lesson - Documentation direction for multivariate statistical analysis [1] Tỷ. Trần Văn, Minh. Huỳnh Vương Thu, 2019. Mô hình toán thủy văn lưu – NXB Đại học Cần Thơ
Outline	1.1. Meaning of multivariate analysis 1.2. Practice multivariate data processing

Course Assignments
Course assignments will constitute a multi-part project:

• Assignment #1 - (in-class) – The quick test of modeling

• Assignment #2 – Group discussion (strengths and weaknesses of mathematical and physical models)

• Assignment #3 – The process of building a mathematical model

• Assignment #4: Construct conceptual models, mathematical models from natural phenomena (group)

Grading

The students' performance will be based on the following:

Assessment	• Personal assignments (10%): Complete all assigned assignments - Group exercise (20%): - Exercises and reports and confirmed by the group to participate - Practice scores (20%): Complete all the exercises on the computer, participate 100% of the hours • Final assessment (50%): Written exam (90 minutes) - Attend 80% theory lessons and 100% practice hours - Compulsory examination
Evaluation	A (8,5 – 10) B (7,0 – 8,4) C (5,5 - 6,9) D (4,0 – 5,4)