UNIKASSEL
VERSITÄT

Master of Engineering
Program in Water Resources Engineering
(International Program)
(New Program B.E. 2552)

Program of Civil and Environmental Engineering

Nakhon Pathom Rajabhat University and

Department of Geohydraulic and Engineering Hydrology

University of Kassel, Republic of Germany

Contents

The curriculum

Master of Engineering in Water Resources Engineering

by

Nakhon Pathom Rajabhat University

and University of Kassel, Republic of Germany

B.E.2552

1. **Program Title**:

   Designation in Thai: หลักสูตรวิศวกรรมศาสตรมหาบัณฑิต
   สาขาวิศวกรรมทรัพยากรน้ำ (หลักสูตรนานาชาติ)

   Designation in English: Master of Engineering Program
   in Water Resources Engineering
   (International Program)

2. **Degree Title:**
   a. **Full Designation in Thai:** วิศวกรรมศาสตรมหาบัณฑิต
   (วิศวกรรมทรัพยากรน้ำ)
   b. **Abbreviated Designation in Thai**: วศ.ม. (วิศวกรรมทรัพยากรน้ำ)
   c. **Full Designation in English:** Master of Engineering
   (Water Resources Engineering)
   d. **Abbreviated Designation in English:**M.Eng.
   (Water Resources Engineering)

3. **Authorized Organizations:**
   a. Program of Civil and Environmental Engineering, Nakhon Pathom Rajabhat University, Kingdom of Thailand and
   b. Department of Geohydraulics and Engineering Hydrology, University of Kassel, Republic of Germany

4. Philosophy and Objective of the Curriculum

4.1 General Statement and Synopsis

Water Resources is the fundamental resource of Thailand. It is trendily deteriorated in both quality and quantity through man-made and climate change as shown in various catastrophic events, i.e., flood inundation, drought, polluted water, groundwater depletion and so on. These evidence the water and environmental resources problems are becoming more and more complex. And these problems nowadays can be found from the village- up to the global scale. To well deal with these mentioned problems, we do need to have the water resource engineers or scientists who specialize in multidisciplinary of water, environmental and climate change fields. Furthermore, no any university nowadays offers a M.Eng of Water Resources Engineering which focuses on the groundwater and climate change fields yet. Although, these human resources in these fields are currently deficient in Department of Groundwater Resources, Department of Water Resources, Royal Irrigation Department and the other departments in Thailand. Then Nakhon Pathom Rajabhat University and University of Kassel which comprise of specialists of Water Engineering, Groundwater environment and Climate change cooperate to set up the M.Eng program in Water Resources Engineering in order to serve for developing the human resource in these fields.

Master of Engineering in Water Resource Engineering is established following on the International- and Higher Education Commission Standard. It aims to produce the qualitative human resources in the broad fields of water and environmental resources in order to serve these human resources for governmental and private sectors in the region, Thailand and Southeast Asian and orients forward driving of the researches to sustain the water and environmental resources in the regions. These above mentioned, they synchronize to the philosophy of Nakhon Pathom Rajabhat University.

The Master of Engineering Program under the friendship cooperation between Nakhon Pathom Rajabhat University, Thailand, and the University of Kassel, Republic of Germany, is an interdisciplinary graduate program designed to provide students with a solid background in quantitative/qualitative groundwater/solute transport, hydrology, water resources-, hydraulic engineering and climate change science to allow them

to explore specialties within these and related fields, with particular emphasis on areas of expertise of the participating faculties of the University of Kassel and Nakhon Pathom Rajabhat University. We offer programs of study in fundamental water resources engineering and related fields of environmental engineering. This M.Eng program is designed to be accomplished within two years. During this time the students will spend at least one year of studies in Thailand and one or two semesters at the University of Kassel for course works and/or for the preparation of a project thesis. For these accomplishments the students will obtain credit certificates from the University of Kassel which will be counted towards the degree of Master of Engineering to be conferred from Nakhon Pathom Rajabhat University.

4.2 Objectives

4.2.1 To provide an international Master Engineering Program in Water Resources Engineering accomplished within at least two years as a sandwich program such that the students can have opportunity to study knowledge and do research of thesis at two universities, one in Thailand and another in Germany with internationally well-known and academic/research experienced faculties.

4.2.2 To produce graduate students who have strong academic/research capabilities to be able to manage water resources in the sustainable manner.

4.2.3 To produce graduate students who have the skills and which are ready to learn a modern technology, the knowhow, and the innovative research skills, herewith he/she can apply those mentioned to deal with issues of sustainable water resources management.

4.2.4 To produce the graduated students who has the morality and ethic in their professional.

5. The Program Commencement

The program will initially enroll the students in the 1st semester of the academic year 2009.

6. Applicant Qualification

Type A:

An applicant holding a Bachelor of Engineering (B.Eng) in Civil Engineering, Irrigation Engineering, Water Resources Engineering or equivalent and who is also meeting the general requirements for admission at the Graduate school.

Type B:

An applicant holding a Bachelor of Science (B.Sc.) in Geology, Geotechnology, Environment Science or the other related fields and who is also meeting the general requirements for admission of the Graduate school.

7. Admission

The applicant will take an exam or/and interview by the Admission Committee.

8. Academic System

Semester system:

At Nakhon Pathom Rajabhat University:

Each academic year consists of two regular 15-week semesters or plus one summer which is equivalent to a regular 15-week semester. The 1st term begins from July to October, while the 2nd term starts from November to March in each year.

At University of Kassel:

The school year is split up into two semesters, i.e., Winter and Summer. Winter Semester (WS) classes usually begin at the end of October till mid-February. There is a 2-week break for Christmas. Summer Semester (SS) classes begin mid-April and end in July.

9. Time Requirement

One academic year runs over two regular semesters, each of which contains 15 weeks. Ordinarily, students are expected to complete the program within 2 years (Qualified applicant from Type A) and 2.5 years (Qualified applicant from Type B). Each student must fulfill all requirements for the degree in no longer than 5 years (Type A and Type B) from the date of his first enrollment.

10. Registration

All requirements regarding thesis examination must comply with Nakhon Pathom Rajabhat University's regulation on Graduate Studies.

11. Academic Evaluation and Graduation

Qualified Applicant from Type A (at least 2 years):

The candidate is required to complete at least a total of 36 credits, of which 24 credits shall be graduate course work. From the latter 24 credit courses 12 credits shall consist of required courses and 12 credits of approved elective credits. The grade point average (GPA) must not be less than 3.00. The remaining 12 credits are given for the preparation of a thesis with a satisfactory passing of an oral examination. Furthermore, every student needs to pass the NPRU test of English language proficiency within the 1st year of study or the TOEFL test with at least 500 points. In addition, the student must publish at least a part of his/her thesis work in a journal or present it at a conference which has a proceeding publication. Finally, a candidate must fulfill all requirements for graduation of the NPRU graduate school.

Qualified Applicant from Type B (At least 2.5 years):

To cover quantitative deficiencies, the candidate is required to pass all prerequisite courses, namely, Fluid Mechanics, Introduction to Hydrology, Hydraulic Engineering and Water Resources Engineering with grade "B" before entering the usual M.Eng program. After that, the program B–student will engage in the same study program with the same degree requirements as

Program A - students. Unless the program B-Student does not need to publish his/her independent study work, but a student must pass the comprehensive examination through oral- or paper examination.

12. Academic Staffs

12.1 The Curriculum Faculty Members (อาจารย์ประจำหลักสูตร)

No.	ID Code	Academic Position	Full Name	Educational Degree	Educational Fields	University	Graduated Year	Text/ Research
1		Full Univ.Prof. (C4-Highest Level)	Dr.rer.nat Manfred Koch	Dr.rer.nat. Diploma Maitrise (Master) Vordiploma	Geophysics Geophysics Physics Physics and Mathematics	University of Karlsruhe University of Karlsruhe University of Paris XI University of Göttingen	1983 1977 1974 1973	**Publications** 80 International Publications in Geophysics, Hydrology, Groundwater, Solute Transport, Climate Change, Mathematics, Physics and Coastal Engineering **Researches** 22 Projects financed by US., German and Thai Agencies.
2		Univ.Prof.	Dr.-Ing.Stephan Theobald	Dr.-Ing. Diploma	Hydraulic Engineering and Hydromechanics Civil Engineering	University of Karlsruhe University of Karlsruhe	1999 1990	**Publications** 34 Publications in Hydraulic and Water Resources Engineering **Researches** 9 Projects
3	3760400244690	Instructor	Dr.-Ing.Phatcharasak Arlai	Dr.-Ing. M.Eng. B.Eng.	Civil Engineering Water Resources Engineering Water Resources Engineering	University of Kassel Chulalongkorn University Kasetsart	2007 2001 1998	**Publications** 20 International Publications **Researches** 8 Projects

						University		
No.	**ID Code**	**Academic Position**	**Full Name**	**Educational Degree**	**Educational Fields**	**University**	**Graduated Year**	**Text/ Research**
4		Senior Full Professor	Dr. Tawatchai Tingsanchali	D.Eng. M.Eng B.Eng (Hons)	Water Resources Engineering Hydraulic Engineering Mechanical Engineering	AIT AIT Chulalongkorn University	1974 1970 1968	**Publications** 230 International Publications **Researches** 36 Projects
5	3102000206348	Instructor	Dr.Jakrapong Keawkao	PhD. M.Sc. B.Sc.	Physics Physics Physics	KMUTT Silapokorn University Silapokorn University	2008 2003 1999	

12.2 External Adjunct Faculty Member

No.	**Academic Position**	**Full Name**	**Educational Degree**	**Educational Fields**	**University**	**Graduated Year**	**Text/ Research**
1	Assoc.Prof.	Dr.Tuantan Kitpaisalsakul	D.Eng M.Eng B.Eng	Water Resources Engineering Water Resources Engineering Civil Engineering	AIT Chulalongkorn University Chulalongkorn University	1996 1991 1983	**Publications** 16 International Publications **Researches** 4 Projects
2	Assist.Prof.	Dr.Kanchit Likitdecharote	D.Eng. M.Eng. B.Eng.	Irrigation Engineering Irrigation Engineering Civil Engineering	Ensa, France Technion-Israel Institute of Technology Chulalongkorn University		**Publications** 34 Publications in Hydraulic and Water Resources Engineering **Researches** 9 Projects

13. Number of Student Enrollment and Graduation

Students	Year 2009	Year 2010	Year 2011	Year 2012	Year 2013
1st Year	15*	15	15	15	15
2nd Year	-	15	15	15	15
Total	15*	30	30	30	30
Expected to Graduate	-	-	15	15	15

Remark: 15* is obtained from the total number of type A- and type B students.

14. Location and Facilities

14.1 Location

a. Program of Civil and Environmental Engineering, Nakhon Pathom Rajabhat University, 85 Malaiman Rd., Muang, Nakhon Pathom, Kingdom of Thailand, 73000
b. Department of Geohydraulic and Engineering Hydrology, University of Kassel, Kassel, D34100, Kassel, Republic of Germany.

14.2 Labs/Facilities

Nakhon Pathom Rajabhat University's Labs and Softwares

a. Hydraulic Laboratory
b. Hydrology Laboratory
c. Survey Laboratory
d. Soil Mechanic Laboratory
e. Hydrodynamic Software
f. Groundwater and Solute Transport Modeling Software
g. GIS software

University of Kassel's Labs and Softwares

a. Hydraulic Laboratory
b. Groundwater and Solute Transport Tank

c. Hydrodynamic Software
d. Groundwater and Solute Transport Modeling Software
e. GIS software
f. Geophysics Investigation Instruments

14.3 Dormitory/Canteen/Computer Center/Language Center

At Nakhon Pathom Rajabhat University

a. University officers will assist to find out the University- or nearby private dormitories for the students.
b. University- or private canteens service from 8.00 till 22.00 o'clock.
c. Computer Center services from 8.00 till 20.00 o'clock and a student can access the university wireless network all days.
d. Language Center services from 8.00 till 16.00 o'clock.
e. A student can work at the Graduate student room for the whole day.

At University of Kassel

a. University officers will assist to find out the University- or nearby private dormitories for the students.
b. University- or private canteens service from 8.00 till 20.00 o'clock.
c. Computer Center services from 8.00 till 16.00 o'clock.
d. Language Center services from 8.00 till 16.00 o'clock.
e. A student can work at the Graduate student room for the whole day.

15. Library

Library	Books	Journals
Nakhon Pathom Rajabhat University, Thailand	100	>100
University of Kassel, Republic of Germany	3,000	>1,000
Total	3,100	>1,100

16. Budget

At Nakhon Pathom Rajabhat University

Students admitted to the program are required to make payment fee following the announcement of Graduate School**.**

At University of Kassel

Students admitted to the program are required to make payment fee around 200 Euro per semester in Republic of Germany. With paying this fee, a student will be able to use his/her student card to board on any German public transport in the north of Hessen region with free of charge and get the other rights as a common German student. Please note that this payment is not yet included the cost of living and traveling to the University of Kassel.

17. Curriculum

This program is offered in English. The details of the curriculum are described as follows

17.1 Total Credit Requirement (at least) 36 Credits

17.2 Curriculum Structure

17.2.1 The Study Plan

The study plan can be mainly divided into 2 programs as follows:

a. **Thesis program** (แผน ก แบบ ก ๒), a graduated candidate must complete the thesis with 12 credits, and relevant academic subjects at least 24 credits.

b. **Non-Thesis program** (แผน ข), a graduated candidate must complete the relevant academic subject at least 30 credits and the independent study with 6 credits.

17.2.2 Thesis Program

The total number of credits of the program is 36 credits which are divided into

Required Courses 12 Credits

Elective Courses 12 Credits

Thesis 12 Credits

17.2.3 Non-Thesis Program

The total number of credits of the program is 36 credits which are divided into

Required Courses 12 Credits

Elective Courses 18 Credits

Independent Study 6 Credits

17.3 List of Academic Courses

17.3.1 Type A - Student

Required Courses 12 Credits

Course Code	Course Title	Credits
5515111	Advanced Fluid Mechanics	3 (3-0-6)
5515112	Advanced Hydrology (or select 5511117*)	3 (3-0-6)
5515113	Advanced Hydraulic Engineering (or select 5511118*)	3 (3-0-6)
5515114	Hydraulic Laboratory	1 (0-3-0)
5515115	Hydrological Laboratory	1 (0-3-0)
5515116	Seminar in Water Resources Engineering	1 (0-3-0)

Alternative required courses for a student focusing on groundwater and solute transport field

5515117	Groundwater of Hydrology*	3 (3-0-6)
5525118	Hydrogeology*	3 (3-0-6)

Remark: * : A student who would like to focus on the groundwater and solute transport field will be able to choose to study required courses of 5515117 and 5515118 instead of 5515112 and 5515113, respectively.

Elective Courses

At least 12 credits must be chosen from the following multi-discipline course list, after approval of the advisor and in accordance with the approved student's plan.

Section "Groundwater and Solute Transport" (or groundwater modelling)

Course Code	Course Title	Credits
5525201	Hydraulics of Groundwater Flow	3 (3-0-6)
5525202	Hydrogeochemistry	3 (3-0-6)
5525203	Contaminant Hydrogeology	3 (3-0-6)
5525204	Groundwater Flow Modeling	3 (3-0-6)
5525205	Numerical Modeling of Contaminant Transport Processes	3 (3-0-6)
5525206	Geostatistics	3 (3-0-6)
5525207	Stochastic Subsurface Hydrology	3 (3-0-6)
5525208	Multiphase Fluid Transport	3 (3-0-6)
5525209	Groundwater Resource Management	3 (3-0-6)
5525210	Special Topics in Groundwater and Solute Transport	3 (3-0-6)

Section "General Hydrology"

Course Code	Course Title	Credits
5525301	Stochastic Process in Hydrology	3 (3-0-6)
5525302	Urban Hydrology and Hydraulics	3 (3-0-6)
5525303	Numerical Modeling in Hydrology	3 (3-0-6)
5525304	Introduction to GIS in Hydrology	3 (3-0-6)
5525305	Advanced Topics in Hydrology	3 (3-0-6)

Section "Water Resources Engineering"

Course Code	Course Title	Credits
5525401	Water Resources Planning and Management	3 (3-0-6)
5525402	River and Flood Water Management	3 (3-0-6)
5525403	Advanced Topics in Water Resources Engineering	3 (3-0-6)

Section "Hydraulic Engineering"

Course Code	Course Title	Credits
5525501	Design of Hydraulic Structures	3 (3-0-6)
5525502	River Engineering	3 (3-0-6)
5525503	Erosion and Sedimentation	3 (3-0-6)
5525504	Numerical Modeling in Hydraulic Engineering	3 (3-0-6)
5525505	Advance Topics in Hydraulic Engineering	3 (3-0-6)

Section "Climate Change"

Course Code	Course Title	Credits
5525601	Introduction to Climate Change	3 (3-0-6)
5525602	Statistical Methods in Climate Change Analysis	3 (3-0-6)
5525603	Advance Topics in Climate Change	3 (3-0-6)

Section "Selected Topics"

Course Code	Course Title	Credits
5525701	Selected Topics	3 (3-0-6)

Thesis Courses

Course Code	Course Title	Credits
5535801	Thesis	12 (12-27-0)

Independent Study Courses

Course Code	Course Title	Credits
5535941	Independent Study	6 (6-18-0)

17.3.2 Type B - Student

To cover quantitative deficiencies, a type B- student is required to take all prerequisite courses 12 credits

Prerequisite Courses 12 Credits

Course Code	Course Title	Credits
5505011	Fluid Mechanics	3 (3-0-6)
5505012	Introduction to Hydrology	3 (3-0-6)
5505013	Hydraulic Engineering	3 (3-0-6)
5505014	Water Resources Engineering	3 (3-0-6)

After passing all prerequisite courses with at least grade “B”, the type B–student will engage in the same study program above as the type A - students.

17.4 Meaning of Course Code

All course codes contain 8 digits. They are identified as follows:

a) The first three digits mean the section of subjects
    a. 550 = Prerequisite Courses
    b. 551 = Required Courses
    c. 552 = Elective Courses
    d. 553 = Thesis/Independent Study
b) The fourth digit means “Graduate Courses”
c) The fifth digit means “Section Courses”
    a. 0 = Prerequisite Courses
    b. 1 = Required Courses
    c. 2 = Groundwater and Solute Transport
    d. 3 = General Hydrology
    e. 4 = Water Resources Engineering
    f. 5 = Hydraulic Engineering
    g. 6 = Climate Change
    h. 7 = Selected Topics
    i. 8 = Thesis
    j. 9 = Independent Study
d) The sixth digit means “Semester Number” and zero means “a student will register it on a semester after approval of the advisor and in accordance with the approved student’s plan”.
e) The seventh digit means “Sequence of Courses”

17.5 Study Plan

Type A – Student (Thesis Program)

First Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5515111	Advanced Fluid Mechanics	3 (3-0-6)
5515112	Advanced Hydrology (or select 5511117*)	3 (3-0-6)
5515113	Advanced Hydraulic Engineering (or select5511118*)	3 (3-0-6)
5515114	Hydraulic Laboratory	1 (0-3-0)
5515115	Hydrological Laboratory	1 (0-3-0)
5515116	Seminar in Water Resources Engineering	1 (0-3-0)
	Total	**12 (9-9-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study required courses of 5515117 and 5515118 instead of 5515112 and 5515113, respectively.

Second Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
552xxxx	Elective Course (or 5525201*)	3 (3-0-6)
552xxxx	Elective Course (or 5525204*)	3 (3-0-6)
5535801	Thesis I	3 (3-0-6)
	Total	**9 (9-0-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study elective courses of 5525201 and 5525204.

Third Semester at University of Kassel

Course Code	Course Title	Credits
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
5535801	Thesis II	3 (3-0-6)
	Total	**9 (9-0-18)**

Fourth Semester at University of Kassel or Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5535801	Thesis III	6 (3-0-6)
	Total	**6 (3-0-6)**

Type A – Student (Non-Thesis Program)

First Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5515111	Advanced Fluid Mechanics	3 (3-0-6)
5515112	Advanced Hydrology (or select 5511117*)	3 (3-0-6)
5515113	Advanced Hydraulic Engineering (or select5511118*)	3 (3-0-6)
5515114	Hydraulic Laboratory	1 (0-3-0)
5515115	Hydrological Laboratory	1 (0-3-0)
5515116	Seminar in Water Resources Engineering	1 (0-3-0)
	Total	**12 (9-9-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study required courses of 5515117 and 5515118 instead of 5515112 and 5515113, respectively.

Second Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
552xxxx	Elective Course (or 5525201*)	3 (3-0-6)
552xxxx	Elective Course (or 5525204*)	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
	Total	**9 (9-0-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study elective courses of 5525201 and 5525204.

Third Semester at University of Kassel

Course Code	Course Title	Credits
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
	Total	**9 (9-0-18)**

Fourth Semester at University of Kassel or Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5535941	Independent Study	6 (3-0-6)
	Total	**6 (3-0-6)**

Type B – Student (Thesis Program)

Pre-Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5505011	Fluid Mechanics	3 (3-0-6)
5505012	Introduction to Hydrology	3 (3-0-6)
5505013	Hydraulic Engineering	3 (3-0-6)
5505014	Water Resources Engineering	3 (3-0-6)
	Total	**12 (12-0-24)**

First Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5515111	Advanced Fluid Mechanics	3 (3-0-6)
5515112	Advanced Hydrology (or select 5511117*)	3 (3-0-6)
5515113	Advanced Hydraulic Engineering (or select5511118*)	3 (3-0-6)
5515114	Hydraulic Laboratory	1 (0-3-0)
5515115	Hydrological Laboratory	1 (0-3-0)
5515116	Seminar in Water Resources Engineering	1 (0-3-0)
	Total	**12 (9-9-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study required courses of 5515117 and 5515118 instead of 5515112 and 5515113, respectively.

Second Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
552xxxx	Elective Course (or 5525201*)	3 (3-0-6)
552xxxx	Elective Course (or 5525204*)	3 (3-0-6)
5535801	Thesis I	3 (3-0-6)
	Total	**9 (9-0-18)**

Remark: * : A student who would like to focus on the groundwater and solute transport field will be recommended to study elective courses of 5525201 and 5525204.

Third Semester at University of Kassel

Course Code	Course Title	Credits
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
5535801	Thesis II	3 (3-0-6)
	Total	**9 (9-0-18)**

Fourth Semester at University of Kassel or Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5535801	Thesis III	6 (3-0-6)
	Total	**6 (3-0-6)**

Type B – Student (Non-Thesis Program)

Pre-Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5505011	Fluid Mechanics	3 (3-0-6)
5505012	Introduction to Hydrology	3 (3-0-6)
5505013	Hydraulic Engineering	3 (3-0-6)
5505014	Water Resources Engineering	3 (3-0-6)
	Total	**12 (12-0-24)**

First Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
5515111	Advanced Fluid Mechanics	3 (3-0-6)
5515112	Advanced Hydrology (or select 5511017*)	3 (3-0-6)
5515113	Advanced Hydraulic Engineering (or select 5511018*)	3 (3-0-6)
5515114	Hydraulic Laboratory	1 (0-3-0)
5515115	Hydrological Laboratory	1 (0-3-0)
5515116	Seminar in Water Resources Engineering	1 (0-3-0)
	Total	**12 (9-9-18)**

Second Semester at Nakhon Pathom Rajabhat University

Course Code	Course Title	Credits
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
553xxxx	Elective Course	3 (3-0-6)

	Total	**9 (9-0-18)**

Third Semester at University of Kassel

Course Code	**Course Title**	**Credits**
552xxxx	Elective Course	3 (3-0-6)
552xxxx	Elective Course	3 (3-0-6)
553xxxx	Elective Course	3 (3-0-6)
	Total	**9 (9-0-18)**

Fourth Semester at University of Kassel or Nakhon Pathom Rajabhat University

Course Code	**Course Title**	**Credits**
5535941	Independent Study	6 (3-0-6)
	Total	**6 (3-0-6)**

17.6 Course Description

Prerequisite Courses

5505011 Fluid Mechanics 3 (3-0-6) Credits

Properties of fluids, fluid statics; momentum and energy equations; equation of continuity and motion; similitude and dimensional analysis; steady incompressible flow; pipe flow and open channel flow.

5505012 Introduction to Hydrology 3 (3-0-6) Credits

Hydrologic cycle; Hydrological data measurement; hydrological data and rainfall data analysis; Detention, Retention, Evaporation, Evapotranspiration and Percolation; Runoff Measurement; Hydrograph Computation; Hydrograph Analysis; Flood Routing; Water balance in Reservoir; Introduction to groundwater; Sedimentation in reservoir and river; Applications of Hydrology.

5505013 Hydraulic Engineering 3 (3-0-6) Credits

Application of Fluid Mechanics principles to study and practice of hydraulic engineering; piping systems; water hammer; pumps and turbines; open channel flow and design; reservoir; dams; spillways; hydraulic models.

5505014 Water Resources Engineering 3 (3-0-6) Credits

Basic hydrology for water resources management efforts, legal aspects of water use; physical works utilized in water resources development projects, basic engineering economy in water resources managemet; principal water uses; planning procedure for single and multipurpose projects.

Required Courses

5515111 Advanced Fluid Mechanics 3 (3-0-6) Credits

The principal concepts and methods of fluid dynamics. Topics include mass conservation, momentum, and energy equations for continua, the Navier-Stokes equation for viscous flows, similarity and dimensional analysis, lubrication theory, boundary layers and separation, circulation and vorticity theorems, potential flow, an introduction to turbulence, lift and drag, surface tension and surface tension driven flows.

5515112 Advanced Hydrology 3 (3-0-6) Credits

Subsurface water, infiltration, surface water, streamflow hydrograph, SCS curve number method, unit hydrograph, lumped flow routing, distributed flow routing, dynamic wave routing, hydrodynamic flow simulation model, hydrologic statistics, frequency analysis, rainfall hyetograph design, tidal level hydrograph design, stochastic time series models, artificial neural network, genetic algorithms.

5515113 Advanced Hydraulic Engineering 3 (3-0-6) Credits

Unsteady flow in pipes, computational methods, design application; water hammer, mass oscillation, unsteady flow in open channels, movement of flood waves, computer-aided design in hydraulic engineering

5515114 Hydraulic Laboratory 1 (0 -3-0) Credits

Experiments on the labs which are involved with hydraulic theories in order to study the flow behaviors and characteristics, i.e., Hydrostatics, Buoyancy, Losses, Open Channel Flow, Turbine, Pump and so on.

5515115 Hydrological Laboratory 1 (0 -3-0) Credits

Laboratory and field techniques in operation, calibration and maintenance of equipment used for measurements of hydrologic data; preparation of reports of experimental results.

5515116 Seminar in Water Resources Engineering 1 (0 -3-0) Credits

Presentation and discussion of interesting topics in water resources engineering at the master level or field trips and seminar with experts are additional required.

5515117 Groundwater Hydrology 3 (3-0-6)

A general course in groundwater hydrology, emphasizing fundamental principles and their applications to practical problems. Topics included are hydrologic cycles, geologic environments and controls, unsaturated and saturated zones, Darcy's law, continuity and energy principles, Navier-stokes equations, flow equations, steady and unsteady hydraulics, aquifer tests, analytical and numerical models and computer codes.

5515118 Hydrogeology 3 (3-0-6)

An introduction to groundwater and geology and to the interactions between the two; It provides a basic understanding of geologic concepts and processes, focusing on understanding the formation and characteristics of water-bearing formations; The theory of groundwater flow, the hydrology of aquifers, well hydraulics, groundwater-resource evaluation, and groundwater chemistry; The relationship between the geologic concepts/processes and the groundwater resource are discussed.

Elective Courses

Section "Groundwater and Solute Transport"

5525201 Hydraulics of Groundwater Flow 3 (3-0-6)

Hydraulics of groundwater from first principles to the complete mathematical statement of forecasting regional aquifer response to management activities. A comprehensive approach is presented and the basic subject-Hydraulics of the flow and accumulation of water and containments in aquifers-is dealt with in the framework and for the purpose of management.

5525202 Hydrogeochemistry 3 (3-0-6)

an overview of the major physico-chemical processes involved in water-rock reactions within the Earth's crust, understanding of which has important applications to understanding mineral deposits, oil & gas generation & migration and metamorphic processes.

5525203 Contaminant Hydrogeology 3 (3-0-6)

Introduction to contaminant hydrogeology, including properties of organic and inorganic contaminants, chemical and physical processes affecting concentration of solutes in the subsurface, mass transport, multiphase flow, contaminant monitoring, and site remediation.

5525204 Groundwater Flow Modeling 3 (3-0-6)

Introduction to groundwater flow modeling; Equations and Numerical Methods; The Conceptual Model and Grid Design; Boundaries; Sources and Sinks; Profile Models; Special Needs for Transient Simulations; Model Execution and the Calibration Process; Documenting and Reporting Your Modeling Study; Postaudits: How Good Are Predictions? Particle Tracking of Groundwater Flow and Advective Transport of Contaminants.

5525205 Numerical Modeling of Contaminant Transport Processes3 (3-0-6)

An overview of transport theory as applied to groundwater problems, an indepth look at the numerical transport code MT3DMS, and an introduction to the application of transport models to field problems. MT3DMS is a popular and widely-used 3-D transient transport code, which uses output from the groundwater flow code MODFLOW. Both MODFLOW and MT3DMS are supported by the pre/post-process.

5525206 Geostatistics 3 (3-0-6)

Numerical and statistical treatment of geological data emphasizing the analysis of spatially and temporally distributed variables and unique aspects of geological variables. Topics include methods of sampling geological data, quantitative procedures for reducing the dimensionality of geological data sets, and techniques for presentation and interpretation of results.

5525207 Stochastic Subsurface Hydrology 3 (3-0-6)

Introduction to stochastic subsurface hydrology; Stochastic description; Temporally variable subsurface flow; Spatial variable in subsurface flow; Transport process in heterogeneous media; Stochastic Characterization and Geostatistics

5525208 Multiphase Fluid Transport 3 (3-0-6)

Gas-Liquid systems, fluid-solid systems, and solid-liquid-gas systems. Design criteria for two-phase and three-phase flow systems. Application of two-phase flow in pollution treatments. Application of two-phase flow in separation technology. Application of three phase flow in fluidized bed, petrochemical process, and petroleum engineering.

5525209 Groundwater Resource Management 3 (3-0-6)

Introduction to groundwater resources engineering and management, with an emphasis on groundwater resources protection and water supply; Technical aspects as well as the legal, regulatory and policy aspects of groundwater resources management; Development of groundwater supplies; Conjunctive use of groundwater and surface water and planning of groundwater resources projects.

5525210 Special Topics in Groundwater and Solute Transport (3-0-6)

Students familiarize themselves with the advance topics of Groundwater and Solute Transport through discussion and reading of journal or academic publications.

Section "General Hydrology"

5525301 Stochastic Process in Hydrology 3 (3-0-6)

Basic concepts and classification of hydrologic processes; Autocorrelation and lag cross correlation; Spectral and cross spectral analysis; Range analysis of hydrologic series; Analysis of hydrologic series by runs; Transient components in hydrologic series; Analysis of intermittent hydrologic processes; Computer Technology and the experimental methods in hydrology.

5525302 Urban Hydrology and Hydraulics 3 (3-0-6)

Rainfall-runoff; hydrograph prediction; unsteady flow, flood routing; culvert hydraulics; flood control structures; stormwater management; storage concepts; river restoration; case studies.

5525303 Numerical Modeling in Hydrology 3 (3-0-6)

Applications of hydrological models (HEC, SWAT) to hydrologic works.

5525304 Introduction to GIS in Hydrology 3 (3-0-6)

The state-of-the-art GIS methods and tools specifically targeting hydrological applications including: spatial and terrain analysis, geostatistical analysis, watershed delineation and identification of river networks, time series analysis and development of GIS integrated Hydrological models.

5525305 Advanced Topics in Hydrology 3 (3-0-6)

Students familiarize themselves with the advance topics of Hydrology through discussion and reading of journal or academic publications.

Section "Water Resources Engineering"

5525401 Water Resources Planning and Management 3 (3-0-6)

Principles and practice of water resources planning and management; Protocols employed at local, state, federal, regional and international levels; Plan formulation, evaluation, and implementation; Stakeholder involvement in planning processes; Analytical tools. Case studies.

5525402 River and Flood Water Management 3 (3-0-6)

Principles of River Basin Management; Flood Protection: Principles, flood area management, technical flood protection, flood prevention; Planning tools: GIS and Models.

5525403 Advanced Topics in Water Resources Engineering 3 (3-0-6)

Students familiarize themselves with the advance topics of Water Resources Engineering through discussion and reading of journal or academic publications.

Section "Hydraulic Engineering"

5525501 Design of Hydraulic Structures 3 (3-0-6)

Types, advantages and functions of hydraulic structures; Flow through orifices, culverts, under gates, over weirs and spillways; Energy dissipation below hydraulic structures; Hydraulic design of culverts, weirs, spillways, syphons, regulators and dams; Computer applications.

5525502 River Engineering 3 (3-0-6)

River morphology, regime theory, erosion and sedimentation, sediment transport, effect by construction of various hydraulic structures in the river.

5525503 Erosion and Sedimentation 3 (3-0-6)

Sediment transport measurement and computation, sedimentation and erosion in river and reservoir, mitigation and prevention methods, sediment routing, dredging, excavation, reservoir storage survey.

5525504 Numerical Modeling in Hydraulic Engineering 3 (3-0-6)

This course is an introduction to numerical methods and computer software, with emphasis on their applications to Hydraulic Engineering.

5525505 Advanced Topics in Hydraulic Engineering 3 (3-0-6)

Students familiarize themselves with the advance topics of Hydraulic Engineering through discussion and reading of journal or academic publications.

Section "Climate Change"

5525601 Introduction to Climate Change 3 (3-0-6)

Exchange of energy, water and momentum through the atmosphere, surface vegetation and oceans. Paleoclimate, climate change, variability and feedbacks.

5525602 Statistical Methods in Climate Change Analysis 3 (3-0-6)

Advanced techniques especially applicable to climatology; space-time random field analysis applied to stochastic models, parameter estimation, statistical forecasting, data interpolation and signal detection; applications to real data and climate model output.

5525603 Advance Topics in Climate Change 3 (3-0-6)

Students familiarize themselves with the advance topics of Climate Change through discussion and reading of journal or academic publications.

Section "Selected Topics"

5525701 Selected Topics 3 (3-0-6)

This course covers a number of advanced "selected topics" in the fields of water and environmental resources.

Thesis Courses

5535801 Thesis I 3 (3-9-0)

A student has the master thesis title; starts to do research under the supervision of his/her advisor and the student can pass the proposal presentation.

5535801 Thesis II 3 (3-9-0)

A student completes research at the half context of the master thesis under the supervision of his/her advisor and the student can present her/his research work in the master seminar.

5535801 Thesis III 6 (6-18-0)

A student completes the master thesis under the supervision of his/her advisor and the student passes an oral defense of a master thesis.

Independent Study Courses

5535941 Independent Study 6 (6-18-0)

Independent research and study in currently relevant water or environmental resource problems whose topics are not covered in the graduate courses based on laboratory and field research or current literatures. A student must complete his/her Independent study report.