เอกสารประกอบวาระที่ 4.9

(Draft)

Graduate Program in Chemical Engineering
School of Chemical Engineering
(Revised 2007)

Institute of Engineering
Suranaree University of Technology

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CONTENTS

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1. Program Titles

1.1. Master Degree Program
Master of Engineering Program in Chemical Engineering
1.2. Doctoral Degree Program
Doctor of Engineering Program in Chemical Engineering

2. Degrees Titles

2.1. Master Degree
Full Title : Master of Engineering (Chemical Engineering)
(Thai) : วิศวกรรมศาสตรมหาบัณฑิต (วิศวกรรมเคมี)
Abbreviation : M. Eng. (Chemical Engineering)
(Thai) : วศ. ม. (วิศวกรรมเคมี)

2.2. Doctoral Degree
Full Title : Doctoral of Engineering (Chemical Engineering)
(Thai) : วิศวกรรมศาสตรดุษฎีบัณฑิต (วิศวกรรมเคมี)
Abbreviation : D. Eng. (Chemical Engineering)
(Thai) : วศ. ด. (วิศวกรรมเคมี)

3. Responsible Unit

School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology.

4. Philosophy and Objectives

It has long been recognized that Thailand needs to develop its industry, especially in the energy, automobile, electronic, petrochemical, food and agro-industrial, and biotechnology sectors as stated in the First through to the Tenth National Economics and Social Development Plans. During Thailand's developmental phase, skilled engineers and qualified researchers, as well as the capability to develop its own technology are especially needed in order to achieve the goal of sustainable development and a sufficiency economy. According to the National Research Council of Thailand, there were 42,379 total full time equivalent (FTE) researchers, or 6.7 FTE researchers per 10,000 population in 2003. This ratio is well below those in Singapore, US, Canada, Germany and South Korea (30-46 FTE researchers per 10,000 population) and also below the target of 10 FTE researchers per 10,000 population set by the National Economics and Social Development Board in the Tenth National Economic and Social Development Plan.

In response to this growing demand, the School of Engineering, Suranaree University of Technology, offers graduate studies in Chemical Engineering, both at the Master and Doctoral levels. One of the primary objectives is to educate and train academic staff and researchers in the field of Chemical Engineering and in related fields. In addition, the programs also aim at reinforcing basic and applied research in Chemical Engineering and related fields. Currently, all Ph.D. students at the School of Chemical Engineering get their financial support through the Royal Golden Jubilee (RGJ) project of the Thailand Research Fund, and by MUA Ph.D. scholarships, while all Master's students get their financial support from the Thailand Research Fund, MTEC, NANOTEC, Energy Conservation Funds, other national funding agencies, and Suranaree University of Technology. Since the beginning of the programs in 1998, the School's faculty members and graduate students have presented their research work to the public continuously in project reports, international and domestic journal publications, international and domestic conferences, and through other avenues.

After eight years from the inception of the graduate programs, a committee is set up for curriculum revision. It consists of the School's faculty members and well-known scholars from other universities. The names of the committee members are shown in Appendix A.

The revised curriculum is designed so that graduates will possess the skills of analytical and creative thinking, and that graduates can perform their own research independently. In response to the various strategic research areas set forth in the Tenth National Economic and Social Development Plan; for example, biofuel, nutraceutical, bioplastic, biotechnology and clean technology, the revised curriculum is more diversified so that students can gain the core knowledge in Chemical Engineering at advanced level and apply that knowledge in each strategic research area through their elective courses and their thesis.

In summary, the objectives of the revised graduate curriculum are:

1. To produce top-level academics and researchers who can independently perform research in the field of chemical engineering for national and provincial academic institutions, state agencies, and private companies.

2. To enhance research in chemical engineering and related fields, e.g., material science and engineering, energy, petroleum and petrochemical engineering, food engineering, environmental engineering, and biotechnology.

3. To promote interdisciplinary research in order to strengthen the Faculty's and the University's research capability, which will be beneficial for the development of technology as well as the improvement of the teaching quality both at the undergraduate and graduate levels.

5. Program Inception

Enrollment of students in the revised programs will begin in the first trimester of the academic year 2007.

6. Admission Requirements

The applicants' qualifications follow those described in SUT Regulation for Graduate Studies. The program welcomes all qualifed applicants holding their Bachelor or Master degrees in chemical engineering, chemical technology, biotechnology, and related fields. In general, admission to the Master program requires applicants to hold their Bachelor degrees with the cumulative GPA no lesser than 2.5 of the 4.0 system or equivalent. Applicants who have their GPAX lesser than 2.5 may apply if the Grade Point Average in their major no lesser than 2.75 or if they have work experience after their graduation. Admission to the Doctoral program requires applicants to hold their Bachelor degrees with the cumulative GPA no lesser than 3.25. Research experience and publication are strongly encouraged for applicants who would like to study in the research and thesis program (Scheme 1). Potential applicants are advised to find more detailed information from the university's announcements.

7. Application Process

As stated in the SUT Regulation for Graduate Studies (Appendix B).

8. Academic System

As stated in the SUT Regulation for Graduate Studies.

9. Study Duration

As stated in the SUT Regulation for Graduate Studies.

10. Registration

As stated in the SUT Regulation for Graduate Studies.

11. Degree Requirements

Master degree

- Register and study courses required by the program with the cumulative GPA no lesser than 3.00
- Pass the comprehensive examination
- Attain the proposal approval
- Present the research work in a conference or publish their research work in a journal
- Pass the thesis defense

Doctoral degree

Scheme 1

- Register 60 credits of Doctoral thesis
- Pass the qualifying examination
- Attain the proposal approval
- Satisfy SUT English requirement as stated in the SUT Regulation for Graduate Studies
- Publish at least 2 papers in international peer-reviewed journal(s) appeared in the Citation Index
- Pass the thesis defense

Scheme 2

- Register and study courses required by the program with the cumulative GPA no lesser than 3.00
- Pass the qualifying examination
- Attain the proposal approval

- Satisfy SUT English requirement as stated in the SUT Regulation for Graduate Studies
- Publish at least one paper in an international peer-reviewed journal appeared in the Citation Index
- Pass the thesis defense

12. Faculty

12.1. Curriculum Faculty

Associate Professor Chaiyot Tangsathitkulchai
Ph. D. (Min. Proc.)
Pennsylvania State University, USA.

Associate Professor Adrian Flood
Ph. D. (Chem. Eng.)
The University of Queensland, Brisbane, Australia

Assistant Professor Chalongsri Flood
Ph. D. (Chem. Eng.)
The University of Queensland, Brisbane, Australia

Assistant Professor Rattanawan Kiatikomol
Ph. D. (Chem. Eng.)
Imperial College, London, United Kingdom

Dr. Terasut Sookkumnerd
Ph. D. (Chem. Eng.)
Lehigh University, Bethlehem, Pennsylvania, USA.

12.2. Teaching Faculty

Dr. Panarat Tomanee, Lecturer
Ph. D. (Chem. Eng.)
Lehigh University, Bethlehem, Pennsylvania, USA.

Dr. Guntima Sirijeerachai
Ph. D. (Chem. Eng.)
Dalhousie University, Nova Scotia, Canada.

13. Enrollments

For the first 5 – year plan, the number of student enrollment to the program in each year is as follows

Academic Year	Number of admission		Number expected to graduate in the academic year	
	Master	Doctoral	Master	Doctoral
2007	5	2	-	-
2008	5	2	-	-
2009	5	2	5	-
2010	5	2	5	2
2011	5	2	5	2

14. Location and Equipment

Location: Classrooms in the Center of Educational Services, SUT campus

Equipment: Laboratory equipment from the Center for Scientific and Technology Equipments; and accessories for lecturing from the Center of Library Resources and Educational Media, Suranaree University of Technology.

15. Library

The Center of Library Resources and Educational Media offers the following resources and services.

15.1 Resources

15.1.1	Books	
	Thai	22,424 titles
	English	68,616 titles
15.1.2	Journals	
	Thai	142 titles
	International	285 titles
	Received from Donation	995 titles
15.1.3	Audio-visual and electronic	3,279 titles

15.2 Inter-Library Loan

Offering loan/photocopying services from other Thai and foreign universities and other public institutions.

15.3 Information Search Service

15.3.1 Search for items at CLREM

15.3.2 Search for items at other libraries

15.4 Database

15.4.1 Database on CD-ROM

- Chemistry Citation Index from 1999
- ComputMath Citation Index from 1999
- Thai theses from B.E.2509

15.4.2 Database On-line

- IEEE/IEL -- Full text database of articles, journals, proceedings and standards in electrical and electronic engineering and other related fields
- DAO -- database of abstracts of Master and Ph.D.thesis from U.S., Canada, etc. in all fields.
- Medline -- database in medicine, public health, nursing and medical sciences.
- FirstSearch over 80 databases covering all fields, e.g. sciences, technology, agriculture, medicine, etc.
- e-journal from American Chemical Society over 24 titles covering chemistry, biochemistry and biotechnology from 1996.

CLREM web: http://library.sut.ac.th

16. Fiscal Budget

The School of Chemical Engineering receives the annual budget from Suranaree University of Technology.

17. Curriculum

The School of Chemical Engineering offers graduate programs that comply with SUT Regulation for Graduate Studies. Details of the program are given as follows :

17.1 Total Credits

Master Degree Program

- Plan A Scheme A2 (Instructional courses with thesis) minimum 47 credits

Doctoral DegreeProgram

For Master degree holders

- Scheme 1.1 (Research and thesis) minimum	60 credits
- Scheme 2.1 (Instructional courses with thesis) minimum	61 credits

For Bachelor degree holders

- Scheme 2.2 (Instructional courses with thesis) minimum	94 credits

17.2 Program Structure

Master Degree Program

Plan A Scheme A2: Instructional Courses with Thesis

Students who pursue their Master degrees under this option are required to take instructional courses and Master thesis of 27 and 20 credits, respectively. Therefore, the total number of credit required is 47 and is comprised of :

- Core courses	16 credits
- Elective courses (minimum)	9 credits
- Graduate seminar courses	2 credits
- Master Thesis (minimum)	20 credits

The grades given to students in graduate seminar courses are S and U.

The conditional acceptance may be offered to some applicants upon the decision of the School. Such applicants must take some undergraduate courses deemed appropriate to strengthen their academic background.

Doctoral Degree Program

Scheme 1: Research and Thesis

Students who pursue their Doctoral degrees under this option are required to conduct original research under the advisor's supervision. The students must demonstrate their ability to conduct their original research independently and be able to present the original findings in international peer-reviewed journals.
The total number of credits required for a Master degree holder is 60.

Scheme 2: Instructional Courses with Thesis

Scheme 2.1

Students who pursue their Doctoral degrees with their Master degrees under this option are required to take instructional courses and Doctoral thesis of 16 and 45 credits, respectively. Therefore, the total number of credits required is 61 and is comprised of:

- Core courses / Elective courses (minimum)	15 credits
- Graduate seminar course	1 credits
- Doctoral Thesis (minimum)	45 credits

The grades given to students in graduate seminar courses are S and U.

Scheme 2.2

Students who pursue their Doctoral degrees with their Bachelor degrees under this option are required to take instructional courses and Doctoral thesis of 34 and 60 credits, respectively. Therefore, the total number of credits required is 94 and is comprised of:

- Core courses	16 credits
- Elective courses (minimum)	15 credits
- Graduate seminar courses	3 credits
- Doctoral Thesis (minimum)	60 credits

The grades given to students in graduate seminar courses are S and U.
The conditional acceptance may be offered to some applicants upon the decision of the School. Such applicants must take some undergraduate courses deemed appropriate to strengthen their academic background.

17.3 Courses

Core courses

424611	Advanced Transport Phenomena	4(4-0-12)
424621	Advanced Chemical Engineering Thermodynamics	4(4-0-12)
424622	Advanced Chemical Reaction Engineering	4(4-0-12)
424631	Advanced Numerical Methods for Chemical Engineers	4(4-0-12)

Elective courses

1. Transport Phenomena and Separation Processes

424711	Advanced Fluid Mechanics	3(3-0-9)
424712	Non-Newtonian Fluid Mechanics	3(3-0-9)
424713	Advanced Heat and Mass Transfer	3(3-0-9)
424714	Diffusional Operations	3(3-0-9)
424715	Separation Processes	3(3-0-9)
424716	Membrane Technology	3(3-0-9)

424717	Crystallization and Modeling	3(3-0-9)
424718	Adsorption Process	3(3-0-9)
424719	Multicomponent Distillation	3(3-0-9)
424811	Multi-Phase Flow in Chemical Engineering	3(3-0-9)

2. Thermodynamics and Chemical Reaction Engineering

424721	Advanced Topics in Thermodynamics	3(3-0-9)
424722	Thermodynamics of Mixtures	3(3-0-9)
424723	Introduction to Statistical Thermodynamics	3(3-0-9)
424724	Advanced Topics in Chemical Reaction Engineering	3(3-0-9)
424725	Reactor Design and Optimization	3(3-0-9)
424726	Polymer Reaction Engineering	3(3-0-9)
424727	Irreversible Thermodynamics	3(3-0-9)

3. Applied Mathematics & Process Simulation and Control

424731	Advanced Mathematics for Chemical Engineers	3(3-0-9)
424732	Modeling and Simulation in Chemical Engineering	3(3-0-9)
424733	Industrial Chemical Process Design	3(3-0-9)
424734	Chemical Process Optimization	3(3-0-9)
424735	Advanced Chemical Process Control	3(3-0-9)
424736	Multivariable Process Control	3(3-0-9)
424737	Design of Experiments and Data Analysis	3(3-0-9)

4. Energy Technology

424741	Principles of Combustion	3(3-0-9)
424742	Biomass Conversion Processes	3(3-0-9)
424743	Natural Gas Processing	3(3-0-9)
424744	Coal Conversion Technology	3(3-0-9)
424745	Energy Management	3(3-0-9)

5. Environmental Engineering

424751	Hazard Analysis, Assessment and Prevention in Chemical Process Industries	3(3-0-9)
432513	Advanced Water and Wastewater Analysis	3(2-3-4)
432514	Advanced Processes for Water and Wastewater Treatment	3(3-0-6)
432521	Air Pollution Control Engineering	3(3-0-6)
432531	Solid Waste and Hazardous Waste Management	3(3-0-6)
432532	Industrial Waste Abatement and Management	3(3-0-6)

6. Biochemical Engineering and Biotechnology

424761	Modeling of Biological System	3(3-0-9)
424762	Bioreactor Design	3(3-0-9)
424763	Fermentation Technology	3(3-0-9)
424764	Bioseparation processes	3(3-0-9)
110752	Biochemical Product Development	3(3-0-9)
110761	Enzyme Technology and Applied Enzymology	3(3-0-9)
304522	Advanced Bioprocess Engineering	3(3-0-9)
304623	Bioprocess Technology for Waste Treatment	3(3-0-9)

7. Materials and Powder Technology

424771	Interfacial Phenomena	3(3-0-9)
424772	Aerosol Technology	3(3-0-9)

424773	Corrosion Control	3(3-0-9)
424774	Electrochemical Engineering	3(3-0-9)

8. Petrochemical Technology

424781	Petroleum Processing	3(3-0-9)
424782	Petrochemical Manufacturing Processes	3(3-0-9)
424783	Chemistry of Catalytic Processes	3(3-0-9)
424784	Heterogeneous Catalysis	3(3-0-9)
424785	Design Method in Petroleum Industry	3(3-0-9)
424786	Design Method in Petrochemical Industry	3(3-0-9)
507502	Polymer Rheology	3(3-0-9)
507503	Advanced Polymer Processing	3(3-0-9)

9. Other Subjects

424891	Advanced Topics in Chemical Engineering	3(3-0-9)
424892	Selected Topics in Chemical Engineering	3(3-0-9)
424893	Special Problems	3
424894	Independent Study	3

10. Seminar and Thesis

424695	Graduate Seminar I		1(0-3-3)
424696	Graduate Seminar II		1(0-3-3)
424697	Graduate Seminar III		1(0-3-3)
424698	Master thesis	minimum	20 credits
424699	Doctoral Thesis	minimum	45-94 credits

11. *Others Subjects in Other Schools*

Students may take a graduated course offered by any Schools in Suranaree University of Technology as an elective course under the consent of School of Chemical Engineering if such a course is critical for their research.

Note: The 6 digit course number has the following meaning

- The first digit represents the Institute code; i.e., Institute of Engineering = 4
- The second and third digits are the School code; i.e., School of Chemical Engineering = 24
- The fourth digit indicates the study levels; i.e., 5 = advanced undergraduate course, 6 = core course and 7-8 = graduate elective course
- The fifth digit shows the specialized area of the course as follows:
  1 : Transport Phenomena & Separation Processes
  2 : Thermodynamics & Chemical Reaction Engineering
  3 : Applied Mathematics & Process Simulation and Control
  4 : Energy Technology
  5 : Environmental Engineering
  6 : Biochemical Engineering and Biotechnology
  7 : Material and Powder Technology
  8 : Petrochemical Technology
  9 : Special Problem/Seminar/Independent Study/Thesis/Other subjects
- The sixth digit indicates the order of the course in the specialized area

17.4 Study Plan

Plan A Scheme A2: Instructional courses with thesis

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	424611 Advanced Transport Phenomena 424631 Advanced Numerical Methods for Chemical Engineers xxxxxx Elective	4 4 3	424621 Advanced Chemical Engineering Thermodynamics 424622 Advanced Chemical Reaction Engineering xxxxxx Elective	4 4 3	xxxxxx Elective 424695 Graduate Seminar I 424698 Master Thesis	3 1 5
	Total	**11**	**Total**	**11**	**Total**	**9**
2	424696 Graduate Seminar II 424698 Master Thesis	1 10	424698 Master Thesis	5		
	Total	**11**	**Total**	**5**		

Total 47 credits

Scheme 1: Research and thesis

Scheme 1.1 For Master degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	424699 Doctoral Thesis	3	424699 Doctoral Thesis	3	424699 Doctoral Thesis	10
	Total	**3**	**Total**	**3**	**Total**	**10**
2	424699 Doctoral Thesis	10	424699 Doctoral Thesis	10	424699 Doctoral Thesis	10
	Total	**10**	**Total**	**10**	**Total**	**10**
3	424699 Doctoral Thesis	10	424699 Doctoral Thesis	4		
	Total	**10**	**Total**	**4**		

Total 60 credits

Scheme 2: Instructional courses and thesis

Scheme 2.1 For Master degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	424xxx Core/Elective course 424xxx Core/Elective course xxxxxx Elective	3 3 3	xxxxxx Elective xxxxxx Elective 424695 Graduate Seminar I	3 3 1	424699 Doctoral Thesis	7
	Total	**9**	**Total**	**7**	**Total**	**7**
2	424699 Doctoral Thesis	7	424699 Doctoral Thesis	7	424699 Doctoral Thesis	7
	Total	**7**	**Total**	**7**	**Total**	**7**
3	424699 Doctoral Thesis	7	424699 Doctoral Thesis	7	424699 Doctoral Thesis	3
	Total	**7**	**Total**	**7**	**Total**	**3**

Total 60 credits

Scheme 2.2 For Bachelor degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	424611 Advanced Transport Phenomena 424631 Advanced Numerical Methods for Chemical Engineers xxxxxx Elective	4 4 3	424621 Advanced Chemical Engineering Thermodynamics 424622 Advanced Chemical Reaction Engineering xxxxxx Elective	4 4 3	xxxxxx Elective 424695 Graduate Seminar I 424699 Doctoral Thesis	3 1 5
	Total	**11**	**Total**	**11**	**Total**	**9**
2	xxxxxx Elective xxxxxx Elective 424699 Doctoral Thesis	3 3 3	424696 Graduate Seminar II 424699 Doctoral Thesis	1 6	424697 Graduate Seminar III 424699 Doctoral Thesis	1 6
	Total	**9**	**Total**	**7**	**Total**	**7**
3	424699 Doctoral Thesis	6	424699 Doctoral Thesis	6	424699 Doctoral Thesis	7
	Total	**6**	**Total**	**6**	**Total**	**7**
4	424699 Doctoral Thesis	7	424699 Doctoral Thesis	7	424699 Doctoral Thesis	7
	Total	**7**	**Total**	**7**	**Total**	**7**

Total 94 credits

17.5 Course Description

17.5.1 Core Courses

424611 Advanced Transport Phenomena 4(4-0-12)

Prerequisite: Undergraduate course in Heat and Mass Transfer or Consent of the School

Course Description

Rigorous analysis of transport equations of mass, energy and momentum and the analogies between them. Kinetic theory and estimate of transport properties. Diffusive and convective transport accompanied by chemical reaction. Boundary layer theory. Non-Newtonian flow. Analysis of multiphase systems. Mechanics of turbulent transport. Simultaneous heat and mass transfer. Applications to special chemical engineering problems.

Course Outline

1. Formulation and analysis of transport equations	(4 hours)
2. Analytical and approximate solutions to the equation of change	(4 hours)
3. Kinetic theory of transport properties	(4 hours)
4. Estimation of transport properties	(4 hours)
5. Diffusive and convective transport with chemical reactions	(5 hours)
6. Boundary layer theory	(5 hours)
7. Non-Newtonian Flow	(5 hours)
8. Equations for multiphase systems	(6 hours)
9. Turbulent transport	(6 hours)
10. Simultaneous heat and mass transfer	(5 hours)

424622 Advanced Chemical Reaction Engineering 4(4-0-12)

Prerequisite: Undergraduate course in Chemical Reaction Engineering or Consent of the School

Course Description

Advanced treatment of chemical kinetics and reactor systems including non-isothermal / adiabatic, non-ideal flow systems. Effect of fluid mixing on reactor performance. Homogeneous and heterogeneous catalysis. Heat and mass transport and chemical reaction in porous catalyst. Analysis of reactor stability. Optimization techniques applied to the design of chemical reactors.

Course Outline

1. Analysis of non-isothermal, non-ideal reactor systems	(10 hours)
2. Mixing effect on reactor performance	(10 hours)
3. Homogeneous & heterogeneous catalysis	(10 hours)
4. Reactor stability concepts	(10 hours)
5. Optimization method for reactor design	(8 hours)

424631 Advanced Numerical Methods for Chemical Engineers **4(4-0-12)**
Prerequisite: Differential Equations and Computer Programming or Consent of the School
Course Description

Study of single and systems of linear and nonlinear algebraic equations, numerical differential and integration. Various single and multiple step methods for initial and boundary type or dinary differential equations. Finite difference methods, method of weighted residue and finite element methods for nonlinear and partial differential equations. Numerical stability.

Course Outline

1. Algebraic system
   1.1 Single equation (6 hours)
      - One point iteration method (OPIM)
      - Multiple point iteration method (MPIM)
   1.2 Systems of linear algebraic equations (5 hours)
   1.3 Systems of non-linear algebraic equations (6 hours)
      - OPIM (Newton's methods, Quasi-Newton method)
      - MPIM
      - Gradient methods (Descent methods, Gauss-Newton Method, Levenberg-Marquardt method)
2. Numerical calculus (3 hours)
   2.1 Numerical differentiation
   2.2 Numerical integration
3. Ordinary differential equations (ODEs)
   3.1 Initial value problems (IVPs) (7 hours)
      - Multiple step method (Adams-Bashforth formulae, Adams-Moulton formulae)
      - Single step method (Euler method, Runge-Kutta methods)
      - Stability analysis
   3.2 Boundary value problems (BVPs) (6 hours)
      - Finite difference method (FDM)
      - Shooting method (SM)
      - Orthogonal collocation (OC)
      - Finite element method (FEM)
4. Partial differential equations (PDEs)
   4.1 Types of equations : (3 hours)
      - Elliptic equation
      - Parabolic equation
      - Hyperbolic equation
      - Boundary conditions (Dirichlet, Neumann, Robbins)
   3.3 Finite difference method (FDM) (4 hours)
   3.4 Finite element method (FEM) (4 hours)
   3.5 Orthogonal collocation (OC) (4 hours)

502621 Advanced Chemical Engineering Thermodynamics **4(4-0-12)**

Prerequisite: Undergraduate course in Chemical Engineering Thermodynamics or Consent of the School

Course Description

Classical Themodynamics of Phase Equilibria. Thermodynamic properties of non-ideal binary and multi-component mixtures. Vapor-liquid equilibrium (VLE) from activity coefficient models (e.g. van Laar NRTL and UNIFAC), VLE using equations of state (e.g. the virial and Peng-Robinson equations). Solubility of gases in liquids. Equilibrium of solids in fluids. Distribution of a solute between two liquid phases. Osmotic equilibrium. Advanced topics in chemical reaction equilibrium.

Course Outline

1. Classical Themodynamics of Phase Equilibria	(6 hours)
2. Thermodynamic Properties from Volumetric Data	(6 hours)
3. Intermolecular Forces and the Theory of Corresponding States	(6 hours)
4. Fugacities in Gas Mixture	(6 hours)
5. Fugacities in Liquid Mixture	(6 hours)
6. Solubilities of Gas in Liquids	(4 hours)
7. Solubilities of Solids in Liquids	(4 hours)
8. High Pressure Equilibria	(6 hours)
9. Introduction to Electrolyte Solutions	(4 hours)

17.5.2 Transport Phenomena & Separation Processes

424711 Advanced Fluid Mechanics **3(3-0-9)**

Prerequisite: Undergraduate course in Fluid Mechanics or Consent of the School

Course Description

Expressions for the equation of change in terms of flux vectors. Derivation of the Navier-Stokes equation. Application of the basic flow equations : ideal (inviscid) and potential flows, low Reynolds number flow, laminar boundary layer flow. Method of flow analysis. Compressible flow. Turbulence and fluid mixing processes.

Course Outline

1. The Equation of Change (6 hours)
    - 1.1 Flux Vectors
    - 1.2 Derivation of Equation of Change
        - Continuity Equation
        - Momentum Equation
        - Energy Equation
2. The Navier-Stokes Equation (4 hours)
3. Application of the Basic Flow Equations (12 hours)
    - 3.1 Ideal or Inviscid Flow
    - 3.2 Exact Solutions for Laminar Viscous Flow
    - 3.3 Very Slow Motion for Laminar Viscous Flow
    - 3.4 The Boundary Layer Theory

4. Method of Flow Analysis	(6 hours)
4.1 Integral Method	
4.2 Dimensional Analysis	
4.3 Modeling	
5. Compressible Flow	(4 hours)
6. Turbulence and Fluid Mixing	(4 hours)

424712 Non-Newtonian Fluid Mechanics **3(3-0-9)**

Prerequisite: Undergraduate course in Fluid Mechanics or Consent of the School

Course Description

Rheological characteristics of materials. Measurement of Rheological properties. Rheological equations of state : empirical and semi-empirical equations, stress constitutive equations. Non-Newtonian fluid flow : viscometric flows, capillary flow and rotational flow. Rhelogy of polymeric liquids and of dispersed systems. Applications in chemical engineering processing.

Course Outline

1. Principles of Non-Newtonian phenomena	(2 hours)
2. Rheological properties of materials	(3 hours)
- Time-independent systems	
- Time-dependent systems	
3. Rheological measurements	(4 hours)
4. Rheological equations of state	(9 hours)
- Empirical equations	
- Semi-empirical equations	
- Constitutive equations	
5. Non-Newtonian fluid flow	(8 hours)
- Viscometry flows	
- Capillary flow	
- Rotational flow	
6. Rheology of polymeric fluids and dispersed systems	(6 hours)
7. Applications of rheological analysis in some chemical engineering processes	(4 hours)

424713 Advanced Heat and Mass Transfer **3(3-0-9)**

Prerequisite: Undergraduate course in Heat and Mass Transfer or Consent of the School

Course Description

Conservation principles and constitutive laws. Steady and transient heat conduction. Convective heat transfer and phase change phenomena. Heat transfer by radiation. Diffusive and convective mass transfer. Mass transfer coefficient and models. Simultaneous heat and mass transfer. Mass transfer with chemical reaction. Application to separation processes.

Course Outline

1. Conservation principles	(1 hour)
2. Constitutive laws	(2 hours)
- Diffusion flux	
- Transfer coefficients	
3. Heat transfer by conduction	(2 hours)
4. Transient heat transfer by conduction	(3 hours)
5. Convective heat transfer	(4 hours)
- Transfer from a flat plate	
- Transfer in pipe flow	
- Correlations and model equations	
6. Phase change phenomena	(3 hours)
7. Heat transfer by radiation	(3 hours)
8. Diffusive and convective mass transfer	(4 hours)
9. Mass transfer coefficient and models	(4 hours)
10. Simultaneous heat and mass transfer	(4 hours)
11. Mass Transfer with chemical reaction	(4 hours)
12. Application to separation processes	(2 hours)

424714 Diffusional Operations **3(3-0-9)**

Prerequisite: Undergraduate course in Mass Transfer or Consent of the School

Course Description

The application of diffusional theories to the design and operation of chemical engineering unit operations and unit processes, such as absorption, solid-liquid extraction, adsorption, drying and chemical reactors.

Course Outline

1. Theory of mass transfer diffusion	(5 hours)
- Molecular diffusion	
- Mass transfer coefficients	
- Interphase mass transfer	
2. Equipment for gas-liquid operations	(4 hours)
3. Gas-liquid operations	(8 hours)
- Humidification	
- Gas absorption	
- Distillation	
4. Liquid-liquid operations	(4 hours)
5. Solid-liquid operations	(8 hours)
- Adsorption	
- Ion-exchange	
- Leaching	
- Drying	
6. Chemical reactor operations	(7 hours)

424715 Separation Processes **3(3-0-9)**

Prerequisite: Undergraduate course in Chemical Engineering Unit Operations or Consent of the School

Course Description

Analysis and practice of multistage separation processes, including distillation, liquid-liquid extraction, fluid-solid processes, rate-governed separation processes. It also deals with design and simulation of separation operations using mass transfer principles. All topics are illustrated by detailed examples.

Course Outline

1. Introduction to separation processes	(1 hour)
2. Mechanism of separation processes	(1 hour)
2. Simple equilibrium processes	(4 hours)
3. Multistage separation processes	(6 hours)
- Multistage distillation	
- Liquid-liquid extraction	
- Fluid-solid separation	
- Rate-governed processes	
4. Computational approaches	(6 hours)
- Binary multistage separations	
- Multicomponent multistage separations	
5. Capacity and efficiency of separation processes	(6 hours)
6. Selection of separation processes	(6 hours)
7. Optimal design and operation of separation processes	(6 hours)

424716 Membrane Technology **3(3-0-9)**

Condition: Consent of the School

Course Description

Study of membrane processes : reverse osmosis, ultrafiltration, electrodialysis, pervaporation and gas permeation. Membrane structure, materials and performance. Mass transport in membrane. Module design and module characteristics. Applications of membrane processes in industries.

Course Outline

1. Membrane processes	(6 hours)
- Reverse osmosis	
- Ultrafiltration	
- Electrodialysis	
- Pervaporation	
- Gas permeation	
2. Membrane structure	(6 hours)
- Materials and performance	
- Asymmetric membranes	
- Symmetrical membranes	

  - Liquid membranes
3. Mass transport in membrane (10 hours)
   - Irreversible thermodynamics
   - Sorption-Capillary flow theory
   - The Solution-Diffusion model
   - Vicious flow model
   - Concentration polarization
   - Permeation model for gasses and liquids
4. Module design and module characteristic (8 hours)
   - Tubular module
   - Plate and frame module
   - Capillary module
   - Hollow fibre module
   - Spiral wound module
   - Cascades
5. Applications in industries (6 hours)

424717 Crystallization and Modeling **3(3-0-9)**
Condition: Consent of the School
Course Description

Principles of crystallization and agglomerization. Particle size distributions and their representations. Deriving the population balance model for microscopic and macroscopic systems. Population balance models for batch and continuous crystallizers. Analysis of size dependent crystal growth. Analysis of crystal growth rate dispersion. Application of the population balance model to agglomeration systems. Birth and death functions in agglomeration systems.

Course Outline

1. Basic principles of crystallization and agglomeration processes (4 hours)
2. Particle size distributions and means of representations (4 hours)
3. Derivation of population balance model for microscopic and macroscopic systems (6 hours)
4. Population balance models for batch and continuous crystallizers (6 hours)
5. Analysis of size dependent crystal growth (3 hours)
6. Analysis of dispersion of crystal growth rate (3 hours)
7. Application of the population balance model to agglomeration systems (6 hours)
8. Birth and death functions in agglomeration systems (4 hours)

424718 Adsorption Process 3(3-0-9)

Prerequisite: Undergraduate course in Mass Transfer or Consent of the School

Course Description

Definition of terms, physical vs chemical adsorption, types, applications and preparation of commercial adsorbents. Adsorption equilibria of pure component and mixtures. Determination of surface area and pore volume distribution of adsorbents by gas-adsorption technique. Transport processes in adsorption systems. Macroscopic description of adsorption systems. Dynamics of fixed-bed adsorption. Adsorption processes and cycles. Design procedures

Course Outline

1. Definition of terms	(3 hours)
2. Equilibria of pure component adsorption	(4 hours)
3. Determination of porous properties of adsorbents	(4 hours)
4. Equilibria of multicomponent adsorption	(4 hours)
5. Transport and kinetics in adsorption process	(4 hours)
6. Macroscopic balances of adsorbers	(4 hours)
7. Dynamics of fixed-bed adsorbers	(5 hours)
8. Cyclic adsorption processes and modeling	(4 hours)
9. Design Methodology	(4 hours)

424719 Multicomponent Distillation 3(3-0-9)

Prerequisite: Undergraduate course in Mass Transfer or Consent of the School

Course Description

Multicomponent thermodynamic equilibrium. Introduction to multicomponent distillation. Optimum separation sequences. Approximate methods for designing multicomponent distillation processes. Rigorous analysis for designing multicomponent distillation processes. Stage design and efficiency. Reduction of energy requirement and heat integration in distillation. Dynamic simulation of multicomponent distillation.

Course Outline

1. Multicomponent thermodynamic equilibrium	(4 hours)
2. Introduction to multicomponent distillation	(1 hour)
3. Choosing the optimum separation Sequence	(4 hours)
4. Approximate methods for distillation design	(6 hours)
5. Rigorous methods for distillation design	(6 hours)
6. Stage Design and efficiency	(6 hours)
7. Energy requirement and heat integration	(4 hours)
8. Dynamic simulation of multicomponent distillation	(5 hours)

424811 Multi-Phase Flow in Chemical Engineering **3(3-0-9)**
Condition: Consent of the School
Course Description

Turbulent in real fluids. Modeling of multi-phase flow using software e.g. Fluent or CFX. Computational Fluid Dynamics (CFD) with multiphase flow equations and a capability by which these flow regimes can be visualized and understood. Numerical simulation of multi phase flow. Selected topics in multi-phase flow related to student's thesis topic.

Course Outline

1. Review of fluid mechanics	(6 hours)
2. Turbulent s in real fluids	(10 hours)
3. Computational Fluid Dynamics (CFD) with multiphase flow equations	(8 hours)
4. Numerical simulation of multi phase flow.	(8 hours)
5. Selected topics in multi-phase flow related to student's thesis topic.	(4 hours)

17.5.3 Thermodynamics & Chemical Reaction Engineering

424721 Advanced Topics in Thermodynamics **3(3-0-9)**
Prerequisite: Undergraduate course in Chemical Engineering Thermodynamics or Consent of the School
Course Description

Vigorous analysis of current literature and research in a certain area of thermodynamics. Possible topics are statistical thermodynamics, phenomena in multicomponent reaction systems, Complex physical and chemical equilibria, etc.

Course Outline

1. Selected topics in a particular area of thermodynamics	(36 hours)

424722 Thermodynamics of Mixtures **3(3-0-9)**
Prerequisite: Undergraduate course in Chemical Engineering Thermodynamics or Consent of the School
Course Description

Properties of ideal and non-ideal vapors and liquids : partial molar properties, chemical potential, ideal and non-ideal solutions, concept of activity and standard states. Ideal and non-ideal multicomponent mixtures : thermodynamic description of mixtures, generalized Gibbs-Duhem equation, the equations of change for a multicomponent system. Estimation of Gibbs free energy and fugacity of a component in a mixture. Phase equilibrium in mixtures. Chemical reaction equilibrium and the balance equations. Electrolyte solutions. Solid-phase thermodynamics.

Course Outline

1. Properties of ideal and non-ideal solutions (4 hours)
    - Partial molar properties
    - Chemical potential
    - Concept of fugacity
    - Ideal and non-ideal solutions
    - Concept of activity and standard states
2. Ideal and non-ideal nulticomponent mixtures (5 hours)
    - Thermodynamic description of mixtures
    - Generalized Gibbs-Duhem Equation
    - The Equations of change for a multicomponent system
3. Estimation of the Gibbs free energy and fugacity (5 hours)
    - Partial molar Gibbs free energy and fugacity
    - Excess mixture properties
    - Fugacity of a species in gaseous, liquid and solid mixtures
4. Phase equilibrium in mixtures (7 hours)
    - Vapor-liquid equilibria using activity coefficient and equation of state
    - Gas-liquid solubility
    - Liquid-liquid solobility
    - Solubility of a solid in a liquid and a gas
5. Chemical reaction equilibrium and the balance equations (7 hours)
    - Chem equilibrium in a single-phase system
    - Heterogeneous chemical reaction
    - Combined chemical and phase equilibrium
    - Overall reactor balance equations
6. Electrolyte solutions (4 hours)
7. Solid-phase thermodynamics (4 hours)

424723 Introduction to Statistical Thermodynamics **3(3-0-9)**
Prerequisite: Undergraduate course in Thermodynamics or Consent of the School
Course Description

Fundamentals of Statistical Thermodynamics. Statistical formulation of the laws of thermodynamics. Classical statistical mechanics, quantum mechanics and spectroscopy. Application of statistical thermodynamics to ideal and real gases, mixtures of gases and transport phenomena and chemical kinetics.

Course Outline

1. Fundamentals of Statistical Thermodynamics and formulation of thermodynamic equations (9 hours)
2. Classical statistical mechanics (9 hours)
3. Quantum mechanics (9 hours)
    - Bohr theory
    - Wave characteristics
    - Wave equation

- Translation
- Electronic states of atoms

4. Applications of Statistical Thermodynamics (9 hours)
   - Contributions to partition function and properties
   - Real gases
   - Mixtures of gases
   - Transport phenomena
   - Chemical reaction

424724 Advanced Topics in Chemical Reaction Engineering 3(3-0-9)

Prerequisite: Undergraduate course in Chemical Kinetics and Reactor Design or Consent of the School

Course Description

Selected topics based on current research interests in chemical reaction engineering. Typical topics include, three-phase reactors, bioreactors, polymerization reactors, reactor stability, diffusion effects in heterogeneous reactors, etc.

Course Outline

1. Advanced selected topics in chemical reaction engineering (36 hours)

424725 Reactor Design and Optimization 3(3-0-9)

Prerequisite: Undergraduate course in Chemical Reactor Design or Consent of the School

Course Description

Fundamentals of reactor design for heterogeneous catalytic. Diffusion and reaction in porous catalysts. External heat and mass effects on the reaction rate. Development of the global reaction rates for heterogeneous catalytic reactors. Optimum design consideration and illustrative problems for various types of heterogeneous reactors including, fixed-bed, fluidized-bed and moving-bed reactors.

Course Outline

1. Types and characters of heterogeneous Catalytic reactors (3 hours)
2. Mass transport processes within porous catalysts (5 hours)
3. Diffusion and reaction in porous catalysts (6 hours)
   - Effectiveness factors
   - Intraparticle temperature gradients
   - Effect of catalyst poisoning
4. External heat and mass transfer effects on the reaction rate (6 hours)
5. Development of the "Global" reaction rate approach (6 hours)
6. Optimum design method for various heterogeneous reactors (10 hours)

424726 Polymer Reaction Engineering 3(3-0-9)

Prerequisite: Undergraduate Course in Chemical Reaction Engineering or Consent of the School

Course Description

Application of the principles of chemical engineering to the analysis and design of polymerization reactions. Theory of polymerization reactions. Mathematical modeling of polymerization kinetics. Polymerization reactor design. Reactor operation and control. Current research work in polymerization reaction engineering. Case studies of important polymer processes.

Course Outline

1. Polymer characterization	(3 hours)
2. Theory of polymerization reactions	(5 hours)
3. Mathematical modeling of polymerization kinetics	(5 hours)
4. Polymerization reactor design	(12 hours)
- Factors in reactor design	
- Choice of phases	
- Choice of reactor types	
- Design fundamentals	
5. Reactor operation and control	(5 hours)
- Reactor selection	
- Reactor operation	
- Instrumentation	
- Process control strategies	
6. Current research work and case studies in polymerization reaction engineering	(6 hours)

424727 Irreversible Thermodynamics 3(3-0-9)

Prerequisite : Undergraduate course in Chemical Engineering Thermodynamics or Consent of School

Course Description

Meaning and scope of irreversible thermodynamics, Thermodynamic criteria for non-equilibrium states, Entropy production and entropy balance, Onsager's reciprocal relations, Theorem of minimum entropy production. Applications of irreversible thermodynamics to diffusion and sedimentation, electrochemical processes, thermal diffusion, rheology and membrane transport.

Course Outline

1. Meaning and Scope of Irreversible Themodynamics	(4 hours)
2. Thermodynamics Criteria for non-Equilibrium States	(6 hours)
3. Entropy Production and Entropy Balance	(6 hours)
4. Onsager's Reciprocal Relations	(4 hours)
5. Theorem of Minimum Entropy Production	(6 hours)
6. Application of Irreversible Thermodynamics	(10 hours)

17.5.4 Applied Mathematics & Process Simulation and Control

424731 Advanced Mathematics for Chemical Engineers **3(3-0-9)**

Condition: Consent of the School

Course Description

Application of advanced mathematical techniques to chemical engineering problems. Such problems are drawn from the areas of transport phenomena, thermodynamics, chemical reactor design and operations, etc. Techniques studied include, solution by series, transformation solutions, and finite differences.

Course Outline

1. Mathematical formulation of the problem	(6 hours)
2. Ordinary differential equations	(6 hours)
3. Solution by series	(6 hours)
4. Laplace transformation	(6 hours)
5. Partial differential equations	(6 hours)
6. Finite differences	(6 hours)

424732 Modeling and Simulation in Chemical Engineering **3(3-0-9)**

Condition: Consent of the School

Course Description

Modeling and analysis of various lumped and distributed parameter process systems. Fundamentals of mathematical modeling. Model formulation. Review of various solution techniques, model fitting and parameter estimation. Computer process simulation. Case studies.

Course Outline

1. Modeling consideration for process engineering systems	(4 hours)
2. Fundamentals of mathematical modeling	(5 hours)
3. Model formulation	(5 hours)
4. Solution techniques	(6 hours)
5. Model fitting and parameter estimation	(8 hours)
6. Computer simulation of selected processes and case studies	(8 hours)

424733 Industrial Chemical Process Design **3(3-0-9)**

Prerequisite: Undergraduate course in Unit Operations in Chemical Engineering or Consent of the School

Course Description

Objective of this course is to focus on the conceptual design of an industrial chemical process which transforms raw materials into the desired products. Emphasis is placed on the proper selection and synthesis of various transformation systems such as chemical reaction, heating, cooling, mixing, etc, leading to the development of process flow sheeting. Aspects of waste minimization and energy efficiency resulting in good economic performance and safety considerations are also stressed.

Course Outline

1. Approaches to process design	(3 hours)
2. Choice of chemical reactor	(3 hours)
3. Choice of separation units	(3 hours)
4. Synthesis of reaction-separation systems	(4 hours)
5. Distillation sequenching	(4 hours)
6. Heat exchanger network and design	(4 hours)
7. Economic tradeoffs	(3 hours)
8. Safety and health considerations	(3 hours)
9. Waste minimization	(3 hours)
10. Overall strategy and economic evaluation	(3 hours)
11. Case studies	(3 hours)

424734 Chemical Process Optimization **3(3-0-9)**
Condition: Consent of the School
Course Description

General problem formulation. Nature of optimization problems. Model fitting to data. Formulation of objective functions. Techniques of modern optimization theory. Optimization of single and multivariable systems with and without constraints. Linear programming and nonlinear programming with constraints. Application of optimization to various chemical engineering processes, for example, heat transfer, separation processes, chemical reactor design and operation. Optimization of large-scale plant design and operation.

Course Outline

1. Problem formulation - Nature of optimization problems - Model fitting to data - Formulation of objective functions	(6 hours)
2. Optimization theory - Single and multivariable optimization - Linear programming - Nonlinear programming with constraints	(15 hours)
3. Application of large-scale plant design and operation	(15 hours)

424735 Advanced Chemical Process Control 3(3-0-9)

Prerequisite: Undergraduate course in Process Dynamics and Control or Consent of the School

Course Description

A study of the analysis, design and simulation of advanced process control systems, including analysis of stability and robustness. Control systems include feedforward, cascade, dead-time compensation, adaptive, model based, and multivariable control. The course will consider both continuous and discrete control of processes.

Course Outline

1. Dynamic analysis of systems using Laplace transforms and z-transforms	(6 hours)
2. Analysis, design and simulation of advanced control systems	(12 hours)
3. Analysis of stability and robustness	(6 hours)
4. Multivariable process control systems	(6 hours)
5. Control of discrete-time processes	(6 hours)

424736 Multivariable Process Control 3(3-0-9)

Prerequisite: Undergraduate course in Process Dynamics and Control or Consent of the School

Course Description

Modeling multivariable systems using transfer function matrices and state variables. Analysis of the stability of multivariable systems using relative gain arrays and inverse Nyquist arrays. Analysis of the robustness of multivariable systems. Design of control systems for multivariable control including selection of controlled and manipulated variables, optimization of pairings and tuning. Model based controllers for multivariable control.

Course Outline

1. Multivariable process modeling using transfer function matrices and state variables	(6 hours)
2. Analysis of stability of multivariable systems	(6 hours)
3. Analysis of robustness of multivariable systems	(6 hours)
4. Design of control systems for multivariable control	(12 hours)
5. Model based controllers for multivariable control	(6 hours)

424737 Design of Experiments and Data Analysis **3(3-0-9)**

Condition: Consent of the School

Course Description

Rationale for design of experiments and analysis of data. Design and construction of research equipment. Considerations in the design and choice of sensors and actuations, including static and dynamic performance characteristics. Uncertainty analysis in complex equipment. Basis statistics for data analysis. Hypothesis testing using statistics. Regression of data and model fitting. Use of the analysis of variance technique (ANOVA). Design of experiments, including full factorial, and partial factorial designs (with and without replication), including blocking, confounding, and design resolutions. Optimization experimental designs, including simplex optimization and response surface based optimization designs.

Course Outline

1. Reasons for performing experiments in engineering, and how these affect the experimental design and analysis.	(1 hour)
2. Design and construction of engineering research equipment for safe and successful experiments (size, materials, safety,...)	(2 hours)
3. Design and choice of sensors and actuators in equipment	(2 hours)
- Static performance criteria	
- Dynamic performance criteria	
- Other issues relating to sensor and actuator performance	
4. Uncertainty analysis in systems of multiple components	(1 hour)
5. Properties of Data	(3 hours)
- Grouped and ungrouped data sets	
- Frequency and cumulative distribution representations of data	
- Moments of data (mean, variance, skewness, kurtosis,...)	
6. Probability density functions (normal distribution, binomial distribution, Poisson distribution,...)	(2 hours)
7. Statistical hypothesis testing	(4 hours)
8. Least squares regression for data fitting	(4 hours)
9. Correlation analysis (the correlation coefficient)	(2 hours)
10. Analysis of Variance (ANOVA) for single factors	(2 hours)
11. Multifactor ANOVA	(3 hours)
12. Factorial Experimental Designs	(4 hours)
- Full factorial designs	
- Partial factorial designs	
- To replicate or not replicate?	
- Blocking and confounding	
- Design resolutions	
13. Simplex experimental design	(2 hours)
14. Response surface based experimental design	(4 hours)

17.5.5 Energy Technology

424741 Principles of Combustion **3(3-0-9)**

Prerequisite: Undergraduate course in Thermodynamics or Consent of the School

Course Description

Fundamental definitions and phenomena. Thermodynamics of combustion processes. Transport phenomena and chemical kinetics. Reaction mechanisms. Laminar premixed and nonpremixed flames, their gross properties, structure and gas dynamics. Ignition processes. The Navier-Stokes equations for three-dimensional reacting systems. Turbulent flames and burning. Combustion of liquid and solid fuels. Formation of nitrogen oxides, hydrocarbons and soot.

Course Outline

1. Introduction, basic definitions and phenomena	(1 hour)
2. Thermodynamics of combustion processes - Laws of thermodynamics - Equilibrium in gas mixtures - Determination of adiabatic flame temperatures	(4 hours)
3. Transport phenomena and chemical kinetics	(3 hours)
4. Reaction mechanisms - Characteristics of reaction mechanisms - Quasi-steady states - Analysis of reaction mechanisms - Reaction flow analysis	(4 hours)
5. Laminar premixed and nonpremixed flames	(4 hours)
6. Ignition processes	(4 hours)
7. The Naviers-Stokes Equations - Equations of continuity - Conservation of momentum - Fick's law of diffusion - Conservation of energy	(4 hours)
8. Turbulent flames and burning - Turbulent reacting flow systems - Turbulent nonpremixed flames - Turbulent premixed flames	(4 hours)
9. Combustion of liquid and solid fuels	(4 hours)
10. Formation of nitrogen oxides, hydrocarbons and soot	(4 hours)

424742 Biomass Conversion Processes 3(3-0-9)

Condition: Consent of the School

Course Description

Introduction to biomass conversion. Characterization of biomass and products from conversion processes. Conversion processes of biomass to bioenergy and bioproducts. Thermochemical conversion by the processes of pyrolysis, gasification and combustion. Biological and engineering concepts associated with microbial and enzymatic conversion of biomass to useful products. Simulation of process behavior.

Course Outline

1. Significance of biomass as energy sources	(4 hours)
2. Physical / chemical properties and characterization of biomass and its derived products	(8 hours)
3. Thermochemical conversion processes of biomass - Pyrolysis - Gasification - Combustion	(8 hours)
4. Biological conversion processes of biomass	(8 hours)
5. Simulation of conversion process behavior	(8 hours)

424743 Natural Gas Processing 3(3-0-9)

Condition: Consent of the School

Course Description

Overview of the gas industry and gas processing. Characterization of natural gas and its products. Gas compression. Vapor-liquid equilibrium and distillation. Physical / chemical absorption methods. Acid gas removal. Minor component recovery and removal. Sweetening and dehydration of condensate and natural gas liquids (NGL). Liquefied natural gas (LNG), production, storage and transportation

Course Outline

1. Overview of the gas industry and processing methods	(2 hours)
2. Physical properties of hydrocarbon fluids	(3 hours)
3. Characterization of natural gas and its products	(5 hours)
4. Vapor-liquid equilibrium & distillation	(5 hours)
5. Physical/chemical absorption processes	(5 hours)
6. Acid gas and minor component removal and recovery	(6 hours)
7. Sweetening and dehydration processes	(5 hours)
8. Liquified natural gas	(5 hours)

424744 Coal Conversion Technology 3(3-0-9)

Condition: Consent of the School

Course Description

The course covers, in details, the major conversion technology such as carbonization, combustion, gasification and liquefaction. Also included is the emission control in coal conversion processes. The course will provide the students with a framework for which they can fully appreciate and understand the current and projected used of the world's dominant energy source-coal.

Course Outline

1. Coal properties	(4 hours)
2. Coal preparation	(5 hours)
3. Coal combustion and carbonization	(7 hours)
4. Coal gasification	(7 hours)
5. Coal liquefaction	(7 hours)
6. Emission control in coal conversion	(6 hours)

424745 Energy Management 3(3-0-9)

Condition: Consent of the School

Course Description

Principles of energy management. Organizing and managing energy management programs : planning, controlling, promoting, monitoring and reporting. Energy auditing : energy auditing services, basic components of an energy audit, specialized audit tools, industrial audits, commercial audits. Economic analysis. Knowledge of energy systems : boilers and fired systems, steam and condensate systems, waste-heat recovery. Energy management control systems. Use of alternative energy.

Course Outline

1. Introduction - Energy and economic growth - Suggested principles of energy management	(3 hours)
2. Organizing and managing energy - Planning - Controlling - Promoting - Monitoring - Reporting	(6 hours)
3. Energy auditing - Energy auditing services - Basic components of an energy audit - Specialized audit tools - Industrial audits - Commercial audits	(6 hours)

4. Economic analysis	(6 hours)
- Objective	
- Details of investment project	
- Basic income equations	
- Methods for evaluation of projects	
5. Energy systems	(6 hours)
- Boilers and fired systems	
- Steam and condensate systems	
- Waste-heat recovery systems	
6. Energy management control systems	(4 hours)
7. Use of alternative energy	(5 hours)

17.5.6 Environmental Engineering

424751 Hazard Analysis, Assessment and Prevention in Chemical Process Industries 3(3-0-9)

Condition: Consent of the School

Course Description

The definition and perception of risk in relation to chemical process plants. Analysis in modelling of hazardous incidents including fires, explosions, emission and dispersion of hazardous materials, toxic release. Safety in design and safety systems. Reliability engineering. Inherently safer design. Risk assessment and analysis. Risk and Hazard identification (HAZOP, what If Analysis etc). Risk reduction and management. Case studies from history and 3-plant visits.

Course Outline

1. The definition and perception of risk in relation to chemical process plants	(2 hours)
2. Analysis and modeling of hazardous incidents, including fires (pool fires and flash fires); explosions (vapor cloud explosions (VCE), vessel burst explosions, boiling liquid expanding vapor explosions (BLEVE), and dust explosions); emission and dispersion of hazardous materials; toxic release.	(8 hours)
3. Case studies from history, possibly including Flixborough; Piper Alpha; Bhopal; Seveso; Mexico City (PEMEX); and Texas City (AMNO)	(4 hours)
4. Safety in design and safety systems	(3 hours)
5. Reliability engineering	(3 hours)
6. Inherently safer design	(2 hours)
7. Risk Assessment and analysis	(6 hours)
8 Risk management and reduction	(3 hours)
9. Human error in chemical process safety	(2 hours)
10. Plant visit	(3 hours)

432513 Advanced Water and Wastewater Analysis 3(2-3-4)

Prerequisite: 432501 or taken concurrently or Consent of the School

Course Description

Standard and advanced analytical techniques for measuring water quality and efficiencies of water and wastewater treatment processes. Course covers both theoretical and laboratory aspects of standard methods and advanced techniques for trace metal and organic analysis. In laboratory session, eight or nine laboratories, each of which lasts three hours, are selected from those listed below.

Course Outline

Lectures

1. Sampling procedures (4 hours)
    - Grab and composite samplings
    - Statistical calculations
2. Basic concepts of quantitative chemistry (10 hours)
    - Gravimetric and volumetric analysis
    - Colorimetry
3. Instrumental methods of analysis (10 hours)
    - Optical methods
    - Electrical methods
    - Chromatographic methods

Laboratories

1. Gravimetric methods
    - Solids analysis
2. Methods of optical analysis
    - Colorimetry and Beer's law.
    - Analysis of phosphate.
    - Analysis of fluoride.
    - Determination of turbidity.
3. Acid-base reactions
    - Acid-base titration and indicators.
    - Alkalinity and the carbonate system
    - Buffer design and intensity
4. Complexation reactions
    - Hardness and calcium determination
    - Chelation and analysis of iron
    - Determination of chloride
5. Precipitation reactions
    - Solubility product determination
6. Oxidation-reduction reactions
    - Chemical oxygen demand.
    - Kjeldahl nitrogen and organic nitrogen
    - Reactions of chlorine with ammonia
    - Biochemical oxygen demand

7. Multiphase systems
    - Solubility of dissolved oxygen
    - Adsorption on activated carbon
    - Stability of colloids in turbid water
    - Distribution of an organic acid between water and an organic solvent
8. Chemical kinetics
    - Kinetics of the perdisulfate-iodide system
    - Kinetics of pyrophosphate hydrolysis
    - Kinetics of ferrous iron oxidation

432514 Advanced Processes for Water and Wastewater Treatment **3(3-0-6)**
Prerequisite: 432511 and 432512 or Consent of the School
Course Description

New technologies in water and wastewater treatment operations with emphasis on expansion of design capacity of existing units; removal of organics from drinking water, nitrogen and phosphorus removal; advanced methods of organic carbon removal, dissolved inorganic removal; technologies for reuse and recycle of treated effluent.

Course Outline

1. Need for advanced water and wastewater treatment (3 hours)
    - Effluent objectives
2. Special topics of hydraulics in water treatment processes (6 hours)
    - Rapid mixing and flow distribution
    - Currents and short circuiting in sedimentation tanks
    - Special hydraulic head losses
3. Innovative processes in water treatment (6 hours)
    - Solid-contact processes
    - Disinfection other than chlorination
    - Removal of iron and manganese
4. Advanced physical processes in wastewater treatment (9 hours)
    - Filtration and microscreening
    - Air stripping
    - Membrane processes
5. Advanced chemical processes in wastewater treatment (6 hours)
    - Ion exchange and carbon adsorption
    - Other chemical aspects on wastewater treatment
6. Advanced biological processes in wastewater treatment (6 hours)
    - Removal of nutrients (nitrogen and phosphorus)
    - Membrane bioreactors
    - Constructed wetlands

432521 Air Pollution Control Engineering 3(3-0-6)

Prerequisite: None

Course Description

Basic concepts of gases, motion of airborne particles, fundamentals of particulate emission control, cyclones, fabric filters, wet scrubbers, electrostatic precipitators, control of volatile organic compounds (VOCs), adsorption, incineration, absorption, selection of air pollution control devices for industrial application

Course Outline

1. Basic concepts of gases	(3 hours)
2. Motion of airborne particles	(3 hours)
3. Fundamentals of particulate emission control	(3 hours)
4. Cyclones	(3 hours)
5. Fabric filters	(3 hours)
6. Wet scrubbers	(3 hours)
7. Electrostatic precipitators	(3 hours)
8. Control of volatile organic compounds (VOCs)	(3 hours)
9. Adsorption	(3 hours)
10. Incineration	(3 hours)
11. Absorption	(3 hours)
12. Selection of air pollution control devices for industrial application	(3 hours)

432531 Solid Waste and Hazardous Waste Management 3(3-0-6)

Condition: Consent of the School

Course Description

Analysis of the sources, quantities, and characteristics of solid waste and hazardous waste; environmental and health effects; laws and regulations; establishment and operation of collection and transportation systems; material recovery system; processing and treatment, waste disposal; remediation of contaminated sites.

Course Outline

1. Introduction	(3 hours)
- Development of solid and hazardous waste management	
- Environmental laws and regulations	
2. Sources, composition and characteristics of solid wastes	(3 hours)
3. Resource, conservation and recovery	(3 hours)
4. Treatment and disposal	(6 hours)
- Landfill	
- Incineration	
- Composting	
5. Characteristics of hazardous wastes	(3 hours)
- Generation	
- Identification	
- Sampling and analysis	
6. Transportation of hazardous wastes	(3 hours)
7. Hazardous waste minimization and environmental audits	(3 hours)

8. Hazardous waste treatment, storage and disposal (12 hours)
    - Treatment and disposal alternatives
    - Storage techniques
    - Destruction techniques
    - Stabilization and solidification techniques
    - Land disposal techniques
    - Case studies and selected topics

432532 Industrial Waste Abatement and Management 3(3-0-6)

Condition: Consent of the School

Course Description

Industrial processes and waste characteristics; thermal and radioactive wastes; in-plant waste management; reduction reuse and recycling; effluent treatment unit processes; operation and costs; regional approaches to industrial waste treatment.

Course Outline

1. Source and characterization of industrial wastes (3 hours)
2. Laws and regulations (3 hours)
    - Current laws and regulations
    - Legislative trends and impacts
3. Planning criteria for industrial waste management (6 hours)
    - Treatment objectives
    - Pollution prevention program
    - Engineering and economic considerations
4. Review of treatment processes (12 hours)
    - Physical processes
    - Chemical processes
    - Biological processes
5. Field trip to selected industries (3 hours)
6. Selected topics of industrial wastes (6 hours)
    - Textile industries
    - Argo-industries
    - Materials industries
    - Chemical industries
7. Class presentation of term-papers (3 hours)

17.5.7 Biochemical Engineering and Biotechnology

424761 Modeling of Biological System 3(3-0-9)

Condition: Consent of the School

Course Description

Review of biological system. Biological models : segregated and non-segregated. Principles of model development and solution for enzyme systems, microbial systems. Parameter estimation, multi-species models, cell transport model.

Course Outline

1. Review of biological system	(5 hours)
2. Introduction to biological models	(8 hours)
3. Principles of model development	(8 hours)
4. Parameter estimation	(6 hours)
5. Models for multi-species	(5 hours)
6. Model for cell transportation	(4 hours)

424762 Bioreactor Design 3(3-0-9)

Condition: Consent of the School

Course Description

Types of reactors, batch and continuous. Considerations on aeration, agitation and heat transfer. Bioreactor for suspension cultures. Bioreactor using cell immobilization. Design of systems for the separation and purification of biological products.

Course Outline

1. Types of reactors	(4 hours)
2. Aeration and agitation in bioreactors	(4 hours)
3. Heat transfer in bioreactors	(6 hours)
4. Bioreactor for suspension culture	(6 hours)
5. Bioreactor using cell immobilization	(6 hours)
6. Design of separation and purification systems	(10 hours)

424763 Fermentation Technology **3(3-0-9)**

Condition: Consent of the School

Course Description

Fermentation systems. Batch and continuous culture. Raw materials for fermentation. Fermentation in food industry. Design of a fermenter. Instrumentation and control. Aeration and agitation. Fermentation modeling. Recovery and purification of fermentation products.

Course Outline

1. Types of fermentors	(4 hours)
2. Fermentation raw materials	(4 hours)
3. Fermentation in food industry	(6 hours)
4. Design of a fermentor	(10 hours)
5. Fermentation modeling	(6 hours)
6. Recovery and purification	(6 hours)

424764 Bioseparation processes **3(3-0-9)**

Condition: Consent of the School

Course Description

Characteristics of biotechnological processes and biological molecules. Overview of fundamentals, design and scale-up principle of separation processes aiming specially for recovery of biological products including sedimentation, flocculation, and centrifugation for product harvest, mechanical and chemical methods for cell disruption, and precipitation, two-phase extraction, membrane separation, adsorption, as well as chromatography for product concentration and purification.

Course Outline

1. Characteristic of biotechnological processes and biological molecules	(3 hours)
2. Method for cell harvest	(3 hours)
3. Chemical and mechanical cell disruption	(3 hours)
4. Precipitation process	(3 hours)
5. Aqueous-two phase extraction process	(4 hours)
6. Membrane separation process	(6 hours)
7. Adsorption process	(6 hours)
8. Chromatography process	(8 hours)

17.5.8 Material and Powder Technology

424771 Interfacial Phenomena 3(3-0-9)

Prerequisite: Undergraduate course in Physical Chemistry or Consent of the School

Course Description

This course concentrates on the thermodynamics, structure and rate processes involving interfacial contact between phases. Phenomenon of capillarity. Nature and thermodynamics of liquid interfaces. Surface films on liquid substrates. Electrical aspects of surface chemistry. The solid-liquid interface-contact angle. Adsorption from solution. Wetting, flotation and detergency. Emulsions, foams and aerosols. The solid-gas interface-adsorption of gases and vapors on solids. Chemisorption and catalysis.

Course Outline

1. General introduction (2 hours)
2. Capillarity (3 hours)
    - Surface tension and surface free energy
    - The equation of Young and Laplace
    - Measurement of surface tension
3. Nature and thermodynamics of liquid interfaces (4 hours)
    - The structural and theoretical treatment of liquid interfaces
    - Orientation at interfaces
    - Determination of surface excess quantities
    - Gibbs monolayers
4. Surface films on liquid substrates (4 hours)
    - Spreading of one liquid on another
    - Techniques for studying monomolecular films
5. Electrical aspects of surface chemistry (5 hours)
    - Electrical double layer
    - The Stern and diffuse layer
    - Zeta potential
6. Solid-liquid interface (3 hours)
    - Contact angle
    - Measurement and results of contact angle
    - Theoretical aspect of contact angle phenomena
7. Adsorption from solution (3 hours)
8. Wetting, flotation and detergency (3 hours)
9. Emulsions, foams and aerosols (3 hours)
10. Adsorption of gases and vapors on solids (3 hours)
11. Chemisorption and catalysis (3 hours)

424772 Aerosol Technology **3(3-0-9)**

Condition: Consent of the School

Course Description

Behavior and properties of particles (solid or liquid) dispersing in a gas. Particle size distributions. Macroscopic fluid properties. Viscous motion and Stokes' law. Particle kinematics : settling, acceleration, deceleration and impaction. Brownian motion and particle diffusion. Thermophoresis. Aerosol-charging mechanisms. Condensation and evaporation phenomena in aerosols. Optical and electrostatic properties. Coagulation of particles.

Course Outline

1. Introduction and definitions of aerosols (2 hours)
    - Definitions of terms
    - Morphological properties of aerosols
    - Surface properties
2. Particle size distributions (2 hours)
    - Mean diameter
    - Histograms
    - Mathematical representation of size distribution
3. Macroscopic fluid properties (2 hours)
4. Viscous motion and Stokes' law (3 hours)
5. Particle kinematics (3 hours)
    - Equation of motion
    - Terminal settling velocity
    - Particle acceleration and deceleration
    - One-dimensional motion at high Reynolds number
    - Impaction of particles
6. Brownian motion and diffusion (4 hours)
    - Fick's law of diffusion
    - Theory of Brownian motion
    - Effect of aerosol mass on diffusion coefficient
    - Mean free path
7. Thermophoresis (4 hours)
8. Aerosol charging mechanisms (4 hours)
9. Condensation and evaporation phenomena (4 hours)
    - Types of nucleation
    - Homogeneous nucleation
    - Heterogeneous nucleation
10. Optical and electrostatic properties of aerosols (4 hours)
11. Coagulation of particles (4 hours)

424773 Corrosion Control 3(3-0-9)

Prerequisite: Undergraduate course in Engineering Materials or Consent of the School

Course Description

Electrochemical nature of corrosion. Types of corrosion. Electrochemical kinetics of corrosion processes. Influence of environments and methods of corrosion control. Behavior of engineering materials in corrosion under industrial environments. Material selection and design to prevent corrosion.

Course Outline

1. Electrochemical nature and types of corrosion (4 hours)
2. Electrochemical kinetics of corrosion (6 hours)
3. Influence of environments and methods of corrosion control (8 hours)
4. Behavior of engineering materials in corrosion (8 hours)
5. Material selection and design to prevent corrosion (4 hours)
6. Process design to prevent corrosion (6 hours)

424774 Electrochemical Engineering 3(3-0-9)

Condition: Consent of the School

Course Description

Basic principles of electrochemical processes. Thermodynamics and equilibrium properties of electrolytes. Electrokinetic phenomena : electrical double layer, electrode kinetics models, kinetics of corrosion processes. Transport processes in electrolyte systems : electrical conductivity in electrolytes, diffusion and migration in electrolyte solutions, mechanisms of ionic transport in solutions. Modeling and simulation of electrochemical processes. Applications of electrochemical engineering. Electrochemical engineering and environment

Course Outline

1. Basic concepts of electrochemical processes (4 hours)
   - Current and voltage efficiency
   - Ion conduction
2. Thermodynamics (6 hours)
   - Cell thermodynamics and equilibrium
   - Nernst equation
   - Temperature and pressure effects
3. Equilibrium Properties (4 hours)
   - Electrolytes and polyelectrolytes
   - Structure of solutions
   - Interionic interactions
   - Acid and bases solution
4. Electrokinetic phenomena (4 hours)
   - Electrical double layer
   - Electrode kinetics models

- Kinetics of corrosion processes

5. Transport processes in electrochemical processes (6 hours)
   - Electrical conductivity in electrolytes
   - Diffusion and migration in solutions
   - Mechanisms of ionic transport
6. Modeling and simulation of electrochemical processes (6 hours)
7. Applications of electrochemical engineering (4 hours)
   - Energy storage and conversion
   - Electrolytic separation processes
8. Electrochemical engineering and environmental (2 hours)

507502 Polymer Rheology **3(3-0-9)**

Condition: Consent of the School

Course Description

Fundamental of rheology. Basic transport phenomena. Polymer melt and constitutive equations. Rheological characterization of polymeric fluids. Experimental methods for rheological measurements. Relationship between the rheological properties and molecular parameters of polymeric materials. Molecular viscoelastic theories of polymer and flow of molten polymers through circular and slit dies.

Course Outline

1. Introduction (3 hours)
   1.1 Fundamental rheology
   1.2 Flow phenomena in polymer systems
   1.3 Transport and thermodynamic properties of polymer
   1.4 Application of rheology to polymer processing
2 Basic Transport Phenomena (5 hours)
   2.1 The balance equations
   2.2 Common boundary conditions and simplifying assumption
   2.3 The lubrication approximation: Reynolds' equation
3. Polymer Melt Constitutive Equations (3 hours)
4. Rheological Characterization of Polymeric Fluids (9 hours)
   4.1 Shear flow
      4.1.1 Kinematics and rheological functions
      4.1.2 Drag-induced rectilinear shear flow
      4.1.3 Rotational viscometers
      4.1.4 Extrusion rheometers
      4.1.5 Slippage on solid walls
   4.2 Elongation Flow
      4.2.1 Kinematics and rheological functions
      4.2.2 Uniaxial extension instruments
      4.2.3 Biaxial and planar extension experiments
      4.2.4 Small-strain experiments

5. Experimental Methods for Rheological Measurements (5 hours)
   5.1 Steady flow measurement
   5.2 Oscillatory flow measurement
6. Relationship Between the Rheological Properties and Molecular Parameters of Polymeric Materials (3 hours)
7. The Molecular Viscoelastic Theories of Polymer (3 hours)
8. Flow of Molten Polymers Through Circular and Slit Dies (6 hours)

507503 Advanced Polymer Processing **3(3-0-9)**
Prerequisite: 507502 Polymer Rheology or Consent of the School
Course Description

Fundamental of fluid flow of polymer melt. Basic engineering parameter for polymer processing. Dimensional groups; isothermal and nonisothermal. Polymer flow through die. Mold filling and secondary shaping. Calculation and computer based modeling for process design. Principles of quality control and assurance in polymer processing industries.

Course Outline

1. Fundamentals of Fluid Flow (3 hours)
   1.1 Principle of continuum mechanics
   1.2 Survey of rheological and viscoelastic properties of polymer fluids
   1.3 Effect of molecular mass, compounding and temperature on properties of polymer products
   1.4 Dynamic flow
2. Basic Engineering Parameters in Polymer Processing (6 hours)
   2.1 Basic heat transfer
   2.2 Heat and melt flow in die
   2.3 Flow in extruder screws
   2.4 Molds and calendar
3. Dimensional Groups (6 hours)
   3.1 Isothermal viscoelastic fluids
   3.2 Plastic fluids
   3.3 Nonisothermal effect
   3.4 Scale-Up
      3.4.1 Isothermal flow
      3.4.2 Nonisothermal flow of viscous fluids
4. Extrusion Through Die (6 hours)
   4.1 Flow through conduits of constant cross section
   4.2 Converging flow into capillary die
   4.3 Flow distribution problem in die design
   4.4 Extrudate swell and distortion
5. Injection Molding (3 hours)
   5.1 Mold filling
   5.2 Injection pressure and filling
   5.3 Quantitative analysis of mold filling

6. Secondary Shaping (3 hours)
   - 6.1 Fiber spinning
   - 6.2 Film manufacturing
   - 6.3 Blow molding
7. Calculator and Computer Based Modeling (6 hours)
   - 7.1 Flow modeling in processing plant
   - 7.2 Design principle for evaluating model output
   - 7.3 Commercial computer based process modeling
8. Principles of Quality Control and Assurance in Polymer Industries (3 hours)
   - 8.1 Quality planning
   - 8.2 Statistical process control (SPC)
   - 8.3 Total quality process control

17.5.9 Petrochemical Technology

424781 Petroleum Processing **3(3-0-9)**

Condition: Consent of the School

Course Description

Description of the chemical make-up of crude oil. Various types of crude and their products. Petroleum analysis and evaluation. Refining process configuration. Operation of crude atmospheric and vacuum distillation units. Conversion and treating processes for manufacturing of various petroleum products.

Course Outline

1. Introduction to crude oil and its processing (6 hours)
   - Crude oil and its constituents
   - Petroleum analysis and evaluation
   - Refining process configuration
2. Distillation processes (12 hours)
   - atmospheric crude distillation unit
   - vacuum distillation unit
   - straight-run light ends unit
3. Conversion processes (12 hours)
   - Cracking process
   - Reforming process
   - Alkylation process
   - Isomerization process
4. Treating process (6 hours)
   - Hydrotreating process
   - Caustic process
   - Acid process
   - Solvent process

424782 Petrochemical Manufacturing Processes **3(3-0-9)**

Condition: Consent of the School

Course Description

Introduction Introduction to petrochemical industry. Developments of petrochemical synthesis technology. Important products of petrochemicals. Processing of raw materials for the production of petrochemicals. Production of upstream petrochemicals, intermediate and downstream petrochemicals.

Course Outline

1. Introduction to petrochemical industry (6 hours)
   - Characteristic and developments of petrochemical technology
   - Key petrochemical products
2. Raw materials for manufacturing of petrochemicals (10 hours)
   - Raw materials from refinery products
   - Raw materials from from natural gas separation plant
3. Production of petrochemical precursors (12 hours)
   (Paraffins, olefins, aromatics, acetylene and synthesis gas)
4. Production of intermediates and downstream petrochemicals (8 hours)
   (monomers, surfactants, synthetic fuels and labricants, solvents and extractants, pesticides, etc.)

424783 Chemistry of Catalytic Processes **3(3-0-9)**

Prerequisite: Undergraduate course in Chemical Reaction Engineering or Consent of the School

Course Description

This course introduces the industrial applications of catalysts to some important petroleum and petrochemical process reactions. Topics include : Basic concepts of catalysis ; Major classes of catalysts ; Catalytic chemistry and process engineering of cracking process, reforming process, partial oxidation of hydrocarbons and hydrodesulfurization, etc ; Catalysis by transition-metal complexes.

Course Outline

1. Basic concepts of catalysis (3 hours)
2. Catalytic chemistry of the major classes of catalysts (3 hours)
   - Acids
   - Metal oxides
   - Transition metals
   - Transition metal complexes
3. Catalytic chemistry and process engineering of
   - Cracking processes (6 hours)
   - Reforming processes (6 hours)
   - Partial oxidation processes (6 hours)
   - Hydrodesulfurization processes (6 hours)

4. Catalysis by transition-metal complexes (6 hours)
    - Ethylene oxidation
    - Vinyl acetate synthesis
    - Oxo process

424784 Heterogeneous Catalysis 3(3-0-9)

Condition: Consent of the School

Course Description

History and concepts of heterogeneous catalysis. Descriptive chemistry of heterogeneous catalysis. Nature and atomic structure of catalytic surfaces. Kinetics and thermodynamic analyses of catalytic reactions. Catalyst preparation and characterization. Catalysis by metals, metal oxides, and zeolite catalysts. Industrial applications of catalytic reactions such as catalytic oxidation processes, processing of petroleum and hydrocarbons and synthesis gas production processes.

Course Outline

1. Introduction and basic concepts (3 hours)
2. Chemistry of heterogeneous catalysis (4 hours)
3. Nature of catalytic surfaces (4 hours)
4. Kinetics and thermodynamics of catalytic reactions (5 hours)
5. Preparation and characterization of catalysts (5 hours)
6. Catalysis by various types of solid catalysts (8 hours)
7. Industrial applications of catalytic reactions (7 hours)

424786 Design Method in Petroleum Industry 3(3-0-9)

Prerequisite: Undergraduate course in Chemical Engineering Unit Operations or Consent of the School

Course Description

Design calculation of processes and equipments used in refining and processing of crude oils and petroleum products. Typical units include, heat exchangers, atmospheric and vacuum distillation columns, reforming and cracking units, etc.

Course Outline

1. Principles of gas-phase and liquid-phase heat and mass transfer (8 hours)
2. Application of heat and mass transfer in petroleum refinery processes (8 hours)
    - Types of heat exchanger
    - Design of heat exchangers
3. Design of petroleum process with simultaneous heat and eat and mass transfer (12 hours)
    - Distillation column
    - Reforming unit
    - Cracking unit
    - Treating unit

4. Design of petroleum process equipments with pressure drop (8 hours)

424787 Design Method in Petrochemical Industry **3(3-0-9)**
Prerequisite: Undergraduate course in Chemical Engineering Unit Operations or Consent of the School
Course Description

Application of chemical engineering principles for process and equipment design of important petrochemical industries such as the manufacture of olefins, aromatics and fertilizers.

Course Outline

1. Principles of gas phase and liquid phase heat and mass transfer (4 hours)
2. Principle of fluid flow in chemical processes (4 hours)
3. Design of heat exchangers (4 hours)
4. Design of mass transfer equipments (8 hours)
5. Design of equipments with simultaneous heat and mass transfer (8 hours)
6. Pressure drop and design of chemical process equipments with pressure drop (8 hours)

17.5.10 Special Problem/Seminar/Independent Study/Thesis/Other subjects

424891 Advanced Topics in Chemical Engineering **3(3-0-9)**
Condition: Consent of the School
Course Description

An advanced study of topics of current interest in the field of chemical engineering.

424892 Selected Topics in Chemical Engineering **3(3-0-9)**
Condition: Consent of the School
Course Description

Study of selected topics in particular areas of chemical engineering, e.g., separation processes, reactor design, thermodynamics, particulate systems, applied mathematics, biochemical engineering, etc.

424893 Special Problems **3**
Condition: Consent of the School
Course Description

Advanced work leading to the analysis and solving methodology of process industrial problems, under the guidance and supervision of teaching faculty.

424894 Independent Study **3**

Condition: Consent of School

Course Description

Individual study or investigation on technological topics in chemical engineering, under the supervision of faculty members. Topics of study must be approved by the department.

424695 Graduate Seminar I **1(0-3-3)**

Prerequisite: None

Course Description

Oral presentation and discussion of papers based on research problems or detailed literature surveys in the areas of chemical engineering or related fields.

424696 Graduate Seminar II **1(0-3-3)**

Prerequisite: 424695 Graduate Seminar I

Course Description

Oral presentation and discussion of papers based on research problems or detailed literature surveys in the areas of chemical engineering or related fields.

424697 Graduate Seminar III **1(0-3-3)**

Prerequisite: 424696 Graduate Seminar II

Course Description

Oral presentation and discussion of papers based on research problems or detailed literature surveys in the areas of chemical engineering or related fields.

424698 Master thesis **(minimum) 20 credits**

Prerequisite: None

Course Description

Thesis research on fundamental or applied research areas for Master degree level in chemical engineering.

424699 Doctoral Thesis **(minimum) 45-94 credits**

Prerequisite: None

Course Description

Thesis research on fundamental or applied research areas for Doctoral degree level in chemical engineering.

18. Curriculum Quality Assurance

Curriculum quality assurance conforms the Education Quality Assurance System of the Suranaree University of Technology (centralization).

19. Curriculum Revision

The assessment of the curriculum will be conducted within 4 years since its inception. The assessment will include the expectation of graduates, academic institution, research agencies and private companies, the analysis of academic trend, and the employment opportunities. The curriculum improvement committee will be set up within 5 years since the inception and the revised curriculum will be based on findings from the assessment.

Appendix A

Curriculum Improvement Committee

คำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี

ที่ ๔๔๙ /๒๕๔๕

เรื่อง แต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมเคมี (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐)

……………………………

เพื่อให้การปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมเคมี เป็นไปด้วยความเรียบร้อย และบรรลุตามวัตถุประสงค์

ฉะนั้น อาศัยอำนาจตามความในมาตรา ๑๘ (๑) (๑๑) มาตรา ๒๑ และมาตรา ๒๔ แห่งพระราชบัญญัติมหาวิทยาลัยเทคโนโลยีสุรนารี พ.ศ. ๒๕๓๓ ประกอบกับมติสภาวิชาการมหาวิทยาลัยเทคโนโลยีสุรนารี ในการประชุมครั้งที่ ๘/๒๕๔๕ เมื่อวันที่ ๒๐ กรกฎาคม ๒๕๔๕ ประกอบกับประกาศสำนักนายกรัฐมนตรี เรื่อง แต่งตั้งอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี ลงวันที่ ๓๑ พฤษภาคม ๒๕๔๘ จึงแต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมเคมี (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) ประกอบด้วยบุคคลดังต่อไปนี้

๑. ศาสตราจารย์ ดร.รัตนา จิระรัตนานนท์	เป็น ประธาน
๒. ศาสตราจารย์ ดร.ดำรง ขุมมงคล	เป็น กรรมการ
๓. รองศาสตราจารย์ ดร.ชัยยศ ตั้งสถิตย์กุลชัย	เป็น กรรมการ
๔. ผู้ช่วยศาสตราจารย์ ดร.ฉลองศรี ฟลัด	เป็น กรรมการ
๕. Asst. Prof. Dr. Adrian Evan Flood	เป็น กรรมการ
๖. ผู้ช่วยศาสตราจารย์ ดร.รัตนวรรณ เกียรติโกมล	เป็น กรรมการ
๗. อาจารย์ ดร.กัณทิมา ศิริจีระชัย	เป็น กรรมการ
๘. อาจารย์ ดร.ธีระสุต สุขกำเนิด	เป็น กรรมการ
๙. อาจารย์ ดร.พนารัตน์ โทมณี	เป็น กรรมการ
๑๐. หัวหน้าสาขาวิชาวิศวกรรมเคมี	เป็น กรรมการและเลขานุการ

ทั้งนี้ ตั้งแต่วันที่ ๒๑ กรกฎาคม ๒๕๔๙ เป็นต้นไป

สั่ง ณ วันที่ ๗ สิงหาคม พ.ศ. ๒๕๔๙

(รองศาสตราจารย์ ดร.ประสาท สืบค้า)
อธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี

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Appendix B
SUT Regulation for Graduate Studies

Assoc. Prof. Dr. Chaiyot Tangsathitkulchai
รองศาสตราจารย์ ดร.ชัยยศ ตั้งสถิตย์กุลชัย

Recognitions and Awards:

2001 – 2002	PTIT Fellow, The Petroleum Institute of Thailand.
2002	Teaching Achievement Award, Suranaree University of Technology.
2004	Research Achievement Award, Suranaree University of Technology.

Academic Outputs:

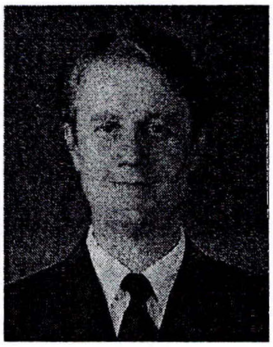
(1) 60 published research articles in referred journals and conference proceedings on powder technology and energy related areas.

(2) one book on Adsorption Processes.

Professional Affiliation: Member of The Thai Institute of Chemical Engineering and Applied Chemistry.

Biographical Data

Institute of Engineering,
Suranaree University of Technology
111 University Avenue, Muang Distric,
Nakhon Ratchasima 30000
Tel: 0 4422 4497 FAX: 0 4422 4609



adrianfl@sut.ac.th

รองศาสตราจารย์ ดร.เอเดรียน ฟลัด
Assoc. Prof. Dr. Adrian Flood

Education and Qualifications:

1990	B. E. (Chemical Engineering), The University of Sydney.
1996	Ph.D. (Chemical Engineering), The University of Queensland.

Present Position:

Associate Professor, School of Chemical Engineering, Suranaree University of Technology.

Work Experience:

1991 –1992	Engineer, Air-Water-Noise (AWN) Consultants, Australia.
1992 – 1995	Engineer on consulting projects on inorganic crystallizations, ammonium nitrate evaporation, and fertilizer surface structure.
1996 – 2000	Lecturer, School of Chemical Engineering, Suranaree University of Technology.
2000 – 2006	Assistant Professor, School of Chemical Engineering, Suranaree University of Technology.

Recognitions and Prestige:

1997 – 2000	Young Researcher Award (Grant), The Thailand ResearchFund.

Academic Output:

(1) 9 research papers published in international peer reviewed journals, in addition to articles in Thai journals, and conference proceedings.

Selected Publications

1) S. Srisa-nga, A. E. Flood and E. T. White. "The Secondary Nucleation Threshold and Crystal Growth of α-Glucose Monohydrate in Aqueous Solution", *Cryst. Growth & Des.* 6(3), 795-801 (2006).
2) P. Pantaraks and A. E. Flood. "Effect of Growth Rate History on Current Crystal Growth: A Second Look at Surface Effects on Crystal Growth Rates", *Cryst. Growth & Des.* 5(1), 365-371 (2005).
3) A. E. Flood. "Thoughts on Recovering Particle Size Distributions from the Moment Form of the Population Balance", *Dev. Chem. Eng. Min. Proc.* 10(5/6), 501-519 (2002).

4) A. E. Flood, M. R. Johns, and E. T. White. "Crystal Growth Rates for D-Fructose from Aqueous Ethanol", *AIChE J.* 46(2), 239-246 (2000).
5) A. E. Flood, M. R. Johns, and E. T. White. "Mutarotation of D-Fructose in Aqueous-Ethanolic Solutions and its Influence on Crystallization", *Carbohydr. Res.* 288, 45-56 (1996).

(2) Supervisor of 2 completed Ph.D. students.
(3) Supervisor of 2 completed M.E. students and co-supervisor of 1 additional M.E. student.
(4) Completed research report for the Thailand Research Fund.
(5) Completed 2 RGJ Ph.D. grants from the Thailand Research Fund.
(6) Holder of 4 current RGJ Ph.D. scholarships and 1 MOE Ph.D. scholarship.
(7) Study guides on the subjects of Process Equipment Design and Operation III (Mass Transfer Operations), Chemical Engineering Thermodynamics, Process Dynamics and Control, and Crystallization and Modeling.

Biographical Data

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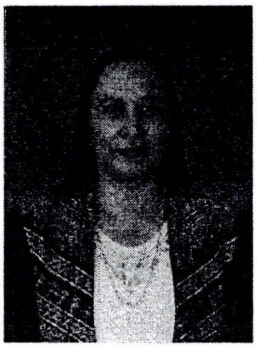

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ผู้ช่วยศาสตราจารย์ ดร. ฉลองศรี ฟลัด
Asst. Prof. Dr. Chalongsri Flood

Education and Qualifications:

1978 B.Sc. (Hons) (Chemical Engineering), Chulalongkorn University.
1982 M.Sc. (Chemical Engineering),Chulalongkorn University.
1993 Ph.D. (Chemical Engineering), The University of Queensland, Australia

Present Position:

Assistant Professor, School of Chemical Engineering, Suranaree University of Technology.

Work Experience:

1978 – 1979 Engineer, Electroplating Factory, Bangkok, Thailand.
1980 – 1993 Lecturer, Department of Chemical Engineering, King Mongkut University of Technology Thonburi, (KMUTT)
1982 – 1984 Research assistant, under Monbusho scholarship at Department of Chemical Engineering , Tokyo University, Japan.
1993 – 2006 Assistant Professor, School of Chemical Engineering, Suranaree University of Technology.

Recognitions and Prestige:

1982 – 1984 Japanese Government Scholarship (Monbusho)
1986 JSPS Scholarship (Japan Science promotion Society) Department of Chemical Engineering, Tokyo University, Japan.
1989 – 1993 PhD scholarship , Department of Chemical Engineering, The University of Queensland, Australia.
1994 JSPS Scholarship (Japan Science promotion Society) Department of Chemical Engineering, Tokyo University, Japan.

Asst. Prof. Dr. Chalongsri Flood
ผู้ช่วยศาสตราจารย์ ดร. ฉลองศรี ฟลัด

Academic Output:

(1) S. Bhumiratana, V. haenbenjapong, C. Flood, and R. Putranon, The use of pressure driven membrane processes in the utilization of pineapple cannery liquid wastes, Proceedings of the second ASEAN workshop on membrane technology, Bangkok, Thailand, October 1-10, 1982.

(2) C. Flood , H. Ohya, and S. Kimura, Application of pore flow models of membrane transport for non-cellulosic ultrafiltration membranes, Proceedings of the third Asian Pacific Confederation of Chemical Engineering (APCChE'84), Bangkok, Thailand. October 8 – 10, 1984.

(3) D. Uttaparp, S Bhumiratana, R. Jiraratannon, and C. Flood, Concentration of bovine by ultrafiltration, Proceedings on the first ASEAN workshop on Biochemical Engineering, Bangkok, Thailand, September 25-27, 1985.

(4) C. Flood, Separation of ethanol-water mixture by pervaporation through membranes, Proceedings of the third ASEAN workshop on membrane technology, Singapore, April 14-16, 1986.

(5) C. Flood, Study on protein adsorption of polysulfone ultrafiltration membrane, Proceedings of the fourth of Asian Pacific Confederation of Chemical Engineering (APPChE'87), Singapore, May 13 – 15, 1897.

(6) C. Flood and D. D. Do, Pervaporation of ethanol-water mixture using silicalite-filled silicone rubber membrane, Proceedings of 20th Australasian Chemical Engineering Conference, (CHEMICA 92), Canberra, Australia, September, 27-30, 1992.

(7) C. Flood, and D.D. Do, Pervaporation of ethanol-water mixture through composite silicalite-filled silicone rubber membrane, Proceedings of the International Membrane Science and Technology Conference (IMSTEC 92) , ydney, Australia, November 10-12 , 1992.

(8) C. Flood, and A. Flood, Removal color from the raw sugar manufacturing process by membrane treatment, Suranaree J. o Sci. and Technol. (13(4), 331-342 (2006)

(9) S. Thongsathit, R. (Wibulswas) Kiattikomol, C. Flood , Preparation and application of Clay membrane, Proceedings of The Reginal Symposium on Chemical Enginerring (13th RSCE), Singapore, 3-5 December 2006.

Biographical Data

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ผู้ช่วยศาสตราจารย์ ดร.รัตนวรรณ (วิบูลย์สวัสดิ์) เกียรติโกมล
Asst. Prof. Dr. Ratanawan (Wibulswas) Kiattikomol

Education:

1994 B. Sc. (2^{nd} Class Honors) (Chemical Engineering), Chulalongkorn University, Thailand.
1996 M. Sc. (Advance Chemical Engineering), Imperial College London, England.
1999 Ph.D. (Chemical Engineering), Imperial College London, England.

Present Position:

Assistant Professor, School of Chemical Engineering, Suranaree University of Technology

Work Experiences:

1999 -2001 Lecturer, School of Chemical Engineering, Suranaree University of Technology.
2002 – Now Assistant Professor, School of Chemical Engineering, Suranaree University of Technology.

Recognitions and Awards:

2005 Young Researcher Award (เมธีวิจัย สกว.), The Thailand Research Fund.
2005 Chemical Engineering Senior Project Silver Medal Award, The Thai Institute of Chemical Engineering and Applied Chemistry.

Selected Publications:

1. R.Wibulswas, D.A. White and R.Rautiu, **Removal of Humic Substances from water by Alumina-based Pillared Clays**, *Environmental Technology*, **19**, 627-632 (1998).
2. R.Wibulswas, D.A. White and R.Rautiu, **Adsorption of Phenolic Compounds from water by Surfactant-modified Pillared Clays**, *ICemE*, **77**, Part B, 88-92 (1999).
3. D.A.White, G.Onkal-Engin and R.Wibulswas, **Simulation of the Errors in Equilibrium Correlations Using the Langmuir and BET Isotherms**, *Separation Science and Technology,* **35**(3), 367-377 (2000).
4. G.Onkal-Engin, R.Wibulswas and D.A. White, **Humic Acid Uptake from Aqueous media using Hydrotalcite and modified Montmorillonite**, *Environmental Technology,* **21**, 167-175 (2000).

5. R.Wibulswas and D.A. White, **Feasibility study of utilizing Montmorillonite clay as an adsorbent for removing organic toxicants from water**, *Regional Symposium on Chemical Engineering 2000*, Singapore, (December 2000).
6. Piyamaporn Jaruwong, and Ratanawan (Wibulswas) Kiattikomol, **Batch and Fixed Bed Column Adsorption of Phenols and Naphthalene by Organo-Clays,** *ASIAN WATERQUAL 2003- IWA Asia-Pacific Regional Conference* (OCTOBER 19-23, 2003).
7. Piyamaporn Jaruwong and Ratanawan (Wibulswas) Kiattikomol, **Raw Sugar Decolorization by Montmorillonite and Organo-clays,** *The 2nd Asian Particle Technology Symposium (APT) 2003,* Malaysia (December 17-19, 2003).
8. Piyamaporn Jaruwong and Ratanawan Wibulswas, **Influence of Organo-clays Carbon Number on the Adsorption of Humic Acid**, *Asian J. Energy Environ.*, **4,** 41-59 (2003).
9. Piyamaporn Jaruwong and Ratanawan (Wibulswas) Kiattikomol, **Adsorption of 2,2-Bipyridyl by BDHDMA-modified Montmorillonite,** *Asia Pacific Confederation of Chemical Engineering (APCChE) 2004* (October 2004).
10. Jakkrit Umpush and Ratanawan (Wibulswas) Kiattikomol, **DYE REMOVAL FROM WASTEWATER OF DYEING PROCESS IN HOUSEHOLD INDUSTRY BY MONTMORILLONITE CLAYS**, *Tri-University International Joint Seminar and Symposium 2004* (October 2004).
11. Ratanawan (Wibulswas) Kiattikomol, **Water softening by Montmorillonite clay**, *International Symposium on Nanotechnology in Environmental Protection and Pollution (ISNEPP) 2005* (January 2005).
12. Piyamaporn Jaruwong, Jakrit Aumpush and Ratanawan (Wibulswas) Kiattikomol, **UPTAKE OF CATIONIC AND AZO DYES BY MONTMORILLONITE IN BATCH AND COLUMN SYSTEMS,** *Thammasat Int .J. Sc. Tech.*, **10(1)**, .47-56 (2005).
13. Jakkrit Umpush and Ratanawan (Wibulswas) Kiattikomol, **UPTAKE OF COMMERCIAL DYE FROM DYEING PROCESS WASTEWATER OF HOUSEHOLD SCALE INDUSTRIES BY MONTMORILLONITE CLAYS IN MIXING TANK SYSTEM,** *The 31stCongress on Science and Technology of Thailand* (October 2005).
14. Jakkrit Umpush and Ratanawan (Wibulswas) Kiattikomol, DECOLORIZATION OF DYEING PROCESS WASTEWATER FROM SILK HOUSEHOLD INDUSTRIES BY ORGANO-CLAY IN FIXED BED COLUMN, *The 5th International Water Association (IWA) Specialty Conference on "Wastewater Reclamation and Reuse for Sustainability (WRRS2005)", Korea, Nov. 7 - 11, 2005.*
15. *Ratanawan (Wibulswas) Kiattikomol, Papus Chanaroke and Suriya Sripothong,* ***Adsorption and Kinetics of Methylene blue Uptake by Magnetic Montmorillonite,*** *Regional Symposium on Chemical Engineering 2006, Singapore, (December 2006).*

16. *Apichaya Chenkarl and Ratanawan (Wibulswas)Kiattikomol,* ***Adsorption Behavior of Montmorillonite in Fludized Bed System,*** *Regional Symposium on Chemical Engineering 2006, Singapore, (December 2006).*
17. *Sutanee Thongsatit, Ratanawan (Wibulswas) Kiattikomol and Chalongsri Flood,* ***Preparation and Application of Clay Membrane,*** *Regional Symposium on Chemical Engineering 2006, Singapore, (December 2006).*

Academic Output:

1. Supervisor of 3 completed M.E. students.
2. Completed 2 research projects supported by The Thailand Research Fund.
3. Completed 2 research projects supported by NSTDA.
4. Holder of 2 current research grants from The Thailand Research Fund and NSDTA respectively.

Appendix D
Course Titles in Thai

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
424611	Advanced Transport Phenomena	ปรากฏการณ์ถ่ายโอนขั้นสูง
424621	Advanced Chemical Engineering Thermodynamics	อุณหพลศาสตร์วิศวกรรมเคมีขั้นสูง
424622	Advanced Chemical Reaction Engineering	วิศวกรรมปฏิกิริยาเคมีขั้นสูง
424631	Advanced Numerical Methods for Chemical Engineers	วิธีการเชิงตัวเลขสำหรับวิศวกรเคมีขั้นสูง
424695	Graduate Seminar I	สัมมนาระดับบัณฑิตศึกษา 1
424696	Graduate Seminar II	สัมมนาระดับบัณฑิตศึกษา 2
424697	Graduate Seminar III	สัมมนาระดับบัณฑิตศึกษา 3
424698	Master thesis	วิทยานิพนธ์ระดับปริญญามหาบัณฑิต
424699	Doctoral Thesis	วิทยานิพนธ์ระดับปริญญาดุษฎีบัณฑิต
424711	Advanced Fluid Mechanics	พลศาสตร์ของไหลขั้นสูง
424712	Non-Newtonian Fluid Mechanics	กลศาสตร์ของไหลนันนิวโทเนียน
424713	Advanced Heat and Mass Transfer	การถ่ายเทความร้อนและมวลสารขั้นสูง
424714	Diffusional Operations	หน่วยปฏิบัติการที่ใช้หลักการแพร่มวลสาร
424715	Separation Processes	กระบวนการแยกสาร
424716	Membrane Technology	เทคโนโลยีเยื่อแผ่นสังเคราะห์
424717	Crystallization and Modeling	การตกผลึกสาร และการสร้างแบบจำลอง
424718	Adsorption Process	กระบวนการดูดซับสาร
424719	Multicomponent Distillation	กระบวนการกลั่นสารหลายองค์ประกอบ
424721	Advanced Topics in Thermodynamics	หัวข้อชั้นสูงทางอุณหพลศาสตร์
424722	Thermodynamics of Mixtures	อุณหพลศาสตร์ของสารผสม
424723	Introduction to Statistical Thermodynamics	อุณหพลศาสตร์เชิงสถิติเบื้องต้น
424724	Advanced Topics in Chemical Reaction Engineering	หัวข้อชั้นสูงทางวิศวกรรมปฏิกิริยาเคมี
424725	Reactor Design and Optimization	การออกแบบปฏิกรณ์เคมีและการหาจุดที่เหมาะสม
424726	Polymer Reaction Engineering	วิศวกรรมปฏิกิริยาพอลิเมอร์

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
424727	Irreversible Thermodynamics	อุณหพลศาสตร์แบบผันกลับไม่ได้
424731	Advanced Mathematics for Chemical Engineers	คณิตศาสตร์ชั้นสูงสำหรับวิศวกรเคมี
424732	Modeling and Simulation in Chemical Engineering	การจำลองและการเลียนแบบกระบวนการทางวิศวกรรมเคมี
424733	Industrial Chemical Process Design	การออกแบบกระบวนการทางอุตสาหกรรมเคมี
424734	Chemical Process Optimization	การหาจุดเหมาะสมที่สุดของกระบวนการทางเคมี
424735	Advanced Chemical Process Control	การควบคุมกระบวนการทางเคมีขั้นสูง
424736	Multivariable Process Control	การควบคุมกระบวนการแบบหลายตัวแปร
424737	Design of Experiments and Data Analysis	การออกแบบการทดลองและการวิเคราะห์ข้อมูล
424741	Principles of Combustion	ทฤษฎีการเผาไหม้
424742	Biomass Conversion Processes	กระบวนการแปรสภาพมวลชีวภาพ
424743	Natural Gas Processing	กระบวนการแปรสภาพแก๊สธรรมชาติ
424744	Coal Conversion Technology	เทคโนโลยีการแปรสภาพถ่านหิน
424745	Energy Management	การจัดการด้านพลังงาน
424751	Hazard Analysis, Assessment and Prevention in Chemical Process Industries	การวิเคราะห์ การประเมินสภาพอันตรายและการป้องกันในกระบวนการทางอุตสาหกรรมเคมี
424761	Modeling of Biological System	การจำลองระบบทางชีวภาพ
424762	Bioreactor Design	การออกแบบปฏิกรณ์ชีวภาพ
424763	Fermentation Technology	เทคโนโลยีการหมัก
424764	Bioseparation processes	กระบวนการแยกทางชีวภาพ
424771	Interfacial Phenomena	ปรากฏการณ์พื้นผิวสัมผัส
424772	Aerosol Technology	เทคโนโลยีอนุภาคละออง
424773	Corrosion Control	การควบคุมกระบวนการกัดกร่อน
424774	Electrochemical Engineering	วิศวกรรมเคมีไฟฟ้า

รหัสวิชา	**ชื่อภาษาอังกฤษ**	**ชื่อภาษาไทย**
424782	Petrochemical Manufacturing Processes	กระบวนการผลิตสารปิโตรเคมี
424783	Chemistry of Catalytic Processes	เคมีของกระบวนการที่ใช้ตัวเร่งปฏิกิริยา
424784	Heterogeneous Catalysis	กระบวนการเร่งปฏิกิริยาวิวิธพันธ์
424785	Design Method in Petroleum Industry	วิธีการออกแบบในอุตสาหกรรมปิโตรเลียม
424786	Design Method in Petrochemical Industry	วิธีการออกแบบในอุตสาหกรรมปิโตรเคมี
424811	Multi-Phase Flow in Chemical Engineering	การไหลพหุภาคในวิศวกรรมเคมี
424891	Advanced Topics in Chemical Engineering	หัวข้อชั้นสูงทางวิศวกรรมเคมี
424892	Selected Topics in Chemical Engineering	เรื่องคัดเฉพาะทางวิศวกรรมเคมี
424893	Special Problems	การศึกษาปัญหาพิเศษ
424894	Independent Study	หัวข้อศึกษาอิสระ
432513	Advanced Water and Wastewater Analysis	การวิเคราะห์น้ำและน้ำเสียชั้นสูง
432514	Advanced Processes for Water and Wastewater Treatment	กระบวนการระดับสูงสำหรับการผลิตประปาและบำบัดน้ำเสีย
432521	Air Pollution Control Engineering	วิศวกรรมการควบคุมมลภาวะอากาศ
432531	Solid Waste and Hazardous Waste Management	การจัดการมูลฝอยและของเสียอันตราย
432532	Industrial Waste Abatement and Management	การลดและการจัดการของเสียอุตสาหกรรม
507502	Polymer Rheology	วิทยากระแสของพอลิเมอร์
507503	Advanced Polymer Processing	การขึ้นรูปพอลิเมอร์ชั้นสูง
110752	Biochemical Product Development	การพัฒนาผลิตภัณฑ์ชีวเคมี
110761	Enzyme Technology and Applied Enzymology	เทคโนโลยีเอนไซม์ และการประยุกต์ด้านเอนไซม์
304522	Advanced Bioprocess Engineering	วิศวกรรมกระบวนการชีวภาพขั้นสูง
304623	Bioprocess Technology for Waste Treatment	เทคโนโลยีการบำบัดของเสียด้วยกระบวนการทางชีวภาพ

เอกสารประกอบวาระที่ 4.9

(Draft)

Graduate Program in Civil Engineering
School of Civil Engineering
(Revised 2007)

Institute of Engineering
Suranaree University of Technology

(Draft)

Graduate Program in Civil Engineering
School of Civil Engineering
(Revised 2007)

Institute of Engineering
Suranaree University of Technology

CONTENTS

Graduate Program in Civil Engineering
School of Civil Engineering
Institute of Engineering
Suranaree University of Technology

1. Program Titles

1.1 Master Program
Master Program in Civil Engineering
1.2 Doctoral Program
Doctoral Program in Civil Engineering

2. Degree Titles

2.1 Master Degree
Full Title : Master of Engineering (Civil Engineering)
(Thai) : วิศวกรรมศาสตรมหาบัณฑิต (วิศวกรรมโยธา)
Abbreviated Title : M. Eng. (Civil Engineering)
(Thai) : วศ.ม. (วิศวกรรมโยธา)
2.2 Doctoral Degree
Full Title : Doctor of Engineering in Civil Engineering
(Thai) : วิศวกรรมศาสตรดุษฎีบัณฑิต (วิศวกรรมโยธา)
Abbreviated Title : D.Eng. (Civil Engineering)
(Thai) : วศ.ด. (วิศวกรรมโยธา)

3. Responsible Department (Unit)

School of Civil Engineering, Institute of Engineering, Suranaree University of Technology.

4. Philosophy and Objectives

By nature, civil engineering deals with public service, i.e., civil engineers design structures, plan land use, build roads, buildings and bridges, construct water reservoirs, handle water supply and wastewater treatment; all these functions are to ensure safety and comfort in our daily life. In a final analysis, civil engineers attempt to improve the quality of life for all citizens.

The fundamental objective of the graduate program in civil engineering at Suranaree University of Technology is to train graduate in advanced knowledge of civil engineering which will them to carry out independent and professional work or research. Additional objectives of the programs are (1) to extend the boundaries of knowledge through research for the betterment of society (2) to preserve, and transmit knowledge to successive generations.

Suranaree University of Technology offers the graduate program in civil engineering to produce master degree and doctoral degree graduates in order to fulfill the country's need. This graduate program is open to all qualified bachelor and master degree graduates in sciences or engineering. Engineering graduates will address the challenges that they will face in their careers, pursue life-long learning and continue to develop their problem-solving skills.

5. Program Inception

Enrollment of the students in this program will begin in the first trimester of academic year 2007.

6. Admission Requirements

Applicants must pass written examination and interviews as a nominal requirement. The school committee may consider offering conditioned or unconditioned acceptance to applicants under specific circumstances. Candidates with high potentials and academic strength may be offered special acceptance with examination requirement waived.

Master degree program

Applicants must possess bachelor degree in Civil Engineering or related fields from an accredited university/institution with a minimum cumulative GPA not less than 2.5 on the scale of 4.0 or consent of the school. The applicants must submit a completed application form together with the following:

1) A transcript of the bachelor degree
2) Three letters of recommendation
3) A two-page double-spaced essay describing the applicant's interest in Civil Engineering, career goals, and reason for applying to the program.

Doctoral degree program

Applicants must have a cumulative GPA of not less than 3.0 for undergraduate degree holders and 3.5 for master degree holders on the scale of 4.0 or Consent of the school. The applicants must submit a completed application form together with the following:

1) Transcripts of bachelor and master degrees
2) Three letters of recommendation
3) A four-page double-spaced essay describing the applicant's interest in Civil Engineering, careergoals, reason for applying to the program and preliminary research proposal.

7. Application Process

As stated in the SUT Regulation for Graduate Studies.

8. Academic System

As stated in the SUT Regulation for Graduate Studies.

9. Study Duration

As stated in the SUT Regulation for Graduate Studies.

10. Registration

As stated in the SUT Regulation for Graduate Studies.

11. Degree Requirement

Master degree

- The student must complete the required workload.
- The thesis must be approved by the School of Civil Engineering.
- Before defending the master thesis, the results of the research leading to the thesis must be published (or accepted for publication) in a national research journal or a national symposium.

Doctoral degree

- The student must complete the required workload.
- The thesis must be approved by the School of Civil Engineering.
- Before defending the doctoral thesis, a full paper which is a part of the thesis must be published (or accepted for publication) in an international journal indexed orlisted in a well recognized database that has been approved by the Institute of Engineering.

12. Faculty

12.1 Curriculum Faculty

Assoc. Prof. Dr. Amnat Apichatvullop
Ph.D. (Water Resources Planning),
Colorado State University, U.S.A.

Assist. Prof. Dr. Mongkol Jiravacharadet
Ph.D. (Civil Engineering),
University of Tokyo, Japan

Assist. Prof. Dr. Suksun Horpibulsuk
Ph.D. (Geotechnical Engineering),
Saga University, Japan

Dr. Tanongsak Bisarnsin
Ph.D. (Civil Engineering),
University of Texas at Arlington, U.S.A.

Dr. Avirut Chinkulkijniwat
Ph.D. (Civil Engineering),
Graz University of Technology, Austria

12.2 Teaching Faculty

Assoc. Prof. Dr. Sittichai Seangatith
Ph.D. (Civil Engineering),
University of Texas at Arlington, U.S.A.

Assist. Prof. Dr. Chatchai Jothiyangkoon
Ph.D. (Environmental Engineering),
University of Western Australia, Australia

Dr. Pornpot Tanseng
Ph.D. (Geotechnical Engineering),
University of Innsbruck, Austria

Dr. Theerawat Sinsiri
Ph.D. (Civil Engineering),
King Mongkut's University of Technology Thonburi, Thailand

13. Enrollments

For the first 5 years, the number of students enrolled in the program in each year is as follows

Academic Year	Number of admission		Number expected to graduate in the academic year	
	Master	Doctoral	Master	Doctoral
2007	5	2	-	-
2008	5	2	5	-
2009	7	2	5	2
2010	7	2	7	2
2011	10	2	7	2

14. Location and Equipment

Location: Classrooms in the Center of Educational Services, Suranaree University of Technology

Equipment: Laboratory equipment from the Center for Scientific and Technology Equipments; and accessories for lecturing from the Center of Library and Education Media, Suranare University of Technology

15. Library

The Center of Library Resources and Educational Media offers the following resources and services.

15.1 Resources

15.1.1	Books		
	Thai	22,424	titles
	English	68,616	titles
15.1.2	Journals		
	Thai	142	titles
	International	285	titles
	Received from Donation	995	titles
15.1.3	Audio-visual and electronic	3,279	titles

15.2 Inter-library Loan

Offering loan/photocopying services from other Thai and foreign universities and other public institutions.

15.3 Information Search Service

15.3.1 Search for items at CLREM
15.3.2 Search for items at other libraries

15.4 Database

15.4.1 Database on CD-ROM

- Chemistry Citation Index from 1999
- ComputMath Citation Index from 1999
- Thai theses from B.E.2509

15.4.2 Database On-line

- IEEE/IEL -- Full text database of articles, journals, proceedings and standards in electrical and electronic engineering and other related fields
- DAO -- database of abstracts of master and Ph.D.thesis from U.S., Canada, etc. in all fields.
- Medline -- database in medicine, public health, nursing and medical sciences.
- FirstSearch over 80 databases covering all fields, e.g. sciences, technology, agriculture, medicine, etc.
- E-journal from American Chemical Society over 24 titles covering chemistry, biochemistry and biotechnology from 1996.

CLREM web: http://library.sut.ac.th

16. Fiscal Budget

The School of Civil Engineering receives the annual budget from Suranaree University of Technology.

17. Curriculum

The School of Civil Engineering offers graduate programs leading to advanced degrees in Civil Engineering with specialization in structural, geotechnical and water resources engineering. Details are as follows.

17.1 Total Credits

Master Degree Program		
- Plan A1 (Research and thesis) (minimum)	45	credits
- Plan A2 (Instructional courses with thesis) (minimum)	45	credits
Doctoral Degree Program		
For Research and thesis		
- Scheme 1 (Master degree holders) (minimum)	60	credits
For Instructional courses with thesis		
- Scheme 2.1 (Master degree holders) (minimum)	60	credits
- Scheme 2.2 (Bachelor degree holders) (minimum)	90	credits

17.2 Program Structure

Master Degree

Plan A1: Research and thesis

Students pursuing master degrees under this option are required to undertake master thesis with a minimum workload of 45 credits with no instructional courses. However, at the advice of the supervisors students may audit (attend as visitors) some courses deemed useful for their research. Students must demonstrate their ability to apply the knowledge to solve original research problems. This option is available for those who have work experience and strong academic background in relevant fields and ability to work independently.

Plan A2: Instructional courses with thesis

Students pursuing master degrees under this option are required to undertake at least 25 credits of instructional courses and 20 credits of master thesis, distributed as follows:

core courses	5 credits
major courses	12 credits
electives (minimum)	8 credits and
master thesis (minimum)	20 credits

Conditional acceptance may be offered to some applicants under this scheme. These applicants will have to undertake some undergraduate courses deemed appropriate to strengthen their academic background.

Doctoral Degree

Scheme 1: Research and thesis

Students pursuing doctoral degrees under this option must be master degree holders. They are not required to undertake instructional course. However, at the advice of the supervisors students may audit some courses deemed useful for their research. Students must demonstrate their ability to apply the knowledge to solve original research problems. The minimum workload for the thesis is 60 credits.

This option is available for those who have strong academic background in relevant fields and ability to work independently.

Scheme 2: Instructional courses with thesis

Scheme 2.1

Prospective students must be master degree holders of relevant fields. They are required to take at least 15 credits of coursework and 45 credits of thesis.The total load is distributed as follows:

core courses/major courses/electives	15 credits, and
doctoral thesis (minimum)	45 credits

Scheme 2.2

Bachelor degree holders admitted under this plan must have graduated with honors in relevant fields. Candidates are required to take minimum of 30 credits of coursework and 60 credits of thesis, distributed as follows:

core courses	6 credits
major courses	12 credits
electives (minimum)	12 credits and
doctoral thesis (minimum)	60 credits

Students under Scheme 2.2 may be waived some graduate courses if they studied such courses not more than 3 years prior to admission to the program. They must seek permission from the school upon recommendation of their academic advisors.

To strengthen their knowledge and upon consultation with their advisors, students may wish to audit some undergraduate courses. Note that no undergraduate courses can be counted toward the above requirements for graduation.

17.3 Civil Engineering courses by area of study

Core courses

430601 Introduction to Finite Element Method	4 (4-0-12)
430602 Graduate Seminar in Civil Engineering I	1 (0-3-4)
430603 Graduate Seminar in Civil Engineering II	1 (0-3-4)

Major courses in Structural Engineering

430620 Advanced Theory of Structures	4 (4-0-12)
430621 Dynamics of Structures	4 (4-0-12)
430622 Advanced Mechanics of Materials	4 (4-0-12)

Major courses in Geotechnical Engineering

430640 Theoretical Soil Mechanics	4 (4-0-12)
430641 Advanced Foundation Engineering	4 (4-0-12)
430642 Ground Improvement Techniques	4 (4-0-12)

Major courses in Water Resources Engineering

430660 Advanced Hydrology	4 (4-0-12)
430661 Computational Hydraulics	4 (4-0-12)
430662 Systems Analysis	4 (4-0-12)

Electives

430610 Numerical Methods in Engineering	
430611 Statistics for Civil Engineering	4 (4-0-12)
430612 Advanced Engineering Geology	4 (4-0-12)
430613 Continuum Mechanics	4 (4-0-12)
430623 Advanced Matrix Method for Structures	4 (4-0-12)
430624 Theory of Elastic Stability	4 (4-0-12)
430625 Theory of Plates and Shells	4 (4-0-12)
430626 Advanced Finite Element Method	4 (4-0-12)
430627 Advanced Concrete Technology	4 (4-0-12)
430628 Reinforced Concrete Structures	4 (4-0-12)
430629 Advanced Prestressed Concrete	4 (4-0-12)
430630 Masonry Structures	4 (4-0-12)
430631 Steel Structures	4 (4-0-12)
430632 Experimental Method in Civil Engineering	4 (3-3-9)
430633 Wind Effects on Structures	4 (4-0-12)
430634 Earthquake-Resistant Design	4 (4-0-12)
430635 Structural Control	4 (4-0-12)
430636 Mechanics of Composite Materials	4 (4-0-12)
430637 Design of Advanced Composite in Civil Engineering Structures	4 (4-0-12)
430638 Advanced Analytical Tools in Cement Based Materials	4 (4-0-12)
430643 Laboratory, Field Testing, and Instrumentation in Geotechnical Engineering	4 (4-0-12)
430644 Soil Dynamics	4 (4-0-12)
430645 Geomechanics	4 (4-0-12)
430646 Earth Structures	4 (4-0-12)
430647 Rock Mechanics	4 (4-0-12)
430648 Analytical Method in Geotechnical Engineering	4 (4-0-12)
430649 Numerical Modeling for Geotechnical Engineering	4 (4-0-12)
430650 Deep Excavation and Tunneling	4 (4-0-12)

430651 Unsaturated Soil Mechanics	4 (4-0-12)
430652 Geostatistics	4 (4-0-12)
430663 Modeling of Hydrologic Processes	4 (4-0-12)
430664 Water Resources Systems Analysis	4 (4-0-12)
430665 River and Floodplain Management	4 (4-0-12)
430666 River Engineering	4 (4-0-12)
430667 Statistical Methods in Hydrology	4 (4-0-12)
430668 Subsurface Hydrology	4 (4-0-12)
430711 Special Problems in Advanced CE I	4 (4-0-12)
430712 Special Problems in Advanced CE II	4 (4-0-12)
430713 Special Problems in Advanced CE III	4 (4-0-12)
430714 Special Problems in Advanced CE IV	4 (4-0-12)

Thesis

430891 Master Thesis I	(20 credits)
430892 Master Thesis II	(45 credits)
430893 Doctoral Thesis I	(60 credits)
430894 Doctoral Thesis II	(45 credits)
430895 Doctoral Thesis III	

Note: The 6-digit course number has the following meaning:

- The first digit represents the institute code, i.e., Institute of Engineering = 4.
- The second and third digits are the department code, i.e., School of Civil Engineering = 30.
- The fourth digit indicates the study levels, i.e., 5 = advanced undergraduate course, graduate course = 6-8.
- The fifth digits show specific meaning as follows: 0 = core courses, 9 = thesis.
- The sixth digit shows the order of the course.

17.4 Study Plan

Plan A1: Research and thesis

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	430892 Master Thesis II	3	430892 Master Thesis II	3	430892 Master Thesis II	9
	Total	**3**	**Total**	**3**	**Total**	**9**
2	430892 Master Thesis II	10	430892 Master Thesis II	10	430892 Master Thesis II	10
	Total	**10**	**Total**	**10**	**Total**	**10**

Total 45 credits

Plan A2: Instructional courses with thesis

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	430601 Introduction to Finite Element Method	4	430602 Graduate Seminar in Civil Engineering I	1	430891 Master Thesis I	3
	Major courses (1)	4	Major courses (3)	4	Electives (2)	4
	Major courses (2)	4	Electives (1)	4		
	Total	12	**Total**	9		
2	430891 Master Thesis I	3	430891 Master Thesis I	7	430891 Master Thesis I	7
	Total	3	**Total**	7		7

Total 45 credits

Scheme 1: Research and thesis

For master degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	430893 Doctoral Thesis I	3	430893 Doctoral Thesis I	3	430893 Doctoral Thesis I	3
	Total	**3**	**Total**	**3**	**Total**	**3**
2	430893 Doctoral Thesis I	8	430893 Doctoral Thesis I	8	430893 Doctoral Thesis I	8
	Total	**8**	**Total**	**8**	**Total**	**8**
3	430893 Doctoral Thesis I	8	430893 Doctoral Thesis I	8	430893 Doctoral Thesis I	11
	Total	**8**	**Total**	**8**	**Total**	**11**

Total 60 credits

Scheme 2.1: Instructional courses with thesis

For master degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	Core courses/Major courses/Electives (1)	4	Core courses/Major courses/Electives (3)	4	430894 Doctoral Thesis II	3
	Core courses/Major courses/Electives (2)	4	Core courses/Major courses/Electives (4)	3		
	Total	**8**	**Total**	**7**	**Total**	**3**
2	430894 Doctoral Thesis II	3	430894 Doctoral Thesis II	3	430894 Doctoral Thesis II	9
	Total	**3**	**Total**	**3**	**Total**	**9**
3	430894 Doctoral Thesis II	9	430894 Doctoral Thesis II	9	430894 Doctoral Thesis II	9
	Total	**9**	**Total**	**9**	**Total**	**9**

Total 60 credits

Scheme 2.2: Instructional courses with thesis

For bachelor degree holders

Year	1st Trimester	Cr.	2nd Trimester	Cr.	3rd Trimester	Cr.
1	430601 Introduction to Finite Element Method	4	430602 Graduate Seminarin Civil Engineering I	1	430603 Graduate Seminar in Civil Engineering II	1
	Major courses (1)	4	Major courses (3)	4	Electives (2)	4
	Major courses (2)	4	Electives (1)	4	Electives (3)	4
	Total	**12**	**Total**	**9**	**Total**	**9**
2	430895 Doctoral Thesis III	3	430895 Doctoral Thesis III	3	430895 Doctoral Thesis III	3
	Total	**3**	**Total**	**3**	**Total**	**3**
3	430895 Doctoral Thesis III	9	430895 Doctoral Thesis III	9	430895 Doctoral Thesis III	9
	Total	**9**	**Total**	**9**	**Total**	**9**
4	430895 Doctoral Thesis III	9	430895 Doctoral Thesis III	9	430895 Doctoral Thesis III	6
	Total	**9**	**Total**	**9**	**Total**	**6**

Total 90 credits

17.5 Course Description

430601 Introduction to Finite Element Method 4 (4-0-12)

Condition: Consent of the School

Course Description

Introduction to finite element method (FEM), boundary and initial conditions, discretization of the domain, interpolation models, derivation of element matrices, assembly of element matrices and derivation of system equations; numerical solution of finite element equations; application to solid mechanics problems; modeling considerations and software use.

Course Outline

1. Overview of finite element method (FEM)	(4 hours)
2. Review of matrix algebra and solution of simultaneous linear equations, Review of variational calculus	(4 hours)
3. Boundary and initial Conditions - Discretization of the domain	(4 hours)
4. Interpolation models	(4 hours)
5. Direct stiffness method	(4 hours)
6. FEM for structures: Bars and beams	(4 hours)
7. FEM for structures: Trusses	(4 hours)
8. FEM for structures: Frames and grids	(4 hours)
9. Plane stress and plane strain problems	(8 hours)
10. Modeling considerations and software use	(8 hours)

430602 Graduate Seminar in Civil Engineering I 1 (0-3-4)

Condition: Consent of the School

Course Description

This course is meant to expose all incoming graduate students to possible areas, topics, and methods of research in Civil Engineering. The students are required to present and discuss academic articles related to their research.

430603 Graduate Seminar in Civil Engineering II 1 (0-3-4)

Condition: Consent of the School

Course Description

Introduction to research methodology, literature survey, discussion and criticism on academic articles, summary and conclusion, presentation of research results, academic writing, multimedia preparation, oral presentation. The students are required to develop a preliminary thesis proposal, by writing a technical report and presenting their work.

430610 Numerical Methods in Engineering 4 (4-0-12)

Condition: Consent of the School

Course Description

Introduction to computer software for solving Civil Engineering problems; numerical methods and applications in Civil Engineering problems.

Course Outline

2. Introduction to computer software	(4 hours)
3. Approximations and errors	(8 hours)
4. Roots of equations	(8 hours)
5. Systems of linear algebraic equations	(4 hours)
6. Curve fitting	(4 hours)
7. Numerical integration	(4 hours)
8. Ordinary differential equations	(4 hours)
9. Finite difference: elliptic equations	(4 hours)
10. Finite-element method	(8 hours)

430611 Statistics for Civil Engineering 4 (4-0-12)

Condition: Consent of the School

Course Description

Introduction to the elements of probability and statistics relevant to the reliability-based design in civil engineering, the concept of system reliability and reliability analysis, and the techniques used to analyze the testing pattern and data.

Course Outline

1. Probability	(4 hours)
2. Statistics for reliability analysis	(4 hours)
3. Regression and correlation	(4 hours)
4. System reliability	(4 hours)
5. Combinatorial reliability	(4 hours)
6. Reliability of civil engineering system	(4 hours)
7. Reliability analysis	(4 hours)
8. Point estimate method	(4 hours)
9. Generalized point estimate method	(4 hours)
10. Gaining information	(4 hours)
11. Risk analysis	(8 hours)

430612 Advanced Engineering Geology 4 (4-0-12)

Condition: Consent of the School

Course Description

Rock minerals; geological characteristic; soil formation; geologic map; rock classification; electric log and radioactive log; geologic hazards.

Course Outline

1. Minerals,Identification of rocks, Laterite versus sapolite, Residual soil terminology (4 hours)
2. Alluvial fan deposits, Cross-bedding directions in a barchan dune and a seif dune in relation to wind direction, Five major classes of dolines, Glaciated terrain (4 hours)
3. Rock and soil symbols, Rock clauses, Soil classification, The activity of soil (4 hours)
4. Topographic maps, Geologic maps, Orientation and study of aerial photographs, Geologic time scale (4 hours)
5. Wulff net, Schmidt's net, and Kalsbeek net (4 hours)
6. Test categories for standardization, Physical properties of rocks (4 hours)
7. Average seismic velocity of some earth materials, Ripper performance estimated by seismic wave velocity, Qualitative interpretation of conventional electric logs, Radioactive logs (4 hours)
8. Quantitative description of rock mass, Engineering classification of intact, Geomechanics classification of jointed rock masses, Geomechanics rock, classification guide for excavation and support in rock tunnels, (4 hours)
9. Geologic hazards (8 hours)

430613 Continuum Mechanics 4 (4-0-12)

Condition: Consent of the School

Course Description

Study of the underlying physical and mathematical principles relating to the behavior of continuous media, emphasizing in solid mechanics, the foundations of the general nonlinear theories of continuum mechanics, the general treatment of motion and deformation of continua, balance laws, and constitutive theory, particular applications to elastic solids and simple materials.

Course Outline

1. Vectors and tensors (4 hours)
2. Stress (4 hours)
3. Principal stresses and principal axes (4 hours)
4. Analysis of strain and deformation (8 hours)
5. Compatibility conditions (4 hours)
6. Constitutive equations (4 hours)
7. Isotropy (8 hours)
8. Mechanical properties of solids (4 hours)
9. Some simple problems in elasticity (8 hours)

430620 Advanced Theory of Structures 4 (4-0-12)

Condition: Consent of the School

Course Description

Work done by loads and strain energy; energy theorems; direct approach to formulation of bar; beam of indeterminate structures; large displacement; stability of structure; formulation of geometrically nonlinear problems; formulation of inelastic problems; numerical methods for nonlinear structural analysis.

Course Outline

1. Introduction to structural analysis	(4 hours)
2. Energy theorem	(4 hours)
3. Application of strain energy	(4 hours)
4. Structural fundamental	(4 hours)
5. Derivation of structural matrices	(4 hours)
6. Structural matrices	(4 hours)
7. Generalized structural system	(4 hours)
8. Introduction to nonlinear analysis	(4 hours)
9. Large displacement analysis	(4 hours)
10. Material nonlinearity	(4 hours)
11. Numerical methods for nonlinear, structural analysis	(8 hours)

430621 Dynamics of Structures 4 (4-0-12)

Condition: Consent of the School

Course Description

Fundamental of structural dynamics analysis; types of dynamics loadings on structures, methods in formulation of equations of motion which indicates the dynamics behavior of structures; the lump mass model of structures; single-degree-of-freedom systems; multi-degree-of-freedom systems; formulation of the equations of motion of these system as well as their response under various kinds of loading.

Course Outline

1. Overview of structural dynamics	(4 hours)
2. Formulation of the equation of motion	(4 hours)
3. Single-degree-of-freedom(SDOF) systems	(4 hours)
4. Responses of SDOF systems	(8 hours)
5. Multi-degree-of-freedom(MDOF) systems	(4 hours)
6. Responses of MDOF systems	(4 hours)
7. Responses by the transition matrix	(4 hours)
8. Stability of the dynamics systems	(4 hours)
9. Eigensolution of the dynamic systems	(4 hours)
10. Modal analysis of the response	(4 hours)
11. Analysis of nonlinear systems	(4 hours)

430622 Advanced Mechanics of Materials 4 (4-0-12)

Codition: 430211 Mechanics of Materials or Consent of the School

Course Description

Analysis of stresses and strains at a point; stress-strain relations for various types of materials; theory of elasticity and energy methods used to analyze structural members; static failure and failure criteria used to predict a failure of structural members; fatigue analysis; introduction to fracture mechanics; beams on elastic foundation; plate bending; buckling and instability of plate.

Course Outline

1. Theories of stress and strain	(4 hours)
2. Stress-strain relations	(4 hours)
3. Elements of theory of elasticity	(8 hours)
4. Applications of energy methods	(8 hours)
5. Static failure and failure criteria	(4 hours)
6. Fatigue	(4 hours)
7. Introduction to fracture mechanics	(4 hours)
8. Beams on elastic foundation	(4 hours)
9. Plate bending	(4 hours)
10. Buckling and instability	(4 hours)

430623 Advanced Matrix Method for Structures 4 (4-0-12)

Condition: Consent of the School

Course Description

Matrices and computers in the analysis of structures; force and displacement methods; direct stiffness, and energy formulation; applications to plane and space trusses, multi-span gable frames, grid and space frames, multistory building frames; partitioning by use of substructures.

Course Outline

1. Structural theorems	(4 hours)
2. Force method	(4 hours)
3. Displacement method	(4 hours)
4. Derivation of stiffness matrices	(4 hours)
5. Stiffness matrices	(4 hours)
6. Analysis of structures in 2D	(4 hours)
7. Analysis of structures in 3D	(4 hours)
8. Irregular boundary conditions	(4 hours)
9. Irregular loading conditions	(4 hours)
10. Analysis of substructures	(8 hours)
11. Structural systems	(4 hours)

430624 Theory of Elastic Stability 4 (4-0-12)

Condition: Consent of the School

Course Description

The analysis of beam-column, elastic buckling, inelastic buckling, and experiments on buckling of bars, torsional buckling and lateral buckling of beams, bending and buckling of thin plates.

Course Outline

1. Beam-columns	(8 hours)
2. Elastic buckling of bars	(4 hours)
3. Elastic buckling of frames	(4 hours)
4. Inelastic buckling of bars	(4 hours)
5. Experiments and design formulas	(4 hours)
6: Torsional buckling	(4 hours)
7. Lateral buckling of beams	(4 hours)
8. Bending of thin plates	(8 hours)
9. Buckling of thin plates	(8 hours)

430625 Theory of Plates and Shells 4 (4-0-12)

Condition: Consent of the School

Course Description

Basic equations for the bending of rectangular, circular, and continuous plates; anisotropic rectangular plate with various edge conditions; general theory of deformation of thin shells with small deflections, effect of edge conditions; analysis of shell structures; cylindrical vaults, domes, double curved roofs, and tanks; Numerical and approximate methods for plate and shell analyses.

Course Outline

1. Pure bending of long rectangular plates	(4 hours)
2. Small deflections of laterally loaded plates	(4 hours)
3. Simply supported rectangular plates	(4 hours)
4. Rectangular plates with various edge conditions	(4 hours)
5. Circular plates	(4 hours)
6. Continuous rectangular plates	(4 hours)
7. Anisotropic rectangular plates	(8 hours)
8. Deformation of shells without bending	(4 hours)
9. General theory of cylindrical shells	(4 hours)
10. Numerical methods for plate and shell analysis	(8 hours)

430626 Advanced Finite Element Method 4 (4-0-12)

Condition: Consent of the School

Course Description

Finite element method, numerical method and computer in the analysis of structures; direct and generalized formulation of the approximate analysis with applications to bar, beam, plane strain and plane stress, axi-symmetric and general solid elements, and the modeling of structural systems.

Course Outline

1. Introduction to finite element method	(4 hours)
2. Structural theorems	(4 hours)
3. Stress and strain in elements	(4 hours)
4. Isoparametric formulation	(4 hours)
5. Derivation of element matrices	(4 hours)
6. Formulation of structural system	(4 hours)
7. Large displacement	(4 hours)
8. Large strain	(4 hours)
9. Material nonlinearity	(4 hours)
10. Plasticity	(4 hours)
11. Creep	(4 hours)
12. Analysis tool and implementation	(4 hours)

410627 Advanced Concrete Technology 4 (4-0-12)

Condition: Consent of the School

Course Description

Review of concrete technology; pozzolanic materials; special concrete; durability of concrete; microstructure of concrete; advanced analytical tools for concrete.

Course Outline

1. Review of concrete technology	(8 hours)
2. Pozzolanic materials in concrete	(8 hours)
3. Special concrete	(8 hours)
4. Durability of concrete	(8 hours)
5. Microstructure of concrete	(8 hours)
6. Advanced analytical tools for concrete	(8 hours)

430628 Reinforced Concrete Structures 4 (4-0-12)

Condition: Consent of the School

Course Description

Design of structural components such as beams, columns, slabs, footings and walls using the ultimate strength method; building code requirements for reinforced concrete; truss models for shear and torsion, development and anchorage.

Course Outline

1. Overview of concrete structures, Design methods and requirements (4 hours)
2. Strength of structural members in bending (4 hours)
3. Shear strength and shear reinforcement (4 hours)
4. Beams in torsion (4 hours)
5. Serviceability of beams (4 hours)
6. Combined compression and bending: Columns (4 hours)
7. Development of reinforcement (4 hours)
8. Two-way slabs, plates, and continuous reinforced concrete structures (4 hours)
9. Structural stability (4 hours)
10. Length effects on columns (4 hours)
11. Design of footings (4 hours)
12. Design of footings (4 hours)

430629 Advanced Prestressed Concrete 4 (4-0-12)

Condition: Consent of the School

Course Description

Discussions concerning materials and methods used in prestressing; design of sections for flexure, shear, anchorage, and torsion; camber, deflections and cable layouts, simple spans, continuous beams, and prestressed tanks.

Course Outline

1. Overview of prestressed concrete, Materials and structural behavior (4 hours)
2. Prestressing systems, End anchorages (4 hours)
3. Loss of prestress (4 hours)
4. Analysis of section in flexure (4 hours)
5. Design of section for flexure (4 hours)
6. Shear, Bond and Bearing (4 hours)
7. Post-tensioned slab, Computer applications (4 hours)
8. Torsion design (4 hours)
9. Camber, Deflection (4 hours)
10. Composite construction (4 hours)
11. Continuous beams (4 hours)
12. Tension members, Circular prestressing (4 hours)

430630 Masonry Structures **4 (4-0-12)**

Condition: Consent of the School

Course Description

Masonry unit types and grades, mortar types, reinforcement and connectors, beam, column, arch, bearing wall design; structural behavior and recommended standard construction practices; Plain and reinforced masonry, design parameter establishment, and recommended practice documents.

Course Outline

1. Overview of masonry structures, Modern masonry construction	(4 hours)
2. Clay brick and tile-material properties, Material and testing	(4 hours)
3. Concrete masonry units, Material properties, Material and testing	(4 hours)
4. Mortar, grout, and steel reinforcement, Materials and testing	(4 hours)
5. Design parameter establishment	(4 hours)
6. Load types and intensities, Loads and load combinations	(4 hours)
7. Design philosophy and methodology, Structural analysis and design	(4 hours)
8. Structural considerations for masonry walls, Load bearing walls, Shear walls	(4 hours)
9. Masonry columns and pilasters	(4 hours)
10. Structural considerations for masonry beams, Bending behavior, Design of reinforced concrete beams	(4 hours)
11. Structural considerations for masonry beam-columns, behavior and design	(4 hours)
12. Connections, joints, and construction details in practice	(4 hours)

430631 Steel Structures **4 (4-0-12)**

Condition: Consent of the School

Course Description

Behavior of steel structures under load; topics include beams, columns, building connections, structural stability and bracing requirements; building codes and related documents.

Course Outline

1. Overview of steel structures, design methods and requirements, ASD and LRFD	(4 hours)
2. Tension member behavior and design	(4 hours)
3. Compression member behavior and design	(4 hours)
4. Beam behavior under load and bracing requirements	(4 hours)
5. Beam design	(4 hours)
6. Torsional design of beam	(4 hours)
7. Beam-columns behavior and design	(4 hours)
8. Building types and connections	(4 hours)
9. Bolted connection	(4 hours)
10. Welded connection	(4 hours)
11. Bracing requirements for compression members	(4 hours)
12. Frame stability and bracing requirements	(4 hours)

430632 Experimental Method in Civil Engineering 4 (3-3-9)

Condition: Consent of the School

Course Description

Principles and techniques of measurements in mechanics; electrical-resistance strain gauges, semiconductor sensors, recording instruments, optical interference methods, photoelasticity, and dynamic measurements.

Course Outline

1. Standards of measurement	(4 hours)
2. Treatment of uncertainties	(4 hours)
3. Introduction to strain measurements	(4 hours)
4. Electric resistance strain gages	(4 hours)
5. Semiconductor sensors	(4 hours)
6. Recording instruments	(4 hours)
7. Analysis of strain-gage data	(4 hours)
8. Displacement measurements	(4 hours)
9. Measurement of force and torque	(4 hours)
10. Measurement of motion	(4 hours)
11. Photoelasticity	(4 hours)

430633 Wind Effects on Structures 4 (4-0-12)

Condition: Consent of the School

Course Description:

Effects of wind loading on civil engineering structures; atmospheric circulation of wind; fundamental of force induced by bluff-body aerodynamics; applications to design problems.

Course Outline

1. Atmosphere wind	(4 hours)
2. Bluff-body aerodynamics	(4 hours)
3. Structural dynamics	(4 hours)
4. Wind-induced vibration	(4 hours)
5. Wind directionality effects	(4 hours)
6. Tall buildings: Structural response and cladding design	(4 hours)
7. Slender towers and stacks with circular cross section	(4 hours)
8. Hyperbolic cooling towers	(4 hours)
9. Trussed frameworks and plate girders	(4 hours)
10. Suspended-span bridges, tension structures, and power lines	(4 hours)
11. Offshore structures	(4 hours)
12. Wind-induced discomfort in and around buildings	(4 hours)

430634 Earthquake-Resistant Design 4 (4-0-12)

Condition: Consent of the School

Course Description

Effects of earthquake loading on civil engineering structures; characteristic of earthquake; effect of earthquake loading on structures; applications to design problems.

Course Outline

1. Seismological background	(4 hours)
2. Earthquake input mechanisms	(4 hours)
3. Earthquake response of single-degree-of-freedom	(4 hours)
4. Earthquake analysis of multi-degree-of-freedom	(4 hours)
5. Earthquake response of linearly elastic buildings	(4 hours)
6. Earthquake response of inelastic buildings	(4 hours)
7. Earthquake dynamics of base-isolated buildings	(4 hours)
8. Excitation by rigid-base rotation,Multiple-support excitation	(4 hours)
9. Soil-structure interaction	(4 hours)
10. Nonlinear response to earthquakes	(4 hours)
11. Stochastic modeling of strong ground motions	(4 hours)
12. Structural dynamics in building codes	(4 hours)

430635 Structural Control 4 (4-0-12)

Prerequisite: 430621 Dynamics of Structures or Consent of the School

Course Description

Introduction of vibration problem in structures; basic concepts of linear system and stability; discussion about how to control structures passively and actively; semi-active control.

Course Outline

1. Introduction	(4 hours)
2. Linear Systems	(4 hours)
3. Stability analysis	(4 hours)
4. Passive control	(4 hours)
5. Active control	(4 hours)
6. Classical control theory	(4 hours)
7. Optimal control theory	(4 hours)
8. Output feedback control	(4 hours)
9. Nonlinear control	(4 hours)
10. Control of buildings	(4 hours)
11. Decentralized control of large scale system	(4 hours)
12. Semi-active control	(4 hours)

430636 Mechanics of Composite Materials **4 (4-0-12)**

Prerequisite: 430622 Advanced Mechanics of Materials or Consent of the School

Course Description

Introduction to fiber-reinforced composite material; linear elastic stress-strain characteristics of fiber-reinforced composite materials; prediction of engineering properties using micromechanics; plane-stress assumptions; plane-stress stress-strain relation in a global coordinate system; classical lamination theory; failure theories for fiber-reinforced composite materials; introduction to fiber-reinforced laminated plates.

Course Outline

1. Introduction to fiber-reinforced composite materials	(4 hours)
2. Linear elastic stress-strain characteristics of fiber-reinforced composite materials	(4 hours)
3. Prediction of engineering properties using micromechanics	(4 hours)
4. Plane-stress assumptions	(4 hours)
5. Plane-stress stress-strain relation in a global coordinate system	(4 hours)
6. Classical lamination theory: Kirchhoff hypothesis	(4 hours)
7. Classical lamination theory: Laminate stiffness matrix	(4 hours)
8. Classical lamination theory: Additional examples	(4 hours)
9. Failure theories for fiber-reinforced composite materials I	(4 hours)
10. Failure theories for fiber-reinforced composite materials II	(4 hours)
11. Introduction to fiber-reinforced laminated plates I	(4 hours)
12. Introduction to fiber-reinforced laminated plates II	(4 hours)

430637 Design of Advanced Composites in Civil Engineering Structures **4 (4-0-12)**

Condition: Consent of the School

Course Description

Design of fiber-reinforced plastic composites (FRP) of civil engineering structures; pertinent fundamental understanding of the constituents; manufacturing processes, and mechanical properties of the fiber reinforced plastic composite materials; the structural behavior and analysis; the design methodology for tension members, compression members, flexural members, and connection.

Course Outline

1. Introduction to fiber-reinforced plastic composite	(4 hours)
2. Manufacturing techniques	(4 hours)
3. Macro mechanical behavior	(4 hours)
4. Standard tests	(4 hours)
5. Micromechanical behavior	(8 hours)
6. Structural analysis	(8 hours)
7. Member selection – manual	(4 hours)
8. Design of compression members	(4 hours)
9. Design of flexural members	(4 hours)
10. Design of connections	(4 hours)

430638 Advanced Analytical Tools in Cement Based Materials 4 (4-0-12)

Prerequisite: Consent of the School

Course Description

Review of advanced xement based materials technology and analytical tools in cement based materials; microstructure of hydration reaction and pozzolanic reaction X-ray diffraction (XRD); thermal analysis (DTA, TGA and DSA) and electron microscope (SEM, BSEM, TEM, EDAX); porosity and pore size distribution of cement based materials; surface area with nitrogen adsorption technique (BET Method) synchrotron radiation technique.

Course Outline

1. Review of Advanced Concrete Technology and Analytical Tools in Cement Based Materials (8 hours)
2. Solid Phase Analysis by X-Ray Diffraction (XRD) (8 hours)
3. Electron Microscopy with Various Techniques (SEM, BSEM, TEM, X-Ray Chemical Analysis (EDAX)) (8 hours)
4. Thermal Analysis (Differential Thermal analysis (DTA), Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC)) (8 hours)
5. Porosity, Pore Size Distribution and Surface Area (Mercury Intrusion Porosimeter (MIP) and Nitrogen Adsorption) (8 hours)
6. Application of Synchrotron Radiation Technique in Cement Based Materials (8 hours)

430640 Theoretical Soil Mechanics 4 (4-0-12)

Condition: Consent of the School

Course Description

Physical properties; soils classification; ground water; coefficient of permeability; seepage; excess pore water pressure; effective stress; consolidation; strength and deformations.

Course Outline

1. Soil formation and soil constituents (4 hours)
2. Soil mineral and soil-water interaction (4 hours)
3. Index properties and soil classification (4 hours)
4. Soil fabric and its measurement (4 hours)
5. Effective, intergranular and total stress (4 hours)
6. Soil structure (4 hours)
7. Engineering properties of desturctured clays and their assessment (8 hours)
8. Engineering properties of structured clays and their assessment (8 hours)

430641 Advanced Foundation Engineering **4 (4-0-12)**
Condition: Consent of the School
Course Description

Site investigation; evaluation of geotechnical parameters; shallow foundation; instrumentation for pile and evaluation of instrumented pile load test results; improvement of bored pile capacity by toe/shaft grouting, earth pressure theories and retaining structures, instrumentation for deep excavation, observational method for design and construction of retaining structures.

Course Outline

1. Review of some essential soil mechanics and foundation engineering (4 hours)
2. Site investigation, Evaluation of geotechnical parameters,Geotechnical report(4 hours)
3. Shallow foundation-combined footings, Mat foundation, Compensated foundation (8 hours)
4. Instrumentation for pile subjected to axial or lateral loading (4 hours)
5. Evaluation of instrumented pile load test results for advanced pile design: Axial or lateral loading (4 hours)
6. Improvement of bored pile capacity by toe/shaft grouting (4 hours)
7. Earth pressure theories and retaining structures, Sheet pile wall, Diaphragm wall, Conventional/top-down construction (8 hours)
8. Instrumentation planning, Evaluation of monitored results, Evaluation of bracing and wall performance for deep excavation (8 hours)
9. Observational method for design and construction of retaining structures (4 hours)

430642 Ground Improvement Techniques **4 (4-0-12)**
Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School
Course Description

Compaction; stone columns; vertical drains; preloading; chemical stabilization; reinforced earth.

Course Outline

1: Principle of ground improvement (4 hours)
2. Physical improvement methods : Compaction, Dewatering, Densification (8 hours)
3. Chemical improvement methods (8 hours)
4. Earth reinforcement (8 hours)

430643 Laboratory, Field Testing, and Instrumentation in Geotechnical Engineering **4 (3-3-9)**
Condition: Consent of the School
Course Description

Physical properties; electronic instruments in laboratory; chemical tests; field permeability test; consolidation test; shear strength determination; field tests; instrumentation.

Course Outline

1. Physical properties (4 hours)
2. Scanning electron microscope (4 hours)
3. X-ray diffraction (4 hours)
4. Pore size distribution analysis (4 hours)
5. Field permeability test (4 hours)
6. Consolidation tests (8 hours)
7. Shear strength tests (8 hours)
8. Instrumentation (8 hours)
9. Field trip (4 hours)

430644 Soil Dynamics 4 (4-0-12)

Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School

Course Description:

Elasticity; visco-elasticity; soil stiffness; soil damping; soil liquefaction; site characterization; in-situ testing; laboratory testing; seismic response analysis; soil sampling; flow failure.

Course Outline:

1. Characteristics of dynamic problems	(4 hours)
2. Characteristic changes in cyclic stress in typical dynamic loading	(4 hours)
3. The presentation of stress-strain relations in cyclic loading	(4 hours)
4. Apparatus and procedures for laboratory tests	(4 hours)
5. In-situ survey by wave propagation	(4 hours)
6. Low-amplitude shear moduli	(4 hours)
7. Effect of loading speed and stiffness degradation of cohesionless soils	(8 hours)
8. Strength of cohesive soils under transient and cyclic loading conditions	(4 hours)
9. Resistance of sand to cyclic loading	(4 hours)
10. Sand behavior under monotonic loading	(4 hours)
11. Analysis of liquefaction	(4 hours)

430645 Geomechanics 4 (4-0-12)

Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School

Course Description

Basic concepts; critical state strength of soil; stress-strain modeling based on critical state theory; behavior of soils before failure.

Course Outline

1. Basic concepts	(4 hours)
2. Critical state theory	(8 hours)
3. Stress-strain modeling	(8 hours)
4. Behavior of soils before failure	(4 hours)
5. Soil parameters for design	(8 hours)
6. Koiter's equation and slip line fields	(8 hours)

430646 Earth Structures 4 (4-0-12)

Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School

Course Description

State of stress in ground; compacted soil; seepage problems and control methods; slope stability calculations; earth dam design.

Course Outline

1. Natural Soils	(8 hours)
2. Properties and applications of compacted soil	(8 hours)
3. Seepage	(8 hours)
4. Slope stability	(8 hours)
5. Earth dam design	(4 hours)
6. Field monitoring	(8 hours)

430647 Rock Mechanics **4 (4-0-12)**

Condition: Consent of the School

Course Description

Index properties and classification; engineering properties; strength of jointed rock masses; factors influencing strength and modulus; foundation on rocks and rock slope.

Course Outline

1. Index properties and classification	(4 hours)
2. Engineering properties of soils and rocks	(8 hours)
3. Rock fracture and failure criteria	(4 hours)
4. Deformability	(4 hours)
5. Creep and moisture sensitive properties	(4 hours)
6. Shear strength of rock discontinuities	(8 hours)
7. Foundations on rocks	(8 hours)
8. Rock slope	(8 hours)

430648 Analytical Methods in Geotechnical Engineering **4 (4-0-12)**

Prerequisite: 430645 Geomechanics or Consent of the School

Course Description

Analytical and numerical methods in geotechnical engineering; modeling the stress-strain behavior of soils (elastic models, rigid-perfectly plastic models, elasto-plastic models); analytical methods for ultimate limit state; upper and lower bound theorems; upper and lower bound methods for undrained analysis; upper and lower bound methods for drained analysis; application of upper and lower bound methods; method of characteristics; constructing a characteristic mesh for undrained loading; constructing a characteristic mesh for drained loading; the limit equilibrium method.

Course Outline

1. Analytical and numerical methods in geotechnical engineering	(4 hours)
2. Modeling the stress-strain behavior of soils	(8 hours)
3. Analytical methods for ultimate limit state	(4 hours)
4. Upper and lower bound methods for undrained analysis	(8 hours)
5. Upper and lower bound methods for drained analysis	(8 hours)
6. Constructing a characteristic mesh	(8 hours)
7. Limit equilibrium method	(8 hours)

430649 Numerical Modeling for Geotechnical Engineering **4 (4-0-12)**

Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School

Course Description

Review of continuum mechanics; physical and numerical modeling; constitutive models for soil and structures; selection of suitable constitutive models; numerical modeling with finite Element and finite difference; stability analysis with phi/c reduction method.

Course Outline

1. Review of continuum mechanics	(8 hours)
2. Physical and numerical modeling in geotechnical engineering	(4 hours)
3. Simple constitutive models and advanced constitutive model for soils and Structures	(4 hours)
4. Selection of suitable constitutive models for geotechnical material	(8 hours)
5. Numerical modeling with finite element method	(8 hours)
6. Numerical modeling with finite difference method	(8 hours)
7. Stability analysis by phi/c reduction method	(8 hours)

430650 Deep Excavation and Tunneling 4 (4-0-12)

Condition: Consent of the School

Course Description

Overview of excavation and tunneling method; selection of construction method; instrumentation types and planning; stress and deformation field around tunnel; earth pressure theories; concept of the NATM; mechanized tunneling method; cut and cover tunneling method; concept of lining design; risk assessment for deep excavation and tunneling.

Course Outline

1. Overview of excavation and tunneling method	(4 hours)
2. Selection of construction method	(4 hours)
3. Instrumentation: Types and planning	(4 hours)
4. Stress and deformation field around tunnel and Earth pressure theories	(8 hours)
5. Concept of the NATM (New Austrian Tunneling Method)	(8 hours)
6. Mechanized tunneling method	(8 hours)
7. Cut and cover tunneling method	(4 hours)
8. Concept of lining design	(4 hours)
9. Risk assessment for deep excavation and tunneling	(4 hours)

430651 Unsaturated Soil Mechanics 4 (4-0-12)

Prerequisite: 430640 Theoretical Soil Mechanics or Consent of the School

Course Description

Introduction to unsaturated soil problems; phase properties and relations; basic principles; stress state variables; measurement of unsaturated soil properties; flow of water in unsaturated soils; steady state and transient flows; soil water characteristic curve; hydraulic conductivity-suction relations; mechanical behavior of unsaturated soils; pore pressure parameters; volume change constitutive relations under drained and undrained loading; critical-state frameworks and applications; coupling seepage and stress-deformation analyses.

Course Outline :

1. Introduction to unsaturated soil mechanics	(4 hours)
2. Phase properties and relations	(4 hours)
3. Basic principles	(4 hours)
4. Stress state variables	(4 hours)
5. Flow of water in unsaturated soils. Steady state and transient flows	(4 hours)
6. Soil water characteristic curve, Hydraulic conductivity-suction relations	(8 hours)
7. Mechanical behavior of unsaturated soils	(8 hours)
8. Application of critical state soil mechanics to unsaturated soils	(8 hours)
9. Fluid-mechanical interaction in unsaturated soils	(4 hours)

430652 Geostatistics **4 (4-0-12)**

Prerequisite: 430611 Statistics for Civil Engineering or Consent of the School

Course Description

Introduction to the geostatistic theory; applications in geotechnical engineering.

Course Outline

1. Geostatistics and engineering geological applications	(4 hours)
2. The theory of regionalized	(16 hours)
3. Structural analysis (Nested structures and the nugget effect, models of variograms,fitting models, hole effect and proportional effect, anisotropies)	(8 hours)
4. Kriging and the estimation of engineering geological characteristics	(12 hours)
5. Sequential Gaussian and indicator simulation and co-simulation	(8 hours)

430660 Advanced Hydrology **4 (4-0-12)**

Condition: Consent of the School

Course Description

Introduction to hydrology; hydrologic processes; atmospheric water; subsurface water; groundwater; surface water; unit hydrograph; lumped flow routing, distributed flow routing, frequency analysis.

Course Outline

1. Hydrologic processes	(8 hours)
2. Atmospheric water	(4 hours)
3. Subsurface water	(4 hours)
4. Groundwater	(4 hours)
5. Surface water	(4 hours)
6. Unit hydrograph	(8 hours)
7. Lumped flow routing	(4 hours)
8. Distributed flow routing	(4 hours)
9. Frequency analysis	(8 hours)

430661 Computational Hydraulics **4 (4-0-12)**

Condition: Consent of the School

Course Description

Equations and numerical solution techniques for hydraulic problems, open channels and rivers, sediment in rivers, pipe systems, groundwater flow; diffusion and dispersion in rivers.

Course Outline

1. Equations and numerical solution techniques for hydraulic problems	(4 hours)
2. Gradually varied flow in irregular open channels	(8 hours)
3. Flood waves in rivers and floodplains	(8 hours)
4. Oscillation of shallow water	(4 hours)
5. Scour and deposition of sediment in river channels	(8 hours)
6. Water hammer in pipe systems	(8 hours)
7. Surge protection and air chambers	(4 hours)
8. Seepage and groundwater flows	(8 hours)
9. Diffusion and dispersion of pollutants in rivers	(8 hours)

430662 Systems Analysis 4 (4-0-12)

Condition: Consent of the School

Course Description

Introduction to the systems approach for solving problems; problem definition and mathematical formulation; economic theory in decision making; linear programming and dynamic programming.

Course Outline

1. Introduction to systems approach	(4 hours)
2. An overview of mathematical optimization methods	(4 hours)
3. Engineering economics for decision making	(8 hours)
4. Linear programming	(16 hours)
5. Sensitivity analysis and the dual-primal relationships	(4 hours)
6. Dynamic programming	(12 hours)

430663 Modeling of Hydrologic Processes 4 (4-0-12)

Condition: Consent of the School

Course Description

Mathematical modeling and numerical solution of hydrologic processes; rainfall; losses, runoff; empirical and process based models, lumped and distributed parameters models; other modeling considerations, model capability and accuracy, optimization.

Course Outline

1. Mathematical modeling and numerical solution of hydrologic processes(4 hours) Rainfall	
2. Infiltration,Unsaturated and saturated flow	(4 hours)
3. Surface storage, Evaporation	(4 hours)
4. Transpiration,Interception	(4 hours)
5. Runoff	(4 hours)
6. Numerical representation of terrain	(4 hours)
7. Model structure,Empirical and process based models	(8 hours)
8. Lumped and distributed parameters	(8 hours)
9. Model capability and accuracy	(4 hours)
10. Model optimization	(4 hours)

430664 Water Resources Systems Analysis 4 (4-0-12)

Prerequisite: 430662 Systems Analysis or Consent of the School

Course Description

Introduction to water resources systems; simulation techniques and mathematical programming used to analyze and plan common water resources systems.

Course Outline

1. Planning and analysis of water resources systems	(4 hours)
2. Identification and evaluation of water management plans	(8 hours)
3. Water resources planning objectives	(4 hours)
4. Water resources planning under uncertainty	(8 hours)
5. Deterministic river basin modeling	(8 hours)
6. Stochastic river basin planning models	(8 hours)
7. Case studies	(8 hours)

430665 River and Floodplain Management 4 (4-0-12)

Condition: Consent of the School

Course Description

Nature of streamflow, fluvial processes and alluvial channel morphology; Modeling of irregular channels and floodplains; Management issues relating to rivers and floodplains.

Course Outline

1. Introduction to river and floodplain management (4 hours)
2. Nature of streamflow and fluvial processes (4 hours)
3. Hydraulics of flow in irregular channels (8 hours)
4. Floodplain and estuaries (8 hours)
5. Floodplain management systems (8 hours)
6. Alluvial channel morphology (4 hours)
7. Alluvial channel modeling (8 hours)
8. Mixing processes for pollutant (4 hours)

430666 River Engineering 4 (4-0-12)

Condition: Consent of the School

Course Description

Catchment characteristics; hydrological cycle; catchment areas; sediment sources and sediment yield; river hydraulics; river morphology; sediment transport; planforms; cross sections and longitudinal profiles; river improvement, construction, control of flow regimes; sediment control devices.

Course Outline

1. Catchment characteristics (8 hours)
    -Hydrological cycle
    -Catchment areas
    -Sediment sources and sediment yield
2. River hydraulics (8 hours)
    -Water levels
    -Discharge
    -Relation curves
    -Backwater curve computation and flood routing
3. River morphology (16 hours)
    -Sediment transport
    -Planforms of river
    -Longitudinal profiles
    -River bends
    -Confluences and bifurcations
4. River engineering works (12 hours)
    -Temporary river improvement
    -Permanent river improvement
    -Constructions
    -Control of flow regime
5. Sediment control devices (4 hours)
    -Bottom intake structures for mountainous streams
    -Sediment control devices and their characteristics

430667 Statistical Methods in Hydrology 4 (4-0-12)

Condition: Consent of the School

Course Description

Probability and probability distribution; properties of random variables; discrete probability distributions; normal distribution; continuous probability distributions; probability plotting and frequency analysis; confidence intervals and hypothesis testing; linear regression; correlation; multivariate analysis; analysis of hydrologic time series; stochastic hydrologic models.

Course Outline

1. Probability and probability distribution	(4 hours)
2. Properties of random variables	(4 hours)
3. Discrete probability distributions	(4 hours)
4. Normal distribution	(4 hours)
5. Continuous probability distributions	(4 hours)
6. Probability plotting and frequency analysis	(4 hours)
7. Confidence intervals and hypothesis testing	(4 hours)
8. Linear regression	(4 hours)
9. Correlation	(4 hours)
10. Multivariate analysis	(4 hours)
11. Analysis of hydrologic time series	(4 hours)
12. Stochastic hydrologic models	(4 hours)

430668 Subsurface Hydrology 4 (4-0-12)

Condition: Consent of the School

Course Description

Water and the subsurface environment; fluid flow and mass transport; the geologic setting; water movement in geological formations; analytical solutions to flow problems; well hydraulics; numerical solutions of the groundwater flow equation, contamination of subsurface water; groundwater-surface water interaction; remediation; multi-fluid flow and transport.

Course Outline

1. Water and subsurface environment	(4 hours)
2. Fluid flow and mass transport	(4 hours)
3. The geologic setting	(4 hours)
4. Water movement in geological formations	(4 hours)
5. Analytical solutions to flow problems	(4 hours)
6. Well hydraulics	(4 hours)
7. Numerical solutions of the groundwater flow equation	(4 hours)
8. Contamination of subsurface water	(4 hours)
9. Groundwater-surface water interaction	(4 hours)
10. Remediation	(4 hours)
11. Multi-fluid flow and transport	(8 hours)

430711 Special Problems in Advanced Civil Engineering I **4 (4-0-12)**
Condition: Consent of the School
Course Description

Study of special problems in advanced civil engineering case studies by using advanced approaches to solve the problems or experiments.

430712 Special Problems in Advanced Civil Engineering II **4 (4-0-12)**
Condition: Consent of the School
Course Description

Study of special problems in advanced civil engineering case studies by using advanced approaches to solve the problems or experiments.

430713 Special Problems in Advanced Civil Engineering III **4 (4-0-12)**
Condition: Consent of the School
Course Description

Study of special problems in advanced civil engineering case studies by using advanced approaches to solve the problems or experiments.

430714 Special Problems in Advanced Civil Engineering IV **4 (4-0-12)**
Condition: Consent of the School
Course Description

Study of special problems in advanced civil engineering case studies by using advanced approaches to solve the problems or experiments.

430891 Master Thesis I **(20 credits)**
Condition: Consent of the School
Course Description

Original research work leading to the preparation of a master thesis in the fulfillment of the requirement for the master degree. Enrollees are bachelor degree holders.

430892 Master Thesis II **(45 credits)**
Condition: Consent of the School
Course Description

Original research work leading to the preparation of a master thesis in the partial fulfillment of the requirement for the master degree.

430893 Doctoral Thesis I **(60 credits)**
Condition: Consent of the School
Course Description

Original research work leading to the preparation of a doctoral thesis in the fulfillment of the requirement for the doctoral degree.

430894 Doctoral Thesis II **(45 credits)**
Condition: Consent of the School
Course Description

Original research work leading to the preparation of a doctoral thesis in the partial fulfillment of the requirement for the doctoral degree.

430895 Doctoral Thesis III **(60 credits)**

Prerequisite: Consent of the School

Course Description

Original research work leading to the preparation of a doctoral thesis in the partial fulfillment of the requirement for the doctoral degree.

18. Curriculum Quality Assurance

Curriculum quality assurance conforms the Education Quality Assurance System of the Suranaree University of Technology (centralization).

19. Program Revision

The graduate Program is to be revised every five years to include new knowledge and advancement. This revised program consists of three fields; namely, structural, geotechnical, and water resources engineering. New courses are added and outdated courses were taken out. The study program consists of core and major courses, electives and thesis. The core courses are common to every field and the major courses are for each field.

Appendix A
Curriculum Improvement Committee

คำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี

ที่ ๔๔๔ /๒๕๔๙

เรื่อง แต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐)

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เพื่อให้การปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา เป็นไปด้วยความเรียบร้อย และบรรลุตามวัตถุประสงค์

ฉะนั้น อาศัยอำนาจตามความในมาตรา ๑๙ (๑) (๑๑) มาตรา ๒๑ และมาตรา ๒๔ แห่งพระราชบัญญัติมหาวิทยาลัยเทคโนโลยีสุรนารี พ.ศ. ๒๕๓๓ ประกอบกับมติสภาวิชาการมหาวิทยาลัยเทคโนโลยีสุรนารี ในการประชุมครั้งที่ ๘/๒๕๔๙ เมื่อวันที่ ๒๐ กรกฎาคม ๒๕๔๙ ประกอบกับประกาศสำนักนายกรัฐมนตรี เรื่อง แต่งตั้งอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี ลงวันที่ ๓๑ พฤษภาคม ๒๕๔๘ จึงแต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) ประกอบด้วยบุคคลดังต่อไปนี้

๑. รองศาสตราจารย์ ดร.ปริญญา จินดาประเสริฐ	เป็น ประธาน
๒. ศาสตราจารย์ ดร.สมชาย ชูชีพสกุล	เป็น รองประธาน
๓. รองศาสตราจารย์ ดร.วรากร ไม้เรียง	เป็น กรรมการ
๔. รองศาสตราจารย์ ดร.อำนาจ อภิชาติวัลลภ	เป็น กรรมการ
๕. รองศาสตราจารย์ ดร.สิทธิชัย แสงอาทิตย์	เป็น กรรมการ
๖. ผู้ช่วยศาสตราจารย์ ดร.วีรพันธ์ ศรีบุญลือ	เป็น กรรมการ
๗. ผู้ช่วยศาสตราจารย์ ดร.มงคล จิรวัชรเดช	เป็น กรรมการ
๘. อาจารย์ ดร.ทนงศักดิ์ พิสาลสิน	เป็น กรรมการ
๙. หัวหน้าสาขาวิชาวิศวกรรมโยธา	เป็น กรรมการและเลขานุการ
๑๐. ผู้ช่วยศาสตราจารย์ ดร.สุขสันติ์ หอพิบูลสุข	เป็น กรรมการและผู้ช่วยเลขานุการ

ทั้งนี้ ตั้งแต่วันที่ ๒๑ กรกฎาคม ๒๕๔๙ เป็นต้นไป

สั่ง ณ วันที่ ๗ สิงหาคม พ.ศ. ๒๕๔๙

(รองศาสตราจารย์ ดร.ประสาท สืบค้า)
อธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี

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SURANAREE UNIVERSITY OF TECHNOLOGY
111 UNIVERSITY AVENUE, SUB DISTRICT SURANAREE, MUANG DISTRICT, NAKHON RATCHASIMA 30000, THAILAND Tel. (044) 223000 Fax. (044) 224070

คำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี

ที่ ๑๘ /๒๕๕๐

เรื่อง แต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) เพิ่มเติม

....

อนุสนธิคำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี ที่ ๕๕๔/๒๕๔๕ ลงวันที่ ๗ สิงหาคม ๒๕๔๕ ได้แต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) นั้น

เพื่อให้การปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา เป็นไปด้วยความเรียบร้อย และมีประสิทธิภาพยิ่งขึ้น ฉะนั้น อาศัยอำนาจตามความในมาตรา ๑๕ (๑) (๑๑) มาตรา ๒๑ และมาตรา ๒๔ แห่งพระราชบัญญัติมหาวิทยาลัยเทคโนโลยีสุรนารี พ.ศ. ๒๕๓๓ ประกอบกับมติสภาวิชาการมหาวิทยาลัยเทคโนโลยีสุรนารี ในการประชุมครั้งที่ ๑๔/๒๕๔๕ เมื่อวันที่ ๒๘ พฤศจิกายน ๒๕๔๕ ประกอบกับประกาศสำนักนายกรัฐมนตรี เรื่อง แต่งตั้งอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี ลงวันที่ ๓๑ พฤษภาคม ๒๕๔๘ จึงแต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาวิศวกรรมโยธา (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) เพิ่มเติม ประกอบด้วยบุคคลดังต่อไปนี้

๑. ผู้ช่วยศาสตราจารย์ ดร.ฉัตรชัย โชติษฐยางกูร	เป็น กรรมการ
๒. อาจารย์ ดร.พรพจน์ ตันเส็ง	เป็น กรรมการ
๓. อาจารย์ ดร.อวิรุทธิ์ ชินกุลกิจนิวัฒน์	เป็น กรรมการ
๔. อาจารย์ ดร.ธีรวัฒน์ สินศิริ	เป็น กรรมการ

ทั้งนี้ ตั้งแต่วันที่ ๒๙ พฤศจิกายน ๒๕๔๕ เป็นต้นไป

สั่ง ณ วันที่ ๙ มกราคม พ.ศ. ๒๕๕๐

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Lawyer/งานข้อมูล/คำสั่งรอ/คกก.ปรับปรุงหลักสูตร.doc

Appendix B
SUT Regulation for Graduate Studies

Appendix C
Curriculum Faculty

Biographical Data

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รองศาสตราจารย์ ดร.อำนาจ อภิชาติวัลลภ
Associate Prof. Dr. Amnat Apichatvullop

Education and Competence:

1972	B.E. (Civil) University of Newcastle, N.S.W.
1976	M. Eng. (Coastal), Asian Institute of Technology
1984	Ph.D. (Water Resources Planning), Colorado State University

Present Position:

1. Lecturer, School of Civil Engineering, Suranaree University of Technology.

Work Experiences:

Employment :

1973-74	Lecturer, Faculty of Engineering, Khon Kaen University (KKU)
1976-77	Research Associate, Water Resources Eng. Div., Asian Institute of Technology
1977-80	Lecturer and Assistant Professor, Faculty of Engineering, KKU
1985-93	Assistant Professor and Associate Professor, Faculty of Engineering, KKU
1986-90	Director, Water Resources and Environment Instittute, Faculty of Engineering, KKU
1986-87	Chair, Graduate Study Committee, Faculty of Engineering, KKU
1992-93	Associate Dean, Faculty of Engineering, KKU
1993-1999	Associate Professor, Institute of Industrial Technology, Suranaree University of Technology (SUT)
1994-1997	Associate Dean, Institute of Industrial Technology, SUT
1989-90	Engineering Consultant (hydrologist), PAL Consultant Co.
1990-present	(part-time) Engineering Consultant, TEAM Consultant and ASDECON Co.
1999-2002	Head, Department of Civil Engineering, Institute of Engineering, Suranaree University of Technology (SUT)
2002 – Present	Lecturer, School of Civil Engineering, Suranaree University of Execution, Suranaree University of Technology.

Project Undertaken:

1992-present	ASDECON Corp. (Part-time) Hydrologist, responsible for hydrological studies of various projects such as Sai Noi-Sai Yai Dam, Tha Dan Dam.
1991-1992	Team Consulting Engineer Co. (Part-time) Hydrologist, responsible for hydrological studies of various projects such as Feasibility of Prasae Irrigation, Feasibility of Pasak Irrigation, etc.
Apr. –May and Aug. 1992	Consultant to Asian Development Bank, appraised technical aspects of three pump irrigation schemes in southern Lao P.D.R.
1989-1991	PAL Consulsultant (Full-time, on leave from KKU.):
1990-1991	Deputy project manager/Hydrologist in Feasibility of the Nam Songkhram Irrigation Project.
Dec.1989- Mar.1990	Water resource planning specialist in Feasibility of the Khong-Chi-Mun Project
Oct.–Nov.1989	Water resource and infrastructure specialist in Evaluation of the Thai-German Land Settlement Promotion Project, responsible for collecting data and assessing water resource development activities in Khuan Bhumibol and Lam Dom Noi Settlements.
May-Jun.1989	Irrigation and training specialist, Appraisal of Proposals in the Thai-Netherlands NE Agricultural Development : On-farm water management (Royal Irrigation Development), Small farmer participation (Department of Agricultural Extension), Ley Farming (Department of Land Development) Northeast land development center (Department of Public Welfare). Each proposal was appraised on relevance and significance of objectives, anticipated achievements, technical merits of methods used, expected benefits and efficiency of resource use.
Jan.1988-Aug 1989	Project leader, Study of Weir Maintenance Program. To design a more efficient system/program to maintain and utilize existing small weirs.

May 1987-Dec. 1990	Project leader, Hydrology of Rainfed Paddy Land. To develop mathematical model for predicting streamflow in small agricultural watrsheds of Northeast Thailand.
Oct.1986-Jun.1987	Project leader, Training of Community Workers in Rural Water Resources Planning. Responsible for developing courses, training materials, training and follow-up of all CD workers in the Northeast.
1978-1979	Hydrologist/Irrigation Engineer, Water Balance of the Nong Wai Irrigation Area. Responsible for evaluating the water use efficiency.
1978-1979	Hydrologist, Physical and Chemical Aspects of the Nam Pong Reservoir. Responsible for evaluating the impacts of land use on the streamflows in the Nam Pong Watershed.
1979	Hydraulic Engineer, Water for Chieng Khong Refugee Camp. Design pumping, delivery, distribution and storage system of water supply for the camp and nearby village.
1980	Hydraulic Engineer, Feasibitity of Lam Sathat Weir. Design irrigation weir.
1979	Water Resources Planning Engineer, Feasibility of Water Resources Development in three settlements. Survey, plan and design appropriate water facilities for drinking, domestic use and irrigation for several villages in the settlements.
1976-1977	Research Associate, Salinity Intrusion of the Chao Phya and Mae Klong Rivers. Develop mathematical model capable of simulationg salinity conditions of the rivers for different river discharges.

Other Training :

Regional Workshop for Instructors and Trainers on Low-Cost Water Supply and Sanitation Technology by Internations Training Network, The World Bank, October 14-24, 1986, Bandung, Indonesia.

Associate Prof. Dr. Amnat Apichatvullop, Ph.D.

Recognitions and Prestige:

1960-1968	Ministry of Education Scholoarship for Secondary Education.
1968-1973	Colombo Plan Scholarship
1974-1976	Japanese Government Scholarship
1980-1983	Ford Foundation Fellowship
1983-1984	Research Assistantship at Colorado State University

Academic Works:

1. Salinity Intrusion in the Chao Phya and Mae Klong Rivers, Reserarch report, Asian Institute of Technology, 1978.
2. Physical and Chemical Aspects of the Nam Pong Reservoir, Research Report, Faculty of Engineering, Khon Kaen University, 1979.
3. Water Blance of the Nong Wai Irrigatin Area, Research Report, Faculty of Engineering, Khon Kaen University, 1979.
4. Hydraulic Design. Faculty of Engineering, Khon Kaen University, 1980. (Thai)
5. Feasibitity Study of Water Resources Development in Ubolrat, None Sang and Huai Luang Resettlement Areas, Project Report, Faculty of Engineering, Khon Kaen University, 1979.
6. Water for Chieng Khong Refugee Camp, Project Report, Faculty of Engineering, Khon Kaen University, 1979.
7. Feasibility of the Lam Sathat Weir, Amphur Pathai, Project Report, Faculty of Engineering, Khon Kaen University, 1979. (Thai)
8. Water Resources Project Planning, Manual, Thai-Australia Water Resoruces Project, 1986. (Thai)
9. Training in Water Resources Planning, Document for Training of Instructors, Faculty of Engineering, Khon Kaen University, 1987. (Thai)
10. Bibliography of Water Resources Development in Thailand, Project, Faculty of Engineering, Khon Kaen University, 1987.
11. Fundamental Systems Analysis. Faculty of Engineering, Khon Kaen University, 1987. (Thai)
12. Fluid Mechanics Laboratory, Manual, Faculty of Engineering, Khon Kaen University, 1987. (Thai)

13. Sethabutra, S. and Apichatvullop, A.Hydrology of Rainfed Paddy Land, in Proceedings of His Majesty's Fifth Cycle Commemorative Conference of USAID Sciences Research Award Grantees, Nakorn Pathom, Thailand, 24-26 July 1987, pp. 285-290.
14. Aryupong, C. and Apichatvullop, A. Water for agriculture in small watersheds, Proceedings of "Crop Production in Problem Soils in Northeast Thailand, Agricultural Development Research Center, Khon Kaen, Thailand, 23-27 May 1987, pp. 101-112.
15. Tingsanchali, T. and Apichatvullop, A. Salinity intrusion problem during severe drought in the Chao Phraya River, Research Report no. 122, Asian Institute of Technology, December 1980.
16. Tingsanchali, T. and Apichatvullop, A.Prediction of Salinity Intrusion during a severe drought in the Chao Phraya River, Engineering Journal of Thailand v. 40, n. 3, 1987.
17. Thai-Netherlands Northeastern Agricultural Development Programme (January 1990-December 1992) : Appraisal Report, Department of Technical and Economic Cooperation Thailand in Cooperation with directorate General For International Cooperation, The Netherlands, July 1988.
18. Apichatvullop, A. Evaluation of the Thai-German Land-Settlement Promotion Project, Phase V. (1987-1988). Final Report Infrastructure Sector, Department of Technical and Economic Cooperation, Thailand in cooperation with Bundes ministerium fuer wirtschaftriche Zusammenarbeit (BMZ), Germany, November 1989.
19. Apichatvullop, A. and Patamatamkul, S. Rapid Appraisal of Moungkao, Pakkoung and Phone Ngam Pump Irrigation Schemes, Report to the Asian Development Bank, August 1992.
20. Hydrology of Rainfed Paddy Land, Final Report, Faculty of Engineering, Khon Kaen University, 1995.
21. Maximum Probable Flood for Pasak Project, Feasibility and Environmental Impact Study of Pasak Project, Proceeding of "Symposium on Maximum Inflow Spillway Design Flood for Storage Dams" Royal River Hotel, Bangkok, 19-20 February 1998.
22. Flood Study of Wastewater Treatment Plant for Srisaket Municipality, Report to the Srisaket Municipality, October 2002. (in Thai)

Biographical Data

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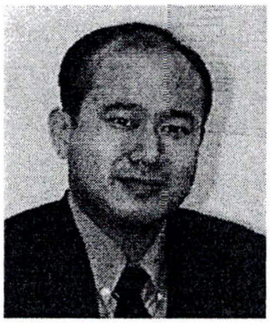

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Assist. Prof. Dr. Mongkol Jiravacharadet

Education and Competence

1990 B.E. (Civil Engineering) Chulalongkorn University, THAILAND
1993 M.Eng. (Civil Engineering) University of Tokyo, JAPAN
1996 Ph.D. (Civil Engineering) University of Tokyo, JAPAN

Present Position

Assistant Professor, School of Civil Engineering,
Suranaree University of Technology

Work Experience

Dec.1996 – Present	Lecturer, School of Civil Engineering, Suranaree University of Technology
Feb.1999	Assistant Professor
Dec.1999 – Aug.2001	Assistant Rector in Buildings & Grounds
Mar.2002 – Sep.2004	Acting Head of School of Civil Engineering
Oct.2004 – Mar.2007	Head of School of Civil Engineering

Recognitions and Prestige

1990	First Class Honor (Gold Medal) for B.E. Degree
1991 – 1995	Monbucha Scholarship from Japanese Goverment for M.Eng and Ph.D. Degrees

Academic Works

(1) Research Publications

1. **J. Mongkol**, and T. Nomura, "Application of an Eddy Viscosity Model to Finite Element Analysis of Turbulent Flow around a Circular Cylinder," Annual Conference of Japan Society of Civil Engineering(JSCE) 1993.
2. **J. Mongkol**, and T. Nomura, "Application of an Eddy Viscosity Model to Finite Element Analysis of Turbulent Flow around a Circular Cylinder," WCCM III The Third World Congress of Computational Mechanics International Association for Computational Mechanics, August 1-5, 1994, Chiba, Japan, pp. I-188, 189.
3. **J. Mongkol**, B. Bhartia, and Y. Fujino, "Optimal Saturation Control of SDOF Structure," Proceeding of the 17th Symposium on Information System, Architecture Institute of Japan, 1994, pp. 433-438.

4. **J. Mongkol**, B. Bhartia, and Y. Fujino, "Optimal Linear-Saturation Control of Structure by Modal Decomposition," EASEC-5 BUILDING FOR 21ST CENTURY, Proceedings of the fifth East Asia-Pacific Conference of structural Engineering and Construction, July 25-27, 1995, Gold Coast, Queenland, Australia, pp. 1455-1460.
5. **J. Mongkol**, B. Bhartia, and Y. Fujino, "Optimal Linear-Saturation Control of MDOF Structure by Modal Approach," Annual Conference of Japan Society of Civil Engineering (JSCE) 1995.
6. **J. Mongkol**, B. Bhartia, and Y. Fujino, "On Linear-Saturation (LS) Control of Buildings," Earthquake Engineering & Structural Dynamics Journal, Vol. 25, 1353-1371, 1996.
7. **Jiravacharadet, M.**, "Noise Control in Building," Civil Engineering Magazine, Engineering Institute of Thailand, 10, 3, July-September 1998.
8. **Jiravacharadet, M.**, "Development of Light-weight Aggregate Concrete from Baked Silty Sand," Research Report No. SUT4-410-41-9-24, Suranaree University of Technology, Thailand, 1999.
9. **Jiravacharadet, M.** "Mechanical Properties of Light-weight Aggregate Concrete from Crushed Masonry," Suranaree J. Sci. Technol 6:91-96, 1999.
10. **Jiravacharadet, M.** "Optimal Height for Steel Roof Truss Design," Suranaree J. Sci. Technol 7:149-153, 2000.
11. **Jiravacharadet, M.**, "Development of Structural Analysis and Design Website," Research Report No. SUT7-712-43-12-44, Suranaree University of Technology, Thailand, 2001.
12. **Jiravacharadet, M.**, "Design to Prevent Floor Vibrations in Steel Structures," Thailand Engineering Journal, Vol. 3, 86-89, 2002.
13. **Jiravacharadet, M.**, "Bone-shaped Short Fiber Composite," Thailand Engineering Journal, Vol. 4, 108-109, 2002.
14. **Jiravacharadet, M.**, "Structural Damage Identification Using Eigensystem Realization Algorithm," Proceedings of the Eight National Convention on Civil Engineering, Khon Kaen, Thailand, 2002.
15. **Jiravacharadet, M.**, "Wind Force Acting on Sign Structures According to ASCE Standard 7-98," Civil Engineering Magazine, Engineering Institute of Thailand, Vol. 1, Jan.-Feb., 2003.

16. Phornpilai KITIRATTRAKARN and **Mongkol JIRAVACHARADET**, "Vibration of Precast-Prestressed Slab from Human Activities," Engineering Innovative for Sustainable Resource Management, 40th Academic Seminar, Faculty of Engineering, Khon Khaen University, 23-25 Jan. 2004.
17. Atiwatch VIMUTHASUUNGVIRIYA and **Mongkol JIRAVACHARADET**, "Wind Speed for Structural Analysis in Thailand," Engineering Innovative for Sustainable Resource Management, 40th Academic Seminar, Faculty of Engineering, Khon Khaen University, 23-25 Jan. 2004.
18. Atiwatch VIMUTHASUUNGVIRIYA and **Mongkol JIRAVACHARADET**, "Wind Speed for Structural Analysis and Design in Thailand," 9th National Conference in Civil Engineering, Petchburi, 19-23 May 2004.
19. Phornpilai KITIRATTRAKARN and **Mongkol JIRAVACHARADET**, "Vibration of Precast-Prestressed Slab from Human Activities," 9th National Conference in Civil Engineering, Petchburi, 19-23 May 2004.
20. Vacharapol BOACHAREON and **Mongkol JIRAVACHARADET**, "Effect of Soil-Structure Interaction for High-Rise Building Design in Bangkok," 11th National Conference in Civil Engineering, Phuget, 20-22 April 2006.
21. Phornpilai KITIRATTRAKARN and **Mongkol JIRAVACHARADET**, "VIBRATION ANALYSIS OF PRECAST-PRESTRESSED CONCRETE SLABS UNDER AEROBIC LOADS," Proceedings of the Tenth East Asia-Pacific Conference on Structural Engineering & Construction (EASEC-10), August 3-5, 2006, Bangkok, Thailand
22. Watcharapon BAOJAROEN and **Mongkol JIRAVACHARADET**, "NON-LINEAR SOIL-STRUCTURE INTERACTION ANALYSIS OF BUILDINGS SUBJECTED TO EARTHQUAKE LOADING IN BANGKOK," Proceedings of the Tenth East Asia-Pacific Conference on Structural Engineering & Construction (EASEC-10), August 3-5, 2006, Bangkok, Thailand

(2) Published Textbooks

1. Mechanics of Materials
2. Structural Steel Design
3. Reinforced Concrete Design

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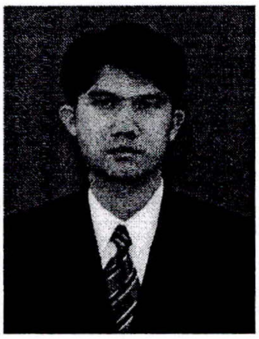

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ผู้ช่วยศาสตราจารย์ ดร.สุขสันติ์ หอพิบูลสุข
Asst. Prof. Suksun Horpibulsuk, Ph.D.

Education and Competence:

1996	B. Eng. (Civil Engineering), Khon Kaen University, Thailand
1998	M. Eng. (Soil Engineering), Asian Institute of Technology, Thailand
2001	Ph.D. (Geotechnical Engineering), Saga University, Japan.
2003	Certificate on Computer Aided Design (CAD) of City Planning, Architecture Design and Interior, MOST, China

Work Experiences:

2002 - 2004	Lecturer, Suranaree University of Technology, Thailand
2004 - present	Assistant Professor, Suranaree University of Technology, Thailand
2004	Visiting Faculty, Graz University of Technology, Austria
2006 - present	Head, Construction Technology Research Unit, Institute of Engineering, Suranaree University of Technology, Thailand

Awards and Scholarships:

1996	B.Eng. with Honor awards
1996	RTG scholarship for M. Eng. study at AIT
1998	JIRCAS scholarship for research in Japan
1998	MONBUSHO scholarship for Ph.D. study at Saga University
2006	Best Young Researcher Award, Suranaree University of Technology

Academic Works:

(1) 8 national journal papers.
(2) 11 international journal papers.
(3) 4 technical reports
(4) 16 national conference papers
(5) 32 international conference papers
(6) 2 books

Thesis Supervisor: 5 Master theses

Selected Publications:

International Journal papers

1) **Horpibulsuk, S.**, Shibuya, S., Fuenkajorn, K. and Katkan, W. (2007), "Assessment of Engineering Properties of Bangkok clay", *Canadian Geotechnical Journal.* Vol.44, No.2, pp.
2) **Horpibulsuk, S.**, Katkan, W., Sirilerdwattna, W., and Rachan, R. (2006), "Strength development in cement stabilized low plasticity and coarse grained soils : Laboratory and field study", *Soils and Foundations*, Vol.46, No.3, pp.351-366.
3) **Horpibulsuk, S.** (2005), "Mechanism controlling undrained shear characteristics of induced cemented clays", *Lowland Technology International.* Vol.7, No.2, pp.9-18.
4) **Horpibulsuk, S.**, Miura, N., Nagaraj, T.S. (2004), "Clay-water/cement ratio Identity of cement admixed soft clay", *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol.131, No.2, pp.187-192.
5) **Horpibulsuk, S.**, Miura, N., and Bergado, D.T. (2004), "Undrained shear behavior of cement admixed clay at high water content", *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol.130, No.10, pp.1096-1105.
6) **Horpibulsuk, S.**, Miura, N., Koga, H., and Nagaraj, T.S. (2004), "Analysis of strength development in deep mixing – A field study", *Ground Improvement Journal*, Vol.8, No.2, pp.59-68.
7) **Horpibulsuk, S.**, Bergado, D.T., and Lorenzo, G.A. (2004), "Compressibility of cement admixed clays at high water content", *Geotechnique*, Vol.54, No.2, pp.151-154.
8) **Horpibulsuk, S.** and Rachan, R. (2004), "Modified hyperbolic model for capturing undrained shear behavior", *Lowland Technology International*, Vol.6, No.2, pp.11-20.
9) **Horpibulsuk, S.**, Miura, N., and Nagaraj, T.S. (2003), "Assessment of strength development in cement-admixed high water content clays with Abrams' law as a basis", *Geotechnique*, Vol.53, No.4, pp.439-444.
10) Bergado, D.T., Sasanakal, I., and **Horpibulsuk, S.** (2003) "Electro-Osmotic Consolidation of Soft Bangkok Clay Using Cooper and Carbon Electrodes with PVD", *Geotechnical Testing Journal*, ASTM, Vol.26, No.3, pp.1-12.
11) Miura, N., **Horpibulsuk, S.**, and Nagaraj, T.S. (2001) "Engineering behavior of cement stabilized clay at high water content", *Soils and Foundations*, Japan Geotechnical Society (JGS), Vol.41, No.5, pp.33-45.

International Conference, Symposium and Seminar Papers

1) **Horpibulsuk, S.**, Katkan, W., and Piyasaengthong, S. (2006), "Prediction of compaction curves of fine-grained soils at various compaction energies using one point test", Proceedings of 6th International Symposium on Soil/Ground Improvement and Geosynthetics.

2) **Horpibulsuk, S.**, Suesook, J., Liu, M.D. and Carter, J.P. (2006), "Simulation of undrained shear behavior of cemented clay with the modified structured cam clay model", Proceedings of 6th International Symposium on Soil/Ground Improvement and Geosynthetics.
3) Nagaraj, T.S. and **Horpibulsuk, S.** (2006), "Composite soft ground – Its installation and characterization", National Conference on Corrective Engineering Practices in Troublesome Soils (CONCEPTS), Kakinada, India, pp.15-20. (Invited lecture).
4) **Horpibulsuk, S.**, Rachan, R., Papattanotai, S., Nagaraj, T.S. (2006), "Analysis of strength development of cement stabilized clay from microstructural considerations", *Proc. International Symposium on Lowland Technology.*
5) **Horpibulsuk. S.**, Rachan, R. and Katkan, W. (2006), "Prediction of compaction curve at various compaction energies using one point test", *Proc. International Symposium on Lowland Technology.*
6) Rachan, R., and **Horpibulsuk, S.** (2006), "Effect of chemistry and mineralogy on geotechnical properties of Bangkok clay", *Proc. International Symposium on Lowland Technology.*
7) **Horpibulsuk, S.**, Rachan, R., Katkan, W. and Nagaraj, T.S. (2006) "Strength development in cement stabilized coarse grained soils", *GeoShanghai 2006*, Geotechnical Special Publication No.152, pp.51-56.
8) Liu M. D., Carter, J.P., **Horpibulsuk, S.** and Liyanapathirana, D.S. (2006), "Modelling the behaviour of cemented clay", *Geo-Shanghai 2006*, Geotechnical Special Publication No.152, pp.37-44.
9) **Horpibulsuk, S.** and Rachan, R. (2005), "On the classification of Bangkok clay deposits and their compressiobility", *International Symposium on Frontiers in Offshore Geotechnics*, Perth, pp.1071-1077.
10) **Horpibulsuk, S.**, and Rachan, R. (2004), "Novel approach for analyzing compressibility and permeability characteristics of Bangkok clayey soils", *Proc. 15th Southeast Asian Geotechnical Engineering Conference*, Bangkok, Thailand, pp.3-8.
11) **Horpibulsuk, S.** (2004), "Phenomenological model for predicting strength of cement admixed clays", *Proc. 5th International Symposium on Ground Improvement and Geosynthetics*, Bangkok, Thailand, pp.138-144.
12) **Horpibulsuk, S.**, Rachan, R. and Katkan, W. (2004), "Phenomenological modeling of compaction curve", *Proc. 5th International Symposium on Ground Improvement and Geosynthetics*, Bangkok, Thailand, pp.131-137.
13) **Horpibulsuk, S.**, Katkan, W., Rachan, R., and Nagaraj, T.S. (2004), "Underpinning technique for repairing cracked building in northeast Thailand", *Proc. International Symposium on Lowland Technology.*
14) **Horpibulsuk, S.**, and Rachan, R. (2004), "Novel approach for analyzing compressibility and permeability characteristics of Bangkok clayey soils", *Proc. 15th Southeast Asian Geotechnical Engineering Conference*, pp.3-8.
15) **Horpibulsuk, S.** and Rachan, R. (2003), "Undrained strength characteristics of cement admixed clay", *Proc. 56th Canadian Geotechnical Conference*, Canada.

16) Rachan, R. and **Horpibulsuk, S.** (2003), "Prediction of strength of cement admixed clays", *Proc. 56th Canadian Geotechnical Conference*, Canada.
17) Nagaraj, T.S., Miura, N., and **Horpibulsuk, S.** (2003), "Composite soft ground with columnar inclusions of required strength", *Proc. Symposium on Advances in Geotechnical Engineering*, Indian Institute of Technology, India, pp.89-99.
18) **Horpibuksuk, S.** and Rachan, R. (2002), "Strength development in cement admixed clays at high water content", *Proc. Ground Improvement and Geosynthetics*, Bangkok, Thailand, pp.232-250.
19) **Horpibulsuk, S.** (2002), "Analysis of compressibility of cement admixed clays", *International Symposium on Lowland Technology*, Saga, Japan, pp.73-78.
20) **Horpibulsuk, S.**, Miura, N., Nagaraj, T.S., and Koga, H. (2002), "Improvement of soft marine clays by deep mixing technique", *Proc. 12th International Conference on Offshore and Polar Engineering*, Kitakyushu, Japan, pp.584-591.
21) **Horpibulsuk, S.**, Bergado, D.T., and Bunchai, W. (2002), "Evaluation of recharge and ground improvement using prefabricated vertical drain (PVD) for the Second Bangkok International Airport (SBIA) project", *Proc. 7th Conference on Geosynthetics*, Paris, France, pp.1035-1038.
22) Bergado, D.T., **Horpibulsuk, S.**, and Ngouchaurieng, P. (2002), "Innovative use of geosynthetics for repair of slope failures along irrigation/drainage canals on soft ground", *International Conference on Geotextile and Geosynthetics*, Paris, France, pp.147-150.
23) **Horpibulsuk, S.**, and Miura, N. (2001) "A new approach for studying behavior of cement stabilized clays" *15th International Conference on Soil Mechanics and Geotechnical Engineering (ISSMGE)*, Istanbul, Turkey, Vol.3, pp.1759-1762.
24) Bergado, D.T., and **Horpibulsuk, S.** (2001), "Ground Improvement by PVD", *Short Course on Ground Improvement using Prefabricated Vertical Drain (PVD)*, pp.1-21.
25) Bergado, D.T., **Horpibulsuk, S.**, and Teerawattanasuk, C. (2001), "Soil Improvement by MSE – Theoretical background", *Short Course on Mechanically Stabilized Earth (MSE)*, Asian Institute of Technology, Bangkok, Thailand, pp.1-26.
26) **Horpibulsuk, S.**, Miura N. and Nagaraj, T.S. (2001), "Analysis and Assessment of strength development in cement admixed clays" *International Conference on Civil Engineering*, Department of Civil Engineering, Indian Institute of Science, India, Vol.2, pp.156-163.
27) **Horpibulsuk, S.**, Miura, N. and Nishida, K. (2000), "Factors influencing field strength of soil-cement column" Year 2000 Geotechnics, *Geotechnical Engineering Conference*, Asian Institute of Technology, Bangkok, Thailand, pp.623-634.
28) **Horpibulsuk, S.**, Miura, N. and Nagaraj, T.S. (2000), "The prime parameter governing the stress~strain characteristics of cement stabilized clay" 2nd *Proceedings of the International Symposium on Lowland Technology*, Institute of Lowland Technology, Saga University, Saga, Japan, pp.153-160.
29) **Horpibulsuk, S.**, Miura, N. and Nagaraj, T.S. (2000), "A new method for predicting strength of cement stabilized clays" International Symposium on Coastal Geotechnical Engineering in Practice, *IS-Yokohama 2000*, Yokohama National University, Yokohama, Japan, pp.605-610.

30) Kohgo, Y. and **Horpibulsuk, S.** (1999), "Estimation of volume change behavior of yellow soil" Highlight of Collaborative Research Activity between Thai Research Organizations and JIRCAS, *JIRCAS Seminar*, Bangkok, Thailand, pp.87-90.
31) Kohgo, Y and **Horpibulsuk, S.** (1999), "Simulation of volume change behavior of yellow soil sampled from Khon Kaen City in Northeast Thailand" *11th Asian Regional Conference on Soil Mechanics and Geotechical Engineering*, Soul, Korea, pp.141-144.
32) Kohgo, Y. and **Horpibulsuk, S.** (1999), "Deformation analysis of a fill-type dam by using FEM consolidation analysis method" Civil and Environmental Engineering Conference, Asian Institute of Technology, Bangkok, Thailand, pp.I77-I86.

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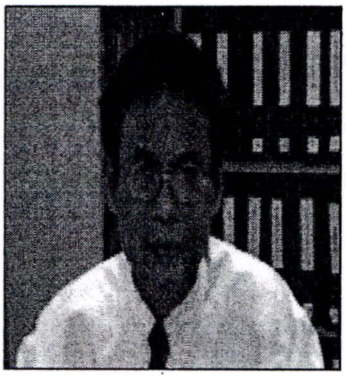

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ดร. ทนงศักดิ์ พิสาลสิน

Dr. TANONGSAK BISARNSIN

Education and Competence:

1983	Ph.D.(Civil Engineering), University of Texas at Arlington, Arlington, Texas,USA
1976	M.Eng.(Civil Engineering), University of Texas at Arlington, Arlington,Texas,USA
1972	B.Eng.(Civil Engineering), Chulalongkorn University,Bangkok, Thailand

Present Position:

1. Director-Computer Center for Services, Suranaree University of Technology, Nakhon Ratchasima, Thailand
2. Lecturer, School of Civil Engineering, Suranaree University of Technology.

Work Experiences:

2005-Present	Director-Computer Center for Services, Suranaree University of Technology, Nakhon Ratchasima, Thailand
1996-2004	Deputy Director-Computer Center for Services, Suranaree University of Technology, Nakhon Ratchasima, Thailand
1996-1994	Lecturer, School of Civil Engineering, Suranaree University of Technology
1994-1989	Engineering Manager, W.R.Grace & Co., Fort Worth Texas, USA
1989-1987	Chief Engineer, Composite Technology, Inc., Fort Worth Texas, USA
1987-1983	Engineer, Composite Technology, Inc., Fort Worth Texas, USA

Dr. TANONGSAK BISARNSIN

Academic and Professional Backgrounds:

Structural Engineering – Behavior and Design of Fiber-Reinforced Composite Structures, also in Computer-Aided Structural Mechanics using Finite Element Methods. Specialized in Enhanced media Instructions in Technical and Engineering Applications through Internet and Intranet. Member of American Society of Civil Engineers Structural Plastics Composites Committee. Registered as a Professional Engineer Thailand.

Technical Reports and Publications:

1. **Bisarnsin, T.,** "Predicting the Effects of Radial Keratotomy," Ph.D. Dissertation, University of Texas at Arlington, Arlington, Texas, 1983.
2. **Green, A., and Bisarnsin, T.,** "Building Construction Materials," Van Nostrand Reinhold, Advanced Thermoset Composites: Industrial and Commercial Applications , pp. 249-271, 1986.
3. **Huang, T, Schachar, R.A., and Bisarnsin, T.,** "Curvature Change Due to Radial Keratotomy," Proceedings of the International Conference of Finite Element Methods, Gordon and Burach, Science Publishers, Inc., NewYork, 1988.
4. **Huang, T., Schachar, R.A., and Bisarnsin, T., and Black, T.D.,** "Corneal Curvature Change Due to Structural Alteratiion by Radial Keratotomy," Transactions of The ASME, Journal of Biomechanical Engineering, Volume 110, August 1988.
5. **Green, A., and Bisarnsin, T.,** "Predicting the Performance of Composites Experimentally," Managing Corrosion with Plastics, Volume IX, The National Association of Corrosion Engineers, 1988.
6. **Yuan, R.L., Hashem,Z., Green, A., and Bisarnsin, T.,** "Fiber-Reinforced Plastic Composite Columns," Proeedings of the ASCE Special Conference: Advanced Composites Materials in Civil Engineering Structures, 1991.
7. **Green, A., and Bisarnsin, T., and Love, E.,** "Pultruded Reinforced Plastics for Civil Engineering Structural Applications," 47th Annual Conference, The Society of Plastic Industry, 1992.
8. **Love, E., and Bisarnsin, T.,** "Experimental Investigation of Self-Tapping Fasteners to Pultruded Fiber-Reinforced Plastics Beams," Proceedings of the Material Congress, ASCE. 1992.
9. **Green, A., Bisarnsin, T., and Love, E.,** "Pultruded Reinforced Plastics for Civil Engineering Structural Applications," Journal of Reinforced Plastics and Composites, October 1994.

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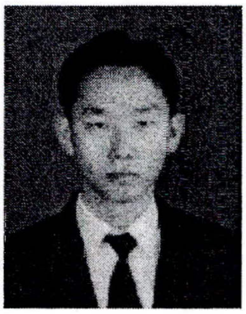

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ดร.อวิรุทธิ์ ชินกุลกิจนิวฒน์
Dr. Avirut Chinkulkijniwat

Education and Competence:

1996	B. Eng (Civil Engineering), Khon Kaen University.
1998	M. Eng. (Geotechnical Engineering), AIT.
2005	Ph.D. (Civil Engineering), Graz University of Technology (TUG)

Present Position:

1. Lecturer, School of Civil Engineering, Suranaree University of Technology.

Work Experiences:

1998 -2002	Lecturer, School of Civil Engineering, Suranaree University of Technology
2002	Member in investigatory building settlement committee, Suranaree University of Technology
2002 – 2005	Research assistant, Institute for Soil Mechanics and Foundation Engineering, Graz University of Technology.
2005 – Present	Lecturer, School of Civil Engineering, Suranaree University of Execution, Suranaree University of Technology.

Recognitions and Prestige:

1996	Second Class Honor, Khon Kaen University
1996-1998	Partial Scholarship, Asian Institute of Technology
2002-2005	Scholarship award technology grant Southeast Asia (Doctoral Program) from Austrian Council for Research and Technology Development Austrian
2004	Best poster award in ITA-AITES 2004 World Tunnel Congress, Singapore

Academic Works:

(1) Scheid, Y., Semprich, S., Chinkulkijniwat, A., Computation of Laboratory Test Results to Estimate the Loss of Air in Compressed Air Tunnelling, Proc. TOUGH Sym. 2003, Lawrence Berkeley National Laboratory, Berkeley, California, May 12-14, 2003, CD-ROM.

(2) Scheid, Y., Chinkulkijniwat, A., Semprich, S., Numerical Simulation of Air Loss during Tunnel Advance in Compressed Air Tunnelling, Unsaturated

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(3) Semprich, S., Scheid, Y., Chinkulkijniwat, A., Numerical Simulation of Tunnel Advance for Compressed Air Tunnelling, Proc.30th ITA-AITES World Tunnel Congress, Singapore, May 22-27, 2004, 466-467.

(4) Chinkulkijniwat, A., Semprich, S., Steger, G., Hydraulic Parameter Estimation and Uncertainty in Using Them to Calculate the Rate of Air Flow in Compressed Air Tunnelling, Proc. 3rd Int. Sym. on Two-phase Flow Modelling and Experimentation, Pisa, Italy, September 22-24, 2004

(5) Chinkulkijniwat, A., Semprich, S., Steger, G., Unsaturated Hydraulic Properties for Compressed Air Tunnelling by Inverse Modeling, Proc.16th Int. Conf. on Soil Mechanics and Geotechnical Engineering, Osaka, Japan, September 12-16, 2005 (in printed).

(6) Chinkulkijniwat, A., Determination of Unsaturated Hydraulic Properties for Compressed Air – Inversion of The Experiment, 7th GEO-DACH Treffen, Graz-Reinischkogel, Austria, 9-11 June, 2005 (in printed)

(7) Steger, G., Semprich, S., Chinkulkijniwat, A., Recent Advances and Encountered Problems in Computing Air Losses in Compressed Air Tunnelling by Consideration of Unsaturated Soil Mechanics, 4th International Conference on Unsaturated Soils, Phoenix, Arizona, USA, April 2-5, 2006 (accepted to be published)

Professional Associations: 1996 Associate Civil Engineer, Council of Engineers

Appendix D
Course Titles in Thai

ลำดับที่	รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
1	430601	Introduction to Finite Element Method	วิธีไฟไนต์อิลิเมนต์เบื้องต้น
2	430602	Graduate Seminar in Civil Engineering I	สัมมนา 1
3	430603	Graduate Seminar in Civil Engineering II	สัมมนา 2
4	430610	Numerical Methods in Engineering	วิธีคำนวณเชิงตัวเลขในงานวิศวกรรม
5	430611	Statistics for Civil Engineering	สถิติเพื่องานวิศวกรรมโยธา
6	430612	Advanced Engineering Geology	วิศวกรรมธรณีชั้นสูง
7	430613	Continuum Mechanics	กลศาสตร์ความต่อเนื่อง
8	430620	Advanced Theory of Structures	ทฤษฎีโครงสร้างชั้นสูง
9	430621	Dynamics of Structures	โครงสร้างพลศาสตร์
10	430622	Advanced Mechanics of Materials	กลศาสตร์วัสดุชั้นสูง
11	430623	Advanced Matrix Method for Structures	วิธีเมตริกชั้นสูงสำหรับโครงสร้าง
12	430624	Theory of Elastic Stability	ทฤษฎีเสถียรภาพในช่วงอิลาสติก
13	430625	Theory of Plates and Shells	ทฤษฎีแผ่นเรียบและแผ่นโค้ง
14	430626	Advanced Finite Element Method	วิธีไฟไนต์อิลิเมนต์ชั้นสูง
15	430627	Advanced Concrete Technology	เทคโนโลยีคอนกรีตชั้นสูง
16	430628	Reinforced Concrete Structures	โครงสร้างคอนกรีตเสริมเหล็ก
17	430629	Advanced Prestressed Concrete	คอนกรีตอัดแรงชั้นสูง
18	430630	Masonry Structures	โครงสร้างอิฐก่อ
19	430631	Steel Structures	โครงสร้างเหล็ก
20	430632	Experimental Method in Civil Engineering	วิธีการทดลองในงานวิศวกรรมโยธา
21	430633	Wind Effects on Structures	ผลกระทบของลมต่อโครงสร้าง
22	430634	Earthquake-Resistant Design	การออกแบบเพื่อต้านทานแผ่นดินไหว
23	430635	Structural Control	การควบคุมโครงสร้าง
24	430636	Mechanics of Composite Materials	กลศาสตร์ของวัสดุคอมโพสิท
25	430637	Design of Advanced Composite in Civil Engineering Structures	การออกแบบโครงสร้างวัสดุผสมชั้นสูงในงานวิศวกรรมโยธา
26	430638	Advanced Analytical Tools in Cement Based Materials	เครื่องมือวิเคราะห์ชั้นสูงสำหรับวัสดุประสาน
27	430640	Theoretical Soil Mechanics	ทฤษฎีปฐพีกลศาสตร์

28	430641	Advanced Foundation Engineering	วิศวกรรมฐานรากชั้นสูง
29	430642	Ground Improvement Techniques	เทคนิคการปรับปรุงพื้นดิน
30	430643	Laboratory, Field Testing, and Instrumentation in Geotechnical Engineering	การใช้เครื่องมือ ปฏิบัติการ และการทดสอบในสนามในสาขาวิชาวิศวกรรมธรณีเทคนิค
31	430644	Soil Dynamics	ปฐพีพลศาสตร์
32	430645	Geomechanics	ธรณีกลศาสตร์
33	430646	Earth Structures	โครงสร้างดิน
34	430647	Rock Mechanics	กลศาสตร์ของหิน
35	430648	Analytical Method in Geotechnical Engineering	วิธีการวิเคราะห์ในงานวิศวกรรมธรณีเทคนิค
36	430649	Numerical Modeling for Geotechnical Engineering	การจำลองเชิงตัวเลขสำหรับวิศวกรรมธรณีเทคนิค
37	430650	Deep Excavation and Tunneling	งานดินขุดระดับลึกและการเจาะอุโมงค์
38	430651	Unsaturated Soil Mechanics	กลศาสตร์ไม่อิ่มตัวด้วยน้ำ
39	430652	Geostatistics	สถิติทางวิศวกรรมธรณีเทคนิค
40	430660	Advanced Hydrology	อุทกวิทยาชั้นสูง
41	430661	Computational Hydraulics	การคำนวณในงานชลศาสตร์
42	430662	Systems Analysis	การวิเคราะห์ระบบ
43	430663	Modeling of Hydrologic Processes	การทำแบบจำลองกระบวนการทางอุทกศาสตร์
44	430664	Water Resources Systems Analysis	การวิเคราะห์ระบบในงานทรัพยากรน้ำ
45	430665	River and Floodplain Management	การจัดการงานเกี่ยวกับแม่น้ำและพื้นที่น้ำท่วม
46	430666	River Engineering	วิศวกรรมแม่น้ำ
47	430667	Statistical Methods in Hydrology	วิธีสถิติชลศาสตร์
48	430668	Subsurface Hydrology	อุทกวิทยาน้ำใต้ดิน

(Draft)

Graduate Program in Geotechnology
School of Geotechnology
(Revised 2007)

Institute of Engineering
Suranaree University of Technology

(Draft)

Graduate Program in Geotechnology
School of Geotechnology
(Revised 2007)

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Suranaree University of Technology

CONTENTS

Graduate Program in Geotechnology
School of Geotechnology
Institute of Engineering
Suranaree University of Technology

1. Program Titles

1.1 Master Program
Master Program in Geotechnology
1.2 Doctoral Program
Doctoral Program in Geotechnology

2. Degree Titles

2.1 Master Degree
Full Title : Master of Engineering (Geotechnology)
(Thai) : วิศวกรรมศาสตรมหาบัณฑิต (เทคโนโลยีธรณี)
Abbreviated Title : M. Eng. (Geotechnology)
(Thai) : วศ.ม. (เทคโนโลยีธรณี)
2.2 Doctoral Degree
Full Title : Doctor of Engineering (Geotechnology
(Thai) : วิศวกรรมศาสตรดุษฎีบัณฑิต (เทคโนโลยีธรณี)
Abbreviated Title : D.Eng. (Geotechnology)
(Thai) : วศ.ด. (เทคโนโลยีธรณี)

3. Responsible Unit

School of Geotechnology, Institute of Engineering, Suranaree University of Technology.

4. Philosophy and Objectives

The Earth's surface and upper crust are valuable geological resources and the foundation for various types of man-made constructions, with varying sizes from small houses to skyscrapers. On the surface of the Earth where human and other kinds of living things are existing, geological processes are predominant factors controlling the environment of the Earth, which has a direct impact on human lives and other living things. Application of Geotechnology has recently played a major role in management of geological resources to give the safest and most efficient utilization, and in planning for civil engineering works, hazard prevention and alleviation to secure and improve the quality of human lives.

The development and progress of the country's industries are based on many factors. One of the factors is the supply of geological resources, such as rocks, industrial minerals, metallic minerals, petroleum and groundwater. These geological resources, which occur naturally, have long been exploited to serve human's need. These resources are natural materials, being used in terms of rocks for construction, metallic minerals for producing various types of metal, and petroleum for producing various types of oil and petrochemical products.

In searching for new supply, investigation, development, and production of natural materials have long been relentlessly carried out since the beginning of modern history. The outcomes have been not only the source of national income and foreign currency, but also the source of raw materials for manufacturing and associated industries, for examples cement, ceramic, construction material, jewelry, petrochemical, and electrical power generation industries. These industries create new jobs, which are sources of personal incomes and governmental income in the form of taxes. These kinds of income will stimulate economic development of society, leading to greater personal income, better social facilities and higher standard of living. Therefore, natural materials are of great value to the nation.

Investigation and development of groundwater solves problems of drought in areas where surface water is scarce. In this case, groundwater will be supplied for household uses and drinking. Natural materials support the successful constructions of dams, roads and buildings. Natural severe catastrophe is caused by rapid geological processes, such as earthquake, landslide, and floods. While less severe catastrophes, such as land subsidence, swelling ground and slope failure are caused by slow geological processes. Geotechnological knowledge has been applied to prevent and alleviate the severity of hazards caused by these catastrophes.

The fast growth of the world's population acquires accelerating supply of geological resources, extracted from the Earth's crust, to maintain the wealthy consumption of mankind. Searching and production of the resources are consequently very active at present and will be so for the distant future. Since modern industries have been consuming a large amount of resources, searching for new natural resources is recently becoming a hard task. Thus, more sophisticated geological technologies are required in exploration processes.

Knowledge of geology and geological data are widely used in various types of activities, for instances exploration and development of natural resources, drilling and development of petroleum and groundwater, natural hazard prevention and alleviation, environmental impact assessment, preservation and control, and planning of civil engineering works. In future, tunneling and underground work in foundation structures for transportation and storage of material and equipment will be increasingly needed. Hence, geotechnology will take part at the stage of planning for these kinds of modern civil engineering works.

The need to apply modern technology in the management of geological resources is in concordance with the 10 th National Economic and Social Development Plan (2007-2011). The management of natural resources and environment must be implemented to increase the efficiency of energy consumption and to develop the alternative energy resources. The reduction of imported energy resources would consequently increase the national economic stability. The development of the natural hazard management and mitigation system for conserving the resources and the ecologic balance has also to be considered seriourly.

Suranaree University of Technology offers the graduate program in geotechnology to produce master degree and doctoral degree graduates in order to fulfill the country's need in management of geological resources and environment. This graduate program is open to all qualified bachelor and master degree graduates in sciences or engineering to attend the master and doctoral program respectively. Two major areas of study are available, i.e. (1) petroleum technology, and (2) geological engineering and applied geology.

5. Program Inception

Enrollment of the students in this program will begin in the first trimester of academic year 2007.

6. Admission Requirements

Applicant's qualification is stated in the 1996 University's Regulation for Graduates Studies, and its first amendment in 1998 and second amendment in 1999. In addition, applicants should have English proficiency at the level specified by the University. The program is open to all qualified applicants, holding bachelor and master degree of engineering, sciences and technology in the fields of geology, geotechnology, petroleum engineering or related fields.

7. Application Process

As stated in the SUT Regulation for Graduate Studies.

8. Academic System

As stated in the SUT Regulation for Graduate Studies.

9. Study Duration

As stated in the SUT Regulation for Graduate Studies.

10. Registration

As stated in the SUT Regulation for Graduate Studies.

11. Degree Requirements

Examination procedures and graduation are stated in the 1996 University's Regulation for Graduates Studies, and ists first amendment in 1998 and second amendment for 1999. Inclusively, all graduate students must study all required courses specified in the program and obtain grade point average of not less than 3.00. Master program students must pass comprehensive examination. Doctoral program student must pass on English examination and also pass the preliminary examination in order to become a doctoral candidate, who has the right to present dissertation for graduation.

12. Faculty

12.1 Curriculum Faculty

Asst. Prof. Thara Lekuthai
M.Sc. (Basin Evolution and Dynamics)
University of London, England

Assoc. Prof. Dr. Kittitep Fuenkajorn
Ph.D. (Geoloical Engineering)
University of Arizona, USA

Assoc. Prof. Kriangkrai Trisarn
M.S.(Petroleum Engineering)
University of Oklahoma, USA

Asst. Prof. Dr. Aimorn Tassanasorn
Dr.rer.nat.
Universität Göttingen, Germany

Dr. Chongpan Chonglakmani
Ph.D.(Geology)
University of Auckland, New Zealand

12.2 Teaching Faculty

Dr.Tawisak Silakul
Ph.D. (Quaternary Geology)
University of Uppsala, Sweden

Dr.Akkapun Wannakomol
Ph.D. (Natural Sciences)
Free University Berlin, Germany

13. Enrollments

For the first 5 years, the number of student enrolled in the program in each year is as follows

Academic Year	Number of admission		Number expected to graduate in the academic year	
	Master	Doctoral	Master	Doctoral
2007	10	5	-	-
2008	10	5	-	-
2009	10	5	5	10
2010	10	5	5	10
2011	10	5	5	10

14. Location and Equipment

Location: Classrooms in the Center of Educational Services, SUT campus
Equipment: Laboratory equipment from the Center for Scientific and Technology Equipments; and accessories for lecturing from the Center of Library Resources and Educational Media, Suranare University of Technology.

15. Library

The Center of Library Resources and Educational Media offers the following resources and services.

15.1 Resources

15.1.1	Books		
	Thai	22,424	titles
	English	68,616	titles
15.1.2	Journals		
	Thai	142	titles
	International	285	titles
	Received from Donation	995	titles
15.1.3	Audio-visual and electronic	3,279	titles

15.2 Inter-Library Loan

Offering loan/photocopying services from other Thai and foreign universities and other public institutions.

15.3 Information Search Service

15.3.1 Search for items at CLREM
15.3.2 Search for items at other libraries

15.4 Database

15.4.1 Database on CD-ROM

- Chemistry Citation Index from 1999
- ComputMath Citation Index from 1999
- Thai theses from B.E.2509

15.4.2 Database On-line

- IEEE/IEL -- Full text database of articles, journals, proceedings and standards in electrical and electronic engineering and other related fields
- DAO -- database of abstracts of master and Ph.D.thesis from U.S., Canada, etc. in all fields.
- Medline -- database in medicine, public health, nursing and medical sciences.
- FirstSearch over 80 databases covering all fields, e.g. sciences, technology, agriculture, medicine, etc.
- e-journal from American Chemical Society over 24 titles covering chemistry, biochemistry and biotechnology from 1996.

CLREM web: http://library.sut.ac.th

16. Fiscal Budget

The School of Geotechnology receives the annual budget from Suranaree University of Technology.

17. Curriculum

17.1 Total Credits

The School of Geotechnology offers graduate programs leading to Master and Doctoral degrees in accordance with the graduate study regulation of the SUT as follows.

Master Degree

- Scheme M1 (Research and thesis)

Students pursuing master degrees under this scheme are required to undertake 45 credits of research and thesis.

- Scheme M2 (Instructional courses with thesis)

Students pursuing master degrees under this scheme are required to undertake 20 credits of research and thesis and 25 credits of instructional courses.

Doctoral Degree

For Master degree holder

- Scheme D1 (Research and thesis)

Students pursuing doctoral degrees under this scheme must be master degree holders. They are required to undertake 60 credits of research and thesis.

- Scheme D2 (Instructional courses with thesis)

Students pursuing this scheme must be master degree holders. They are required to undertake 45 credits of research and thesis and 15 credits of coursework.

For Bachelor degree holder

- Scheme D2 (Instructional courses with thesis)

Students pursuing this scheme must be bachelor degree holders. Candidates are required to take 60 credits of research and thesis and 30 credits of coursework.

17.2 Program Structure

Majors of Study

For both master and doctoral degree programs, two major areas of geotechnology are recommended, i.e.

(1) Petroleum Technology is emphasized on petroleum engineering and petroleum exploration technology.

(2) Geological Engineering and Applied Geology are concerned about application of geology in engineering work for instances dam construction, road construction, tunneling, exploration and production of mineral resources, prevention and alleviation of natural hazard caused by geological processes.

Nevertheless, students can study other major courses under the recommendation of the advisor, including other available graduate courses offered by other institutions, in order to deepen and widen the student's knowledge profitably for his or her course work study and research thesis.

17.3 Geotechnology courses by area of study

Core Courses

434700	Geotechnology Seminar I	1(0-3-4)
434701	Geotechnology Seminar II	1(0-3-4)
434702	Geotechnology Seminar III	1(0-3-4)
434703	Special Topics in Geotechnology	3 Credits
434704	Special Projects in Geotechnology	3 Credits
434790	Research and Thesis for M.Eng. I	20 Credits
434791	Research and Thesis for M.Eng. II	45 Credits
434890	Research and Thesis for Ph.D. I	45 Credits
434891	Research and Thesis for Ph.D. II	60 Credits

Major courses in Petroleum Technology

434610	Sequence Stratigraphy	3(3-0-6)
434611	Advanced Well Log Interpretation	3(2-3-4)
434612	Applied Micropaleontology	3(2-3-4)
434613	Reservoir Sedimentology	3(3-0-6)
434614	Petroleum Geochemistry	3(3-0-6)
434615	Applied Biostratigraphy	3(3-0-6)
434616	Petroleum Exploration Techniques	3(3-0-6)
434617	Petroleum Prospect Assessment	2(0-6-0)
434618	Petroleum Field Exploration and Development	4(4-0-8)
434619	Advanced Reservoir Engineering	4(4-0-8)
434620	Advanced Drilling Engineering	4(4-0-8)
434621	Reservoir Simulation	4(4-0-8)
434622	Well Test Analysis	4(4-0-8)
434623	Advanced Natural Gas Engineering	3(3-0-6)
434624	Secondary Oil Recovery	4(4-0-8)
434625	Enhanced Oil Recovery	4(4-0-8)
434626	Production System Analysis	3(3-0-6)
434627	Gas Processing	3(3-0-6)
434628	Advanced Petroleum Economics	3(3-0-6)
434667	Well Control and Safety	3(3-0-6)
434668	New Technology of Drilling	3(3-0-6)

Major courses in Geological Engineering and Applied Geology

434530	Fundamental of Rock Mechanics	4(3-3-6)
434531	Mining Geology	3(3-0-6)

434630	Rock Blasting	3(3-0-6)
434631	Mining Engineering	4(4-0-8)
434632	Health and Safety in Mining	1(1-0-3)
434633	Rock Slope Engineering	4(4-0-8)
434634	Underground Excavations in Rock	4(4-0-8)
434635	Advanced Rock Mechanics	4(3-3-6)
434636	Foundations on Rock	4(4-0-8)
434637	Field Instrumentation in Geomechanics	3(3-0-6)
434638	Numerical Methods in Geomechanics	3(3-0-6)
434639	Design Methodology in Rock Engineering	4(4-0-8)
434640	Rock Salt Mechanics	4(4-0-8)
434641	Fracture Mechanics of Rock	3(3-0-6)
434642	Earthquake Engineering	3(3-0-6)
434643	Applied Geomorphology	3(2-3-4)
434644	Applied Quaternary Geology	3(3-0-6)
434645	Applied Geochemistry	3(3-0-6)
434646	Applied Sedimentology	3(2-3-4)
434647	Advanced Structural Geology	3(2-3-4)
434648	Advanced Photogeology	3(2-3-4)
434649	Seismic Exploration	3(2-3-4)
434650	Geology and Geological Resources of Thailand	3(3-0-6)
434651	Geotectonic Evolution of Southeast Asia	3(3-0-6)
434652	Southeast Asian Geological Resources	3(3-0-6)
434653	Block Theory in Rock Engineering	3(3-0-6)
434654	Advanced Testing in Geomechanics	3(3-0-6)
434655	Flow in Fractured Rock	4(4-0-8)
434656	Computer Methods in Geological Engineering	4(4-0-8)
434657	Probability and Statistical Concepts in Geologic Media	3(3-0-6)
434658	Waste Disposal in Rock	4(4-0-8)
434659	Dam Site Investigation	4(4-0-8)
434660	Fractal Theory and Applications in Geo-Engineering	3(3-0-6)
434661	Artificial Intelligence in Rock Engineering	4(4-0-8)
434662	Salt Mining Technology	4(4-0-8)
434663	Theory of Linear Poroelasticity	4(4-0-8)
434664	Coal Mining Technology	4(4-0-8)
434665	Environmental Geomechanics	3(3-0-6)
434666	Advanced Geophysical Exploration	4(4-0-8)

Note: The 6-digit course number has the following meaning.

- The first digit represents the code of Institute, for example the Institute of Engineering = 4
- The second and third digit demonstrate the code of School, for example
- The School of Geotechnology = 34
- The fourth digit indicates the study level, i.e. senior bachelor and first year graduate level = 5 and master and doctoral degree = 6-8
- The fifth digit shows the major courses as :

0 = graduate seminar and special studies
1 - 8 = recommended courses for the major or Petroleum Technology, Geological Engineering and Applied Geology
9 = research thesis

- The last digit is for listing number of the courses.

Number following course name indicate as credits (lecture hours – laboratory hours – self study hours)

Core Courses are designed as the common courses for students of both major areas of study.

17.4 Study Plan

The following curiculla are recommended for students in each scheme and each major.

17.4.1 Master Program

Recommended M.Eng. curriculum for Scheme M1

Year	1st Trimester	Credits	2nd Trimester	Credits	3rd Trimester	Credits
1	434791 Research and Thesis for M.Eng.II	3	434791 Research and Thesis for M.Eng.II	3	434791 Research and Thesis for M.Eng.II 434700 Geotechnology Seminar I	9 1
	Total	3	Total	3	Total	10
2	434791 Research and Thesis for M.Eng.II	11	434791 Research and Thesis for M.Eng.II	11	434791 Research and Thesis for M.Eng.II 434701 Geotechnology Seminar II	8 1
	Total	11	Total	11	Total	9

Total 47 Credits

Recommended M.Eng. curriculum for Scheme M2

Year	1st Trimester	Credits	2nd Trimester	Credits	3rd Trimester	Credits
1	Major courses	8	Major courses	8	Major courses 434700 Geotechnology Seminar I	7 1
	Total	8	Total	8	Total	8
2	434790 Research and Thesis for M.Eng.I	3	434790 Research and Thesis for M.Eng.I	9	434790 Research and Thesis for M.Eng.I 434701 Geotechnology Seminar II	8 1
	Total	3	Total	9	Total	9

Total 45 Credits

17.4.2 Doctoral Program

Recommended D.Eng. curriculum for Scheme D1 for Master degree students.

Year	1st Trimester	Credits	2nd Trimester	Credits	3rd Trimester	Credits
1	434891 Research and Thesis for Ph.D.II	3	434891 Research and Thesis for Ph.D.II	3	434891 Research and Thesis for Ph.D.II 434700 Geotechnology Seminar I	12 1
	Total	3	Total	3	Total	13
2	434891 Research and Thesis for Ph.D.II	14	434891 Research and Thesis for Ph.D.II	14	434891 Research and Thesis for Ph.D.II 434701 Geotechnology Seminar II	14 1
	Total	14	Total	14	Total	15

Total 62 Credits

Recommended D.Eng. curriculum for Scheme D2 for Master degree students.

Year	1st Trimester	Credits	2nd Trimester	Credits	3rd Trimester	Credits
1	Major courses	8	Major courses 434890 Research and Thesis for Ph.D.I	6 3	434890 Research and Thesis for Ph.D.I	10
	Total	8	Total	10	Total	10
2	434890 Research and Thesis for Ph.D.I	11	434890 Research and Thesis for Ph.D.I	11	434890 Research and Thesis for Ph.D.I 434700 Geotechnology Seminar I	10 1
	Total	11	Total	11	Total	11

Total 61 Credits

Recommended D.Eng. curriculum for Scheme D2 for Bachelor degree students.

Year	1st Trimester	Credits	2nd Trimester	Credits	3rd Trimester	Credits
1	Major courses	6	Major courses	8	Major courses	8
	Total	6	Total	8	Total	8
2	Major courses 434891 Research and Thesis for Ph.D.II	6 3	434891 Research and Thesis for Ph.D.II	8	434891 Research and Thesis for Ph.D.II	8
	Total	9	Total	8	Total	8
3	434891 Research and Thesis for Ph.D.II	8	434891 Research and Thesis for Ph.D.II	8	434891 Research and Thesis for Ph.D.II 434700 Geotechnology Seminar I	8 1
	Total	8	Total	8	Total	9
4	434891 Research and Thesis for Ph.D.II	6	434891 Research and Thesis for Ph.D.II	6	434891 Research and Thesis for Ph.D.II 434701 Geotechnology Seminar II	5 1
	Total	6	Total	6	Total	6

Total 90 Credits

17.5 Course Description

17.5.1 Petroleum Technology Courses

434610 Sequence Stratigraphy **3(3-0-6)**

Prerequisite: 434306 Sedimentology or Consent of the School

Course Description

Depositional sequence. Recognition of depositional sequence by well logs, seismic data and outcrop. Controls on sequence development and system tracts. Seismic facies analysis. Siliciclastic and carbonate depositional model. Eustasy versus tectonics.

Course Outline

1.	Definition of a depositional sequence	(6 hours)
2.	Recognition of depositional sequence by well logs, seismic data and outcrop	(6 hours)
3.	Controls on sequence development and system tracts	(6 hours)
4.	Seismic facies analysis	(6 hours)
5.	Siliciclastic and carbonate depositional model	(6 hours)
6.	Eustasy versus tectonics	(6 hours)

434611 Advanced Well Log Interpretation **3(2-3-4)**

Prerequisite: 434250 Petroleum Geology or Consent of the School

Course Description

Well and borehole environment. Archie equation. Types of geological well logging. Borehole imaging. Clean and shaly sand formation evaluation. Petroleum producibility. Specialty logs. Cased-hole logs and log quality control. Logging for structural and stratigraphic correlation. Reservoir formation evaluation.

Course Outline(Lecture)

1.	Well and borehole environment	(2 hours)
2.	Archie equation	(2 hours)
3.	Gamma ray, spontaneous potential, and resistivity logging	(4 hours)
4.	Density, neutron, and sonic logs	(2 hours)
5.	Borehole imaging	(2 hours)
6.	Clean and shaly sand formation evaluation (lithology, fluids and saturation)	(2 hours)
7.	Petroleum producibility (porosity, permeability, and effective permeability)	(2 hours)
8.	Specialty logs (epithermal, nuclear resonance)	(2 hours)
9.	Cased-hole logs, and log quality control	(2 hours)
10.	Logging for structural and stratigraphic correlation	(4 hours)

Course Outline (Laboratory)

1.	Interpretation and using of gamma ray, spontaneous potential, and resistivity logging data	(6 hours)
2.	Interpretation and using of density, neutron, and logging data	(6 hours)
	Evaluation of clean and shaly sand formation (lithology, fluids and saturation)	(6 hours)
3.	Evaluation of petroleum producibility (porosity, permeability, and effective permeability)	(6 hours)

4.	Interpretation and using of cased-hole logs	(6 hours)
5.	Using of logging data for structural and stratigraphic correlation	(6 hours)

434612 Applied Micropaleontology 3(2-3-4)

Condition: Consent of the School

Course Description

Basic principles of micropaleontology. Laboratory procedures in micropaleontology. Micropalynological groups including foraminiferas, pollen, nannofossils, dinoflagellates. Application of palynology for exploration and development of petroleum.

Course Outline (Lecture)

1.	Basic principles of micropaleontology	(2 hours)
2.	Laboratory procedures in micropaleontology	(2 hours)
3.	Foraminiferas	(4 hours)
4.	Palynology	(4 hours)
5.	Nannofossils	(4 hours)
6.	Dinoflagellates	(4 hours)
7.	Application in petroleum industry	(4 hours)

Course Outline (Laboratory)

1.	Equipment and chemicals for preparation of micropaleontology samples	(3 hours)
2.	Preparation procedures for micropaleontology samples in laboratory	(3 hours)
3.	Preparation and study of foraminifera fossils	(6 hours)
4.	Preparation and study of pollen fossils	(6 hours)
5.	Preparation and study of nannofossils	(6 hours)
6.	Preparation and study of dinoflagellate fossils	(6 hours)
7.	Preparation of other microfossils	(6 hours)

434613 Reservoir Sedimentology 3(3-0-6)

Prerequisite: 434306 Sedimentology or Consent of the School

Course Description

Fluid flow. Sediment transport mechanisms. Bed forms and sedimentary structures. Sedimentary gravity flows. Depositional environments and facies models for clastic sedimentary facies. Composition, classification and facies models for carbonate rocks. Processes affecting on porosity and permeability of hydrocarbon reservoir.

Course Outline

1.	Fluid flow	(3 hours)
2.	Sediment transport mechanisms	(3 hours)
3.	Bed forms and sedimentary structures	(6 hours)
4.	Sedimentary gravity flows and waves	(6 hours)
5.	Depositional environments and facies models for clastic Sedimentary facies	(6 hours)
6.	Composition, classification and facies models for carbonate rocks	(6 hours)
7.	Compaction, diagenesis, cementation and dissolution of clastic and carbonate rocks and their affect on porosity and permeability of hydrocarbon reservoirs.	(6 hours)

434614 Petroleum Geochemistry 3(3-0-6)

Prerequisite: 434250 Petroleum Geology or Consent of the School

Course Description

Basic concepts and terminology of petroleum geochemistry. Composition and characterization of kerogen, bitumen, and petroleum. Conversion of kerogen to hydrocarbon. Principles and interpretation of geochemical data. Basic concepts of maturity modeling. Integrating measured geochemical data with conceptual geologic models. Modeling of burial and thermal history and prediction of hydrocarbon generation and migration routes.

Course Outline

1.	Basic concepts and terminology of petroleum geochemistry	(3 hours)
2.	Processes related to preservation of organic matter in sedimentary environments	(3 hours)
3.	Composition and characterization of kerogen, bitumen, and petroleum	(6 hours)
4.	Conversion of kerogen to hydrocarbon	(3 hours)
5.	Principles and interpretation of geochemical data	(6 hours)
6.	Basic concepts of maturity modeling	(3 hours)
7.	Integrating measured geochemical data with conceptual geologic models	(6 hours)
8.	Modeling of burial and thermal history and prediction of hydrocarbon generation and migration routes.	(6 hours)

434615 Applied Biostratigraphy 3(3-0-6)

Prerequisite: 434306 Sedimentology or Consent of the School

Course Description

Principles and concepts of biostratigraphy. Types of microfossils in exploration and development of petroleum. Palynomorphs, spores and pollen. Dinoflagellates. Benthic and planktonic foraminifera. Calcareous nannofossils. Biozonation of the Tertiary in Southeast Asia. Global biozonation. Sequence stratigraphic application. Biostratigraphy in hydrocarbon exploration.

Course Outline

1.	Palynomorphs, spores and pollen	(6 hours)
2.	Dinoflagellates	(3 hours)
3.	Benthic and planktonic foraminifera	(3 hours)
4.	Calcareous nannofossils	(3 hours)
5.	Biozonation of the Tertiary of southeast Asia	(6 hours)
6.	Global biozonation	(3 hours)
7.	Sequence stratigraphic application	(6 hours)
8.	Biostratigraphy in hydrocarbon exploration	(6 hours)

434616 Petroleum Exploration Techniques 3(3-0-6)

Prerequisite: 434250 Petroleum Geology and 434308 Geophysical Exploration or Consent of the School

Course Description

Identification and mapping of structural and stratigraphic trap from seismic data. Prediction of trap integrity and volume estimation of hydrocarbon accumulations. Application of facies models and sequence stratigraphy to the estimation of reservoir geometry and quality. Tectonic and subsidence models for passive continental margins. Fold and thrust belts. Rift and pull-apart basins and basin inversion. Analysis of basin development for determining hydrocarbon source rock potential and migration pathways. Integration of technical data with economic principles and risk assessment in making exploration decisions, and developing exploration strategies.

Course Outline

1. Identification and mapping of structural and stratigraphic trap from seismic data	(3 hours)
2. Prediction of trap integrity and volume estimation of hydrocarbon accumulations	(6 hours)
3. Application of facies models and sequence stratigraphy to the estimation of reservoir geometry and quality	(6 hours)
4. Tectonic and subsidence models for passive continental margins	(3 hours)
5. Fold and thrust belts	(3 hours)
6. Rift and pull-apart basins and basin inversion	(3 hours)
7. Analysis of basin development for determining hydrocarbon source rock potential and migration pathways	(6 hours)
8. Integration of technical data with economic principles and risk assessment in making exploration decisions, and developing exploration strategies	(6 hours)

434617 Petroleum Prospect Assessment 2(0-6-0)

Prerequisite: 434616 Petroleum Exploration Techniques or Consent of the School

Course Description

Practical exercise where well, outcrop, seismic and other geophysical data are interpreted in order to evaluate the exploration potential of an area.

434618 Petroleum Field Exploration and Development 4(4-0-8)

Condition: Consent of the School

Course Description

Oil and gas exploration and exploitation venture. Interpretations of the geology, engineering specification for well evaluation and production, reservoir performance and production forecast. Lease acquisition, and preparation of financial forecasts. Area and resource management. Petroleum accounting.

Course Outline

1. Exploration agreements	(4 hours)
2. Exploration data interpretation	(8 hours)
3. Drilling exploration and development wells	(4 hours)
4. Well evaluation and production	(4 hours)
5. Exploration risk analysis	(4 hours)
6. Reservoir performance and production forecast	(4 hours)
7. Production facilities and storage an transportation	(4 hours)
8. Oil and gas pricing	(4 hours)
9. Economic analysis and financial performance	(4 hours)
10. Area and resource management	(4 hours)
11. Conclude and present final report	(4 hours)

434619 Advanced Reservoir Engineering 4(4-0-8)

Prerequisite: 434353 Reservoir Engineering I or Consent of the School

Course Description

Optimization of material balance equation. Saturation and relative permeability calculation. Radial flow equation; steady state flow, pseudo-steady state flow, and superposition. Type curve analysis. Displacement efficiency. Potential flow and streamlines. Dynamics of water drive reservoir. Gas and water coning. Miscible process, and enhanced oil recovery.

Course Outline

1. Optimization of material balance equation	(4 hours)
2. Saturation and relative permeability calculation	(4 hours)
3. Radial flow equation and steady state flow	(4 hours)
4. Pseudo-steady state flow and superposition	(4 hours)
5. Well testing pressure build up, pressure drawdown	(4 hours)
6. Interference testing and type curve analysis	(4 hours)
7. Displacement efficiency	(4 hours)
8. Potential flow and streamlines	(4 hours)
9. Dynamics of water drive reservoir	(4 hours)
10. Gas and water coning	(4 hours)
11. Miscible process	(4 hours)
12. Enhanced oil recovery	(4 hours)

434620 Advanced Drilling Engineering 4(4-0-8)

Prerequisite: 434381 Drilling Technology or Consent of the School

Course Description

Well planning and proposals. Cost control. Hole problems. Type of drilling fluid. Solid removal. Pressure loss control, lifting capacity, surge and swab pressure. Pore pressure and fracture gradients. Blowout control procedure and equipment. Directional well and slim hole drilling. Rotary drilling bits.

Course Outline

1. Introduction to rotary drilling and how to get permission	(4 hours)
2. Well planning and proposals	(4 hours)
3. Cost estimation and control	(4 hours)
4. Hole problem	(4 hours)
5. Type of drilling fluids	(4 hours)
6. Factors effecting rate of penetration	(4 hours)
7. Pressure control	(4 hours)
8. Pore pressure and fracture gradient	(4 hours)
9. Blowout control procedure and equipment	(4 hours)
10. Directional well and slim hole drilling	(4 hours)
11. Rotary drilling bit design	(2 hours)
12. New technology of drilling	(6 hours)

434621 Reservoir Simulation 4(4-0-8)

Prerequisite: 434353 Reservoir Engineering I or Consent of the School

Course Description

Fundamentals of petroleum reservoir simulation. Development of finite differential equations and multicomponent equation. Multiphase flow between grid blocks comprising petroleum reservoir. Solution of equation. Relationships between black-oil and compositional models. Data preparation. Flow diagram and history match. Practical consideration in the use of simulators for prediction reservoir performance.

Course Outline

1. Introduction to reservoir engineering	(4 hours)
2. Fundamentals of reservoir simulation	(4 hours)
3. Finite differential equation	(4 hours)
4. Development of multicomponent equation	(4 hours)
5. Multiphase flow between grid blocks	(4 hours)
6. Solution of equation	(4 hours)
7. Relationships between black-oil and compositional models	(4 hours)
8. Data preparation	(4 hours)
9. Flow diagram and history match	(4 hours)
10. Selection of simulator	(4 hours)
11. Practical consideration in the use of simulator	(4 hours)
12. Optimization and report	(4 hours)

434622 Well Test Analysis 4(4-0-8)

Prerequisite: 434353 Reservoir Engineering I or Consent of the School

Course Description

Fluid flow diffusivity equation. Exponential integral solution. Principle of superposition. Drawdown testing, skin effects, and well bore storage. Type curve matching; reservoir limit test, pressure buildup test, drill stem test, interference test, pulse test. Reservoir heterogeneity.

Course Outline

1. Fluid flow in reservoir	(4 hours)
2. Diffusivity and differential equation	(4 hours)
3. Exponential integral solution	(4 hours)
4. Principle of superposition	(4 hours)
5. Pressure drawdown testing	(4 hours)
6. Type curve matching	(4 hours)
7. Reservoir limit test	(4 hours)
8. Multiple-phases flow test	(4 hours)
9. Interference test	(4 hours)
10. Pressure buildup test	(4 hours)
11. Drill stem test	(4 hours)
12. Effect of reservoir heterogeneity	(2 hours)
13. Practical aspects of pressure analysis	(2 hours)

434623 Advanced Natural Gas Engineering 3(3-0-6)

Prerequisite: 434357 Natural Gas Technology or Consent of the School

Course Description

PVT analysis. Flow of gas in porous media; three-dimensional flow, radial flow, closed reservoir, low permeability reservoirs. Gas well testing; drawdown, buildup, back pressure isochronal, deliverability. Storage and transport of liquified gas; pipeline system. Gas sweetening. Gas Processing design. Gas Utilization. Gas supply and demand. Gas sale and contract marketing. Petrochemical industry.

Course Outline

1. PVT analysis	(3 hours)
2. Gas flow in porous media	(3 hours)
3. Gas well testing	(4 hours)
4. Gas reserves and production forecast	(3 hours)
5. Gas storage and transportation	(3 hours)
6. Gas pipe line system and design	(3 hours)
7. Gas sampling and testing	(3 hours)
8. Gas processing and sweetening	(6 hours)
9. Gas utilization	(4 hours)
10. Petrochemical processes and products	(4 hours)

434624 Secondary Oil Recovery 4(4-0-8)

Prerequisite: 434353 Reservoir Engineering I or Consent of the School

Course Description

Fluid flow in water drive reservoir. Combination drive displacement efficiency. Evaluating and operating secondary project. Considerations of petroleum engineering and reservoir behavior applied to secondary recovery of oil. Enhanced oil recovery.

Course Outline

1. Fluid flow in reservoir	(4 hours)
2. Water drive reservoir	(4 hours)
3. Combination drive reservoir	(4 hours)
4. Efficiency of oil displacement by water	(4 hours)
5. Arial sweep efficiency	(4 hours)
6. Vertical and volumetric sweep efficiency	(4 hours)
7. Methods of predicting water flood performance	(4 hours)
8. Pilot water flooding	(4 hours)
9. Evaluating and operating secondary recovery project	(6 hours)
10. Considerations of petroleum engineering and reservoir behavior applied to secondary recovery of oil	(6 hours)
11. Enhanced oil recovery	(4 hours)

434625 Enhanced Oil Recovery 4(4-0-8)

Prerequisite: 434353 Reservoir Engineering I or Consent of the School

Course Description

Physical principle applications to increase oil recovery. Water flooding. Miscible flooding. In-situ combustion. Cyclic steam injection and steam flooding. Oil recovery and heat losses calculation. Selection of suitable reservoir. Operational problems.

Course Outline

1. Physical principle applications to increase oil recovery	(6 hours)
2. Water flooding	(8 hours)
3. Miscible flooding	(8 hours)
4. In-situ combustion	(4 hours)
5. Cyclic steam injection and steam flooding	(4 hours)
6. Oil recovery and heat losses calculation	(6 hours)
7. Selection of suitable reservoir	(6 hours)
8. Operational problems	(6 hours)

434626 Production System Analysis 3(3-0-6)

Prerequisite: 434355 Production Engineering I or Consent of the School

Course Description

Analysis of production system performance. Inflow performance. Horizontal and vertical multiphase flows. Tubing performance. Choke performance. Surface flow lines. Separators. Artificial lift methods. Production waste management.

Course Outline

1. Analysis of production system performance	(3 hours)
2. Inflow performance	(3 hours)
3. Horizontal and vertical multiphase flows	(6 hours)
4. Tubing performance	(3 hours)
5. Choke performance	(3 hours)
6. Surface flow lines	(3 hours)
7. Separators	(3 hours)
8. Artificial lift methods	(9 hours)
9. Production waste management	(3 hours)

434627 Gas Processing 3(3-0-6)

Prerequisite: 434357 Natural Gas Technology or Consent of the School

Course Description

Principles of procession gas processing. Design of plant equipment. Gas and liquid sweetening. Petrochemical process. Liquified gas processing.

Course Outline

1. Principles of gas processing	(6 hours)
2. Design of plant equipment	(12 hours)
3. Gas and liquid sweetening	(6 hours)
4. Protrochemical process	(6 hours)
5. Liquified gas processing	(6 hours)

434628 Advanced Petroleum Economics 3(3-0-6)

Prerequisite : 434360 Petroleum Economics or Consent of the School

Course Description

Macroeconomics of petroleum industry. Cash flow analysis. Cost analysis. Economic analysis and financing. Decision, risk and uncertainty. Project planning and Control. Strategic and corporate planning in petroleum industry.

Course Outline

1. Macroeconomics of petroleum industry	(3 hours)
2. Cash flow analysis	(6 hours)
3. Cost analysis	(3 hours)
4. Petroleum pricing and contracts	(3 hours)
5. Economic analysis and financing	(6 hours
6. Decision, risk and uncertainty	(6 hours)
7. Project planning and control	(6 hours)
8. Strategic and corporate planning in petroleum industry	(6 hours)

17.5.2 Geological Engineering and Applied Geology Courses

434530 Fundamental of Rock Mechanics 4(3-3-6)

Prerequisite: 434330 Geological Engineering or Consent of the School

Course Description

Introduction of basic mechanical properties and behavior of rocks. Theories and concepts governing the classification and utilization of geomechanics data. Fundamental of the design considerations, design criteria, and design processes in rock mechanics field.

Course Outline (Lecture)

1. Mechanical rock classification systems	(4 hours)
2. Rigid body mechanics	(4 hours)
3. Continuum theory and analysis	(4 hours)
4. Elastic theory	(5 hours)
5. Failure criteria	(4 hours)
6. Behavior and properties of intact rock and rock mass	(5 hours)
7. In-situ stress states in rock mass	(3 hours)
8. Field instrumentation and measurements	(4 hours)
9. Site investigation	(3 hours)

Course Outline (Laboratory)

1. Introduction to rock testing	(3 hours)
2. Rock specimen collection and preparation	(9 hours)
3. Uniaxial compression testing	(6 hours)
4. Triaxial compression testing	(6 hours)
5. Brazilian tension testing	(3 hours)
6. Dynamic wave velocity testing	(3 hours)
7. Direct shear testing	(3 hours)
8. Rock index testing	(3 hours)

434531 Mining Geology **3(3-0-6)**

Prerequisite: 434200 General Geology or Consent of the School

Course Description

Overviews of geologist's work in mineral discovery, and mineral production. Collection of geologic data relevant to mineral deposit, and ore reserve estimation.

Course Outline

1. Engineering properties and conditions	(3 hours)
2. Approaches to mining	(3 hours)
3. Mine and mineral economic	(6 hours)
4. Concepts of ore body	(3 hours)
5. Surface mapping of ore	(3 hours)
6. Subsurface mapping of ore	(3 hours)
7. Drilling and sampling	(3 hours)
8. Explorations and mining	(6 hours)
9. Mining geology	(6 hours)

434630 Rock Blasting **3(3-0-6)**

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Theories and practices of blasting in rocks. Commercial explosives and their applications to the underground and surface mining, and the engineering structures.

Course Outline

1. Explosive properties	(3 hours)
2. Blasting theory	(6 hours)
3. Dynamite	(3 hours)
4. Blasting agents	(6 hours
5. Initiation system and delay	(3 hours)
6. Primers	(3 hours)
7. Surface blasting	(3 hours)
8. Underground blasting	(3 hours)
9. Blasting in construction	(3 hours)
10. Blasting safety	(3 hours)

434631 Mining Engineering **4(4-0-8)**

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Methods and current practices used in the surface and underground mining industry. A minimum of one site tour or excursion is included.

Course Outline

1. Mine planning	(12 hours)
2. Ore reserve estimation	(3 hours)
3. Surface and underground mining developments	(12 hours)
4. Mine evaluation and investment	(6 hours)
5. Mining methods	(6 hours)
6. Environmental health and safety	(3 hours)
7. Post-mining operation	(6 hours)

434632 Health and Safety in Mining 1(1-0-3)

Prerequisite: 434631 Mining Engineering or Consent of the School

Course Description

Environmental and safety issues for mine workers and machine used in surface and underground mining of metal and non-metal mines. Relevant regulations, and current safety practice.

Course Outline

1.	Personnel health and safety	(1 hours)
2.	Gas and dust control	(2 hours)
3.	Heat and humidity control	(2 hours)
4.	Exhaust emission control	(2 hours)
5.	Ventilation requirements	(3 hours)
6.	Noise abatement	(1 hours)
7.	Mine illumination	(1 hours)

434633 Rock Slope Engineering 4(4-0-8)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Applications of rock mechanics knowledge to the surface excavations in rock mass, with a main emphasis on design and analysis of roadways, land development, dam embankments, landfills, and open-pit mines. A minimum of one site tour or excursion is included.

Course Outline

1.	Characteristics and classification of rock mass	(3 hours)
2.	Collection of geologic data	(3 hours)
3.	Interpretation and representation of geologic data	(3 hours)
4.	Joint shear strength criteria	(6 hours)
5.	Slope failure mechanisms	(3 hours)
6.	Plane failure analysis	(6 hours)
7.	Wedge failure analysis	(6 hours)
8.	Circular failure analysis	(6 hours)
9.	Toppling failure	(6 hours)
10.	Rock slope support design	(3 hours)
11.	Rock slope blasting	(3 hours)

434634 Underground Excavations in Rock 4(4-0-8)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Applications of rock mechanics knowledge to the underground excavations in rock mass, with a main emphasis on design and analysis of mine openings, tunnels, shafts, and underground caverns. A minimum of one site tour or excursion is included.

Course Outline

1.	Characteristics and classifications of rock mass	(6 hours)
2.	Collection of geologic data	(6 hours)
3.	Stresses around underground openings	(6 hours)
4.	Failure mechanisms of underground openings	(6 hours)
5.	Stability analysis	(6 hours)

6.	Opening design criteria	(6 hours)
7.	Underground support design	(6 hours)
8.	Excavation methods	(6 hours)

434635 Advanced Rock Mechanics 4(3-3-6)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Constitutional theories of rock mechanics and rock engineering. The derivation, applications and limitations of the theories. Three-dimensional stress. Infinitesimal strain. Rock friction. Scale effect and time-dependent effect. Strain-hardening and strain softening behavior. Fracture mechanics. Field measurements and monitoring of stresses and properties. A minimum of one site tour or excursion is included.

Course Outline (Lecture)

1.	Three-dimensional stress state	(6 hours)
2.	Infinitesimal strain	(6 hours)
3.	Rock friction	(3 hours)
4.	Scale effect	(3 hours)
5.	Time-dependent effect	(3 hours)
6.	Strain-hardening and strain softening behavior	(6 hours)
7.	Fracture mechanics	(3 hours)
8.	Field measurements and monitoring of stresses and properties	(6 hours)

Course Outline (Laboratory)

1.	Scale effect	(12 hours)
2.	Loading rate effect	(6 hours)
3.	Thermal effect	(6 hours)
4.	Time-dependent effect	(6 hours)
5.	Test machine effect	(6 hours)

434636 Foundations on Rock 4(4-0-8)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Applications of rock mechanics knowledge to the design and construction of engineering structures in rock mass (e.g., buildings, dams, piers, bridges, and footings). A minimum of one site tour or excursion is included.

Course Outline

1.	In-situ investigation and testing	(6 hours)
2.	Bearing capacity and settlement determination	(9 hours)
3.	Foundation stability analysis	(9 hours)
4.	Seismic design	(9 hours)
5.	Dam and pier foundations design	(9 hours)
6.	Tension foundations design	(6 hours)

434637 Field Instrumentation in Geomechanics 3(3-0-6)

Prerequisite: 434530 Fundamental of Rock Mechanics or Cconsent of the School

Course Description

Description of components and applications of field instrumentation and devices used in testing, monitoring and measurement of rock mass properties and its behavioral response to the engineering structures. A minimum of one site tour or excursion is included.

Course Outline

1.	Introduction to field measurements	(3 hours)
2.	Measurement components and devices	(3 hours)
3.	Load and pressure measurements	(6 hours)
4.	Deformation and displacement measurements	(6 hours)
5.	Pore pressure measurements	(6 hours)
6.	Planning and implementation program	(3 hours)
7.	Data interpretation and analysis	(9 hours)
8.	Database development	(6 hours)

434638 Numerical Methods in Geomechanics 3(3-0-6)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Applications of the numerical techniques and computer modeling in stability analysis and design of engineering structures in rock mass.

Course Outline

1.	Constitutive equations for rock and rock mass	(6 hours)
2.	Applications and limitations of computer modeling	(3 hours)
3.	Computer-assisted design and analysis	(6 hours)
4.	Finite element methods	(6 hours)
5.	Boundary element methods	(6 hours)
6.	Other computer modeling schemes	(9 hours)

434639 Design Methodology in Rock Engineering 4(4-0-8)

Prerequisite: 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Description of philosophy and methodology used in the design of engineering and geologic structures in rock mass, such as dams, reservoirs, rock slopes, tunnels, bridges and mines.

Course Outline

1.	Design philosophy	(6 hours)
2.	Planning and development	(6 hours)
3.	Geological factors	(6 hours)
4.	Design considerations	(6 hours)
5.	Design processes	(6 hours)
6.	Design criteria	(6 hours)
7.	Design limitations	(6 hours)
8.	Case histories	(6 hours)

434640 Rock Salt Mechanics 4(4-0-8)

Prerequisite: 434635 Advanced Rock Mechanics or Consent of the School

Course Description

The theories and concepts used to describe the rheological behavior and properties of rock salt and other time-dependent materials. Main emphases are placed on the design and analysis of underground structures (i.e., mine openings, brine caverns, storage caverns, and waste disposal) in salt and potash formations. A minimum of one site tour or excursion is included.

Course Outline

1. Elastic-plastic theories	(6 hours)
2. Visco-elasticity	(9 hours)
3. Visco-plasticity	(9 hours)
4. Constitutive law and parameter determination	(6 hours)
5. Numerical simulation in creeping media	(6 hours)
6. Stress-control concept	(6 hours)
7. Numerical-assisted design	(6 hours)

434641 Fracture Mechanics of Rock 3(3-0-6)

Prerequisite: 434635 Advanced Rock Mechanics or Consent of the School

Course Description

Theories, experimentation and applications of fracture mechanics knowledge to the crack initiation and failure of rocks, minerals, and rock mass.

Course Outline

1. Introduction to fracture mechanics	(3 hours)
2. Joint and shear fractures in rock	(3 hours)
3. Theory of crack initiation and propagation	(6 hours)
4. Theory of sub-critical crack growth	(6 hours)
5. Fracture mechanics approach to hydro-fracturing	(6 hours)
6. Fracture mechanics approach to hot dry rock	(6 hours)
7. Fracture mechanics approach to earthquake zone	(6 hours)

434642 Earthquake Engineering 3(3-0-6)

Prerequisite: 434308 Geophysical Exploration or Consent of the School

Course Description

Engineering fundamentals, experimentation, and measurement of the earthquake. Predicting of the earthquake process.

Course Outline

1. Elastic wave propagation theory	(3 hours)
2. Strong ground motion	(3 hours)
3. Design spectrum	(6 hours)
4. Ground motion measurements	(6 hours)
5. Dynamic testing	(3 hours)
6. Formulation of mathematical models	(6 hours)
7. Earthquake response to structures	(9 hours)

434643 Applied Geomorphology 3(2-3-4)

Prerequisite: 434203 Geomorphology or Consent of the School

Application of geomorphology in geological mapping, geological engineering, petroleum geology and structural engineering.

Course Outline (Lecture)

1. Introduction	(2 hours)
2. Primary and secondary characteristics of marine sedimentary rocks	(3 hours)
3. Primary and secondary characteristics of continental sedimentary rocks	(3 hours)
4. Landforms of metamorphic rocks	(3 hours)
5. Landforms of igneous rocks	(3 hours)
6. Relationship between geomorphology and geological structures	(4 hours)
7. Study of geomorphology for application in geological engineering, petroleum geology, geological mapping, and structural engineering	(6 hours)

Course Outline (Laboratory)

1. Topographic maps and landforms	(6 hours)
2. Primary and secondary characteristics of marine sedimentary rocks	(3 hours)
3. Primary and secondary characteristics of continental sedimentary rocks	(3 hours)
4. Geomorphology of metamorphic rocks	(6 hours)
5. Geomorphology of igneous rocks	(6 hours)
6. Geomorphology and geological structures	(6 hours)
7. Geomorphology in geological engineering, petroleum geology, and structural engineering projects	(6 hours)

434644 Applied Quaternary Geology 3(3-0-6)

Prerequisite: 434203 Geomorphology and 434306 Sedimentology
or Consent of the School

Course Description

Climate and climatic changes. Sea-level change and its effects. Geochronometric dating methods and dating quaternary events. Quaternary deposition and erosion processes. Soil genesis and development. Methods and techniques in Quaternary investigation. Economic significance of Quaternary studies. Quaternary geology of Thailand.

Course Outline

1. Introduction	(1 hours)
2. Climate and climatic changes	(3 hours)
3. Evidence of climatic changes from oceanic deposits	(3 hours)
4. Evidence of climatic changes from continental deposits	(3 hours)
5. Sea-level change and its effects	(2 hours)
6. Geochronometric dating methods and dating quaternary events	(3 hours)
7. Quaternary deposition and erosion processes	(5 hours)
8. Soil genesis and development	(2 hours)
9. Methods and techniques in Quaternary investigation	(6 hours)
10. Economic significance of Quaternary studies	(2 hours)
11. Quaternary geology of Thailand	(6 hours)

434645 Applied Geochemistry 3(3-0-6)

Condition: Consent of the School

Course Description

Geochemical principles and their applications in the study of geothermal system, hydrothermal solution system, metamorphism and petroleum genesis. Applications of geochemistry in exploration and detection of mineral deposits.

Course Outline

1. Geochemical principles and applications	(6 hours)
2. Low-Temperature aqueous systems	(3 hours)
3. Carbonate equilibrium	(3 hours)
4. Geothermal and hydrothermal systems	(6 hours)
5. Metamorphism and Igneous Processes	(6 hours)
6. Petroleum generation	(6 hours)
7. An integrated application to geochemical exploration for the detection of mineral deposits	(6 hours)

434646 Applied Sedimentology 3(2-3-4)

Prerequisite: 434306 Sedimentology or Consent of the School

Course Description

Sedimentary cycle; weathering, transportation and sedimentation. Structures of sedimentary rocks. Types of sedimentary rocks and environment of deposition. Types of sedimentary basins. Basin evolution, metallogeny and petroleum generation

Course Outline (Lecture)

1. Weathering and sedimentary cycle	(4 hours)
2. Transportation and sedimentation	(2 hours)
3. Particles, pores and permeability	(2 hours)
4. Environments and facies	(4 hours)
5. Allochthonous sediments	(2 hours)
6. Autochthonous sediments	(2 hours)
7. Sedimentary basins	(4 hours)
8. Basin evolution, metallogeny and petroleum generation	(4 hours)

Course Outline (Laboratory)

1. Analysis of sedimentary particles	(12 hours)
2. Analysis of sedimentary minerals	(12 hours)
3. Analysis of sandstone and limestone	(12 hours)

434647 Advanced Structural Geology 3(2-3-4)

Prerequisite: 434201 Structural Geology or Consent of the School

Course Description

Fault and fold mechanics. Plate tectonics. Geologic cross-section construction techniques. Structural interpretation of seismic data. Structural styles in different tectonic settings. Structural geology of reservoir units.

Course Outline (Lecture)

1. Fault and fold mechanics	(6 hours)
2. Current concepts in plate tectonics	(2 hours)
3. Cross-section construction techniques	(4 hours)

4.	Structural interpretation of seismic data	(4 hours)
5.	Structural styles in different tectonic settings (thrust and fold belts, rifts, strike-slip, gravity tectonics, inversion)	(4 hours)
6.	Structural geology of reservoir units	(4 hours)

Course Outline (Laboratory)

1.	Analysis of fault mechanics	(6 hours)
2.	Analysis of fold mechanics	(6 hours)
3.	Construction of geologic cross-section	(6 hours)
4.	Structural interpretation of seismic data	(6 hours)
5.	Analysis of structural styles in different tectonic settings	(6 hours)
6.	Analysis of structural geology of reservoir units	(6 hours)

434648 Advanced Photogeology 3(2-3-4)

Prerequisite: 434305 Photogeology or Consent of the School

Course Description

Use of aerial photographs in geologic mapping. Advanced photo interpretation in geologic field mapping.

Course Outline (Lecture)

1.	Introduction	(3 hours)
2.	Geological data and data acquisition from aerial photographs	(3 hours)
3.	Scale, direction and positioning in aerial photographs	(3 hours)
4.	Classification of geological structures from aerial photographs	(3 hours)
5.	Classification of rocks using data from aerial photographs	(3 hours)
6.	Drawing of geologic cross section using data from aerial photographs	(3 hours)
7.	Geologic field mapping using data from aerial photographs	(6 hours)

Course Outline (Laboratory)

1.	Acquisition and classification of geological data from aerial photographs	(12 hours)
2.	Scale, direction and positioning in aerial photographs	(6 hours)
3.	Classification of geological structures and drawing of geologic cross section using data from aerial photographs	(6 hours)
4.	Classification of rocks using data from aerial photographs	(6 hours)
5.	Geologic field mapping using data from aerial photographs	(6 hours)

434649 Seismic Exploration 3(2-3-4)

Prerequisite : 434308 Geophysical Exploration or Consent of the School

Course Description

Data processing. Interpretation of signal and geophysical data. Seismic stratigraphy. Construction of 3D modeling by geophysical data.

Course Outline (Lecture)

1.	Description of waveforms, propagation of seismic waves	(2 hours)
2.	Data acquisition, digital signal analysis	(2 hours)
3.	Data processing	(2 hours)
4.	Seismic interpretation in time	(2 hours)
5.	Time to depth conversion	(2 hours)
6.	3D data acquisition and processing	(2 hours)

7. Seismic modeling	(2 hours)
8. Synthetic seismograms, VSP	(2 hours)
9. Seismic stratigraphy	(4 hours)
10. Seismic refraction methods	(4 hours)

Course Outline (Laboratory)

1. Property and behavior of wave	(3 hours)
2. Data acquisition, data processing and digital signal analysis	(3 hours)
3. Seismic interpretation in time and time to depth conversion	(6 hours)
4. 3D data acquisition, processing and interpretation	(3 hours)
5. Seismic modeling	(3 hours)
6. Vertical seismic profiling	(6 hours)
7. Seismic stratigraphy	(6 hours)
8. Seismic refraction survey methods and data interpretation	(6 hours)

434650 Geology and Geological Resources of Thailand 3(3-0-6)

Condition: Consent of the School

Course Description

Structural setting, stratigraphy, igneous activity, and tectonic evolution. Non-metallic and industrial mineral resources, mineral fuels resources, and metallic mineral resources of Thailand.

Course Outline

1. Introduction	(3 hours)
2. Structural setting	(6 hours)
3. Stratigraphy	(6 hours)
4. Igneous activity	(3 hours)
5. Tectonic evolution	(3 hours)
6. Non-metallic and industrial mineral resources	(6 hours)
7. Mineral fuels resources	(6 hours)
8. Metallic mineral resources	(3 hours)

434651 Geotectonic Evolution of Southeast Asia 3(3-0-6)

Condition: Consent of the School

Course Description

Present day tectonic setting and plate interactions. Tectonostratigraphic terrane of Southeast Asia and their boundaries. Southeast Asian Phanerozoic terrane evolution. Palaeogeographic reconstruction.

Course Outline

1. Present day tectonic setting and plate interactions	(9 hours)
2. Tectonostratigraphic terrane of the region and their boundaries	(9 hours)
3. Southeast Asian Phanerozoic terrane evolution	(9 hours)
4. Palaeogeographic reconstruction	(9 hours)

434652 Southeast Asian Geological Resources 3(3-0-6)

Condition : Consent of the School

Course Description

Paleozoic, Mesozoic and Cenozoic evolution of the Southeast Asia. Palaeogeographic and plate reconstruction. Metallic deposits and metallogeny. Accumulation of oil and gas. Coal, diamonds, sapphires and other gems deposits. New approaches to exploration utilizing plate reconstruction and palaeogeography.

Course Outline

1.	Paleozoic, Mesozoic and Cenozoic evolution of the region	(9 hours)
2.	Palaeogeographic and plate reconstruction	(6 hours)
3.	Metallic deposits of the region and metallogeny	(3 hours)
4.	Oil and gas accumulations of the region	(6 hours)
5.	Coal deposits	(3 hours)
6.	Diamonds, sapphires and other gems	(3 hours)
7.	New approaches to exploration utilizing regional spatial information in conjunction with plate reconstruction and palaeogeography	(6 hours)

434653 Block Theory in Rock Engineering 3(3-0-6)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics
or Consent of the School

Course Description

Block geometry, stability evaluation using vector methods, graphical methods, removability of block, joint block, kinematics and stability of removable block.

Course Outline

1.	Introduction	(1 hour)
2.	Block geometry and stability using vector methods	(3 hours)
3.	Graphical methods	(2 hours)
4.	Removability of blocks	(3 hours)
5.	Joint block	(3 hours)
6.	Block theory for surface excavations	(6 hours)
7.	Block theory for underground chamber	(6 hours)
8.	Block theory for tunnels and shafts	(6 hours)
9.	Kinematic analysis	(6 hours)

434654 Advanced Testing in Geomechanics 3(3-0-6)

Prerequisite: 434635 Advanced Rock Mechanics or Consent of the School

Course Description

Designing test program, verification of results, influence of test parameters on the results, designing specimen configurations, implications and applications of test results, effect of loading rate, size and shape of sample, measurement precision.

Course Outline

1.	Introduction	(1 hour)
2.	Effects of specimen size and shape on rock strengths	(6 hours)
3.	Time-dependent properties of rocks	(6 hours)
4.	Effects of deformation rate on rock strengths	(6 hours)
5.	Pre- and post-failure properties of rocks	(6 hours)
6.	Dynamic properties of rocks	(3 hours)

7. Deformation and fracture of saturated rocks	(6 hours)
8. Measurement precision, accuracy and errors	(2 hours)

434655 Flow in Fractured Rock 4(4-0-8)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

A application of hydrologic and engineering principles to flow in fractured rock. Emphasis is on theories and principles of flow through parallel plates and the differences between flow and transport in porous media and fractured rock. Do independent research.

Course Outline

1. Introduction	(1 hour)
2. Continuum and discrete models	(2 hours)
3. Constitutive equation of flow	(9 hours)
4. Morphology of fractured rock	(9 hours)
5. Models of fractured rock	(9 hours)
6. Flow and dispersion in fractured rock	(9 hours)
7. Multi-phase flow	(9 hours)

434656 Computer Methods in Geological Engineering 4(4-0-8)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Use of computers to solve problems in geological engineering, including data bases, stability evaluation and back-analysis, computer contouring, map filtering and enhancement, multivariate analysis of geologic data, basic numerical methods, and back-analysis approaches.

Course Outline

1. Introduction	(3 hours)
2. Scope and limitations of 3-D graphic softwares	(6 hours)
3. Basic equations for contouring and interpolation	(6 hours)
4. Constitutive equations for geologic materials	(9 hours)
5. Linear and non-linear modeling	(6 hours)
6. Load and boundary conditions	(6 hours)
7. Introductory numerical methods	(6 hours)
8. Back-analysis methods	(6 hours)

434657 Probability and Statistical Concepts in Geologic Media 3(3-0-6)

Prerequisite : 434330 Geological Engineering or Consent of the School

Course Description

Univariate probabilistic and statistical methods: data reduction, basic probability concepts, discrete and continuous probability distributions, sampling distributions, confidence intervals, goodness-of-fit-tests; applications in geologic media. Introduction to a few statistical packages.

Course Outline

1. Introduction	(1 hour)
2. Review of probability and statistical methods	(5 hours)

3. Univariate description	(3 hours)
4. Bivariate description	(3 hours)
5. Spatial description	(6 hours)
6. Estimation	(3 hours)
7. Ordinary kriging	(6 hours)
8. Block kriging	(3 hours)
9. Assessing uncertainty	(3 hours)
10. Geostatistical simulation of RQD	(3 hours)

434658 Waste Disposal in Rock 4(4-0-8)

Prerequisite: 434330 Geological Engineering or consent of the School

Course Description

Analysis and review of technical problems surrounding the shallow and deep geologic disposal, with special emphasis on hazardous solid and liquid wastes. Methods of investigation of new waste disposal sites. Analysis of contaminant movement in the ground, design of containment and monitoring systems, case histories of field performance, and current research findings.

Course Outline

1. Introduction	(2 hours)
2. Advantages of storing wastes in rock	(2 hours)
3. Principle of waste disposal	(5 hours)
4. Deep hole injection methods	(6 hours)
5. Waste disposal in abandoned mines	(6 hours)
6. Waste disposal in abandoned salt cavern	(6 hours)
7. Repository design	(9 hours)
8. Sealing of boreholes and underground excavation	(6 hours)
9. Engineering seal properties	(6 hours)

434659 Dam Site Investigation 4(4-0-8)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Site investigation, data collection and design of dams and reservoir, with a main emphasis on embankment dam. Calculation of seepage and uplift. Analysis of the stability of rock foundation and abutment.

Course Outline

1. Introduction	hour)
2. Dam types, components, and siting	hours)
3. Design issues and objectives for dams	hours)
4. Functional requirements and design components	hours)
5. Geologic data collection and evaluation	hours)
6. Seepage and earthdam	hours)
7. Dam foundation design	hours)
8. Reservoir stability and aging	hours)

434660 Fractal Theory and Applications in Geo-Engineering 3(3-0-6)

Prerequisite: 434330 Geological Engineering
or Consent of the School

Course Description

Theory and applications of the following topics to geo-engineering: (a) self-similarity and self-similar fractals, (b) divider method, (c) box method, (d) perimeter area method, (e) self-affinity and self-affine fractals, (f) roughness length method, (g) variogram method, (h) spectral method and (i) line scaling method.

Course Outline

1. Introduction	(1 hour)
2. Fractals theory	(5 hours)
3. Mathematical background	(6 hours)
4. Fractal image compression	(6 hours)
5. Fractals and their applications to geology	(6 hours)
6. Fractals as applied to rock fractures	(6 hours)
7. Fractal dimension analysis of soil and flow	(6 hours)

434661 Artificial Intelligence in Rock Engineering 4(4-0-8)

Prerequisite: 434635 Advanced Rock Mechanics or Consent of the School

Course Description

Neural network formulation, expert system development, heuristic search techniques, knowledge representation, predicate logic and statistical reasoning.

Course Outline

1. Introduction	(3 hours)
2. Artificial intelligence problem-solving concept	(6 hours)
3. Knowledge representation	(9 hours)
4. Knowledge acquisition	(9 hours)
5. Inference techniques	(9 hours)
6. Validation	(3 hours)
7. Knowledge base and expert system program examples in rock engineering	(9 hours)

434662 Salt Mining Technology 4(4-0-8)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics
or Consent of the School

Course Description

Principles of mining systems for thin and thick deposits, design considerations of mine structures, stability evaluation, stress analysis, and access and mine development.

Course Outline

1. Geology of salt and potash	(3 hours)
2. Exploration and classification	(6 hours)
3. Mine development	(6 hours)
4. Risk of inflow	(6 hours)
5. Analysis of time-dependent deformation	(6 hours)
6. Dry salt mine system	(6 hours)
7. Solution salt mine system	(6 hours)
8. Storage cavern	(3 hours)
9. Salt mining subsidence	(6 hours)

434663 Theory of Linear Poroelasticity **4(4-0-8)**

Prerequisite : 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

Interaction between mechanical effects and adding or removing fluid from rock, as related to earthquakes, landslides, dams, groundwater withdrawal, and petroleum extraction. Classical solutions and applications of the theory. The theory's constitutive and governing equations and their associated material parameters. Example problems from geomechanics, hydrogeology, and petroleum engineering are incorporated throughout to illustrate poroelastic behavior and solution methods.

Course Outline

1. Overview of poroelastic materials	(3 hours)
2. Continuum constitutive equations	(6 hours)
3. Theory of poroelasticity	
3.1 Governing equations	(3 hours)
3.2 Compatability equations	(3 hours)
3.3 Field equations	(6 hours)
4. Method of solutions	(6 hours)
5. Fundamental problems	(6 hours)
6. Geomechanics applications	(6 hours)
7. Hydrogeology applications	(6 hours)
8. Petroleum engineering application	(6 hours)

434664 Coal Mining Technology **4(4-0-8)**

Prerequisite : 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics or Consent of the School

Course Description

The course contents include geology of coal, coal statistics, mine planning and development, ventilation, ground control, room-and-pillar mining, longwall and shortwall mining, haulage, mine electrical power, surface mining, mine drainage, communication and lighting, and case studies.

Course Outline

1. Geology of coal	(6 hours)
2. Coal statistics	(3 hours)
3. Mine planning and development	(6 hours)
4. Ventilation	(3 hours)
5. Ground control	(6 hours)
6. Room-and-pillar mining	(6 hours)
7. Longwall and shortwall mining	(3 hours)
8. Haulage	(3 hours)
9. Mine electrical power	(3 hours)
10. Surface mining	(3 hours)
11. Mine drainage, communication, and lighting	(3 hours)
12. Case studies	(3 hours)

434665 Environmental Geomechanics 3(3-0-6)

Prerequisite: 434370 Rock Mechanics or 434530 Fundamental of Rock Mechanics
or Consent of the School

Course Description

Environmental impact assessment from mining and geological engineering projects, surface subsidence, change in groundwater system, potential groundwater contamination, landslide and blasting vibration.

Course Outline

1.	Introduction	(1 hour)
2.	Relevant EIA	(3 hours)
3.	Mechanisms of mine subsidence	(6 hours)
4.	Impacts and migration of mine subsidence	(5 hours)
5.	Impacts of mine dewatering	(3 hours)
6.	Mine tailing	(3 hours)
7.	Landslides from blast vibration	(6 hours)
8.	Mine Decommissioning	(6 hours)
9.	Dust and noise control	(3 hours)

434666 Advanced Geophysical Exploration 4(4-0-8)

Prerequisite : 434308 Geophysical Exploration or Consent of the School

Course Description

Introduction, gravity method, magnetic method, electrical properties of rocks and minerals, electrical method, resistivity method, electromagnetic method, induced polarization method.

Course Outline (lecture)

1.	Introduction	(1 hour)
2.	Gravity Method	(3 hours)
3.	Magnetic Method	(4 hours)
4.	Electrical properties of rocks and minerals	(2 hours)
5.	Resistivity method	(6 hours)
6.	Electromagnetic method	(4 hours)
7.	Induced polarization method	(4 hours)

Course Outline (Laboratory)

1.	Gravity Method, field operation, data processing and interpretation	(6 hours)
2.	Magnetic Method, field operation, data processing and interpretation	(6 hours)
3.	Measurement of electrical properties of rocks and minerals	(3 hours)
4.	Resistivity method, field operation, data processing and interpretation	(9 hours)
5.	Electromagnetic method, data processing and interpretation	(6 hours)
6.	Induced polarization method, data processing and interpretation	(6 hours)

434667 Well Control and Safety 3(3-0-6)

Prerequisite: 434381 Drilling Engineering or Consent of the School

Course Description

Well control equipment, definitions and calculations, volume calculation, maximum well surface pressure and behavior of gas influx, kick & shut-in procedure by driller's and engineer's methods, problems in well killing operations, simulator test, safety in petroleum E&P.

Course Outline

1.	Well control equipment	(3 hours)
2.	Definitions and calculations	(6 hours)
3.	Volume calculations	(3 hours)
4.	Maximum well surface pressure and pressure balance calculation	(3 hours)
5.	Well killing methods	(3 hours)
6.	Behavior of gas influx	(3 hours)
7.	Kick & shut-in procedure by driller's and engineer's methods	(3 hours)
8.	Problems in well killing operations	(3 hours)
9.	Simulator test	(6 hours)
10.	Safety in petroleum E&P	(6 hours)

434668 New Technology in Drilling 3(3-0-6)

Prerequisite: 434381 Drilling Engineering or Consent of the School

Course Description

Rotary drilling and components, slime hole drilling, directional and horizontal drilling, air and gas drilling, underbalanced drilling, deep sea drilling, new technologies in drilling

Course Outline

1.	Rotary drilling and components	(6 hours)
2.	Slim hole drilling	(6 hours)
3.	Directional and horizontal drilling	(6 hours)
4.	Air and gas drilling	(3 hours)
5.	Underbalanced drilling	(3 hours)
6.	Deep sea drilling	(6 hours)
7.	New Technologies	(6 hours)

17.5.3 Common Core Courses

434700 Geotechnology Seminar I 1(0-3-4)

Prerequisite: None

Course Description

Detailed study and group discussions of current literature and related graduate research projects. External experts from governmental and private sectors will be invited to give presentation weekly. This course can be attended more than one time.

434701 Geotechnology Seminar II 1(0-3-4)

Prerequisite: None

Course Description

Detailed study and group discussions of current literature and related graduate research projects. External experts from governmental and private sectors will be invited to give presentation weekly. This course can be attended more than one time.

434702 Geotechnology Seminar III 1(0-3-4)

Prerequisite: None

Course Description

Detailed study and group discussions of current literature and related graduate research projects. External experts from governmental and private sectors will be invited to give presentation weekly. This course can be attended more than one time.

434703 Special Topics in Geotechnology **3 Credits**
Condition: Consent of the School
Course Description

Lectures and discussions on topics pertinent to geotechnology. Attending this can be repeated but no more than twice.

434704 Special Projects in Geotechnology **3 Credits**
Condition: Consent of the School
Course Description

Individual projects on selected study topics. Independent graduate work is provided under direction of a faculty member on a subject of mutual interest. Written report is required.

434790 Research and Thesis for M.Eng. I **20 Credits**
Condition: Consent of the School
Course Description

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the master degree.

434791 Research and Thesis for M.Eng. II **45 Credits**
Condition: Consent of the School
Course Description

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the master degree.

434890 Research and Thesis for Ph.D. I **45 Credits**
Condition: Consent of the School
Course Description

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the doctoral degree.

434891 Research and Thesis for Ph.D. II **60 Credits**
Condition: Consent of the School
Course Description

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the doctoral degree.

18. Curriculum Quality Assurance

Curriculum quality assurance conforms the Education Quality Assurance System of the Suranaree University of Technology(centralization).

19. Curriculum Revision

The assessment of the curriculum will be undertaken every 5 years from the expectation of both the employing corporations and the graduates, including the analysis of the academic trend and the career and employment opportunities in order to amend the curriculum to meet the satisfaction and requirement of the graduate employers and the country.

Appendix A

Curriumlum Inprovement Committee

คำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี

ที่ ๔๕๖ /๒๕๔๙

เรื่อง แต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาเทคโนโลยีธรณี (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐)

……………………………………

เพื่อให้การปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาเทคโนโลยีธรณี เป็นไปด้วยความเรียบร้อย และบรรลุตามวัตถุประสงค์

ฉะนั้น อาศัยอำนาจตามความในมาตรา ๑๘ (๑) (๑๑) มาตรา ๒๑ และมาตรา ๒๔ แห่งพระราชบัญญัติมหาวิทยาลัยเทคโนโลยีสุรนารี พ.ศ. ๒๕๓๓ ประกอบกับมติสภาวิชาการมหาวิทยาลัยเทคโนโลยีสุรนารี ในการประชุมครั้งที่ ๘/๒๕๔๙ เมื่อวันที่ ๒๐ กรกฎาคม ๒๕๔๙ ประกอบกับประกาศสำนักนายกรัฐมนตรี เรื่อง แต่งตั้งอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี ลงวันที่ ๓๑ พฤษภาคม ๒๕๔๘ จึงแต่งตั้งคณะกรรมการปรับปรุงหลักสูตรวิศวกรรมศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาเทคโนโลยีธรณี (หลักสูตรปรับปรุง พ.ศ. ๒๕๕๐) ประกอบด้วยบุคคลดังต่อไปนี้

๑.	อาจารย์ ดร.จงพันธ์ จงลักษมณี	เป็น ประธาน
๒.	รองศาสตราจารย์ ดร.กิตติเทพ เฟื่องขจร	เป็น กรรมการ
๓.	รองศาสตราจารย์ เกรียงไกร ไตรสาร	เป็น กรรมการ
๔.	ผู้ช่วยศาสตราจารย์ ดร.เอมอร ทัศนศร	เป็น กรรมการ
๕.	ผู้ช่วยศาสตราจารย์ ธารา เล็กอุทัย	เป็น กรรมการ
๖.	อาจารย์ ดร.ทวีศักดิ์ ศิลกุล	เป็น กรรมการ
๗.	ดร.ทรงภพ พลจันทร์	เป็น กรรมการ
๘.	ดร.จิรวัฒน์ ชีวรุ่งโรจน์	เป็น กรรมการ
๙.	หัวหน้าสาขาวิชาเทคโนโลยีธรณี	เป็น กรรมการและเลขานุการ
๑๐.	อาจารย์ ดร.อัฆพรรค์ วรรณโกมล	เป็น กรรมการและผู้ช่วยเลขานุการ

ทั้งนี้ ตั้งแต่วันที่ ๒๑ กรกฎาคม ๒๕๔๙ เป็นต้นไป

สั่ง ณ วันที่ ๗ สิงหาคม พ.ศ. ๒๕๔๙

(รองศาสตราจารย์ ดร.ประสาท สืบค้า)
อธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี

Lawyer:/d/รวมข้อมูล/คำสั่ง49/คกก.ปรับปรุงหลักสูตร.doc P.19

Appendix B

SUT Regulation

Appendix C

Curriumlum Faculty

Biographical Data

Institute of Engineering,
Suranaree University of Technology
111 University Avenue, Muang Distric,
Nakhon Ratchasima 30000
Tel 0 4422 4446 FAX 0 4422 4611

thara@sut.ac.th

ผู้ช่วยศาสตราจารย์ ธารา เล็กอุทัย

Asst. Prof. Thara Lekuthai

Education and Competence:

1976 Chiang Mai University B.Sc. (Geology)
1991 University of London M.Sc. (Basin Evolution & Dynamics)

Present Position:

Chair, School of Geotechnology,
Institute of Engineering

Work Experiences:

1982-1983	Sub-committee of technical working group, Thailand Malaysia joint development area.
1991	Guest lecturer for Petroleum technology course at Faculty of science, Chulalongkorn University, Thailand.
1991	Guest lecturer for "Evolution and Hydrocarbon prospectivity in Kra Basin" at PTTEP and British Gas Thailand limited, Thailand.
1992-1993	Thailand national coordinator of Heat Flow project and Oil & Gas Resource Management (OGRM) project which are under Coordinating committee for offshore prospecting (CCOP).
1992-1993	Thai delegate in CCOP 31st & 32nd Annual session meeting. Thai delegate in CCOP 25th & 26th Steeling committee meeting.
1993-1996	As a member and secretary of technical working group for the petroleum production area approval in Thailand which are under petroleum concessionaire and legal problem sub-committee.
1994	Guest lecturer for "Thailand policy on energy and forestry management" at Institute of social technology (Kerk), Bangkok, Thailand.
1995	Guest lecturer for Petroleum geology course at Faculty of engineering, Department of Mining and Petroleum Engineering, Chulalongkorn University, Thailand.

1995	Member of petroleum thesis committee examination group for M.Sc. student at Faculty of science, Department of geology, Chulalongkorn University, Thailand.
2001	Guest lecturer "Potential for petroleum source rock in Andaman sea" for M.Sc. and Ph.D. students, Chiang Mai University
2002	A lecturer "Geology for science school teachers" organized by the Institute for the promotion of teaching science and technology (IPST) at Suranaree University of Technology
2002	Guest lecturer "Introduction to petroleum industry" at EGAT, Bangkok, Thailand
2002	A working group committee of "Training book for science school teachers", Kanchanaburi province, organized by the Institute for the promotion of teaching science and technology (IPST)
2003	A working group committee of "Training book for science school teachers", Royal Bencha Hotel, Bangkok, organized by the Institute for the promotion of teaching science and technology (IPST) (15-16 February 2003)
2003	Guest lecturer "Introduction to petroleum industry" at Halliburton, Bangkok, Thailand (31 May 2003)
2004	Guest speaker "Petrify wood" FM 105.25 Mhz at Radio-broadcasting of Thailand Nakhon Ratchasima (23 February 2004)

Academic Works:

(1) Geothermal gradient in the Gulf of Thailand, Mineral fuels division, Department of Mineral Resources (June 1992).

(2) Petroleum potential of Thailand, Annual Report (1993) Mineral Fuels Division, Department of Mineral Resources.

(3) Review Oil & Gas Activities of Thailand for CCOP 31st & 32nd Annual session meeting.

(4) Petroleum source rock potential in Andaman sea, The 5th Mining and petroleum engineering conference, Songkhlanakrarin university, Songkhla (24-25 November 1994)

(5) Heat flow map of the Gulf of Thailand (1995) CCOP Technical Bulletin, Vol. 25, pp.63-78.

(6) Geology in the Gulf of Thailand and Andaman sea, status of studying in marine science and oceanographic, March 1997, 117-128 pp.

(7) Poster presentation on the topic of "The oil stained carbonate outcrop in the southern part of Thailand." In an international workshop of "Tectonics, Stratigraphy and Petroleum Systems of Borneo" on 22-25 June 1997 at the Department of Petroleum Geoscience, Universiti Brunei Darussalam.

(8) Final report (July 1999) "Petroleum potential assessment of Northeastern Thailand" is conducted under the contract no. 31/2541, 11 June 1998, between the Department of Mineral Resources and GMT Corporation Ltd. In association with the School of Geotechnology, Institute of Engineering, of Suranaree University of Technology

(9) Final report (November 2000) "Petroleum geology guide book along Highway No. 2 Saraburi - Nakhon Ratchasima" Suranaree University of Technology

(10) Final report (April 2003) "Thermal Maturity Modelling" Suranaree University of Technology

Biographical Data

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รองศาสตราจารย์ ดร.กิตติเทพ เฟืองขจร

Assoc. Prof. Dr.Kittitep Fuenkajorn

Education and Competence:

1988 – 1990	Postdoctoral Fellow, University of Arizona, U.S.A.
1988	Ph.D. Geological Engineering, University of Arizona, U.S.A. Civil Engineering (Minor), U.S.A.
1985	M.S. Geological Engineering, University of Arizona, U.S.A.
1979	B.S. Geology, Chulalongkorn University, Bangkok, Thailand.

Present Position:

Lecturer, School of Geotechnology
Suranaree University of Technolog

Work Experiences:

March 1998- Present

Associate Professor : SURANAREE UNIVERSITY OF TECHNOLOGY.

Teaching Courses

- Rock Mechanics
- Rock Slope Engineering
- Mining Geology
- Geological Engineering
- Mining Engineering
- Advanced Rock Mechanics
- Underground Excavations in Rock
- Rock Salt Mechanics
- Numerical Methods in Geomechanics.
- Design Methodology in Geomechanics

July 1994- Present

Principal : ROCK ENGINEERING INTERNATIONAL, ARIZONA

Direct and conduct research and consulting projects in rock and soil mechanics with a main emphasis on design and analysis of slopes and openings in rock.

- Design of tunnels and slope stabilization system in rock.
- Conducted technical review of DOE design reports on underground repository facility, including site characterization, TBM excavation, blast design, shaft, ramp and drift design, tunnel supports, and ventilation.
- Developed Compliance Determination Methods for the designs of the underground facility for the US Nuclear Regulatory Commission.
- Designed operating pressures for gas storage caverns.
- Investigated ground failure and subsidence of salt mine in Michigan basin.

Jan. 1991-June 1994 ***Project Manager :*** SERATA GEOMECHANICS, INC., CALIFORNIA

Directed and conducted research and consulting projects in geomechanics, hydrology, and geotechnical engineering, including numerical modeling, laboratory testing, and site investigation.

- Measured *in situ* stresses and mechanical properties in underground coal, salt and potash mines using borehole stress-meter and penetrometer.
- Designed operating pressures for storage caverns in salt.
- Designed pressure cells and stress-meter probes for in-situ measurements
- Developed computer model to determine the mechanical and hydraulic behavior of openings and caverns in rock salt.
- Computer modeling of mine roof stability and ground subsidence.
- Laboratory rock characterization tests.

June 1988- Jan. 1991 ***Adjunct Professor :*** UNIVERSITY OF ARIZONA

Conducted lab. and field investigations to assess mechanical and hydrological performance of nuclear waste repository tuff and backfill materials, i.e. mechanical characterization tests, *in situ* flow tests, fracture grouting tests, and borehole permeability tests under triaxial and dynamic loading.

Project manager of borehole sealing research funded by the US Nuclear Regulatory Commission (NRC).

- Performed site investigation, *in situ* drilling, core and video logging.
- Derived empirical strength criterion for heterogeneous tuff.
- Applied FEM & BEM to analyze stresses and fluid flow in rock, borehole seals, and their interface under waste repository environments.
- Developed and implemented Quality Assurance program.

May 1986- May 1988 ***Research Assistant II :*** UNIVERSITY OF ARIZONA

Conducted laboratory research on salt mechanics for nuclear waste disposal.

- Performed creep and rate-controlled uniaxial & triaxial tests and borehole closure test under triaxial and polyaxial stresses.
- Measured brine flow through rock salt under triaxial loading.
- Derived mechanical constitutive models for salt.

Aug. 1982- Dec. 1986 ***Teaching/Research Assistant I :*** UNIVERSITY OF ARIZONA

- Derived analytical solutions to determine stability of rock slope subject to bolt force, water pressure and static acceleration.
- Assisted in teaching GEN626 - Rock Slope Design.
- Conducted laboratory experiments to assess the effect of borehole wall drilling damage on nuclear waste repository sealing in basaltic rock, i.e. ring tension tests, fracture flow tests, and petrographic analyses.

July 1979-Dec. 1979 ***Engineering Geologist :*** ITALIAN-THAI DEV. CO, BANGKOK

- Supervised drilling of 140 observation and pressure-relief wells.
- Designed blasting program for emergency spillway construction.
- Site investigation for diversion tunnels and dam abutment.

Recognitions and Prestige:

2002	Cash Award from Thailand Research Fund, for Excellent Research Project and Project Management.
1988-1990	Postdoctoral Fellowship from the U.S. Nuclear Regulatory Commission, Washington D.C.
1980	Honor Center for English as a Second Language, University of Arizona.
1979	Gold Medal Award Geology Department, Chulalongkorn U., Bangkok.
1976-1979	Cash Prizes 1st rank of class, Chulalongkorn U., Bangkok.

Academic Works:

Technical Publications

Books:

(1) Fuenkajorn, K. and J.J.K. Daemen (authors & editors), 1996, *Sealing of Boreholes and Underground Excavations in Rock*, Chapman & Hall, London, 322 pp.

Technical Papers:

(1) Fuenkajorn, K., 2006, "Experimental Assessment of Healing of Fractures in Rock Salt," ISRM International Symposium 2006, Rock Mechanics in Underground Construction, 8-10 November, Singapore, pp.402. (Published in CD-ROM).

(2) Phueakphum, D. And Fuenkajorn, K., 2006, Experimental Assessment of Solar Thermal Energy Storage in Rock Fills, In the 2nd Conference on Energy Technology Network of Thailand; E-NETT, 27-29 July 2006, Suranaree University of Technology, Nakhon Ratchasima, 7 pp.

(3) Fuenkajorn, K., 2006, "Healing of Fractures in Rock Salt," *Suranaree Journal of Science and Technology*, Vol. 13, No. 4, pp. 307-316.

(4) Fuenkajorn, K., 2005, "Predictability of Barton's Joint Shear Strength Criterion with Field-Identification Parameters," *Suranaree Journal of Science and Technology*, Vol. 12, No. 4, pp. 296-308.

(5) Fuenkajorn, K. and R. Kemthong, 2005, "Assessment of Barton's Joint Shear Strength Criterion Using Field-Determined Parameters," *International Conference on Geology, Geotechnology and Mineral Resources of INDOCHINA (GEOINDO 2005)*, Khon Kaen, November 28-30, pp. 171-176.

(6) Tepnarong, P. and K. Fuenkajorn, 2004, "Determination of Elasticity and Strengths of Intact Rocks using Modified Point Load Test," *Proceedings of the 3rd Asian Rock Mechanics Symposium*, Kyoto, November 30 - December 2.

(7) Fuenkajorn, K. and A Warin, 2004, "Design of Borehole Seals in Rock: Methodology and Process," *Proceedings of the 4th Asian Symposium on Engineering Geology and the Environment*, Hong Kong, May 3-5, pp. 137-142.

(8) Fuenkajorn, K. and K. Klayvimut, 2004, "Geomechanical Performance of Salt Formation for Nuclear Waste Repository in Thailand," Proceedings of the 9th Australia New Zealand Conference on Geomechanics*, Auckland, February 8-11, pp. 604-611.*

(9) Fuenkajorn, K. and S. Kamutchat, 2003, "Neural Network for Rock Slope Stability Evaluation," *Proceedings of the 4th Regional Symposium on Infrastructure Development in Civil Engineering*, Bangkok, April 4-8, pp. 655-664.

(10) Fuenkajorn, K. and M Jandakaew, 2003, "Compressed-Air Energy Storage in Salt Dome at Borabu District, Thailand: Geotechnical Aspects," *Proceedings of the 38th Symposium on Engineering Geology and Geotechnical Engineering*, University of Nevada, Reno, Nevada, March 19-21, pp. 377-392.

(11) Fuenkajorn, K., D. Phuakpoom, and M. Jandakaew, 2003, "Healing of Rock Salt Fractures," *Proceedings of the 38th Symposium on Engineering Geology and Geotechnical engineering*, University of Nevada, Reno, Nevada, March 19-21, pp. 393-408.

(12)Fuenkajorn, K. and P. Thongtiengdee, 2002, "Slope Failure along Lomsak-Chumpae Highway, Thailand," *Proceedings of the 3rd International Conference on Landslides, Slope Stability and the Safety of Infra-Structures*, Singapore, July 11-12, pp. 205-213.

(13)Fuenkajorn, K., 2002, "Design Guideline for Salt Solution Mining in Thailand," *Research and Development Journal of the Engineering Institute of Thailand*, Vol. 13, No. 1, pp. 1-8.

(14)Fuenkajorn, K., 2002, "Modified Point Load Test Determining Uniaxial Compressive Strength of Intact Rocks," *Proceedings of the North American Rock Mechanics Symposium*, Toronto, Ontario, Canada, July 7-10, pp. 457-465.

(15)Fuenkajorn, K. and P. Tepnarong, 2001, "Size and Stress Gradient Effects on the Modified Point Load Strengths of Saraburi Marble," *Sixth Mining, Metallurgical, and Petroleum Engineering Conference*, Chulalongkorn University, Bangkok, Oct 24-26. (Published in CD Rom).

(16)Fuenkajorn, K. and S. Kamutchat, 2001 "Rock Slope Design using Expert System: ROSES Program," *6th Mining, Metallurgical, and Petroleum Engineering Conference*, Chulalongkorn University, Bangkok, Oct. 24-26. (Published in CD Rom)

(17)Fuenkajorn, K. and K. Wetchasat, 2001 "Rock Salt Formations as Potential Nuclear Waste Repository," *6th Mining, Metallurgical, and Petroleum Engineering Conference*, Chulalongkorn University, Bangkok, Oct. 24-26. (Published in CD Rom)

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Academic Works:

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(2) Petroleum Production Efficiency in Carbonate Reservoir.International Conference on : Geology, Geotechnology and Mineral Resources of INDOCHINA (GEOINDO 2005) 28-30 November 2005 Kosa Hotel., Khonkaen, Thailand.

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(5) ACID FRACTURING INCREASES PRODUCTION IN TIGHT GAS CARBONATE in Academic Conference 40 year anniversary of Institute of Engineering 23-24 January 2004. Engineering Innovation for Sustainable Resources Management, 23-24 January 2004, Khonkaen University.

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Academic Works:

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Responsibilities : Lecture in Petroleum Engineering & Geology.

1995-1997 : Petroleum Engineering at the Petroleum Assessment & Development Section, Mineral Fuels Division, Department of Minerals Resources, Ministry of Industry, Bangkok.

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Petroleum Production Planning & Developing

Academic Works:

(1) Petroleum Reserves of Thailand, Petroleum and Coal Activities in Thailand, Annual Report 1994, Mineral Fuels Division, Department of Mineral Resources, Ministry of Industry, Thailand, p. 20-22.
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Appendix D

Courses Title in Thai

Core Courses

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
434700	Geotechnology Seminar I	สัมมนาเทคโนโลยีธรณี 1
434701	Geotechnology Seminar II	สัมมนาเทคโนโลยีธรณี 2
434702	Geotechnology Seminar III	สัมมนาเทคโนโลยีธรณี 3
434703	Special Topics in Geotechnology	เรื่องศึกษาเฉพาะทางเทคโนโลยีธรณี
434704	Special Projects in Geotechnology	โครงการศึกษาเฉพาะทางเทคโนโลยีธรณี
434790	Research and Thesis for M.Eng. I	การวิจัยและวิทยานิพนธ์สำหรับวิศวกรรมศาสตรมหาบัณฑิต 1
434791	Research and Thesis for M.Eng. II	การวิจัยและวิทยานิพนธ์สำหรับวิศวกรรมศาสตรมหาบัณฑิต 2
434890	Research and Thesis for Ph.D. I	การวิจัยและวิทยานิพนธ์สำหรับวิศวกรรมศาสตรดุษฎีบัณฑิต แบบ 1
434891	Research and Thesis for Ph.D. II	การวิจัยและวิทยานิพนธ์สำหรับวิศวกรรมศาสตรดุษฎีบัณฑิต แบบ 2

Major courses in Petroleum Technology

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
434610	Sequence Stratigraphy	ลำดับชั้นหินซีเควนซ์
434611	Advanced Well Log Interpretation	การแปลข้อมูลการหยั่งธรณีขั้นสูง
434612	Applied Micropaleontology	จุลบรรพชีวินวิทยาประยุกต์
434613	Reservoir Sedimentology	วิทยาการตะกอนหินกักเก็บ
434614	Petroleum Geochemistry	ธรณีเคมีปิโตรเลียม
434615	Applied Biostratigraphy	ลำดับชั้นหินตามชีวภาพประยุกต์
434616	Petroleum Exploration Techniques	เทคนิคการสำรวจปิโตรเลียม
434617	Petroleum Prospect Assessment	การประเมินแหล่งปิโตรเลียม
434618	Petroleum Field Exploration and Development	การสำรวจและพัฒนาแหล่งปิโตรเลียม
434619	Advanced Reservoir Engineering	วิศวกรรมแหล่งกักเก็บขั้นสูง
434620	Advanced Drilling Engineering	วิศวกรรมการเจาะขั้นสูง
434621	Reservoir Simulation	การจำลองแหล่งกักเก็บ
434622	Well Test Analysis	การทดสอบหลุมเจาะปิโตรเลียม
434623	Advanced Natural Gas Engineering	วิศวกรรมก๊าซธรรมชาติขั้นสูง

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
434624	Secondary Oil Recovery	การเพิ่มปริมาณการผลิตน้ำมัน
434625	Enhanced Oil Recovery	การเพิ่มปริมาณการผลิตน้ำมัน
434626	Production System Analysis	การวิเคราะห์ระบบการผลิต
434627	Gas Processing	กระบวนการแยกก๊าซ
434628	Advanced Petroleum Economics	เศรษฐศาสตร์ปิโตรเลียมขั้นสูง
434667	Well Control and Safety	การควบคุมหลุมและความปลอดภัย
434668	New Technology of Drilling	เทคนิคใหม่ในการเจาะ

Major courses in Geological Engineering and Applied Geology

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
434530	Fundamental of Rock Mechanics	กลศาสตร์หินพื้นฐาน
434531	Mining Geology	ธรณีวิทยาเหมืองแร่
434630	Rock Blasting	การระเบิดหิน
434631	Mining Engineering	วิศวกรรมเหมืองแร่
434632	Health and Safety in Mining	สุขภาพและความปลอดภัยในการทำเหมืองแร่
434633	Rock Slope Engineering	วิศวกรรมพื้นหินลาดเอียงของหิน
434634	Underground Excavations in Rock	การขุดเจาะใต้ดินในหิน
434635	Advanced Rock Mechanics	กลศาสตร์หินขั้นสูง
434636	Foundations on Rock	ฐานรากบนหิน
434637	Field Instrumentation in Geomechanics	การใช้เครื่องมือสนามในกลศาสตร์ธรณี
434638	Numerical Methods in Geomechanics	ระเบียบวิธีคำนวณเชิงตัวเลขในกลศาสตร์ธรณี
434639	Design Methodology in Rock Engineering	การออกแบบในวิศวกรรมหิน
434640	Rock Salt Mechanics	กลศาสตร์เกลือหิน
434641	Fracture Mechanics of Rock	กลศาสตร์การแตกของหิน
434642	Earthquake Engineering	วิศวกรรมแผ่นดินไหว
434643	Applied Geomorphology	ภูมิสัณฐานวิทยาประยุกต์
434644	Applied Quaternary Geology	ธรณีวิทยาควอเทอร์นารีประยุกต์
434645	Applied Geochemistry	ธรณีเคมีประยุกต์
434646	Applied Sedimentology	วิทยาการตะกอนประยุกต์
434647	Advanced Structural Geology	ธรณีวิทยาโครงสร้างขั้นสูง

รหัสวิชา	ชื่อภาษาอังกฤษ	ชื่อภาษาไทย
434648	Advanced Photogeology	ธรณีวิทยาภาพถ่ายทางอากาศขั้นสูง
434649	Seismic Exploration	การสำรวจคลื่นไหวสะเทือน
434650	Geology and Geological Resources of Thailand	ธรณีวิทยาและทรัพยากรธรณีของประเทศไทย
434651	Geotectonic Evolution of Southeast Asia	พัฒนาการธรณีแปรสัณฐานของเอเชียตะวันออกเฉียงใต้
434652	Southeast Asian Geological Resources	ทรัพยากรธรณีเอเชียตะวันออกเฉียงใต้
434653	Block Theory in Rock Engineering	ทฤษฎีบล็อกในวิศวกรรมหิน
434654	Advanced Testing in Geomechanics	การทดสอบขั้นสูงในกลศาสตร์ธรณี
434655	Flow in Fractured Rock	การไหลในหินแตก
434656	Computer Methods in Geological Engineering	การคำนวณด้วยคอมพิวเตอร์ในวิศวกรรมธรณี
434657	Probability and Statistical Concepts in Geologic Media	หลักการความน่าจะเป็นและสถิติในตัวกลางทางธรณี
434658	Waste Disposal in Rock	การทิ้งของเสียในหิน
434659	Dam Site Investigation	การสำรวจพื้นที่สร้างเขื่อน
434660	Fractal Theory and Applications in Geo-Engineering	ทฤษฎีแฟรคทอล และการประยุกต์ใช้ในวิศวกรรมธรณี
434661	Artificial Intelligence in Rock Engineering	ระบบปัญญาประดิษฐ์สำหรับวิศวกรรมหิน
434662	Salt Mining Technology	เทคโนโลยีการทำเหมืองเกลือ
434663	Theory of Linear Poroelasticity	ทฤษฎีความยืดหยุ่นเชิงเส้นตรงของวัสดุพรุน
434664	Coal Mining Technology	เทคโนโลยีการทำเหมืองถ่านหิน
434665	Environmental Geomechanics	กลศาสตร์ธรณีสิ่งแวดล้อม
434666	Advanced Geophysical Exploration	การสำรวจทางธรณีฟิสิกส์ขั้นสูง

จัดทำสำเนาโดย : ฝ่ายบริการสื่อการศึกษา
ศูนย์บรรณสารและสื่อการศึกษา
มหาวิทยาลัยเทคโนโลยีสุรนารี

วาระที่ 3.4 ขอความเห็นชอบ (ร่าง) หลักสูตรของสำนักวิชาเทคโนโลยีการเกษตร

(ผู้แถลง : คณบดีสำนักวิชาเทคโนโลยีการเกษตร)

ตามที่สภาวิชาการ ในการประชุมครั้งที่ 3/2550 เมื่อวันที่ 29 มีนาคม 2550 มีมติมอบให้กรรมการนำหลักสูตรกลับไปศึกษาแล้วนำเข้าพิจารณาในการประชุมครั้งต่อไป ตามแนวปฏิบัติ นั้น

สำนักวิชาเทคโนโลยีการเกษตรจึงขอเสนอหลักสูตรต่อสภาวิชาการ ดังนี้

1. (ร่าง) หลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาเทคโนโลยีอาหาร (หลักสูตรปรับปรุง พ.ศ. 2550) และรายวิชาเอกเพื่อการคำนวณแต้มระดับคะแนนเฉลี่ยในรายวิชาเอก
2. (ร่าง) หลักสูตรวิทยาศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาเทคโนโลยีการผลิตสัตว์ (หลักสูตรปรับปรุง พ.ศ. 2550)

ดังรายละเอียดปรากฏตามเอกสารประกอบวาระการประชุม

จึงนำเสนอสภาวิชาการเพื่อพิจารณา

ข้อสังเกต

มติ

หลักสูตรทั้ง 2 หลักสูตร
อยู่ในแฟ้มครั้งที่ 3/50

หลักสูตรวิทยาศาสตรมหาบัณฑิตและดุษฎีบัณฑิต สาขาวิชาเทคโนโลยีการผลิตสัตว์

(หลักสูตรปรับปรุง พ.ศ. 2550)

ข้อเสนอแนะในการแก้ไขรูปแบบการจัดทำหลักสูตร

1. ข้อ 12. อาจารย์ผู้สอน
    - ข้อ 12.1 อาจารย์ประจำหลักสูตร ต้องระบุอาจารย์ผู้รับผิดชอบหลักสูตร จำนวนอย่างน้อย 3 คน ตามเกณฑ์ของ สกอ.
    - ควรระบุชื่ออาจารย์ผู้สอนด้วย
2. ข้อ 17 หลักสูตร
    - ระดับปริญญามหาบัณฑิต มี 2 แบบ ควรปรับให้ถูกต้องเป็น แบบ ก 1 และ แบบ ก 2 และควรแก้ไขส่วนอื่น ๆ ในเล่มให้สอดคล้องด้วย รวมทั้งรายวิชาวิทยานิพนธ์ (สำหรับภาษาอังกฤษ จะเป็น Plan A 1 และ Plan A 2)
    - ระดับปริญญาดุษฎีบัณฑิต
        - ข้อ 17.2.2.1 โครงสร้างหลักสูตรสำหรับผู้ที่ศึกษาต่อจากปริญญาตรี ตามข้อบังคับฯ จะไม่มีแบบ 1 มีเพียงแบบเดียว คือ แบบ 2 ซึ่งกำหนดเป็น แบบ 2.2 และควรแก้ไขส่วนอื่น ๆ ในเล่มให้สอดคล้องด้วย
        - ข้อ 17.2.2.2 โครงสร้างหลักสูตรสำหรับผู้ที่ศึกษาต่อจากปริญญาโท มี 2 แบบ ควรแก้ไขให้ถูกต้อง จาก แบบ 1 เป็น แบบ 1.1 และแบบ 2 เป็น แบบ 2.1 และควรแก้ไขส่วนอื่น ๆ ในเล่มให้สอดคล้องด้วย
        - ข้อ 17.3 ความหมายของเลขประจำวิชา ควรใช้ตามแนวทางที่มหาวิทยาลัยกำหนด
3. ข้อ 18. การประกันคุณภาพของหลักสูตร ในข้อ 4) ความต้องการของตลาดแรงงาน สังคม และ/หรือความพึงพอใจของผู้ใช้บัณฑิต ระบุว่า ยังไม่เคยมีการสำรวจต้องการของตลาดแรงงาน สังคม และ/หรือ ความพึงพอใจของผู้ใช้บัณฑิตระดับปริญญาโทและเอก จะเหมาะสมหรือไม่
4. ข้อ 19.4 ตารางเปรียบเทียบข้อแตกต่างระหว่างหลักสูตรเดิมกับหลักสูตรที่ปรับปรุงใหม่ การเปรียบเทียบโครงสร้างหลักสูตร ควรแก้ไข แผน/แบบการศึกษาในแต่ละระดับให้ถูกต้อง

ส่วนส่งเสริมวิชาการ
รับที่ 676 / 50
วันที่ 2 เม.ย. 2550
เวลา 10.00 น.

บันทึกข้อความ
มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน

ที่ - วันที่ 14 มีค. 2550

เรื่อง การเตรียมการประชุม SUT-AUAP ช่วงวันสถาปนา มทส. 32

① เรียน อธิการบดี

คณะทำงานได้จัดทำกำหนดการเบื้องต้น เพื่อจะนำเสนอคณะกรรมการอำนวยการจัดการประชุม วันศุกร์ที่ 23 มีค. ทั้งนี้มีข้อหารือ อธิการบดี ดังนี้

1. Panel Discussion II : Best Pratices in Asia-Pacific Region ยังไม่มีผู้แทนจากประเทศ Australia ซึ่งไม่ได้เป็นสมาชิก AUAP การเชิญ อาจต้องจ่ายค่าโดยสารเครื่องบิน จะทำได้หรือไม่
2. Keynote Speech I คือ รองนายกรัฐมนตรี ดร.โฆสิต อธิการบดีจะเป็นผู้ทักทาย ได้หรือไม่

จึงเรียนมาเพื่อโปรดให้ความเห็น

(ผู้ช่วยศาสตราจารย์ ดร. ฉัตรชัย โชติษฐยางกูร)
รองอธิการบดีฝ่ายพัฒนา
ผอ. เทคโนธานี

② โปรดนำเสนอสภาวิชาการ

15/3/50
(รองศาสตราจารย์ ดร. ประสาท สืบค้า)
อธิการบดี

③ เรียน รองอธิการบดีฝ่ายวิชาการ
เพื่อโปรดพิจารณาบรรจุเป็น
วาระการประชุมสภาวิชาการ
วันที่ 2 เม.ย. 50

29 มี.ค. 50
(ผู้ช่วยศาสตราจารย์ ดร. ฉัตรชัย โชติษฐยางกูร)
รองอธิการบดีฝ่ายพัฒนา

วาระที่ 4.1 การจัดประชุมสัมมนาเชิงวิชาการนานาชาติในโอกาสฉลองวันครบรอบการสถาปนามหาวิทยาลัยฯ

ตามที่มหาวิทยาลัยฯ ในฐานะมหาวิทยาลัยผู้ก่อตั้งสมาคมมหาวิทยาลัยแห่งเอเชียและแปซิฟิก (The Association of Universities of Asia and the Pacific-AUAP) และปัจจุบันเป็นมหาวิทยาลัยสมาชิก โดยอธิการบดีดำรงตำแหน่งรองประธานสมาคมคนที่สอง (Second Vice-President) ได้เห็นชอบกับที่ประชุมคณะกรรมการบริหารสมาคมฯ ครั้งที่ 22 เมื่อวันที่ 20 ตุลาคม 2549 ณ University of Macau ซึ่งมีมติให้ มทส เป็นมหาวิทยาลัยเจ้าภาพจัดการประชุมคณะกรรมการบริหารสมาคมฯ ครั้งที่ 23 และในโอกาสเดียวกัน มทส และสมาคม AUAP จะร่วมกันจัดประชุมสัมมนาเชิงวิชาการนานาชาติในหัวข้อที่เหมาะสมเพื่อร่วมกันฉลองวันครบรอบการสถาปนามหาวิทยาลัยฯ (วันที่ 27 กรกฎาคม) และวันก่อตั้งสมาคมฯ (28 กรกฎาคม) ต่อมา ทั้งสองฝ่ายได้หารือร่วมกันและเห็นชอบที่จะจัดให้มีการประชุมสัมมนาทางวิชาการนานาชาติในหัวข้อ “University-Industry-Government Tripartite Cooperation in Higher Education in Asia and the Pacific Region” ระหว่างวันที่ 26-28 กรกฎาคม 2550 ณ สุรสัมมนาคาร มทส

โดยที่การประชุมสัมมนาดังกล่าวจะเป็นประโยชน์ต่อสถาบันอุดมศึกษา หน่วยงานภาครัฐบาลที่เกี่ยวข้อง และภาคอุตสหกรรม ทั้งในประเทศและในภูมิภาคเอเชีย-แปซิฟิก ที่จะได้แลกเปลี่ยนความรู้ ข้อมูล และประสบการณ์ในการดำเนินการความร่วมมือสามฝ่ายดังกล่าวจากหลายประเทศในภูมิภาค เช่น ประเทศไทย จีน มาเลเซีย อินโดนีเซีย ฟิลิปปินส์ เกาหลี และออสเตรเลีย จึงจำเป็นจะต้องดำเนินการประชาสัมพันธ์โดยเร็ว มหาวิทยาลัยฯ จึงได้มอบหมายให้หน่วยงานที่เกี่ยวข้องโดยตรง คือ เทคโนธานี โครงการสหกิจศึกษาและพัฒนาอาชีพ และศูนย์กิจการนานาชาติ ร่วมกับเลขาธิการสมาคม AUAP (ศาสตราจารย์ ดร. รูเบ็น ซี. อุมาลี) จัดทำร่างโปรแกรมการสัมมนาและพิจารณาแสวงหาผู้ทรงคุณวุฒิจากทั้งในประเทศและภูมิภาคเอเชียและแปซิฟิกเพื่อเป็นผู้บรรยายพิเศษ (Keynote Speaker) และผู้ร่วมอภิปรายในการอภิปรายในหัวข้อต่าง ๆ ของการประชุมสัมมนาฯ รายละเอียดปรากฏตามเอกสารประกอบวาระการประชุม ซึ่งจากการประชุมคณะกรรมการอำนวยการในการจัดประชุมฯ ดังกล่าว เมื่อวันที่ 23 มีนาคม 2550 ที่ประชุมเห็นชอบให้นำเสนอสภาวิชาการเพื่อพิจารณา

จึงเสนอมาเพื่อโปรดพิจารณา

SUT-AUAP International Conference on

University-Industry-Government Tripartite Cooperation

in Higher Education
in Asia and the Pacific Region
26-28 July 2007
Suranaree University of Technology
Nakhon Ratchasima, Thailand

I. RATIONALE :

Most industries in the countries of the Asia - Pacific region are Small-to-Medium Enterprises (SMEs) which play an important role in the country's economy as supporters of large- scale industries and as local and national income generators. Under the current socio-economic situation it is thus necessary for SMEs to be strengthened with respect to their potential or capacity for adaptation in the knowledge-based economy, ability to benefit from globalization, and the Local Link, Global Reach concept. This strengthening requires three main factors; sufficient capital, efficient management, and markets. However, SMEs have encountered significant problems concerning these factors, especially the lack of efficient management and modern technology, as well as having limited market access.

The government sector has a major role in supporting industries with respect to the factors mentioned above. In general, SMEs find it difficult to obtain capital in comparison to large-scale industries that are supported by the government, and thus government venture capital is needed. In addition, governments should allocate funds to support the production capacity, technology transfer, and market access of SMEs. Property rights and taxation should also be instruments used to support SMEs.

Obstacles to the development of technology in SMEs (from non-skilled or skilled labor to technological applications and research and development) are the lack of technical knowledge, researchers, engineers, consultants/experts, equipment, and laboratories. These are factors which universities can provide or use to support SMEs, for example by producing qualified/skilled manpower in response to the need of manpower in industry, by cooperative education, and by entrepreneur incubation including servicing SMEs by the use of Science Parks.

At present, university-industry-government tripartite cooperation to enhance national social and economic development has commenced in many Asia - Pacific countries. Thus it is hoped that the International Conference on University-Industry-Government Tripartite Cooperation in Higher Education in Asia and the Pacific Region, jointly held by the Association of Universities of Asia and the Pacific and Suranaree University of Technology, will be a forum to exchange knowledge and share experiences, and will lead to concrete action based on current Best Practices leading to a more efficient tripartite cooperation.

II. OBJECTIVES :

1. To be a forum for academia, government officers from higher educational institutions and the agencies concerned, as well as personnel from SMEs in Thailand and other Asia - Pacific countries, to meet and exchange information, knowledge, and ideas.
2. To promote university-industry-government tripartite cooperation among the relevant agencies and industries in the countries of the Asia - Pacific region, especially in Human Resource Development (HRD) in industry and resolution of obstacles to industry.
3. To present cases of Best Practice in tripartite cooperation in the Asia - Pacific region.

III. EXPECTED OUTCOMES :

1. The conference will assist management and employees of industry in the Asia - Pacific region, academics and university officials, and government officials to learn best practices in university-industry-government tripartite cooperation, to enable industry in the region, particularly SMEs, to be strengthened.
2. The conference will produce suggestions for governments to consider with respect to policy in university-industry-government tripartite cooperation in the region. The policy should aim to strengthen collaboration and cooperation between these institutions so that industry may be strengthened, universities may become more relevant to the national economy, and the qualifications of workers may be upgraded and made more relevant to the current economic and technological requirements.

IV. CONFERENCE THEMES :

Principal theme: University Industry Government Tripartite Cooperation in Higher Education in Asia and the Pacific Region

Sub-themes:

- New Modalities and Promising Areas of Tripartite Cooperation
- Human Resources Development in Industry
- Overcoming Barriers and Providing Incentives for Tripartite Cooperation
- Best Practices in Asia-Pacific Region

V. INVITED KEYNOTE SPEAKERS & PANELISTS

Keynote Speakers:

1. **Prof. Ian Goulter,** *Vice Chancellor, Charles Sturt University, Australia, President, World Association for Cooperative Education* *
2. *H.E Deputy Prime Minister,* **Dr. Kosit Panpiemras**
3. *H.E Minister of Education,* **Prof. Dr. Wichit Srisa-an**
4. **Assoc. Prof. Dr. Sakarindr Bhumiratana,** *President, National Science and Technology Development Agency (NSTDA), Thailand*
5. **Prof. Dr. Ruben C. Umaly,** *Vice President for Academic Affairs, Angeles University Foundation, Secretary-General Association of Universities of Asia and the Pacific (AUAP)*

Panelists: HRD in Industry

1. **Mr. Sampan Silapanad,** *Federation of Thai Industries, Thailand*
2. **Mr. Noberto A.Viera,** *President, Texas Instrument Industry, Philippines**
3. *Chair, Thai Engineering Council, Thailand*
4. **Prof. David Lamond,** *Macquarie University, Australia**

5. *Telecom Industry, Indonesia**

Panelists: Best Practices

1. **Prof. Dr. Chachanat Thebtaranonth,** *President, International Association of Science Parks, Vice President, National Science and Technology Development Agency (NSTDA), Thailand*
2. **Prof. Dr. Iu Vai Pan,** *Rector, University of Macau, Macao SAR China*
3. **Prof. David Brereton,** *University of Queensland, Australia**
4. *Pohang University of Science and Technology, Korea**
5. **Prof. Dato. Dr. Sharifah,** *Universiti Kebangsaan Malaysia, Malaysia*
6. **Dr. Padolina,** *Ministry of Science, Philippines**

Moderators:

1. **Dr. Carmen Z. Lamagna,** *Vice Chancellor, American International University Bangladesh, Bangladesh, AUAP Fisrt Vice President*
2. **Dr. Pornchai Mongkhonvanit,** *President, Siam University, President, International Association of University Presidents (IAUP), Chairman, AUAP Advisory Council*
3. **Dr. Ricardo Pama,** *President, Angeles University Foundation, Philippines, AUAP Board Member*

Remark :* 7 speakers/panelists require air fare of approx 288,000 Baht

Tentative Program

University-Industry-Government Tripartite Cooperation

in Higher Education
in Asia and the Pacific Region
26-28 July 2007
Surasammanakhan, Suranaree University of Technology

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25 July 2007:	Arrival of AUAP Board Members at SUT
18:30	Dinner at Surasammanakhan
26 July 2007:	Arrival of conference speakers/panelists/participants at SUT
09:00	AUAP Board Meeting
10:00 –12:00	Visit I: Campus Tour & Visit to National Synchrotron Research Center **(for conference participants)**
11:00	Visit I: SUT (i.e Computer Center, Library, Production House, laboratories), National Synchrotron Research Center **(for AUAP Board Members)**
12:00	Lunch at Surasammanakhan
13:30	**Opening Ceremony**
14:00	**-Prominent Keynote Speech**: " University-Industry-Government Tripartite Cooperation in Higher Education in Asia and the Pacific Region: An Assessment" *by Prof. Ian Goulter, Vice Chancellor, Charles Sturt University, Australia, President, World Association for Cooperative Education*
14:30	**-Keynote Speech I**: "New Modalities and Promising Areas of Tripartite Cooperation in a Globalized Society from Government Perspectives" *by H.E Deputy Prime Minister, Dr. Kosit Panpiemras*
15:00-15:15	Coffee /Tea Break
15:15	**-Keynote Speech II:** New Modalities and promising Areas of Tripartite Cooperation in a Globalized Society from University Perspectives" *by H.E Minister of Education, Prof. Dr. Wichit Srisa-an*
15:45	**-Panel Discsusion I: "Human Resources Development in Industry** 1. Mr. Sampan Silapanad, *Federation of Thai Industry, Thailand* 2. Mr. Noberto A.Viera, *President, Texas Instrument Industry, Philippines** 3. *Chair, Thai Engineering Council, Thailand* 4. Prof. David Lamond, *Macquarie University, Australia** 5. *Telecom Industry, Indonesia** ***Moderator:*** *SUT/AUAP*
18:30	Welcome Dinner for AUAP Board Members & Conference participants Performances

27 July 2007

09:00-09:30	**Keynote Speech III**: " Overcoming Barriers and Providing Incentives for Tripartite Cooperation" *by Assoc. Prof. Dr. Sakarindr Bhumiratana* *Executive Director, National Science and Technology Development Agency (NSTDA), Thailand*
09:30-11:30	**Group Discussion:** (3-4 groups) " Towards a Roadmap for University-Industry-Government Tripartite Cooperation" ***Group Chairperson:*** *Dr. Pornchai Mongkhonvanit,* *President, Siam University,* *President, International Association of University Presidents (IAUP)* *Chairman, AUAP Advisory Council*
11:30-12:00	**Report of Group Discussion** *by: Group Chairperson and group representatives*
12:20	Lunch at Surasammanakhan
PM:	-**Visit II:** Seagate Technology (Nakhon Ratchasima Plant) -**Visit III:** Agricultural Processing Plant in Nakhon Ratchasima
18:30	Dinner at Surasammanakhan Performances

28 July 2007

09:00-09:30	**Keynote Speech IV:** "University-Industry-Government Tripartite Cooperation : Making It Work" *by Prof. Dr. Ruben C. Umaly* *Vice President for Academic Affairs, Angeles University Foundation, Philippines,* *Secretary-General, Association of Universities of Asia and the Pacific (AUAP)*
09:30-10:30	**Panel Discussion II** "Best Practices in Asia-Pacific Region" ***Panelists:*** *1. Prof. Dr. Chatchanart Taeptaranon, Deputy Executive Director, Industrial Technology Assistance Program -ITAP, NSTDA, Thailand* *2. Prof. Dr. Iu Vai Pan, Rector, University of Macau, Macao SAR China* *3. Prof. David Brereton, University of Queensland, Australia** *4. Pohang University of Science and Technology, Korea** *5. Prof. Dato. Dr. Sharifah, Universiti Kebangsaan Malaysia, Malaysia* *6. Dr. Padolina, Ministry of Science, Philippines** ***Moderator:*** *Dr. Ricardo Pama* *President, Angeles University Foundation, Philippines* *Board Member, AUAP*
10:30-10:45	Coffee/Tea Break
10:45-11:45	Panel Discussion II (continued)
11:50	-Closing Ceremony
12:00	Lunch at Surasammanakhan
P.M.	-Visit to Pimai Historical Sanctuary -Departure from Nakhon Ratchasima

ส่วนส่งเสริมวิชาการ
รับที่ 678 / 90
วันที่ ๒ 2 เม.ย. 2550
เวลา 10.00 น.

ฝ่ายวิชาการ
สำนักงานอธิการบดี
รับที่ 1009
วันที่ 3 0 ส.ค. 2550
เวลา 1600 น.

เอกสารประกอบวาระที่ 4.2

บันทึกข้อความ
มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สำนักวิชาเทคโนโลยีการเกษตร โทรศัพท์ 4152-3 โทรสาร 4150

ที่ ศธ 5613(1)/188 **วันที่** 28 มีนาคม 2550

เรื่อง ขออนุมัติเปลี่ยนระดับการศึกษาให้กับนักศึกษาบัณฑิตศึกษา จากระดับปริญญาโท เป็นระดับปริญญาเอก แบบ 1

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① **เรียน** เลขานุการสภาวิชาการ

ด้วยนายผจญ อยู่ยืน เลขประจำตัว M4830153 นักศึกษาระดับปริญญาโท สาขาวิชาเทคโนโลยีชีวภาพ สำนักวิชาเทคโนโลยีการเกษตร มีความประสงค์ขอเปลี่ยนระดับการศึกษา จาก ระดับปริญญาโท เป็น ระดับปริญญาเอก แบบ 1 ซึ่งนักศึกษามีคุณสมบัติดังต่อไปนี้

1. นักศึกษาอยู่ในข่ายที่สามารถเปลี่ยนระดับการศึกษาได้ ตามข้อบังคับ มทส ว่าด้วยการศึกษาขั้นบัณฑิตศึกษา พ.ศ. 2545 หมวด 10 การเปลี่ยนระดับการศึกษาตามข้อ 25.2.2 ได้สอบผ่านการสอบวัดคุณสมบัติที่จัดขึ้นสำหรับนักศึกษาขั้นปริญญาเอก ในวันที่ 2 กุมภาพันธ์ 2550 ประจำภาคการศึกษาที่ 3/2549 และได้แจ้งผลการสอบวัดคุณสมบัติไปยังศูนย์บริการการศึกษา ตามบันทึกที่ ศธ 5613(1)/156 ลงวันที่ 13 มีนาคม 2550 (ดังเอกสารแนบ 1)
2. การเปลี่ยนระดับการศึกษาไม่มีการเปลี่ยนแปลงสาขาวิชา ตามข้อบังคับ มทส ว่าด้วยการศึกษาขั้นบัณฑิตศึกษา พ.ศ.2545 ข้อ 25.3
3. สำเร็จการศึกษาวิทยาศาสตร์บัณฑิต (วิทยาศาสตร์และเทคโนโลยีการอาหาร) เกียรตินิยมดันดับ 2 (ดังเอกสารแนบ 2)
4. มีคุณสมบัติในการทำวิจัยชั้นสูงในระดับปริญญาเอกได้
5. ปัจจุบันทำงานวิจัย เรื่อง การปรับปรุงคุณภาพไวน์องุ่น Cabernet sauvignon และ Merlot ซึ่งมีองุ่นคุณภาพสูงกว่าพันไร่ เน้นกระบวนการหมักไวน์ ในสภาพแวดล้อมต่าง ๆ มานานกว่า 3 ปี ในบริษัทเจริญโภคภัณฑ์เมล็ดพันธ์ จำกัด ที่ประเทศจีน (ดังเอกสารข้อมูลดิบของงานวิจัยที่แนบ 3)
6. หน่วยงานต้นสังกัดต้องการพัฒนาคุณภาพบุคลากรให้มีระดับสูงขึ้น

ในการนี้ คณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร ในการประชุมครั้งที่ 5/2550 วันที่ 27 มีนาคม 2550 ได้พิจารณาแล้วว่า สมควรเปลี่ยนระดับการศึกษาให้กับนายผจญ อยู่ยืน จากระดับปริญญาโท เป็นระดับปริญญาเอก แบบ 1 โดยมี ผศ.ดร.โชคชัย วนภู เป็นอาจารย์ที่ปรึกษาทั่วไป และอาจารย์ที่ปรึกษาวิทยานิพนธ์ จึงเสนอสภาวิชาการเพื่อขออนุมัติเปลี่ยนระดับการศึกษาให้กับนายผจญ อยู่ยืน จาก ระดับปริญญาโท เป็น ระดับปริญญาเอก แบบ 1

③ มอบงานสภาฯ.
[illegible]
2 เม.ย. 50
(นางสาวจันทนา พรหมศิริ)
หัวหน้าส่วนส่งเสริมวิชาการ

จึงเรียนมาเพื่อโปรดเสนอสภาวิชาการพิจารณา

(ผู้ช่วยศาสตราจารย์ ดร.สุเวทย์ นิงสานนท์)
คณบดีสำนักวิชาเทคโนโลยีการเกษตร

② เรียน รอง. [illegible]
เพื่อโปรดพิจารณาดำเนินการ

(รองศาสตราจารย์ ดร. เสาวณีย์ รัตนพานี)
รองอธิการบดีฝ่ายวิชาการ
3 0 ส.ค. 2550

เอกสารแนบ 1

บันทึกข้อความ
มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สำนักวิชาเทคโนโลยีการเกษตร โทร 4152-3

ที่ ศธ 5613(1)/ 156 **วันที่** 13 มีนาคม 2550

เรื่อง ขอแจ้งผลการสอบวัดคุณสมบัติ

เรียน ผู้อำนวยการศูนย์บริการการศึกษา

ตามที่คณะกรรมการสอบวัดคุณสมบัติ ของ สาขาวิชาเทคโนโลยีชีวภาพ สำนักวิชาเทคโนโลยีการเกษตร ได้ดำเนินการสอบวัดคุณสมบัติให้กับนักศึกษาระดับบัณฑิตศึกษา ของสาขาวิชา ฯ ประจำภาคการศึกษาที่ 3/2549 จำนวน 2 ราย ไปแล้ว นั้น บัดนี้ สำนักวิชา ฯ ขอแจ้งผลการสอบวัดคุณสมบัติให้กับนักศึกษา ดังนี้

<u>ระดับปริญญาเอก</u>

1.D4730163 นางสาวนันทนิจ จารุเศรณีย์ ได้รับระดับคะแนน “S” (Satisfactory) โดยผ่านความเห็นชอบจากคณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร บันทึกที่ ศธ 5613(4)/158 ลงวันที่ 22 กุมภาพันธ์ 2550

<u>ระดับปริญญาโท</u>

1.M4830153 นายผจญ อยู่ยืน ได้รับระดับคะแนน “S” (Satisfactory) โดยผ่านความเห็นชอบจากคณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร บันทึกที่ ศธ 5613(4)/150 ลงวันที่ 20 กุมภาพันธ์ 2550 ทั้งนี้ นักศึกษาขอเปลี่ยนระดับการศึกษาจากระดับปริญญาโทเป็นระดับปริญญาเอกซึ่งอยู่ในระหว่างการแจ้งเวียนขอความเห็นชอบจากคณะกรรมการประจำสำนักวิชา ฯ และเสนอสภาวิชาการอนุมัติต่อไป

จึงเรียนมาเพื่อโปรดทราบและพิจารณาดำเนินการ

(ผู้ช่วยศาสตราจารย์ ดร.สุเวทย์ นิงสานนท์)
คณบดีสำนักวิชาเทคโนโลยีการเกษตร

บันทึกข้อความ

มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สาขาวิชาเทคโนโลยีชีวภาพ สำนักวิชาเทคโนโลยีการเกษตร โทรศัพท์ 4154 โทรสาร 4150

ที่ ศธ 5613(4)/๙๘ **วันที่** 24 มกราคม 2549

เรื่อง ขอสอบวัดคุณสมบัติและเสนอแต่งตั้งคณะกรรมการสอบวัดคุณสมบัติ

เรียน ประธานคณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร

ด้วย นายผจญ อยู่ยืน เลขประจำตัว M4830153 นักศึกษาปริญญาโทที่มีความประสงค์ขอปรับระดับการศึกษาเป็นนักศึกษาปริญญาเอก สาขาวิชาเทคโนโลยีชีวภาพจึงกำหนดให้มีการสอบวัดคุณสมบัติ ในภาคการศึกษาที่ 3 ปีการศึกษา 2549 ในวันที่ 2 กุมภาพันธ์ 2550 โดยขอเสนอรายชื่อคณะกรรมการการสอบวัดคุณสมบัติดังนี้

1. หัวหน้าสาขาวิชาเทคโนโลยีชีวภาพ (ผศ.ดร.โชคชัย วนภู) ประธานกรรมการ
2. ศ.ดร.นันทกร บุญเกิด กรรมการ
3. รศ.ดร.หนึ่ง เตียอำรุง กรรมการ
4. ดร.อเนก ศิลปพันธุ์ กรรมการ (ผู้ทรงคุณวุฒิภายนอก)

จึงเรียนมาเพื่อโปรดพิจารณา

(ผู้ช่วยศาสตราจารย์ ดร. โชคชัย วนภู)
หัวหน้าสาขาวิชาเทคโนโลยีชีวภาพ

คำสั่งสำนักวิชาเทคโนโลยีการเกษตร

ที่ 12/2550

เรื่อง แต่งตั้งคณะกรรมการสอบวัดคุณสมบัติ

เพื่อให้การสอบวัดคุณสมบัติของนักศึกษาระดับบัณฑิตศึกษา สำนักวิชาเทคโนโลยีการเกษตร สอดคล้องกับหลักสูตร ระเบียบ ข้อบังคับ เป็นไปด้วยความถูกต้องเรียบร้อย และมีประสิทธิภาพ

ฉะนั้น อาศัยอำนาจตามความในมาตรา 26 แห่งพระราชบัญญัติมหาวิทยาลัยเทคโนโลยีสุรนารี พ.ศ. 2533 ประกอบกับข้อ 28 แห่งข้อบังคับมหาวิทยาลัยเทคโนโลยีสุรนารี ว่าด้วยการศึกษาขั้นบัณฑิตศึกษา พ.ศ. 2545 คำสั่งมหาวิทยาลัยเทคโนโลยีสุรนารี ที่ 570/2548 เรื่อง การรักษาการแทนคณบดีสำนักวิชาเทคโนโลยีการเกษตร ลงวันที่ 6 ตุลาคม 2548 และโดยความเห็นชอบจากคณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร บันทึก ที่ ศธ 5613(4)/98 ลงวันที่ 24 มกราคม 2550 จึงแต่งตั้งคณะกรรมการสอบวัดคุณสมบัติ นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาเทคโนโลยีชีวภาพ สำนักวิชาเทคโนโลยีการเกษตร ดังต่อไปนี้

ชื่อนักศึกษา	คณะกรรมการสอบวัดคุณสมบัติ	
นายผจญ อยู่ยืน M4830153	1.หัวหน้าสาขาวิชาเทคโนโลยีชีวภาพ 2.ศาสตราจารย์ ดร.นันทกร บุญเกิด 3.รองศาสตราจารย์ ดร.หนึ่ง เตียอำรุง 4.ดร.เอนก ศิลปพันธุ์	เป็น ประธานกรรมการ เป็น กรรมการ เป็น กรรมการ เป็น กรรมการ

ทั้งนี้ ตั้งแต่บัดนี้เป็นต้นไป

สั่ง ณ วันที่ 2 กุมภาพันธ์ พ.ศ.2550

(รองศาสตราจารย์ ดร.พงษ์ชาญ ณ ลำปาง)
หัวหน้าสาขาวิชาเทคโนโลยีการผลิตสัตว์
รักษาการแทนคณบดีสำนักวิชาเทคโนโลยีการเกษตร

สำนักวิชาเทคโนโลยีการเกษตร
รับที่ 548
วันที่ 21 ก.พ. 2550
เวลา 09.50 น.

บันทึกข้อความ

มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สาขาวิชาเทคโนโลยีชีวภาพ สำนักวิชาเทคโนโลยีการเกษตร โทรศัพท์ 4234 โทรสาร 4154

ที่ ศธ 5613(4)/150 **วันที่** 20 กุมภาพันธ์ 2550

เรื่อง แจ้งผลการสอบวัดคุณสมบัติ

เรียน ประธานคณะกรรมการประจำสำนักวิชาเทคโนโลยีการเกษตร

ตามที่สาขาวิชาเทคโนโลยีชีวภาพได้กำหนดให้มีการสอบวัดคุณสมบัติ นายผจญ อยู่ยืน เลขประจำตัว M4830153 นักศึกษาปริญญาโท ซึ่งสอบในวันที่ 2 กุมภาพันธ์ 2550 ในภาคการศึกษาที่ 3 ปีการศึกษา 2549 แล้วนั้น คณะกรรมการสอบฯ ได้พิจารณาแล้วเห็นสมควรให้ผล ผ่าน (ระดับคะแนนตัวอักษร S) แก่นักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดพิจารณา

(ผู้ช่วยศาสตราจารย์ ดร. โชคชัย วนภู)
หัวหน้าสาขาวิชาเทคโนโลยีชีวภาพ

เห็น [illegible]
เพื่อ [illegible]

(อาจารย์ ดร.โสภณ วงศ์แก้ว)
หัวหน้าสาขาวิชาเทคโนโลยีการผลิตพืช
รักษาการแทนคณบดีสำนักวิชาเทคโนโลยีการเกษตร
21 ก.พ. 2550

สถาบันเทคโนโลยีราชมงคล

โดยอนุมัติสภาสถาบัน ให้ปริญญาบัตรฉบับนี้ไว้เพื่อแสดงว่า

นายพจญ อยู่ยืน

ได้ศึกษาสำเร็จตามหลักสูตร

วิทยาศาสตรบัณฑิต (วิทยาศาสตร์และเทคโนโลยีการอาหาร) เกียรตินิยมอันดับ ๒

มีศักดิ์และสิทธิแห่งปริญญานี้ทุกประการ

ตั้งแต่วันที่ ๑๒ เดือน มีนาคม พุทธศักราช ๒๕๔๓

นายกสภา

อธิการบดี

คณบดี

Brix Exp. 2005 Crop Season

Table 1 Chemistry analysis of Cabernet sauvignon grape that picked in 2005 season

Treatment	Chemistry analysis				
	Brix	SG	pH	TA (g/l)	VA (g/l)
T1	14.2	1.0600	3.09	11.6	0.07
T2	16.5	1.0680	3.08	10.3	0.10
T3	18.1	1.0740	3.17	9.4	0.12
T4	19.5	1.0790	3.28	8.4	0.13
T5	21.8	1.0870	3.32	8.2	0.15

Table 2 Chemistry analysis of Merlot grape that picked in 2005 season

Treatment	Chemistry analysis				
	Brix	SG	pH	TA (g/l)	VA (g/l)
T1	14.5	1.0610	3.01	11.4	0.11
T2	16.5	1.0680	3.02	11.2	0.15
T3	18.1	1.0740	3.23	9.0	0.15
T4	19.6	1.0790	3.24	8.6	0.16
T5	22.2	1.0890	3.31	8.4	0.17

Table 3 Chemistry analysis of Cabernet sauvignon and Merlot grape that picked in 2005 season

Treatment	Chemistry analysis				
	Brix	SG	pH	TA (g/l)	VA (g/l)
T1	14.4	1.0610	3.01	11.5	0.09
T2	16.5	1.0680	3.05	11.3	0.13
T3	18.1	1.0140	3.20	9.2	0.14
T4	19.6	1.0790	3.26	8.5	0.15
T5	22.0	1.0890	3.32	8.3	0.16

Table 4 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season

SV	df	Mean squares						
		Brix	SG	pH	TA	VA	Alc.	RS
Variety (a)	1	0.00ns	8.33x10^{7}ns	0.104**	1.408**	0.001ns	0.120**	1.045**
Brix (b)	4	0.00ns	3.13x10^{6}*	0.037**	5.061**	0.025**	0.03ns	0.501**
a*b	4	0.00ns	2.33x10^{6}*	0.003**	1.194**	0.003**	0.010ns	0.038**
Error	20	0.001	5.00x10^{7}	0.0001	0.011	0.0001	0.004	0.003
Total	29							

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season

Treatment	Chemistry analysis						
(·Brix)	Brix	SG	pH	TA (g/l)	VA (g/l)	Alc (% v/v)	RS (g/l)
14.0	-0.4a	0.9915b	3.30a	7.17a	0.52c	11.77a	1.63a
16.0	-0.4a	0.9905a	3.35b	7.17a	0.52c	11.77a	1.80b
18.0	-0.4a	0.9911a	3.39c	7.17a	0.43b	11.77a	2.05c
20.0	-0.4a	0.9918b	3.46d	7.17a	0.40a	11.77a	2.10c
22.0	-0.4a	0.9916b	3.50e	7.18a	0.39a	11.82a	2.38d

Means with the same letter in each column are not significantly different at 95%.

Table 5 Mean squares for chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Variety (a)	1	22.533**	58.241**	365.403**	143.445**	0.415**	0.415**
Brix (b)	4	461.646**	221.212**	36.912**	141/713**	0.166**	0.166**
a*b	4	18.338**	0.702**	75.228**	60.585**	0.085**	0.085**
Error	20	0.351	0.046	54.246	1.131	0.011	0.011
Total	29						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 5.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season.

Treatment	Chemistry analysis					
(·Brix)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
14.0	17.12a	10.77a	22.62d	29.47c	1.64b	1.64b
16.0	21.17b	14.13b	23.78e	28.47c	1.72b	1.72b
18.0	22.20c	22.20c	17.32a	20.03a	1.87c	1.87c
20.0	30.83d	23.35d	20.18b	19.07a	1.48a	1.48a
22.0	38.15e	24.18e	21.12c	21.80b	1.50a	1.50a

Means with the same letter each column are not significantly different at 95%.

Table 6 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Variety (a)	1	5.109**	0.675**	0.002*	0.022*
Brix (b)	4	14.837**	10.411**	0.010**	0.010**
a*b	4	0.729**	0.906**	0.003**	0.003**
Error	20	0.040	0.038	0.0001	0.0001
Total	29				

Means with the same letter each column are not significantly different at 95%.

* Significantly different at 99%.

* Significantly different at 95%.

ns Not significantly different

Table 6.1 Mean squares for chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 season

Treatment	Chemistry analysis			
(·Brix)	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
14.0	3.79a	4.67a	0.62d	0.62d
16.0	5.23b	6.11b	0.59c	0.59c
18.0	5.93c	6.61c	0.56b	0.56b
20.0	7.15d	6.96d	0.53a	0.53a
22.0	7.76e	8.30e	0.52a	0.52a

Means with the same letter each column are not significantly different at 95%.

Brix Exp. 2005 and 2006 Crop Season

Table 1 Chemistry analysis of Merlot grape that picked in 2005 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.5	1.0610	3.01	11.4	0.11	-	-	-	-
T2	16.5	1.0680	3.02	11.2	0.15	-	-	-	-
T3	18.1	1.0740	3.23	9.0	0.15	-	-	-	-
T4	19.6	1.0790	3.24	8.6	0.16	-	-	-	-
T5	22.2	1.0890	3.31	8.4	0.17	-	-	-	-

Table 2 Chemistry analysis of Merlot grape that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.7	1.0610	3.15	11.8	0.06	0.37	0.31	1.05	0.87
T2	16.1	1.0670	3.20	10.2	0.06	0.40	0.40	1.17	1.11
T3	18.4	1.0750	3.26	8.7	0.10	0.65	0.55	1.31	1.13
T4	19.7	1.0790	3.30	7.6	0.15	1.05	1.05	1.33	1.17
T5	21.9	1.0880	3.37	7.3	0.20	1.15	1.15	1.62	1.26

Table 3 Chemistry analysis of Merlot grape that picked in 2005 and 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.6	1.0610	3.08	11.6	0.09	0.37	0.31	1.05	0.87
T2	16.3	1.0680	3.11	10.7	0.11	0.40	0.40	1.17	1.11
T3	18.3	1.0750	3.25	8.9	0.13	0.65	0.55	1.31	1.13
T4	19.7	1.0790	3.27	8.1	0.61	1.05	1.05	1.33	1.17
T5	22.1	1.0890	3.34	7.9	0.66	1.15	1.15	1.62	1.26

Table 4 Mean squares of chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

SV	df	Mean squares						
		Brix	SG	pH	TA	VA	Alc.	RS
Variety (a)	1	0.00ns	$4.32\text{x}10^{5}$**	0.018**	13.872**	0.275**	0.016**	
Brix (b)	4	0.00ns	$3.28\text{x}10^{6}$**	0.031**	5.830**	0.010**	0.017ns	
a*b	4	0.00ns	$7.83\text{x}10^{7}$ns	0.001**	0.849**	0.000ns	0.015ns	
Error	20	0.001	$7.00\text{x}10^{6}$	0.0001	0.014	0.0001	0.009	
Total	29							

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis						
(·Brix)	Brix	SG	pH (g/l)	TA (g/l)	VA (% v/v)	Alc (g/l)	RS
14.0	-0.4a	0.9922a	3.23a	7.72d	0.41c	11.77ab	
16.0	-0.4a	0.9918a	3.41b	7.48c	0.39c	11.77a	
18.0	-0.4a	0.9913a	3.44c	6.03b	0.35b	11.70a	
20.0	-0.4a	0.9920a	3.49d	5.72a	0.34b	11.80ab	
22.0	-0.4a	0.9933b	3.51e	5.72a	0.32a	11.83b	

Means with the same letter in each column are not significantly different at 95%.

Table 5 Mean squares for chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Variety (a)	1	1.925ns	2.080*	520.000**	587.065**	4.340**	4.340**
Brix (b)	4	448.781**	250.241**	34.298**	71.881**	0.151**	0.151**
a*b	4	12.438**	10.838**	25.345**	77.239**	0.147**	0.147**
Error	20	1.606	0.287	1.017	1.226	0.010	0.010
Total	29						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis					
(°Brix)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
14.0	17.23a	9.27a	23.78b	24.03c	1.17a	1.17a
16.0	20.92b	12.12b	21.78b	26.27d	1.32b	1.32b
18.0	28.55c	18.48c	19.42a	19.85b	1.56c	1.56c
20.0	32.47d	21.93d	18.43a	19.46b	1.52c	1.52c
22.0	38.67e	24.55e	18.23a	18.05a	1.35b	1.35b

Means with the same letter each column are not significantly different at 95%.

Table 5 Mean squares of chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Variety (a)	1	17.146**	20.634**	0.693**	0.327**
Brix (b)	4	12.470**	11.882**	0.024**	0.008**
a*b	4	0.216**	1.638**	0.015**	0.028**
Error	20	0.038	0.032	0.003	0.001
Total	29				

Means with the same letter each column are not significantly different at 95%.

* Significantly different at 99%.

* Significantly different at 95%.

^{ns} Not significantly different

Table 5.1 Mean squares for chemistry analysis of Merlot wine after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis			
(°Brix)	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
14.0	3.83a	3.77a	0.77c	0.73b
16.0	4.40b	5.25b	0.70bc	0.70b
18.0	6.09c	6.01c	0.72bc	0.66a
20.0	6.83d	7.02d	0.74bc	0.65a
22.0	7.01d	7.21d	0.61a	0.65a

Means with the same letter each column are not significantly different at 95%.

Brix Exp. 2005 and 2006 Crop Season

Table 1 Chemistry analysis of Cabernet sauvignon grape that picked in 2005 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.2	1.0600	3.09	11.6	0.07	-	-	-	-
T2	16.5	1.0680	3.08	10.3	0.10	-	-	-	-
T3	18.1	1.0740	3.17	9.4	0.12	-	-	-	-
T4	19.5	1.0790	3.28	8.4	0.13	-	-	-	-
T5	21.8	1.0870	3.32	8.2	0.15	-	-	-	-

Table 2 Chemistry analysis of Cabernet sauvignon grape that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.6	1.0610	3.01	14.0	0.06	0.41	0.37	1.02	0.86
T2	16.1	1.0670	3.08	11.8	0.08	0.57	0.45	1.08	0.91
T3	17.7	1.0710	3.15	10.5	0.09	0.99	0.94	1.21	1.13
T4	19.8	1.0800	3.18	10.3	0.09	1.06	0.96	1.25	1.15
T5	21.8	1.0870	3.22	9.8	0.19	1.49	1.10	1.54	1.18

Table 3 Chemistry analysis of Cabernet sauvignon grape that picked in 2005 and 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.4	1.0610	3.05	12.8	0.07	0.41	0.37	1.02	0.86
T2	16.3	1.0690	3.08	11.1	0.09	0.57	0.45	1.08	0.91
T3	17.9	1.0730	3.16	10.0	0.11	0.99	0.94	1.21	1.13
T4	19.7	1.0850	3.23	9.4	0.11	1.06	0.96	1.25	1.15
T5	21.8	1.0870	3.27	9.0	0.17	1.49	1.10	1.54	1.18

Table 4 Mean squares of chemistry analysis of Cabernet sauvignon wine after fermentation finished in 2005 and 2006 season

SV	df	Mean squares						
		Brix	SG	pH	TA	VA	Alc.	RS
Variety (a)	1	0.00ns	$2.00x10^6$ns	0.030**	0.341**	0.195**	0.005ns	
Brix (b)	4	0.00ns	$3.88x10^6$**	0.053**	2.004**	0.039**	0.006ns	
a*b	4	0.00ns	$1.12x10^6$ns	0.002**	0.230**	0.002**	0.012ns	
Error	20	0.001	6.33x107	0.0001	0.018	0.0001	0.016	
Total	29							

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon wine after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis						
(·Brix)	Brix	SG	pH (g/l)	TA (g/l)	VA (% v/v)	Alc (g/l)	RS
14.0	-0.4a	0.9918bc	3.26a	8.50d	0.45c	11.75a	
16.0	-0.4a	0.9905a	3.32b	8.10c	0.45c	11.68a	
18.0	-0.4a	0.9912ab	3.35c	7.90b	0.35b	11.75a	
20.0	-0.4a	0.9927c	3.46d	7.20a	0.29a	11.70a	
22.0	-0.4a	0.9917bc	3.48e	7.10a	0.29a	11.75a	

Means with the same letter in each column are not significantly different at 95%.

Brix Exp. 2005 & 2006 Crop Season

Table 1 Chemistry analysis of Cabernet sauvignon and Merlot grapes that picked in 2005 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.4	1.0610	3.01	11.5	0.09	-	-	-	-
T2	16.5	1.0680	3.05	11.3	0.13	-	-	-	-
T3	18.1	1.0740	3.20	9.2	0.14	-	-	-	-
T4	19.6	1.0790	3.26	8.5	0.15	-	-	-	-
T5	22.0	1.0880	3.32	8.3	0.16	-	-	-	-

Table 2 Chemistry analysis of Cabernet sauvignon and Merlot grapes that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.7	1.0610	3.08	12.9	0.06	0.39	0.34	1.04	0.87
T2	16.1	1.0670	3.14	11.0	0.07	0.49	0.43	1.13	1.01
T3	18.1	1.0730	3.21	9.6	0.10	0.82	0.75	1.26	1.13
T4	19.8	1.0795	3.24	9.0	0.12	1.06	1.01	1.29	1.16
T5	21.9	1.0875	3.30	8.6	0.20	1.32	1.13	1.58	1.22

Table 3 Chemistry analysis of Cabernet sauvignon and Merlot grapes that picked in 2005 and 200 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.6	1.0610	3.05	12.2	0.08	0.39	0.34	1.04	0.87
T2	16.3	1.0680	3.10	11.2	0.10	0.49	0.43	1.13	1.01
T3	18.1	1.0740	3.21	9.4	0.12	0.82	0.75	1.26	1.13
T4	19.7	1.0790	3.25	8.8	0.14	1.06	1.01	1.29	1.16
T5	22.0	1.0880	3.31	8.5	0.18	1.32	1.13	1.58	1.22

Table 4 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares						
		Brix	SG	pH	TA	VA	Alc.	RS
Year (a)	1	0.00ns	$3.37\text{x}10^5$ **	0.001*	4.931**	0.466**	0.054*	
Variety (b)	1	0.00ns	$4.82\text{x}10^6$*	0.058**	22.326**	0.001ns	0.024ns	
Brix (c)	4	0.00ns	$4.52\text{x}10^6$**	0.082**	6.959**	0.043**	0.007ns	
a*b	1	0.00ns	$1.22\text{x}10^5$**	0.047**	9.283**	0.003**	0.113**	
a*c	4	0.00ns	$9.17\text{x}10^7$ns	0.001**	0.533**	0.001*	0.005ns	
b*c	4	0.00ns	$2.65\text{x}10^6$**	0.003**	0.875**	0.006**	0.005ns	
a*b*c	4	0.00ns	$9.83\text{x}10^7$ns	0.001**	0.546**	0.001**	0.022ns	
Error	40	0.001	$6.67\text{x}10^7$	0.0001	0.016**	0.0001	0.013	
Total	59							

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis						
(·Brix)	Brix	SG	pH (g/l)	TA (g/l)	VA (% v/v)	Alc (g/l)	RS
14.0	-0.4a	0.9920b	3.29a	8.80d	0.43c	11.76a	
16.0	-0.4a	0.9912a	3.36b	7.78c	0.42c	11.76a	
18.0	-0.4a	0.9913a	3.40c	7.00b	0.35b	11.73a	
20.0	-0.4a	0.9923b	3.47d	6.47a	0.31a	11.72a	
22.0	-0.4a	0.9925b	3.49e	6.41a	0.30a	11.78a	

Means with the same letter in each column are not significantly different at 95%.

Table 5 Mean squares for chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 and 2006 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Year (a)	1	5.704ns	29.822**	343.683**	770.918**	8.155**	8.155**
Variety (b)	1	5.582ns	334.648**	177.504**	110.134**	0.674**	0.674**
Brix (c)	4	722.988**	444.563**	13.031**	158.111**	0.117**	0.117**
a*b	1	18.928**	56.260**	187.974**	42.252**	0.008**	0.008**
a*c	4	13.250**	8.273**	29.738**	65.873**	0.332**	0.332**
b*c	4	26.874**	8.963**	29.881**	93.460**	0.054**	0.054**
a*b*c	4	6.799**	4.725**	10.014**	42.950**	0.175**	0.175**
Error	40	1.543	0.499	0.817	1.030	0.008	0.008
Total	59						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 and 2006 season.

Treatment	Chemistry analysis					
(°Brix)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
14.0	18.04a	11.38a	19.80c	21.91d	1.17a	1.17a
16.0	21.63b	15.32b	19.61c	21.32c	1.21ab	1.21ab
18.0	30.16c	21.52c	17.43a	16.54a	1.41c	1.41c
20.0	33.14d	24.37d	18.00ab	18.48b	1.35c	1.35c
22.0	36.38e	25.58e	18.22b	18.63b	1.25b	1.25b

Means with the same letter each column are not significantly different at 95%.

Table 5 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 and 2006 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Year (a)	1	2.979**	19.086*	0.422**	0.353**
Variety (b)	1	0.871**	0.798**	0.217**	0.190**
Brix (c)	4	28.139**	20.304**	0.025**	0.010**
a*b	1	17.056**	4.224**	0.279**	0.046**
a*c	4	0.742**	4.700**	0.006**	0.029**
b*c	4	0.661**	3.426**	0.010**	0.020**
a*b*c	4	0.620**	2.634**	0.010**	0.007**
Error	40	0.048**	0.072	0.002	0.001
Total	59				

Means with the same letter each column are not significantly different at 95%.
* Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 5.1 Mean squares for chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2005 and 2006 season

Treatment	Chemistry analysis			
(°Brix)	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
14.0	3.69a	4.65a	0.71c	0.60ab
16.0	4.75b	5.01b	0.66b	0.67c
18.0	3.59c	5.49c	0.64b	0.68b
20.0	7.09d	7.19d	0.65b	0.61ab
22.0	7.26d	7.51e	0.58a	0.59a

Means with the same letter each column are not significantly different at 95%.

Fermaid E Exp. 2006 Season

Table 1 Chemistry analysis of Cabernet sauvignon grape that picked in 2006 season

	Treatment	Chemistry analysis								
Fermaid E (g/L)		Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
0	T1	18.1	1.0740	3.28	9.2	0.08	0.97	0.86	1.17	1.04
0.1	T2	18.1	1.0740	3.28	9.2	0.08	0.97	0.86	1.17	1.04
0.15	T3	18.1	1.0740	3.28	9.2	0.08	0.97	0.86	1.17	1.04
	T4	18.1	1.0730	3.28	9.2	0.08	0.97	0.86	1.17	1.04
0.2	T5	18.1	1.0740	3.28	9.2	0.08	0.97	0.86	1.17	1.04
0.25	T6	18.1	1.0740	3.28	9.2	0.08	0.97	0.86	1.17	1.04

Table 2 Chemistry analysis of Merlot grape that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03
T2	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03
T3	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03
T4	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03
T5	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03
T6	19.5	1.0790	3.48	7.5	0.06	0.85	0.72	1.21	1.03

Table 3 Chemistry analysis of Cabernet sauvignon and Merlot grapes that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04
T2	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04
T3	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04
T4	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04
T5	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04
T6	18.8	1.0770	3.32	8.4	0.07	0.91	0.79	1.19	1.04

Table 4 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares						
		Brix	SG	pH	TA	VA	Alc.	RS
Variety (a)	1	0.00ns	1.36x10**	0.097**	73.960**	0.008ns	0.303**	
Fermaid E (b)	5	0.00ns	5.61x10^{7}**	0.004**	0.055ns	0.001ns	0.017ns	
a*b	5	0.00ns	1.89x10^{7}**	0.001**	0.195ns	0.002ns	0.019ns	
Error	24	0.001	1.11x10^{7}	0.001	0.150	0.002	0.016	
Total	35							

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season .

Fermaid E	Chemistry analysis						
(g/l)	Brix	SG	pH	TA (g/l)	VA (g/l)	Alc (% v/v)	RS (g/l)
0.00	-0.4a	0.9930b	3.58c	6.97a	0.26a	11.98a	
0.20	-0.4a	0.9925ab	3.58c	6.97a	0.24a	11.90a	
0.40	-0.4a	0.9930b	3.56bc	6.97a	0.22a	11.92a	
0.60	-0.4a	0.9923a	3.54ab	7.00a	0.25a	11.85a	
0.80	-0.4a	0.9930b	3.53a	6.83a	0.23a	11.83a	
1.00	-0.4a	0.9930b	3.52a	7.13a	0.23a	11.90a	

Means with the same letter are not significantly different at 95%.

Table 5 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Variety (a)	1	260.823**	21.007*	0.614ns	0.090ns	0.091*	0.091*
Fermaid E (b)	5	6.994ns	3.042ns	19.157**	4.743*	0.038ns	0.038ns
a*b	5	9.466ns	2.102ns	4.357*	2.679ns	0.024ns	0.024ns
Error	24	5.036	2.848	1.640	1.637	0.016	0.016
Total	35						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 5-1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

Fermaid E	Chemistry analysis					
(g/l)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
0.00	32.02a	25.23a	12.70a	15.45a	1.09ab	1.09ab
0.20	31.33a	24.47a	13.93a	16.40a	1.14b	1.14b
0.40	31.23a	23.23a	17.52c	18.03b	1.11b	1.11b
0.60	33.00a	23.53a	16.43bc	16.48a	1.06ab	1.06ab
0.80	30.25a	24.03a	15.68b	15.83a	1.00ab	1.00ab
1.00	30.15a	23.88a	16.35bc	16.17a	0.92a	0.92a

Means with the same letter are not significantly different at 95%.

Table 6 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Variety (a)	1	0.672*	0.595*	0.014*	0.017**
Fermaid E (b)	4	0.608**	0.300*	0.045**	0.003ns
a*b	4	0.126ns	0.232ns	0.024**	0.001ns
Error	20	0.142	0.103	0.002	0.001
Total	35				

Means with the same letter each column are not significantly different at 95%.

** Significantly different at 99%.

* Significantly different at 95%.

ns Not significantly different

Table 6-1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

Brix	Chemistry analysis			
	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
0.00	5.86a	6.57ab	0.87b	0.70b
0.20	6.11ab	6.68ab	0.81b	0.68ab
0.40	6.88c	6.68b	0.68a	0.65ab
0.60	6.47bc	6.49ab	0.67a	0.67ab
0.80	6.31ab	6.28a	0.68a	0.65ab
1.00	6.41bc	6.32a	0.54a	0.64a

Means with the same letter are not significantly different at 95%.

Table 7 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

SV	df	Mean squares	
		pH	TA (g/l)
Variety (a)	1	0.588**	33.834**
Fermaid E (b)	5	0.009**	0.250ns
a*b	5	0.002*	0.253ns
Error	24	0.001	0.111
Total	35		

Means with the same letter each column are not significantly different at 95%.

** Significantly different at 99%.

* Significantly different at 95%.

ns Not significantly different

Table 7.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

Fermaid E	Chemistry analysis	
(g/l)	pH	TA (g/l)
0.00	3.58b	6.07a
0.20	3.57b	6.32ab
0.40	3.55b	6.10a
0.60	3.55b	6.33ab
0.80	3.50a	6.48ab
1.00	3.48a	6.58b

Means with the same letter are not significantly different at 95%.

Table 8 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Variety (a)	1	427.800**	2.947ns	206.401**	0.071ns	0.393**	0.393**
Fermaid E (b)	5	11.814*	5.212*	3.837ns	0.760ns	0.061**	0.061**
a*b	5	6.556ns	3.609ns	6.308*	1.432ns	0.006ns	0.006ns
Error	24	3.734	1.685	2.021	0.762	0.003	0.003
Total	35						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 8.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

Fermaid E	Chemistry analysis					
(g/l)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
0.00	29.48ab	20.33a	16.32ab	18.32a	0.97b	0.97b
0.20	29.83ab	20.77ab	17.22b	18.88a	1.04b	1.04b
0.40	32.48c	22.85c	15.82ab	18.87a	1.04b	1.04b
0.60	30.88bc	21.65abc	15.95ab	18.88a	0.98b	0.98b
0.80	28.33a	21.88abc	15.07a	18.10a	0.97ab	0.97ab
1.00	30.40abc	22.85bc	15.13a	18.32a	0.90a	0.90a

Means with the same letter are not significantly different at 95%.

Table 9 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Variety (a)	1	19.536**	0.093ns	0.019*	0.046**
Fermaid E (b)	5	0.365*	0.644**	0.001ns	0.001ns
a*b	5	0.580*	0.050ns	0.003ns	0.001ns
Error	24	0.119	0.053	0.004	0.001
Total	35				

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 9.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished and SO_2 added in wines in 2006 season

Brix	Chemistry analysis			
	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
0.00	5.50a	6.02a	0.67a	0.62a
0.20	6.02b	6.40b	0.69a	0.63a
0.40	6.05b	7.03c	0.70a	0.64a
0.60	5.77ab	6.58b	0.69a	0.64a
0.80	5.54a	6.43b	0.69a	0.63a
1.00	5.58a	6.56b	0.67a	0.61a

Means with the same letter are not significantly different at 95%.

Brix Exp. 2006 Crop Season

Table 1 Chemistry analysis of Cabernet sauvignon grape that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.6	1.0610	3.01	14.0	0.06	0.41	0.37	1.02	0.86
T2	16.1	1.0670	3.08	11.8	0.08	0.57	0.45	1.08	0.91
T3	17.7	1.0710	3.15	10.5	0.09	0.99	0.94	1.21	1.13
T4	19.8	1.0800	3.18	10.3	0.09	1.06	0.96	1.25	1.15
T5	21.8	1.0870	3.22	9.8	0.19	1.49	1.10	1.54	1.18

Table 2 Chemistry analysis of Merlot grape that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.7	1.0610	3.15	11.8	0.06	0.37	0.31	1.05	0.87
T2	16.1	1.0670	3.20	10.2	0.06	0.40	0.40	1.17	1.11
T3	18.4	1.0750	3.26	8.7	0.10	0.65	0.55	1.31	1.13
T4	19.7	1.0790	3.30	7.6	0.15	1.05	1.05	1.33	1.17
T5	21.9	1.0880	3.37	7.3	0.20	1.15	1.15	1.62	1.26

Table 3 Chemistry analysis of Cabernet sauvignon and Merlot grapes that picked in 2006 season

Treatment	Chemistry analysis								
	Brix	SG	pH	TA (g/l)	VA (g/l)	mg Color /Berry	mg Color /g Berry	Total phenolic /Berry	Total phenolic /g Berry
T1	14.7	1.0610	3.08	12.9	0.06	0.39	0.34	1.04	0.87
T2	16.1	1.0670	3.14	11.0	0.07	0.49	0.43	1.13	1.01
T3	18.1	1.0730	3.21	9.6	0.10	0.82	0.75	1.26	1.13
T4	19.8	1.0795	3.24	9.0	0.12	1.06	1.01	1.29	1.16
T5	21.9	1.0875	3.30	8.6	0.20	1.32	1.13	1.58	1.22

Table 5 Mean squares for chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares					
		Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
Variety (a)	1	1.976ns	332.667**	0.075**	8.216**	0.267**	0.267**
Brix (b)	4	274.591**	2231.558**	5.656**	81.830**	0.283**	0.283**
a*b	4	15.336**	12.986**	14.365**	75.771**	0.144**	0.144**
Error	20	2.735	0.951	1.144	0.921	0.004	0.004
Total	29						

Means with the same letter each column are not significantly different at 95%.
** Significantly different at 99%.
* Significantly different at 95%.
ns Not significantly different

Table 4.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

Treatment	Chemistry analysis					
(·Brix)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigments (%)	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
14.0	18.97a	11.98a	17.17b	22.37d	0.70a	0.70a
16.0	22.10b	16.50b	15.43a	14.18a	0.70a	0.70a
18.0	29.48c	20.83c	17.34b	13.07a	0.93b	0.93b
20.0	32.65d	25.38d	15.81a	17.90c	1.21c	1.21c
22.0	34.62e	26.98e	15.32a	15.47b	1.00b	1.00b

Means with the same letter each column are not significantly different at 95%.

Table 5 Mean squares of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

SV	df	Mean squares			
		Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
Variety (a)	1	12.818**	4.347**	0.494**	0.212**
Brix (b)	4	14.036**	14.593**	0.021**	0.026**
a*b	4	0.552**	5.155**	0.017**	0.015**
Error	20	0.056	0.101	0.003	0.001
Total	29				

Means with the same letter each column are not significantly different at 95%.
* Significantly different at 99%.
* Significantly different at 95%.
^{ns} Not significantly different

Table 5.1 ANOVA of chemistry analysis of Cabernet sauvignon and Merlot wines after fermentation finished in 2006 season

Treatment	Chemistry analysis			
(·Brix)	Wine color density	Modified wine color density	Wine color hue	Modified wine color hue
14.0	3.58a	4.62b	0.80c	0.71b
16.0	4.27b	3.90a	0.73b	0.75b
18.0	6.00c	4.36b	0.72b	0.76b
20.0	6.77d	7.41d	0.77bc	0.64a
22.0	7.02e	6.72c	0.64a	0.62a

Means with the same letter each column are not significantly different at 95%.

Table 3 Chemistry analysis of Cabernet sauvignon wine (Fermaid E)®

Fermaid E (g/l)	pH	TA (g/l)	Alc. (% v/v)	VA (g/l)	RS (g/l)	SG	
0.00	3.46a	7.47a	11.77a	0.41a	2.03a	0.991a	
0.10	3.46a	7.47a	11.83a	0.39b	2.03a	0.991a	
0.15	3.46a	7.47a	11.77a	0.31c	2.07a	0.991a	0.116
0.20	3.46a	7.47a	11.87a	0.31cd	1.77b	0.991a	0.121
0.25	3.46a	7.47a	11.77a	0.30d	1.77b	0.991a	0.126

Means with the same letter are not significantly different at 95%.

Table 3-1 Chemistry analysis of Cabernet sauvignon wine (Fermaid E)

Fermaid E (g/l)	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigment coloration (%)
0.00	31.67a	22.43a	18.17c	24.17a
0.10	31.20ab	21.53ab	20.27b	26.68a
0.15	29.67b	20.50b	21.73ab	26.87a
0.20	29.33bc	20.30bc	21.80a	26.10a
0.25	28.80c	20.00c	19.40bc	26.17a

Means with the same letter are not significantly different at 95%.

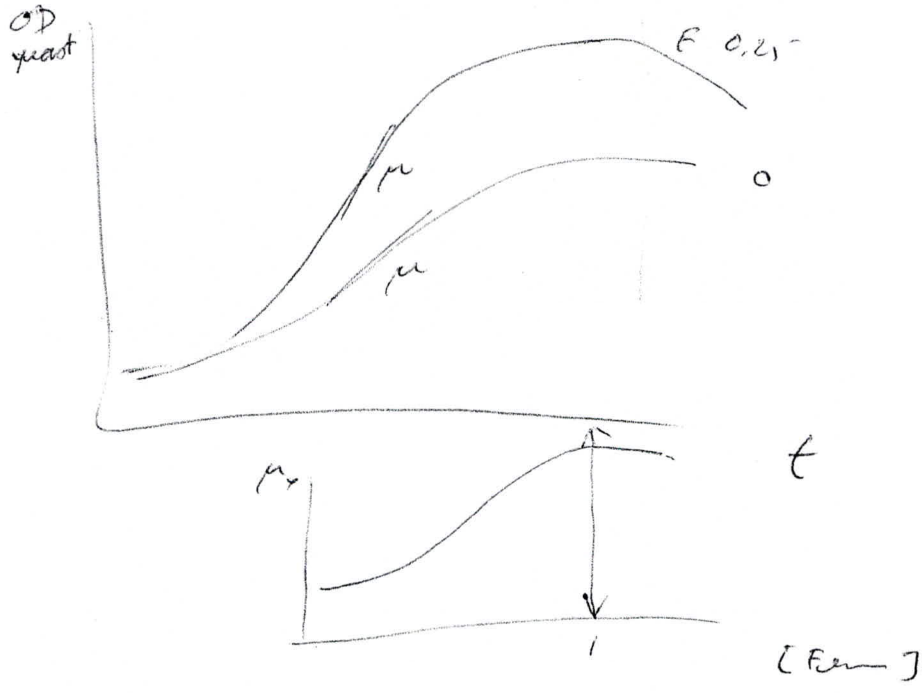


Table 3 - 2 Chemistry analysis of Cabernet sauvignon wine (Fermaid E)

Fermaid E (g/l)	Chemistry analysis			
	Wine color density	Modified wine color density	Wine color hue	Modified wine Color hue
0.00	6.40a	8.30a	0.56b	0.53a
0.10	7.00a	8.67a	0.60b	0.50a
0.15	7.13a	8.47a	0.61ab	0.48a
0.20	6.93a	6.03a	0.56b	0.51a
0.25	6.43a	8.07a	0.66a	0.54a

Means with the same letter are not significantly different at 95%.

Table 3-3 Chemistry analysis of Cabernet sauvignon wine (Fermaid E)

Fermaid E (g/l)	Chemistry analysis	
	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
0.00	1.19b	1.19b
0.10	1.47ab	1.47ab
0.15	1.78a	1.78a
0.20	1.37b	1.37b
0.25	1.13b	1.13b

Means with the same letter are not significantly different at 95%.

Table 4 Chemistry analysis of Merlot wine (Fermaid E)

Fermaid E (g/l)	Chemistry analysis					
	pH	TA (g/l)	Alc. (% v/v)	VA (g/l)	RS (g/l)	SG
0.00	3.49a	6.87a	11.77a	0.38b	2.57a	0.992a
0.10	3.49a	6.87a	11.77a	0.43a	2.53a	0.991a
0.15	3.50a	6.90a	11.83a	0.43a	2.57a	0.991a
0.20	3.49a	6.87a	11.77a	0.32c	2.23b	0.992a
0.25	3.49a	6.87a	11.87a	0.37c	2.10b	0.992a

Means with the same letter are not significantly different at 95%.

Table 4-1 Chemistry analysis of Merlot wine (Fermaid E)

Fermaid E (g/l)	Chemistry analysis			
	Total phenolics (a.u.)	Total red pigments (a.u.)	Degree of red pigment coloration (%)	Modified degree of red pigment coloration (%)
0.00	32.10a	13.17a	49.33a	24.17a
0.10	32.77a	14.00a	42.53a	26.68a
0.15	29.53a	14.30a	45.63a	26.87a
0.20	29.53a	14.47a	42.53a	26.10a
0.25	31.67a	15.00a	39.17a	26.17a

Means with the same letter are not significantly different at 95%.

Table ~~3~~4 - 2 Chemistry analysis of Merlot wine (Fermaid E)

Fermaid E (g/l)	Chemistry analysis			
	Wine color density	Modified wine color density	Wine color hue	Modified wine Color hue
0.00	10.07a	9.93a	0.56a	0.58a
0.10	10.00a	9.57a	0.61a	0.58a
0.15	9.97a	9.43a	0.54a	0.56a
0.20	9.70a	9.10a	0.61a	0.57a
0.25	9.33a	8.90a	0.59a	0.57a

Means with the same letter are not significantly different at 95%.

Table ~~3~~4-3 Chemistry analysis of Merlot wine (Fermaid E)

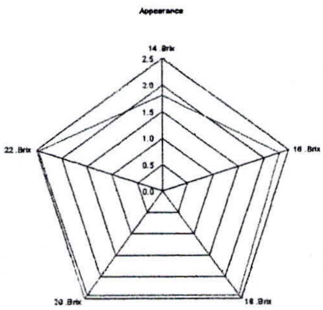
Fermaid E (g/l)	Chemistry analysis	
	Estimate of SO2 resistant pigments (a.u.)	Modified estimate of SO2 resistant pigments (a.u.)
0.00	2.80a	2.80a
0.10	2.77a	2.77a
0.15	2.53a	2.53a
0.20	2.22a	2.22a
0.25	2.12a	2.12a

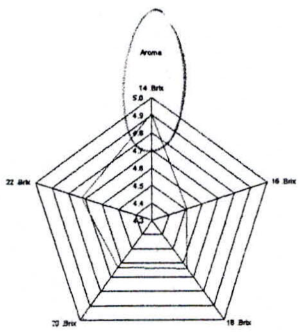
Means with the same letter are not significantly different at 95%.

Table 1 Wine evaluation scoring of Cabernet sauvignon wine that fermentation at different total soluble solid.

Brix	Wine evaluation					
	Appearance (3 pts.)	Aroma (6 pts.)	Taste (6 pts.)	Aftertaste (3 pts.)	Overall (2 pts.)	Total (20 pts.)
14	1.81c	4.19b	3.38c	1.83c	1.20c	12.86c
16	2.32b	4.51ab	4.41b	2.10b	1.40b	14.71b
18	2.42a	4.67a	4.61a	2.17a	1.47a	15.31a
20	2.42a	4.64a	4.58a	2.15ab	1.47ab	15.25a
22	2.46a	4.72a	4.65a	2.18a	1.50a	15.51a

Means with the same letter are not significantly different at 95%.





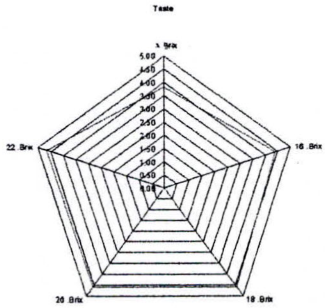


Table 2 Wine evaluations scoring of Merlot wine that fermentation at different total soluble solid.

Brix	Chemistry analysis					
	Appearance (3 pts.)	Aroma (6 pts.)	Taste (6 pts.)	Aftertaste (3 pts.)	Overall (2 pts.)	Total (20 pts.)
14	2.16c	4.17b	4.18b	1.97b	1.37b	13.89b
16	2.25b	4.27ab	4.19b	2.02ab	1.40b	14.14b
18	2.33a	4.40a	4.42a	2.09a	1.51a	14.78a
20	2.40a	4.60a	4.47a	2.11a	1.50a	15.04a
22	2.39a	4.53a	4.50a	2.15a	1.50a	15.06a

Means with the same letter are not significantly different at 95%.

Table 3 Wine evaluation scoring of Cabernet sauvignon wine that fermentation at different quantity of nutrient (Fermaid E).

Brix	Wine evaluation					
	Appearance (3 pts.)	Aroma (6 pts.)	Taste (6 pts.)	Aftertaste (3 pts.)	Overall (2 pts.)	Total (20 pts.)
14	2.43a	4.64a	4.56a	2.09a	1.52a	15.25a
16	2.43a	4.65a	4.54a	2.09a	1.49a	15.20a
18	2.42a	4.63a	4.56a	2.07a	1.51a	15.19a
20	2.43a	4.63a	4.54a	2.08a	1.51ab	15.20a
22	2.42a	4.75a	4.57a	2.10a	1.52a	15.26a

Means with the same letter are not significantly different at 95%.

Table 4 Wine evaluation scoring of Merlot wine that fermentation at different quantity of nutrient (Fermaid E).

Brix	Wine evaluation					
	Appearance (3 pts.)	Aroma (6 pts.)	Taste (6 pts.)	Aftertaste (3 pts.)	Overall (2 pts.)	Total (20 pts.)
14	2.40a	4.64a	4.56a	2.03a	1.44a	15.25a
16	2.41a	4.65a	4.58a	2.01a	1.45a	15.20a
18	2.43a	4.63a	4.60a	2.02a	1.43a	15.19a
20	2.41a	4.63a	4.55a	2.05a	1.44ab	15.20a
22	2.42a	4.65a	4.58a	2.02a	1.46a	15.26a

Means with the same letter are not significantly different at 95%.

การทดลองที่ 1

ปริมาณน้ำตาลที่ระดับต่างๆ กัน ที่มีผลต่อคุณภาพของไวน์ Cab and Mer

Variety	Treat.	Code	Rep	escripti	Day1		Day2		Day3		Day4		Day5		Day6		Day7		Day8		Day9		Day10		Day11	
					Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix
Cab	1	A1B1	2CA1	14 Brix	18.5	22.0	17.0	18.2	16.5	13.5	15.5	8.4	14.0	4.9	13.5	2.7	14.0	1.0	13.5	0.2	14.0	-0.1				
			2CA2	14 Brix	18.5	22.0	18.0	18.8	15.5	13.7	15.5	8.4	14.0	4.7	13.5	2.4	14.0	0.9	13.0	0.1	14.0	-0.2				
			2CA3	14 Brix	19.0	22.0	16.5	19.0	15.5	15.0	15.5	9.2	14.0	5.4	13.5	3.0	14.0	1.2	13.0	0.3	14.0	-0.2				
	2.0	A1B2	2CB1	16 Brix	18.0	22.0	17.0	13.0	14.5	8.3	16.0	3.3	14.0	0.7	14.0	0.1	14.0	-0.1								
			2CB2	16 Brix	18.5	22.0	17.0	12.5	16.0	7.7	16.0	2.7	13.5	0.4	14.0	0.1	14.0	-0.2								
			2CB3	16 Brix	18.0	22.0	16.5	12.6	15.5	8.0	16.0	2.9	13.5	0.6	13.5	0.1	14.0	-0.1								
	3	A1B3	2CC1	18 Brix	18.5	22.0	17.5	16.7	15.0	13.5	16.0	9.8	15.5	5.3	14.5	3.4	14.0	1.6	14.0	0.8	14.0	0.1	13.5	-0.1		
			2CC2	18 Brix	18.5	22.0	18.0	16.5	15.5	13.3	15.5	9.9	15.5	5.5	14.5	3.2	14.0	1.6	14.0	0.7	14.0	0.1	14.0	-0.3		
			2CC3	18 Brix	18.5	22.0	17.0	17.2	15.0	14.2	16.0	10.7	15.5	6.6	14.5	4.0	14.0	2.3	14.0	1.7	14.0	0.6	13.5	0.2		
	4	A1B4	2CD1	20 Brix	19.0	22.0	17.5	17.2	15.5	14.3	15.0	10.1	15.5	8.9	14.5	4.1	14.5	1.6	14.0	0.8	13.0	0.1	13.0	-0.1		
			2CD2	20 Brix	19.0	22.0	18.0	17.0	15.0	14.5	15.0	10.1	15.0	8.9	14.5	4.0	14.5	1.6	14.0	0.8	13.0	0.0	13.0	0.0		
			2CD3	20 Brix	19.0	22.0	18.0	17.3	15.0	14.0	15.5	10.7	15.5	8.8	14.0	4.1	14.5	1.9	14.0	0.9	13.0	0.0	13.0	0.0		
	5	A1B5	2CE1	22 Brix	19.0	22.0	18.0	19.1	16.0	15.2	16.0	14.0	15.5	11.6	14.5	6.5	14.5	4.4	14.5	3.4	14.0	0.7	13.0	0.2		
			2CE2	22 Brix	19.0	22.0	18.0	19.4	15.5	16.0	16.5	13.5	15.0	11.4	15.0	6.1	14.5	4.1	14.5	3.1	14.0	1.0	13.0	0.3		
			2CE3	22 Brix	18.5	22.0	17.5	19.5	15.5	15.6	15.0	13.6	15.0	11.5	15.0	6.8	14.5	4.4	14.5	3.3	14.0	1.1	13.0	0.3		
Merlot	1	A2B1	2MA1	14 Brix	17.5	22.0	15.0	19.5	14.5	14.6	14.5	8.8	14.0	3.9	14.0	1.7	14.5	0.3	13.0	-0.2						
			2MA2	14 Brix	3.4	22.0	15.0	18.1	14.5	13.9	14.5	9.0	14.0	4.0	14.0	1.5	14.0	0.4	13.0	-0.2						

			2MA3	14 Brix	18.0	22.0	15.0	18.3	14.5	14.2	14.5	9.0	14.0	4.1	14.0	1.7	14.0	0.2	13.0	-0.4						
	2	A2B2	2MB1	16 Brix	17.5	22.0	15.0	17.0	14.0	12.4	14.5	7.3	13.5	3.3	13.0	1.0	13.0	0.0	14.0	0.1	13.0	-0.3				
			2MB2	16 Brix	17.5	22.0	16.0	17.2	14.0	12.5	14.5	7.6	13.5	3.3	13.0	1.0	13.0	0.2	13.0	0.0	13.0	-0.1				
			2MB3	16 Brix	17.0	22.0	16.0	17.3	14.0	12.8	14.0	7.6	13.5	3.4	14.0	1.3	13.0	0.2	14.0	-0.1						
	3	A2B3	2MC1	18 Brix	17.0	22.0	15.5	18.6	15.5	14.1	14.5	10.0	14.0	7.0	14.0	4.2	13.0	2.3	13.0	1.3	13.5	0.4	14.5	0.1		
			2MC2	18 Brix	17.0	22.0	16.0	18.4	16.0	13.6	14.5	9.6	14.0	6.3	14.0	4.1	13.5	2.2	13.0	1.2	13.5	0.1	13.5	-0.1		
			2MC3	18 Brix	17.0	22.0	16.0	18.3	15.0	14.2	14.5	9.7	14.0	6.4	13.5	4.3	13.5	2.4	13.0	1.3	13.5	0.4	13.0	-0.2		
	4	A2B4	2MD1	20 Brix	17.0	22.0	15.5	18.7	14.5	15.4	15.5	11.0	15.0	8.2	15.0	5.9	14.5	4.0	14.5	2.3	14.5	1.2	13.5	0.1	13.5	-0.2
			2MD2	20 Brix	17.5	22.0	16.0	19.0	16.0	15.2	15.5	11.5	14.5	8.3	14.5	6.1	14.5	4.2	14.5	2.4	14.5	1.1	13.0	0.1	13.5	-0.2
			2MD3	20 Brix	17.5	22.0	16.0	19.0	15.5	15.5	15.5	11.3	15.0	8.3	14.5	6.0	14.5	4.1	14.5	2.5	14.5	1.3	13.5	0.2	13.5	-0.1
	5	A2B5	2ME1	22 Brix	17.5	22.0	15.5	20.6	14.5	17.5	14.5	12.5	13.5	8.8	14.5	6.8	14.0	3.5	15.0	1.7	14.5	0.7	13.5	-0.1		
			2ME2	22 Brix	17.5	22.0	15.5	21.0	15.0	16.9	15.0	12.5	14.0	9.1	14.5	6.2	14.5	3.5	14.5	1.7	14.0	0.6	14.0	0.3	13.5	-0.2
			2ME3	22 Brix	17.0	22.0	15.5	20.8	15.0	16.4	14.5	12.3	14.0	9.2	14.5	6.4	14.0	3.7	14.5	2.0	14.0	0.7	13.5	0.1	13.5	-0.1

การทดลองที่ 2

ปริมาณ Fermaid E ที่ระดับต่างๆ กัน ที่มีผลต่อคุณภาพของไวน์ Cab and Mer

Variety	Treat.	Code	Rep	Description	Day1		Day2		Day3		Day4		Day5		Day6		Day7		Day8		Day9		Day10		Day
					Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.
Cab	1	A1B1	CA1	Fermaid E 0.0 g/l	16.0	22.0	18.0	20.1	18.0	14.2	16.0	9.0	14.5	5.4	15.0	2.5	14.0	0.9	14.0	-0.3					
			CA2	Fermaid E 0.0 g/l	17.0	22.0	18.0	20.4	18.0	14.3	16.0	8.6	14.5	5.5	14.5	2.5	14.0	0.9	14.0	-0.2					
			CA3	Fermaid E 0.0 g/l	16.5	22.0	17.0	19.4	19.0	15.3	16.0	9.5	14.5	5.8	14.5	2.7	13.5	1.1	14.0	0.0	13.5	-0.4			
	2	A1B2	CB1	Fermaid E 0.10 g/l	18.0	22.0	18.0	20.1	18.0	14.3	17.0	8.3	14.5	4.4	14.5	2.0	13.0	0.4	13.5	-0.3					
			CB2	Fermaid E 0.10 g/l	18.0	22.0	18.0	19.9	18.5	14.1	16.0	7.7	14.0	4.4	14.5	1.8	13.0	0.2	13.0	-0.2					
			CB3	Fermaid E 0.10 g/l	18.0	22.0	17.0	19.2	18.0	14.2	16.0	8.7	14.5	5.4	14.5	2.5	13.5	0.7	13.0	-0.2					
	3	A1B3	CC1	Fermaid E 0.15 g/l	18.0	22.0	19.0	21.1	18.0	14.4	17.0	8.5	15.0	5.0	14.5	2.3	14.0	0.8	13.5	-0.3					
			CC2	Fermaid E 0.15 g/l	18.5	22.0	19.0	19.0	18.5	14.1	17.0	7.6	15.0	4.1	14.5	1.6	13.0	0.3	13.5	-0.3					
			CC3	Fermaid E 0.15 g/l	17.0	22.0	18.0	18.6	18.0	14.2	16.0	8.3	14.5	4.8	14.0	2.1	13.5	0.5	14.0	-0.2					
	4	A1B4	CD1	Fermaid E 0.20 g/l	18.0	22.0	18.0	19.0	18.0	12.2	17.0	7.3	14.5	4.1	14.0	1.7	13.5	0.1	14.0	-0.3					
			CD2	Fermaid E 0.20 g/l	18.0	22.0	19.0	19.0	18.0	13.3	16.0	7.9	15.0	4.7	14.0	2.0	14.0	0.0	14.0	-0.1					
			CD3	Fermaid E 0.20 g/l	18.0	22.0	19.0	20.5	17.0	14.7	16.0	8.8	15.0	5.1	14.0	2.3	14.0	0.4	13.5	-0.3					
	5	A1B5	CE1	Fermaid E 0.25 g/l	18.0	22.0	19.0	17.6	16.0	10.9	15.0	6.9	14.5	3.8	14.0	1.7	13.5	0.0	13.5	-0.3					
			CE2	Fermaid E 0.25 g/l	18.0	22.0	19.0	18.7	17.0	12.1	15.0	7.4	14.5	4.5	14.0	2.0	13.5	0.0	14.0	-0.2					
			CE3	Fermaid E 0.25 g/l	17.5	22.0	18.0	19.8	19.0	17.2	15.0	11.2	14.5	6.6	14.0	3.3	13.5	1.1	14.0	-0.2					
Merlot	1	A2B1	MA1	Fermaid E 0.0 g/l	16.0	22.0	16.0	21.5	15.0	17.6	14.5	13.6	14.5	10.3	14.0	8.2	14.0	6.0	14.0	4.1	14.5	2.8	14.5	1.5	15.0
			MA2	Fermaid E 0.0 g/l	16.0	22.0	16.5	21.0	15.5	17.4	14.5	13.5	14.5	10.1	14.0	7.8	14.5	5.6	14.0	4.0	14.5	2.4	14.5	1.3	14.5
			MA3	Fermaid E 0.0 g/l	15.5	22.0	16.0	21.0	15.0	19.0	14.5	14.3	14.0	11.0	14.0	8.8	14.5	6.3	14.0	4.8	14.0	3.1	13.0	1.9	14.0
	2	A2B2	MB1	Fermaid E 0.10 g/l	15.5	22.0	16.0	20.6	16.0	18.2	15.0	13.2	14.5	9.6	15.0	7.4	14.5	5.2	14.0	3.4	14.0	1.9	14.0	1.2	14.0
			MB2	Fermaid E 0.10 g/l	16.0	22.0	16.5	21.4	16.0	16.6	15.0	12.5	14.5	9.5	14.5	7.6	14.5	5.7	14.0	4.1	14.0	2.6	13.5	2.1	14.0
			MB3	Fermaid E 0.10 g/l	16.5	22.0	16.5	20.4	16.0	19.0	15.0	13.6	14.5	10.2	14.5	8.0	14.5	5.6	14.0	3.9	14.0	2.2	13.5	1.3	14.0

	3	A2B3	MC1	Fermaid E 0.15 g/l	17.0	22.0	16.5	20.1	16.5	17.6	16.0	12.4	14.5	9.0	14.5	7.1	14.5	4.5	14.0	3.1	14.5	1.4	14.0	0.5	14.5
			MC2	Fermaid E 0.15 g/l	17.5	22.0	16.0	19.8	16.0	16.4	15.5	12.4	14.5	9.2	14.5	7.2	14.5	5.1	14.0	3.7	14.5	2.3	14.0	1.4	14.0
			MC3	Fermaid E 0.15 g/l	17.0	22.0	16.0	20.0	15.5	16.0	15.0	12.5	14.5	9.4	14.5	7.1	14.5	5.2	14.0	3.6	14.5	2.4	14.0	1.6	14.0
	4	A2B4	MD1	Fermaid E 0.20 g/l	17.5	22.0	16.5	19.5	16.0	17.6	15.5	13.0	14.5	9.7	14.5	7.5	14.5	5.4	14.5	3.9	14.5	2.5	14.5	1.3	14.5
			MD2	Fermaid E 0.20 g/l	17.5	22.0	16.5	21.0	16.0	17.1	15.5	13.2	14.5	10.5	14.0	8.4	14.5	6.3	14.0	4.3	14.5	3.6	14.0	2.5	14.5
			MD3	Fermaid E 0.20 g/l	16.5	22.0	16.5	19.6	16.0	17.0	15.5	13.0	14.5	9.8	14.0	7.6	14.5	5.5	14.0	4.0	14.5	2.5	14.5	1.2	14.0
	5	A2B5	ME1	Fermaid E 0.25 g/l	17.5	22.0	16.0	19.7	16.0	15.4	15.0	11.7	14.5	8.9	14.0	6.8	14.5	5.0	14.0	3.6	14.5	2.3	14.0	1.5	14.0
			ME2	Fermaid E 0.25 g/l	17.0	22.0	16.0	20.1	15.5	14.6	15.0	10.5	14.5	7.4	14.0	5.5	14.5	3.6	14.0	2.0	14.0	0.6	14.0	0.0	14.0
			ME3	Fermaid E 0.25 g/l	16.0	22.0	16.0	21.0	15.5	15.6	14.5	11.9	14.5	9.3	14.0	7.3	14.5	5.3	14.0	3.8	14.0	2.4	14.0	1.8	13.5

11	Day12		Day13		Day14		Day15	
Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix	Temp.	Brix
0.5	14.0	0.1	13.5	-0.3				
0.1	14.0	-0.2						
0.9	14.0	0.4	14.0	-0.1				
0.5	14.5	0.0	13.5	-0.3				
1.3	14.5	0.8	13.5	0.4	13.5	0.0	13.0	-0.1
0.5	14.0	0.1	14.0	-0.2				

0.0	14.0	-0.3						
0.9	14.0	0.4	13.5	-0.1				
1.1	14.0	0.6	13.5	0.2	13.5	-0.2		
0.5	14.5	0.0	13.5	-0.3				
1.5	14.0	1.0	14.0	0.5	13.0	0.2	13.0	-0.3
0.3	14.0	0.0	14.0	-0.2				
1.0	13.5	0.5	13.5	0.1				
-0.1	14.0							
1.3	14.5	0.7	14.0	0.6				

Variety	Treat.	Code	Rep	Description	Temp	Brix	SG	pH	TA	Alc	FSO2	TSO2	VA	RS	ML Com. %
Cab	1	A1B1	2CA1	14 Brix		- 0.1		3.15	10.6	11.6					
			2CA2	14 Brix		- 0.1		3.05	11.6	11.2					
			2CA3	14 Brix		- 0.1		3.08	8.7	11.2			0.3		
	2.0	A1B2	2CB1	16 Brix				3.24	7.5	7.8	-	2.5	0.3		100
			2CB2	16 Brix				3.23	7.6	7.8	-	2.5	0.3		100
			2CB3	16 Brix				3.23	7.6	7.8	-	2.1	0.3		100
	3	A1B3	2CC1	18 Brix											
			2CC2	18 Brix		- 0.1		3.32	8.7	12.1	-	2.5	0.4		
			2CC3	18 Brix				3.27	8.6	11.4					
	4	A1B4	2CD1	20 Brix				3.20	9.3	10.4	-	2.1	0.2		
			2CD2	20 Brix				3.21	9.3	10.3	-	2.4	0.2		
			2CD3	20 Brix				3.19	9.2	9.3	-	2.4	0.2		
	5	A1B5	2CE1	22 Brix				3.23	9.8	11.4	-	1.6	0.2		
			2CE2	22 Brix				3.21	9.2	11.8	-	3.2	0.2		
			2CE3	22 Brix				3.21	9.9	12.1	-	1.6	0.2		
Merlot	1	A2B1	2MA1	14 Brix		- 0.1		3.34	8.6	13.1	-	2.3	0.7		
			2MA2	14 Brix		- 0.1		3.23	8.4	12.6			0.6		
			2MA3	14 Brix		- 0.1		3.23	8.6	12.5			0.6		
	2	A2B2	2MB1	16 Brix		- 0.1		3.35	8.3	12.3					100
			2MB2	16 Brix		- 0.1		3.43	7.6	12.1	-	2.4	0.7		95
			2MB3	16 Brix		- 0.1		3.23	8.9	11.7			0.6		90
	3	A2B3	2MC1	18 Brix				3.33	8.7	10.8					100
			2MC2	18 Brix		- 0.1		3.35	8.4	11.2					
			2MC3	18 Brix											
	4	A2B4	2MD1	20 Brix				3.28	6.5	11.4			0.3		
			2MD2	20 Brix				3.34	6.6	11.4			0.3		
			2MD3	20 Brix				3.33	7.2	10.7			0.2		
	5	A2B5	2ME1	22 Brix				3.38	8.7	12.6	-	2.3	0.3		
			2ME2	22 Brix				3.39	7.8	12.2	-	2.5	0.2		
			2ME3	22 Brix				3.32	7.9	12.1			0.3		
Variety	Treat.	Code	Rep	Description	Temp	Brix	SG	pH	TA	Alc	FSO2	TSO2	VA	RS	ML Com.

Cab	1	A1B1	CA1	Fermaid E 0.0 g/l				3.23	10.7	12.1			0.3		
			CA2	Fermaid E 0.0 g/l				3.24	10.0	13.1			0.2		
			CA3	Fermaid E 0.0 g/l		- 0.6	1.0	3.22	10.8	12.6	-	4.1	0.3		
	2	A1B2	CB1	Fermaid E 0.10 g/l				3.25	10.3	12.8			0.2		
			CB2	Fermaid E 0.10 g/l				3.20	10.5	12.1			0.2		
			CB3	Fermaid E 0.10 g/l				3.24	10.3	12.1			0.2		
	3	A1B3	CC1	Fermaid E 0.15 g/l				3.20	10.0	12.6			0.3		
			CC2	Fermaid E 0.15 g/l				3.32	10.5	11.8			0.2		
			CC3	Fermaid E 0.15 g/l				3.19	10.3	11.8			0.3		
	4	A1B4	CD1	Fermaid E 0.20 g/l				3.19	8.2	11.6			0.2		
			CD2	Fermaid E 0.20 g/l				3.24	10.7	12.6			0.2		
			CD3	Fermaid E 0.20 g/l											
	5	A1B5	CE1	Fermaid E 0.25 g/l				3.22	9.8	13.1			0.2		
			CE2	Fermaid E 0.25 g/l				3.24	10.5	12.4			0.2		
			CE3	Fermaid E 0.25 g/l				3.25	9.8	12.3			0.2		
Merlot	1	A2B1	MA1	Fermaid E 0.0 g/l				3.37	8.3	13.5			0.3		
			MA2	Fermaid E 0.0 g/l				3.35	8.8	13.5			0.3		
			MA3	Fermaid E 0.0 g/l				3.37	9.4	13.3			0.3		
	2	A2B2	MB1	Fermaid E 0.10 g/l				3.38	8.4	13.1			0.3		
			MB2	Fermaid E 0.10 g/l				3.35	8.3	12.1	-	0.2	0.3		
			MB3	Fermaid E 0.10 g/l				3.37	7.3	12.6	-	0.3	0.3		
	3	A2B3	MC1	Fermaid E 0.15 g/l											
			MC2	Fermaid E 0.15 g/l				3.36	9.8	13.2			0.3		
			MC3	Fermaid E 0.15 g/l				3.42	8.3	13.0			0.3		
	4	A2B4	MD1	Fermaid E 0.20 g/l				3.35	8.2	13.8			0.3		
			MD2	Fermaid E 0.20 g/l				3.40	9.6	14.0			0.3		
			MD3	Fermaid E 0.20 g/l				3.35	9.0	13.6			0.3		
	5	A2B5	ME1	Fermaid E 0.25 g/l											
			ME2	Fermaid E 0.25 g/l				3.32	8.9	12.6					
			ME3	Fermaid E 0.25 g/l											

ผลการทดลองการสกัดสีโดยใช้เอนไซม์ Zafizyme col plus และ Rapidase ex color ที่อุณหภูมิต่างๆ กัน

Cabernet Sauvignon

Enzyme	Grape weight	Temp.	Rep.	Chemistry analysis			Color by Spectophotometry	
	(g)	(.C)		Brix	pH	TA (g/l)	420 nm	520 nm
Control	250	10	1	18.0	3.40	6.50	0.049	0.132
	250		2	18.0	3.40	6.40	0.047	0.222
	250		3	18.0	3.40	6.50	0.045	0.133
Control	250	20	1	18.0	3.36	7.40	0.051	0.126
	250		2	18.0	3.36	7.50	0.046	0.118
	250		3	18.0	3.36	7.40	0.049	0.131
Control	250	30	1	18.0	3.35	8.40	0.075	0.179
	250		2	18.0	3.36	8.30	0.070	0.202
	250		3	18.0	3.36	8.30	0.069	0.210
Control	250	40	1	18.0	3.35	7.20	0.116	0.323
	250		2	18.0	3.35	7.20	0.125	0.367
	250		3	18.0	3.35	7.30	0.114	0.332
Control	250	50	1	18.2	3.39	9.50	0.162	0.551
	250		2	18.0	3.39	9.50	0.185	0.582
	250		3	18.0	3.39	9.40	0.178	0.499
Safizym Col Plus	250	10	1	17.5	3.40	7.80	0.040	0.143
	250		2	17.5	3.40	7.90	0.043	0.137
	250		3	17.5	3.40	8.20	0.035	0.112
Safizym Col Plus	250	20	1	17.5	3.40	8.40	0.051	0.148
	250		2	17.5	3.40	8.40	0.050	0.146
	250		3	17.5	3.40	8.60	0.049	0.147
Safizym Col Plus	250	30	1	17.5	3.42	8.50	0.068	0.277
	250		2	17.5	3.42	8.70	0.068	0.221

	250		3	17.5	3.42	8.80	0.071	0.219
Safizym Col Plus	250	40	1	17.5	3.38	8.70	0.099	0.325
	250		2	17.5	3.38	8.80	0.098	0.324
	250		3	17.5	3.38	8.50	0.980	0.325
Safizym Col Plus	250	50	1	17.5	3.39	8.40	0.136	0.391
	250		2	17.5	3.39	8.30	0.126	0.446
	250		3	17.5	3.39	8.60	0.035	0.395
Rapidase EX Color	250	10	1	17.0	3.34	9.00	0.049	0.163
	250		2	17.0	3.34	9.20	0.054	0.169
	250		3	17.0	3.34	9.40	0.053	0.168
Rapidase EX Color	250	20	1	17.0	3.37	9.50	0.065	0.145
	250		2	17.0	3.37	9.40	0.066	0.148
	250		3	17.0	3.37	9.20	0.065	0.145
Rapidase EX Color	250	30	1	17.0	3.35	8.50	0.057	0.207
	250		2	17.0	3.35	8.70	0.068	0.217
	250		3	17.0	3.35	8.80	0.058	0.208
Rapidase EX Color	250	40	1	17.5	3.37	8.40	0.100	0.329
	250		2	17.5	3.37	8.60	0.100	0.347
	250		3	17.5	3.37	8.90	0.098	0.335
Rapidase EX Color	250	50	1	17.0	3.38	8.50	0.036	0.408
	250		2	17.0	3.38	8.70	0.035	0.409
	250		3	17.0	3.38	8.30	0.028	0.385

ผลการทดลองการสกัดสีโดยใช้เอนไซม์ **Zafizyme col plus** และ **Rapidase ex color** ที่อุณหภูมิต่างๆ กัน

Merlot

Enzyme	Grape weight	Temp.	Rep.	Chemistry analysis			Color by Spectophotometry	
	(g)	(.C)		Brix	pH	TA (g/l)	420 nm	520 nm
Control	250	10	1	18.5	3.51	5.9	0.132	0.335
	250		2	18.7	3.52	5.9	0.142	0.352
	250		3	18.2	3.51	5.9	0.14	0.345
Control	250	20	1	18.5	3.5	6.3	0.113	0.292
	250		2	18.5	3.5	6.3	0.123	0.321
	250		3	18.0	3.51	6.3	0.109	0.283
Control	250	30	1	18.7	3.54	6.9	0.128	0.331
	250		2	18.5	3.54	6.9	0.117	0.306
	250		3	18.7	3.49	6.9	0.13	0.332
Control	250	40	1	19.0	3.58	6.5	0.164	0.402
	250		2	18.5	3.57	6.5	0.213	0.442
	250		3	18.6	3.58	6.5	0.143	0.374
Control	250	50	1	20.0	3.61	7.2	0.162	0.412
	250		2	19.5	3.57	7.2	0.147	0.382
	250		3	19.0	3.58	7.2	0.164	0.415
Safizym Col Plus	250	10	1	18.2	3.5	5.9	0.11	0.255
	250		2	18.0	3.51	5.9	0.129	0.326
	250		3	18.3	3.53	5.9	0.126	0.273
Safizym Col Plus	250	20	1	18.5	3.53	6.6	0.119	0.305
	250		2	18.2	3.51	6.6	0.101	0.251
	250		3	18.0	3.52	6.6	0.097	0.266
Safizym Col Plus	250	30	1	18.6	3.53	6.9	0.129	0.382
	250		2	18.0	3.53	6.9	0.107	0.277
	250		3	18.0	3.54	6.9	0.117	0.305
Safizym Col Plus	250	40	1	18.5	3.56	6.4	0.137	0.362
	250		2	18.5	3.55	6.4	0.125	0.378

	250		3	19.0	3.55	6.4	0.164	0.361
Safizym Col Plus	250	50	1	19.0	3.58	6.5	0.127	0.371
	250		2	18.5	3.58	6.5	0.138	0.367
	250		3	18.5	3.59	6.5	0.134	0.345
Rapidase EX Color	250	10	1	18.0	3.44	5.8	0.107	0.29
	250		2	18.0	3.44	5.8	0.105	0.248
	250		3	18.3	3.52	5.8	0.089	0.237
Rapidase EX Color	250	20	1	18.0	3.53	6.2	0.119	0.311
	250		2	18.2	3.52	6.2	0.118	0.304
	250		3	18.0	3.53	6.2	0.12	0.307
Rapidase EX Color	250	30	1	18.5	3.57	7.2	0.113	0.315
	250		2	18.5	3.60	7.2	0.12	0.359
	250		3	18.7	3.54	7.2	0.123	0.327
Rapidase EX Color	250	40	1	18.6	3.56	6.8	0.122	0.365
	250		2	18.2	3.55	6.8	0.105	0.326
	250		3	18.5	3.55	6.8	0.135	0.364
Rapidase EX Color	250	50	1	18.5	3.58	7.6	0.139	0.422
	250		2	19.0	3.58	7.6	0.14	0.405
	250		3	18.9	3.59	7.6	0.104	0.356

ผลการทดลองการสกัดสีโดยใช้เอนไซม์ Zafizyme col plus และ Rapidase ex color
ที่อุณหภูมิต่างๆกัน

Variety	Blocks/Rep.	No Enzyme (Control)										Zafizyme col plu					
		10 ˙C		20 ˙C		30 ˙C		40 ˙C		50 ˙C		10 ˙C		20 ˙C		30 ˙C	
		420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm
Cab.S	1	0.049	0.132	0.051	0.126	0.075	0.179	0.116	0.323	0.162	0.551	0.040	0.143	0.051	0.148	0.068	0.277
	2	0.047	0.222	0.046	0.118	0.070	0.202	0.125	0.367	0.185	0.582	0.043	0.137	0.050	0.146	0.068	0.221
	3	0.045	0.133	0.049	0.131	0.069	0.210	0.114	0.332	0.178	0.499	0.035	0.112	0.049	0.147	0.071	0.219
Merlot	1	0.132	0.335	0.113	0.292	0.128	0.331	0.164	0.402	0.162	0.412	0.110	0.255	0.119	0.305	0.129	0.382
	2	0.142	0.352	0.123	0.321	0.117	0.306	0.213	0.442	0.147	0.382	0.129	0.326	0.101	0.251	0.107	0.277
	3	0.140	0.345	0.109	0.283	0.130	0.332	0.143	0.374	0.164	0.415	0.126	0.273	0.097	0.266	0.117	0.305

s				Rapidase ex color									
40 ˙C		50 ˙C		10 ˙C		20 ˙C		30 ˙C		40 ˙C		50 ˙C	
420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm	420 nm	520 nm
0.099	0.325	0.136	0.391	0.049	0.163	0.065	0.145	0.057	0.207	0.100	0.329	0.036	0.408
0.098	0.324	0.126	0.446	0.054	0.169	0.066	0.148	0.068	0.217	0.100	0.347	0.035	0.409
0.980	0.325	0.035	0.395	0.053	0.168	0.065	0.145	0.058	0.208	0.098	0.335	0.028	0.385
0.137	0.362	0.127	0.371	0.107	0.290	0.119	0.311	0.113	0.315	0.122	0.365	0.139	0.422
0.125	0.378	0.138	0.367	0.105	0.248	0.118	0.304	0.120	0.359	0.105	0.326	0.140	0.405
0.164	0.361	0.134	0.345	0.089	0.237	0.120	0.307	0.123	0.327	0.135	0.364	0.104	0.356

เอกสารประกอบวาระที่ 4.3

ส่วนส่งเสริมวิชาการ
รับที่ 684/50
วันที่ - 2 เม.ย. 2550
เวลา 11.45 น.

บันทึกข้อความ

มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สาขาวิชาภาษาอังกฤษ สำนักวิชาเทคโนโลยีสังคม โทรศัพท์ 4213-4 โทรสาร 4205

ที่ ศธ 5612(3) / **วันที่** เมษายน 2550

เรื่อง ส่งเอกสารแปล ข้อบังคับการศึกษาระดับบัณฑิตศึกษา

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① **เรียน** รองอธิการบดีฝ่ายวิชาการ

ข้าพเจ้าขอส่งเอกสารงานแปล ข้อบังคับมหาวิทยาลัยเทคโนโลยีสุรนารี ว่าด้วยการศึกษาขั้นบัณฑิตศึกษา พ.ศ. 2550 จำนวน 1 ชุด ตามที่ได้รับมอบหมายให้ดำเนินการแปล

ในการแปลครั้งนี้ ได้มีอาจารย์ Peter Bint และ ผู้ช่วยศาสตราจารย์ ดร.เอมอร ทัศนศร ช่วยดูแลความถูกต้องทางภาษา เนื้อหาและความกระชับทางภาษา

แต่อย่างไรก็ตาม ผู้แปลยังคิดว่างานแปลนี้ยังคงต้องขัดเกลา อีกครั้งหนึ่ง ดังนั้นถ้ากรรมการสภาวิชาการหรือผู้รู้ จะกรุณาให้ความเห็นเพื่อการแก้ไขเพิ่มเติม จะเป็นพระคุณยิ่ง

จึงเรียนมาเพื่อโปรดพิจารณา

(ผศ.พยอม ก้อนในเมือง)
อาจารย์ประจำสาขาวิชาภาษาอังกฤษ

② เรียน หน. สสว./ผอ.ศบก.
เพื่อโปรดนำเสนอ สภาวิชาการ
เพื่อพิจารณา

(รองศาสตราจารย์ ดร. เสาวณีย์ รัตนพานี)
รองอธิการบดีฝ่ายวิชาการ
- 2 เม.ย. 2550

③ มอบงานสภาวิชาการ
โปรดดำเนินการตาม ②
2 เม.ย. 50
(นางสาวจันทนา พรหมศิริ)
หัวหน้าส่วนส่งเสริมวิชาการ

Regulations for the Graduate Studies, Suranaree University of Technology, B.E. 2550 (2007)

It has been deemed necessary to revise the existing regulations of the Graduate Studies. Consequently by virtue of clause 16(2) and (3) of the University Act of B.E. 2533 (1990), the University Council, Suranaree University of Technology has enacted the regulations of the Graduate Studies, B.E. 2550 (2007) at the University Council 1st meeting on the 3rd Day of February 2550 (2007) with the recommendations of the University Academic Senate, as follows:

Section 1 These regulations are called the "Regulations for the Graduate Studies, B.E. 2550 (2007)"

Section 2 These regulations come into force from the academic year 2550 (2007)

Section 3 The Regulations for the Graduate Studies, B.E. 2545 (2002) are annulled. All existing rules, announcements, and codes of practice contrary to or in conflict with the provisions of these regulations are annulled and henceforth replaced by the following regulations.

Section 4 In these regulations:

"University"	refers to Suranaree University of Technology
"University Council"	refers to the University Council of Suranaree University of Technology
"Academic Senate"	refers to the Academic Senate of Suranaree University of Technology
"Rector"	refers to the Rector of Suranaree University of Technology

"Institutes" refer to the Institutes of Suranaree University of Technology

"Schools" refer to the Schools in the Institutes of Suranaree University of Technology

"Deans" refer to Deans of the Institutes to which students are affiliated

"Chairs of the School" refer to the Chairs of the Schools to which students are affiliated.

"Courses" refer to subjects offered in the programs of Studies at Suranaree University of Technology excluding theses.

"Graduate Instructors for Master's Degree Level" refer to instructors appointed by the University Academic Senate to teach at the Master's Degree level.

"Graduate Instructors for Doctoral Degree Level" refer to instructors appointed by the University Academic Senate to teach at the Doctoral level

"Ph.D. Students" refer to students studying a Doctoral Degree and have not yet passed the Qualifying Examination

"Ph.D. candidates" refer to students studying a Doctoral level who have already passed the Qualifying Examination.

Section 5 The Rector of Suranaree University of Technology is authorized to take charge and control the execution of these regulations. In case of problems from the implementation of these regulations, the Rector's judgment and decision is considered final.

Section 6 Students must conform to the regulations, rules, announcements and codes of practice of the University which are not contrary to or in conflict with these regulations.

Chapter 1

Admission

Section 7 Qualifications of Applicants for Graduate Programs

7.1 Graduate Diploma Program

A Bachelor's Degree or equivalent from an Institution of Higher Education, recognized by the University or a student studying in the last term of the undergraduate program or equivalent in an Institution of Higher Education, recognized by the University and other qualifications as required by the University.

7.2 Master's Degree

7.2.1 An applicant must have a Bachelor's degree or equivalent from an Institution of Higher Education recognized by the University or there is evidence showing that he/she will graduate with a Bachelor's degree or equivalent from an Institution of Higher Education recognized by the University.

7.2.2 The accumulated grade point average must not be less than 2.50 or equivalent or

7.2.3 If item 7.2.2 is not applicable, a grade point average of major subjects in the Master's degree program must not be less than 2.75 or equivalent or have work experience in the field related to field to be studied, with a letter of recommendation from the applicant's organization regarding the applicant's potential to study at graduate level.

7.3 Higher Graduate Diploma Program.

An applicant must hold a Master's degree or equivalent or have A document showing that an applicant will graduate with a Master's degree or equivalent from an institution of Higher Education recognized by the University and other qualifications as required by the University.

7.4 Doctoral Degree Program.

7.4.1 An applicant must hold a Master's degree or equivalent or have a document stating that he/she will graduate with a Master's degree or equivalent from an Institution of Higher Education recognized by the University or

7.4.2 An applicant must hold a bachelor's degree with honors or equivalent from the university or an Institution of Higher Education recognized by the University or a document stating that an applicant will graduate with a Bachelor's degree or equivalent, from an Institute of Higher Education recognized by the University in the same field as that of the Doctoral degree program an applicant is to study, and he/she must have an accumulated grade point average computed from the trimester prior to the term of graduation of no less than the criteria for an honors degree of the institution at which the applicant is studying.

7.4.3 An applicant for the Doctoral program which especially focuses on research must hold a Master's degree in research-based program and have research work published in an academic journal recognized by the School.

7.5 An applicant must not have had his /her student status previously terminated from the program to be studied..

7.6 An applicant must have other qualifications as specified by the University.

7.7 An applicant for any of the programs mentioned above must not have been disqualified from graduate level studies because of being unable to graduate within the due time of the program.

7.8 The Academic Senate, with recommendations from the Institute Committee may exempt an applicant from the qualifications specified above on a case by case basis.

Section 8 Admission

8.1 Admission of students is carried out through an Admission Committee appointed by a Dean with the recommendations of the relevant School.

8.2 Admission means could be written examinations, tests of practical knowledge or other means approved by the Dean with the recommendations of the relevant School.

8.3 Admission is approved by the Institute Committee with the recommendations of the Admission Committee.

8.4 Admission for a Master's Degree Program Scheme A 1 and a Doctoral Degree Scheme 1 which specifically focus on research for Dissertation must be approved by the Academic Senate.

8.5 If the Admission Committee agrees that an applicant applying for a Doctoral Degree Program is not academically ready to enter the program, the School, with the approval of the Institute Committee, may consider accepting the applicant to study in the Master's degree program that the applicant has applied for.

Section 9 Student Registration

9.1 Students who have been accepted by the University will obtain complete student status only when those students are registered by the University.

9.2 Student Registration must follow the procedures required by the University.

Chapter 2

Student Status

Section 10 Student Status

10.1 Students are categorized as follows

- 10.1.1 Regular students refer to those who have been accepted to study without any conditions.
- 10.1.2 Trial students refer to those who have been accepted with certain conditions to study in his/her first trimester.

10.2 Trial students will be accepted as regular students when they meet the required conditions as follows:

- 10.2.1 pass all the undergraduate courses required for the trial conditions with a grade point average of no less than 2.50 but the course credits will neither be calculated in an accumulated grade point average nor counted as credits earned.
- 10.2.2 pass all the graduate courses required for the trial conditions with a grade point average of no less than 3.00

Chapter 3

The Educational System

Section 11 The Educational System

11.1 A trimester credit system is used. An academic year consists of three trimesters of no less than 12 weeks duration in each trimester.

11.2 "Credits" refer to trimester units designating the amount of academic work. One credit for each course is granted according to the following criteria:

- 11.2.1 Lectures or other equivalent modes of teaching of no less than 12 hours per trimester.
- 11.2.2 Laboratory studies, experimental work, training or other equivalent modes of no less than 24 hours per trimester.

11.2.3 Independent study or thesis work of no less than 36 hours per trimester.

11.2.4 Fieldwork practice of no less than 36 hours per trimester.

11.3 "Credits Studied" refer to the number of credits students have registered for in each trimester.

11.4 "Aggregated Credits per trimester" refer to the total number of credits for every subject for which a student has received the grades A B^+ B C^+ C and F in that trimester.

11.5 "Accumulated Credits" refer to the total number of credits for all subjects for which a student has received the grades A B^+ B C^+ C and F. If a student repeats a course, only the credits of the last course are counted.

11.6 "Credits Earned" refer to the total number of credits for all subjects for which a student has received the grades A B^+ B C^+ C or S and the number of credits for a thesis which has been assessed with a "Pass" or "Very Good"

Chapter 4

Type and Structure of Study Programs

Section 12 Type of Study programs

12.1 A Graduate Diploma Program is a program of study leading to academic advancement, professional expertise or efficiency in specific field of studies at a higher level than a Bachelor's degree, but lower than a Master's degree.

12.2 A Master's Degree Program is a program of study leading to academic professional and research advancement at a higher level than a Bachelor's degree aiming at producing academics and professionals who are knowledgeable in the subject areas and competent in conducting research or independent study.

12.3 A Higher Graduate Diploma Program is a program of study leading to academic advancement, professional expertise or proficiency in a specific field of study at a higher level than a Master's degree but lower than a Doctoral degree.

12.4 A Doctoral Program is a program of study leading to academic and research advancement at a higher level than a Master's degree, aiming at producing academics and professionals with a high level of competence especially in conducting research independently for the pursuit of new knowledge and sustained academic progress.

Section 13 The Structure of Study Programs

13.1 A Graduate Diploma Program has a total number of credits of no less than 30.

13.2 A Master's Degree program has a total number of credits of no less than 45. There are two plans for the Master's Degree programs as follows:

(1) Plan A: Research-based program leading to a thesis available in two schemes.

Scheme A1: Conducting research leading to a thesis of no less than 45 credits without taking any courses. However, non-credit courses or academic activities may be required and must be accomplished as prescribed by the School.

Scheme A2: A research-based program leading to a thesis worth no less than 15 credits, and courses of no less than 15 credits must be taken. The total credits must not be less than 45.

(2) Plan B: Course work-based program: A thesis is not required. The aim is to produce knowledgeable academics and well-qualified professionals with wide knowledge which can be applied for the improvement of their work. The syllabus consists of courses of no less than 38 credits, including an independent study or a special project of no less than 4 credits but not exceeding 7 credits. The total number of credits

is 45. Plan B is offered only when there are personnel shortages in the field. To offer this program, approval from the Academic Senate must be obtained.

13.3 A Higher Graduate Diploma Program: The total number of credits is no less than 30.

13.4 A Doctoral Degree Program: The total number of credits is no less than 60 for students continuing their study from a Master's degree and no less than 90 credits for those continuing their study from a Bachelor's degree. This program consists of 2 schemes as follows:

(1) Scheme 1: Research-based scheme leading for a dissertation. No course work is required, but the School may assign additional non-credit courses or other academic activities, without counting the credits earned but students must satisfy the criteria required.

Scheme 1.1 For a student with a Master's degree, the dissertation of no less than 60 credits is required.

(2) Scheme 2: Research-based scheme leading to a dissertation and course work.

Scheme 2.1 For a student with a Master's degree, a dissertation of no less than 45 credits is required and the coursework is no less than 15 credits.

Scheme 2.2 For a student with a Bachelor's degree, the dissertation of no less than 60 credits is required and the course work is no less than 30 credits.

The dissertations mentioned in Scheme 2.1 and Scheme 2.2 must be of the same basic quality and standard.

Chapter 5

Registration

Section 14 Course Registration

14.1 A new student must enroll for courses in his/her first trimester within a period specified by the University. Otherwise, his/her student status lapses and his/her name will be removed from the registration.

14.2 A current student must register within a period specified by the University. Otherwise, they will not be eligible to register for that particular trimester.

14.3 A current student who does not register within a period specified by the University, must take leave of absence under Section 34 and a fee for retaining student status must be paid. Failure to observe this regulation will result in termination of student status.

14.4 A current student who has completed all courses for which they are required to register by the program, but has not yet graduated must ask to retain his/her student status and pay a retaining fee and any other fees specified by the University. Failure to observe this regulation will result in termination of student status.

14.5 The number of credits in each trimester must be as follows.

14.5.1 Course credits of a conditional student under item 10.2.1 and 10.2.2 must be counted as credits studied.

14.5.2 Course credits earned by a student registering as 'visitor' must be counted as credits studied.

14.6 Re- registration

14.6.1 A student who receives grades F U or W in compulsory courses need to re-register for those courses until he/she obtains grades A B^+ B C^+ or S

14.6.2 Students who receive the grades F U or W in the elective courses may re-register so as to earn the grades A B^+ B C^+ or S or other elective courses may be registered for instead with the consent of the academic advisor and the approval of the Chair of the School. The grades obtained the last registration for those course will be used in the calculation of the accumulated grade point average.

14.7 Thesis Registration

14.7.1 A student whose thesis proposal has not yet been approved can register for a thesis of no more than 3 credits per trimester.

14.7.2 A student whose thesis proposal has been approved must register for a thesis of no more than 15 credits per trimester.

14.7.3 If the number of remaining thesis credits is more than the number of credits stated in item 14.7.2, the number of credits a student registers for can exceed the number stipulated.

14.8 Course registration must meet the program requirements and the announcements of the University and with the consent of the advisor.

14.9 A student who may want to register for additional courses which are not required by the program and not conditioned as a trial study must submit the petition to the Center for Educational Services with the consent of the advisor, the instructor and with approval of the Chair of the School. The grades assigned will be either S or U only and the course credits will be counted as credit studied.

14.10 The School may allow other students to register as visitors for certain courses as required by the University.

14.11 Graduate students from other institutions may be permitted by the Academic Senate to register for courses at the University in order to transfer credits and the result of the study is counted as a part of their studying program.

14.12 Students may be permitted by the Institute Committee and the Academic Senate to register for courses offered by other Universities and the thesis advisor agrees that those courses are relevant and beneficial to the thesis. The course credit, then, can be transferred and be part of the study program.

14.13 The total number of credits for courses under item 14.12 must not exceed 1/3 of the number of credits for courses in the students' program being studied. The credits for the thesis are excluded.

14.14 Date, registration procedure, and courses offered should be in accordance with university announcements.

Section 15 Addition, Reduction, and Withdrawal from Courses.

15.1 An addition of courses must be completed within the first 10 days of the trimester.

15.2 Reduction of courses is permitted within the first 5 weeks of the trimester and there will no record of these courses on the transcript.

15.3 Withdrawal can be made after the first 5 weeks of the trimester but no later than the first ten weeks of trimester. The courses withdrawn will be recorded on the transcript.

15.4 The addition and the reduction of courses must be agreed by the advisor. The withdrawal from courses must be approved by the Chair of the School with the recommendation of the advisor and the instructor of that particular course.

Chapter 6

Program Duration

Section 16 Program Duration

16.1 A Graduate Diploma Program takes no more than 9 trimesters.

16.2 A Master's Degree Program takes no more than 15 trimesters.

16.3 A Higher Graduate Diploma Program takes no more than 9 trimesters.

16.4 A Doctoral Degree Program take no more than 18 trimesters for students who continue their study from a Master's degree, and no more than 24 trimesters for those from a Bachelor's degree.

16.5 The duration of study is counted from the first trimester for which students register. Those who do not graduate within the time limit will lose their student status automatically. If students are permitted to change their major or level of study, the duration of study is counted from the trimester in which approval was given. If approval is given after the first two weeks of the trimester or during the trimester break, the duration of study will be counted starting from the following trimester. However, the total duration must not exceed the time required by the University.

Chapter 7

Grading and Evaluation System

Section 17 Grading System

17.1 To evaluate students in each course, grades are used with credit points as follows.

Grades	Meanings	Grade point
A	Excellent	4.00
B^+	Very good	3.50
B	Good	3.00
C^+	Fairly Good	2.50
C	Fair	2.00
F	Fail	0

In some cases, grades the above are not applicable. The following grades will be applied

Grades	Meanings
I	Incomplete
M	Missing
P	In Progress
S	Satisfactory
St	Satisfactory, Transferred credit
U	Unsatisfactory
V	Visitor
W	Withdrawal
X	No report

17.2 Assigning Grades

17.2.1 The grades **A** **B$^+$** **B** **C$^+$** **C** **and** **F** are assigned in the following cases:

(1) To students taking the examination and/or having their academic performance evaluated.

(2) The change of **I** or **M** must be completed and sent to the Center for Educational Services within the first week of the following trimester.

(3) There is a change of **P** or **X**.

17.2.2 Besides assigning an **F** grade as in 17.2.1, an **F** grade is also assigned in the following cases.

(1) If students violate the examination regulations and those who have been given the **F** grade according to item 35.1

(2) If there is an automatic change from **I** or **M** when there is no report of a change from the Institute after the first week of the following trimester.

17.2.3 An **I** grade is assigned to students in the following cases

(1) Absence from an examination due to illness, and the regulation in Section 33 has been observed.

(2) Absence from an examination due to extreme circumstances and with the approval of the Chair of the School

(3) Assignments which are parts of the course have not been completed and an instructor with the recommendations of the Chair of the School agrees to postpone the assessment.

17.2.4 An **M** grade is assigned to students who do not attend the examination and are unable to show evidence clarifying their absence from an examination

17.2.5 A **P** grade is assigned when coursework, the research, thesis work , or project work is not completed within one trimester and there is a continuing study in the next trimester with satisfying progress.

17.2.6 **S** and **U** are assigned when the result of the evaluation is **satisfactory** or **unsatisfactory** respectively for the following courses.

(1) Courses specified by the program to be assessed by **S** or **U**
(2) Courses students registered according to item 14.9
(3) There is a change of grades from **M, P or X**

17.2.7 An **ST** grade is for those courses for which transfer has been approved.

17.2.8 A **V** grade is assigned to students who are allowed to register for courses as visitors, with no less than 80% of attendance, and being very attentive.

17.2.9 A **W** grade can be assigned after the first five weeks of the trimester in the following categories:

(1) Students who have been allowed to withdraw according to item 15.4
(2) Students who could not take the examination due to their illness and the regulation in Section 33 has been observed. The Chair of the School together with the instructor agrees that the course should be withdrawn.
(3) Students who are allowed to take leave of absence for with reasons as stated in item 34.1 and 34.2
(4) Students who are ordered to take leave of absence for other reasons in addition to those stated in item 35.1
(5) The Chair of the School approves the change from **I** grade stated in 17.2.3 (1) and (2) due to illness or extreme circumstances which still continue.
(6) Students on courses for which they register as visitors under item 14.10 and the attendance is less than 80% of the total and the course instructor has justified that students are not attentive.
(7) Students who fail to meet the conditions of the registration of those course..

17.2.10 An **X** is assigned only to the courses which the Center for Educational Services has not received the students' evaluations in a specified period of time.

Chapter 8

Educational Control

Section 18 Graduate Instructors

18.1 Graduate Instructors for Master's degree programs must possess one of the following qualifications.

18.1.1 A Ph.D. degree or equivalent in that particular field or related field of study and with teaching experience.

18.1.2 A Master's degree or equivalent in that particular field or related field of study; and they must have research work other than their own theses.

18.1.3 A Master's degree or equivalent in the particular field or in the related field and must hold an academic title of at least an Assistant Professor.

18.1.4 A specialist who has been approved by the Academic Senate in that particular field or in a related field if that person is not affiliated to any Institution of Higher Education.

18.2 Graduate Instructors for Ph.D. program must posses one of the following qualifications.

18.2.1 A Ph.D. or equivalent in that particular field or a related field; with teaching experience and research work in addition to their own theses.

18.2.2 A Master's degree or equivalent in that particular field or a related field and hold an academic title of at least an Associate Professor and have research work in addition to their own theses.

18.2.3 A specialist who has been approved by the Academic Senate in that particular field or a related field for at least 5 years if that person is not affiliated to any Institution of Higher Education.

18.3 Graduate instructors may teach at lower levels than the level approved.

Section 19 General Advisor

19.1 Must be a permanent instructor and graduate instructor in the School to which students are affiliated.

19.2 Give suggestions and support for making student's study plans in line with the syllabus and the regulations.

19.3 Give advice to students on other matters as necessary and appropriate.

19.4 The Chair of the School will propose the name of an instructor to be appointed as a general advisor promptly.

Section 20 Thesis Advisor

20.1 A thesis advisor for a Master's degree student must be a permanent instructor and graduate instructor of the University at the date being appointed and must have one of the following qualifications.

20.1.1 A Ph.D. degree or equivalent in the field or a related field of the thesis.

20.1.2 A Master's degree or equivalent in the field or a related field of the thesis. and hold an academic title of at least an Associate Professor with research work in addition to his/her thesis.

20.1.3 A specialist who has been approved by the Academic Senate in the field of the thesis.

20.2 A thesis advisor for a Doctoral degree must be a permanent instructor, and graduate instructor of the University at the time being appointed and must have one of the following qualifications.

20.2.1 A Ph.D. degree or equivalent in the field or a related field of the thesis and has research work in addition to his /her own thesis.

20.2.2 A Master's degree or equivalent in the field or a related field of the thesis and hold an academic title at least of Associate Professor and have other research work in addition to his /her own thesis.

20.2.3 A specialist who has been approved by the Academic Senate in the field of the thesis.

20.3 Responsibilities of a Thesis Advisor

20.3.1 To advise students on how to study and conduct research as well as how to deal with problems occurring while students are in the process of studying and conducting research.

20.3.2 To advise students on the writing of an academic thesis and on the use of appropriate language.

20.3.3 To assess students' progress on their theses in each trimester and report the result to the Chair of the School.

20.3.4 To propose students' request for their thesis examination to the Chair of School.

20.3.5 To be a member of the Thesis Examination Committee.

Section 21 Appointing Thesis Advisors or the Thesis Advisory Committee.

21.1 A general advisor and a thesis advisor can be the same person.

21.2 The Dean will appoint a thesis advisor or the thesis advisory committee, with the approval of the Institute Committee and the recommendations from the Chair of the School prior to students' registration for their theses.

21.3 A student may have only one thesis advisor or may have co-advisors of no more than four, who are internal instructors or an external authority as the Thesis Advisory Committee and a thesis advisor will take the role of the Chair and the co-advisors are the members of the committee.

Section 22 Report on the Progress of a Thesis.

22.1 A student who has registered for a thesis or who maintains his or her student status after completing registration for thesis, must report the progress on the thesis on a form as required by the University and present it to the thesis advisor before the final day of each trimester.

22.2 The thesis advisor must report the result of the evaluation of the progress on the thesis each trimester to the Chair of the School for submission to the Institute Committee. If the result of the evaluation is not satisfactory, the Institute Committee may terminate the study.

Chapter 9

Transfer of Program, Course, and Credit

Section 23 Transfer of Program

23.1 A transfer of the program can be requested with the consent of the Chair of the School of the previous study program and that of the program to be transferred to, and with the approval of the Institute Committee of both parties.

23.2 The earliest submission of a request for program transfer must be processed in the student's second trimester with an accumulated grade point average of no less than 3.00.

Section 24 Criteria for Transfer of Courses, and Transfer of Credits

24.1 In the case of a transfer of program, all courses registered for in the previous program must be transferred to the new program earning the same grades.

24.2 In the case of the students who used to study in Suranaree University of Technology and now have re-entered the program, the credits for their courses in the previous program can be transferred but they must have been earned within the period of nine trimesters.

24.3 In addition to item 24.1 students may be given permission to transfer courses with grade **S** or not lower than **B** or the equivalent. These courses must contain the equivalent or similar content and quality to substitute the courses in the new program.

24.4 In the case of the transfer of courses and the transfer of credits for a Graduate Diploma student pursuing a Master's degree in the same field or a related field, the transfer of courses and the transfer of credits must be no more than 40% of the total credits required by the new program and the transfer must be processed only once and completed on first trimester enrolling to the new program.

24.5 The transfer of courses at Master's degree and Doctoral degree level must be no more than one - third of the total credits of the new program,_not including the thesis credits. The transfer of courses and credits must be processed only once and completed on first trimester enrolling to the new program.

24.6 For the transfer of courses from other institutions of Higher Education, students must have an accumulated grade point average from the previous institution of no less than 3 on a scale of 4 or the equivalent and those courses must be assigned with grade **S** or no less than B or the equivalent and have been taken no more than three academic years.

24.7 If credits of a course has been transferred, it is assumed that a student has passed that course and the grade assigned will be **ST** and the credits of the course will be counted as credits earned in the new program.

24.8 Only the credits of courses can be transferred but not the credits of a thesis.

24.9 For the transfer of courses, the School may test a student's knowledge on the courses to be transferred as an additional verification.

24.10 The transfer of courses must be approved by the Institute Committee.

24.11 Credits of courses which have been transferred must be included in the calculation of the accumulated grade point average whereas credits transferred of courses will not be calculated for the accumulated grade point average.

Chapter 10

Change of Study Level

Section 25 Change of Study Level

25.1 A change of study level may take place from a lower to a higher level or vice versa.

25.2 The following cases are eligible for change of study level.

25.2.1 A student in a Master's degree program Plan A who is awarded a scholarship for a Doctoral degree.

25.2.2 A student in a Master's degree program who has passed the qualifying examination organized for students in Doctoral program.

25.2.3 A student in a Doctoral program who has not passed the qualifying examination may be proposed by the School to the Institute Committee for admission into a Master's degree program.

25.3 A change of study level can only be allowed when there is no program change and with the approval of the Institute Committee. Then it will be reported to the Academic Senate for further comments.

Chapter 11

Assessment and Evaluation

Section 26 Evaluation and Calculation of Grade Point Average.

26.1 Evaluation must be conducted at the end of each trimester.

26.2 Calculation of the grade point average.

26.2.1 A grade point average for a trimester is calculated from all courses taken in that trimester. The total number of credits for each course is multiplied by the grade point received. Then the summation of the multiplication for all courses is divided by the total number of credits for that trimester.

26.2.2 An accumulated grade point average is calculated from all credits earned from the time of enrollment to the time being evaluated . The total number of credits for each course is multiplied by the grade point received. Then the summation of the multiplication for all courses is divided by the total number of credits for courses registered.

Section 27 Comprehensive Examination

27.1 For the Graduate Diploma, the Master's Degree and the Higher Graduate Diploma, students must pass a comprehensive examination. which evaluates the student's ability and potential to apply knowledge and academic experience in working and in conducting research.

27.2 Master's degree students in Scheme A1 and Scheme A2 must complete the comprehensive examination within the first 4 trimesters of the program studying. If students fail to meet this regulation, their student status will be terminated. Should there be sufficient reasons, an extension can be requested with the approval of the Institute Committee.

27.3 Students on the Master's degree Plan B, the Graduate Diploma, and the Higher Graduate Diploma program must take the comprehensive examination after completing the credits required by the program and they must pass it within 2 trimesters after having been completed required credits .Failing to meet this requirement will result in the termination of the student status. Should there be sufficient reasons, an extension can be requested with the approval of the Institute Committee.

27.4 The comprehensive examination can be either a written examination or an oral examination or both.

27.5 The administration of the comprehensive examination is the responsibility of the School and the comprehensive examination should be administered at least once per trimester. Each examination must be carried out by a committee appointed by the Dean with the approval of the Institute Committee.

27.6 The Comprehensive Examination Committee consists of the Chair of the School or a person authorized by the Chair of the School to be the Chair of the Comprehensive Examination Committee and Master's degree graduate instructors of not less than 3 but not over 5 persons An external examiner may be invited with the approval of the Institute Committee.

27.7 The Comprehensive Examination Committee must administer the comprehensive examination at the date and time specified by the Institute Committee and the result of the examination must be reported to the Institute Committee within 1 week after the day of the examination.

27.8 The result of the comprehensive examination will be reported in a grade **S** when passed and **U** when failed.

27.9 A student failing the first comprehensive examination is allowed to retake the examination only once. A second failure results in automatic termination of student status.

27.10 If a student fails the comprehensive examination, the result will appear on the transcript only when it affects the student's status.

Section 28 Qualifying Examination

28.1 Doctoral students must pass a qualifying examination which aims to evaluate students' academic ability in order to conduct independent scholarly research for a doctoral dissertation.

28.2 Doctoral students must pass a qualifying examination within the first six trimesters of the program studying.. Failure to observe this regulation will result in the termination of student status. Should there be sufficient reasons, an extension can be requested with the approval of the Institute Committee except in the case of those students taking the qualifying examination as in item 28.3.2

28.3 Students eligible for the qualifying examination are as follows:

28.3.1 Doctoral students

28.3.2 Master's degree students Scheme A2 with cumulative credits of no less than 15 credits and accumulated grade point average of not less 3.50 or Master's degree students on Scheme A1 who are doing research work with the potential to be developed into a doctoral dissertation. The latter needs the approval of the Institute committee. Then the approval will be reported to the Academic Senate for further comments. In both cases, students must have completed their comprehensive examination and if they pass this qualifying examination, they are automatically pass the doctoral qualifying examination required for doctoral degree level.

28.4 A qualifying examination may be a written or an oral examination or both.

28.5 The School is responsible for organizing qualifying examinations and they should be organized at least once a trimester. Each qualifying examination must be conducted by a committee appointed by the Dean with the approval of the Institute Committee.

28.6 The Qualifying Examination Committee consists of the Chair of the School, or the person authorized by the Chair of the School to act as the Chair of the Qualifying Examination , Doctoral degree graduate instructors of no less than 3 but not over 5 persons.

External examiners, no more than 2 persons can be invited with the approval of the Institute Committee.

28.7 The Qualifying Examination Committee must organize the examination on the date and time specified by the Institute Committee and the result must be reported to the Institute Committee within 1 week after the day if the examination.

28.8 The results of the Qualifying Examination are reported using grades: **S** for passed and **U** for failed.

28.9 Doctoral students who have passed the Qualifying Examination are eligible to propose their dissertation for a doctorate degree.

28.10 Students according to item 28.3.1 who fail the qualifying examination at the first attempt, can re-take the examination for only one other attempt. Failure at the second attempt will result in automatic termination of student status unless permission is given to change the level of studies according to item 25.2.3

28.11 Students specified in item 28.3.2 can take the Qualifying Examination only once.

28.12 In case of failure, the result will be recorded in the transcript when it affects the student's status.

Section 29 Approval of Thesis Proposal

29.1 Master's degree thesis

Students must submit their thesis proposals to the School.

The School must, then , propose them to the Thesis Proposal Committee and the Institute Committee for approval. The proposal must be approved within 5 trimesters from their first trimester of the program of studying. Otherwise, the student status will be terminated. If necessary, extension time may be granted by the Institute Committee.

29.2 Ph.D. Thesis

Students must submit their thesis proposals for Ph.D. thesis to the School.

The School, then, must propose them to the Thesis Proposal Committee and to the Institute Committee for approval. A Ph.D.

thesis proposal must be approved within seven trimesters from their first enrollment, otherwise, student status will be terminated If necessary, extension time may be granted by the Institute Committee.

29.3 A Thesis Proposal Committee may be of the same composition and qualifications as a Thesis Examination Committee.

29.4 The language used in writing a thesis may be Thai or a foreign language which a student must indicate clearly at the same time of submitting the proposal.

Section 30 Thesis Examination.

30.1 Master's degree Thesis

30.1.1 The thesis examination must be organized by a committee appointed by the Dean with the approval of the Institute Committee.

30.1.2 The Thesis Examination Committee consists of the Chair of the School or a person authorizes by the Chair to be the Chair of the Thesis Examination Committee, the thesis advisor and at least one authority in the field. The authority examining a student's thesis for Scheme A1 must be an external examiner.

30.1.3 The members of the Thesis Examination Committee must hold one of the following qualifications.

(1) A Ph.D. degree or equivalent in the field or a related the field of the thesis.

(2) A Master's degree or equivalent in the field or a related field of the thesis and an academic title of no less than an Associate Professor and have research work other than his/her thesis.

(3) A person approved by the Academic Senate as a specialist in the field of the thesis if the person is not affiliated to any Institute of Higher Education.

30.1.4 When a student has finished a thesis in a format specified by the University, he/she must submit a request for a thesis examination to the Chair of the School with the recommendation of the thesis advisor or the Chair person of the thesis advisory committee, together with a draft of the thesis for the Dean's approval no less than 2 weeks prior to the examination date.

30.1.5 In administering the thesis examination, every member of the Thesis Examination Committee must be present. If any member is absent, the examination must be postponed until all of the committee can be present.

30.1.6 In the case that a vote is needed in considering the result of a thesis examination, the majority vote of the Thesis Examination Committee must be used.

30.2 Doctoral Thesis

30.2.1 The thesis examination must be organized by a committee appointed by the Dean with approval of the Institute Committee.

30.2.2 The Thesis Examination Committee consists of the Chair of the School or a person authorized by the Chair to be the Chair of the Thesis Examination Committee, the thesis advisor, and the member of the committee of no less than 3 but not over 5 persons. At least one person out of 5 stated above must be an external authority chosen according to the criteria specified by the University.

30.2.3 Members of the Thesis Examination Committee must hold one of the following qualifications

(1) A Ph.D. degree or equivalent in the field or in a related field of the thesis and have research work other than his/her own thesis.

(2) A Master's degree or equivalent, in the field or a related field of the thesis, holding an academic title of no less than an Associate Professor and having research work other than his/her own thesis.

(3) A specialist approved by the academic Senate in the field or in a related field of the thesis for at least 5 years, if the person is not affiliated to an Institute Higher of Education.

30.2.4 When a thesis is completed in the format specified by the University the student must submit a request for a thesis examination to the Chair of the School with a recommendation of the thesis advisor or of the Chair person of the Thesis Examination Committee in order to propose the draft of the thesis to the Dean at least 3 weeks prior to the examination date.

30.2.5 In administering the thesis examination, every member of the Thesis Examination Committee must be present. If any member is absent, the examination must be postponed until all of the committee can be present. In the case that a vote is needed in considering the result of a thesis examination, the majority vote of the members of the Thesis Examination Committee of no less than 4 must be used in all cases.

30.3 During the thesis examination, any interested party can attend as an observer. The Chair of the Thesis Examination Committee may permit the observer to pose some questions after the Thesis Examination Committee have completed the examination.

In the case that the Institute Committee considers that the content of the thesis should not be disclosed to the public, the Rector might not give permission to those who are not directly involved with the thesis to observe the thesis examination.

30.4 The result of the thesis examination will be reported as follows.

(1) **Very good** means a student has passed and the Thesis Examination Committee has agreed unanimously that the student has presented his/her thesis and answered all the questions most satisfactorily and the contents of the thesis are correct and complete.

(2) **Passed** means a student has passed and the Thesis Examination Committee has agreed that the student has presented the thesis and answered all the questions fairly satisfactorily and the contents of the thesis only requires minor revisions.

(3) **Fail** means a student does not pass the thesis examination. The Thesis Examination Committee has agreed that a student has presented the thesis or answered all the questions unsatisfactorily.

30.5 In the case where a student does not pass the thesis examination, the Chair of the Examination Committee must inform the student to revise the thesis as suggested by the Thesis Examination Committee and the time allowed for the revision. Then the student must submit a request for a second thesis examination.

30.6 Failure of the thesis examination for a second time will result in the loss of student status automatically.

30.7 The Chair of the Thesis Examination Committee must not be the same person as the Thesis Advisor.

30.8 The Institute Committee approves of the result of the thesis examination with the recommendations of the School and the Thesis Examination Committee.

Section 31 Format, Submission and Publication of Thesis.

31.1 The completed thesis must be submitted in a format, on the date and time, and the number of copies specified by the University.

31.2 For Master's degree Plan A students, the research work from the thesis must be published or at least has been accepted to be published in a journal or an academic publication or presented to an academic conference which publishes its proceedings.

31.3 For Ph.D. students, the research work from the thesis must be published or at least has been accepted to be published in a journal or an academic publication with a recognized external authority in a related field to do a peer review prior to the publication.

Section 32 Foreign Language Examination

32.1 All Ph.D. students are required to take a foreign language examination and pass it according to the criteria specified by the University. In case of failure, the examination can be re-taken but this must be within 9 trimesters of their study program.
Failure to observe this regulation will result in a termination of student status.

32.2 The Academic Senate will specify the foreign language a student must take. It must not be the language students use regularly for communication.

32.3 Foreign Language Examination mainly aims to measure students' reading comprehension but other skills of language may be included. The Academic Senate may specify other means of measurement rather than a test to assess students' foreign language proficiency.

32.4 The Academic Senate and the Dean of the Institute of Social Technology or their representative must organize the foreign language examination stipulated by the Doctoral degree programs, at least once a trimester. The arrangements for this examination will be carried out by a committee appointed by the Rector with approval of the Academic Senate.

32.5 The results of the foreign language examination or the results acquired by using other means of examination will be reported by grades: **S** when passed and **U** when failed. The grade **U** can be recorded only once when student status is removed resulted from failure in the foreign language examination.

32.6 In the case that English is the foreign language required, exemption can be requested by submitting TOEFL scores or the equivalent as specified by the Academic Senate.

Chapter 12

Leave of Absence, Penalties, and Termination of Student Status

Section 33 Sick Leave

33.1 Sick leave refers to leave of absence for a student who is so ill that he/she can not attend the examinations for certain courses or all courses.

33.2 For sick leave as stated in item 33.1, a student must submit a petition to the Chair of the School within 1 week from the initial date of illness, including a medical certificate from the University infirmary or any other hospitals recognized by the University.

Section 34 Academic Leave

34.1 A student may submit a petition through his/her advisor to the Chair of the School for approval in the following circumstances.

- 34.1.1 For military conscription
- 34.1.2 For an overseas exchange student scholarship or other scholarships to which the University agrees.
- 34.1.3 For hospitalization with a severe illness that requires more than 3 weeks' medical treatment as verified by a medical certificate as stated in item 33.2.
- 34.1.4 For other personal reasons on condition that a student has studied in the University for no less than 1 trimester with accumulated grade point average of no less than 3.00
- 34.1.5 No registration as stated in item 14.3.

34.2 A student whose accumulated grade point average is less than 3.00 or who does not have his/her result of study but must take academic leave should immediately submit the petition to the Chair of the School and approval will be given by the Institute Committee.

34.3 The submission of a petition as stated in item 34.1 or 34.2 must be done within the first 10 days of the trimester for a student who hasn't registered for any courses, or within10 weeks for a student who has already registered for his/her courses.

34.5 The duration of the approved academic leave must be counted as part of the duration of study of that student except for absence as stated in item 34.1.1 and 34.1.2

34.6 A student whose leave of absence has been approved must pay a fee to retain his/her student status for every trimester during the absence except for the trimester for which credits have already been paid. Failure to comply with this regulation results in the termination of student status.

34.7 A student who intends to be re-admitted before the due date of leave of absence he/she must submit a petition for re-admittance to the Chair of the School for approval. Once it is approved, the student must inform the Center for Educational Services no less than 1 week prior to the date of course registration on the trimester the student will be re-admitted.

34.8 A student who has been re-admitted after leave of absence will retain his/her student status.

Section 35 Penalties for Misconduct

35.1 A student found cheating in an examination or involved in any form of academic dishonesty will be investigated by the committee appointed by the Academic Senate. Then the result will be reported to the University which will carry out the penalty and notify the parties concerned.

35.2 The duration of a student's suspension is included in the duration of the period of a student's studies.

35.3 A student being suspended according to item 35.1 must pay a fee to maintain his/her student status for every trimester of the suspension except for the trimester in which the registration fee has been paid. Otherwise, student status will be terminated.

Section 36 Termination of Student Status

Apart from those cases referred to in other sections, student status will be terminated in the following circumstances.

36.1 Having completed the program requirements and conferment has been granted according to section 40.

36.2 Receiving approval of resignation from the Dean with a recommendation from the Chair of the School.

36.3 Failing to register or to pay fee to retain student status within the first 10 days of trimester. A student losing his/her student status in this case may request reinstatement of student status in a particular trimester with the approval of the Dean.

36.4 Being a trial student and the results of the study do not meet the specified conditions.

36.5 Being a regular student obtaining accumulated grade point average lower than 3.00 in two consecutive trimesters.

36.7 Death.

Chapter 13

Benefits from Research Work

Section 37 Copyrights of Theses

The ownership of the copyrights of theses and related publications will be in accordance with the University's regulations.

Section 38 Patents

The ownership of patents or any commercial benefits derived from research for theses will be in accordance with the University's regulations.

เอกสารประกอบวาระที่ 4.4

ฝ่ายวิชาการ
สำนักงานอธิการบดี
รับที่ 1215
วันที่ 2 เม.ย. 2550
เวลา 13.30 น.

สำนักงานอธิการบดี
มหาวิทยาลัยเทคโนโลยีสุรนารี
รับที่ 1193/50
วันที่ 2 เม.ย. 2550
เวลา 10.00 น.

บันทึกข้อความ

มหาวิทยาลัยเทคโนโลยีสุรนารี

หน่วยงาน สาขาวิชาภาษาอังกฤษ สำนักวิชาเทคโนโลยีสังคม โทรศัพท์ 4213-4

ที่ ศธ 5612(3)/ 188 วันที่ 27 มีนาคม 2550

เรื่อง ขออนุมัติการจัดตั้งสถาบันขงจื๊อมหาวิทยาลัยเทคโนโลยีสุรนารี

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① เรียน อธิการบดี (ผ่านคณบดีสำนักวิชาเทคโนโลยีสังคม)

ด้วย The Office of Chinese Language Council International (Hanban) ได้เปิดโอกาสให้มหาวิทยาลัยจีนร่วมกับมหาวิทยาลัยไทย ขอจัดตั้งสถาบันขงจื๊อ (Confucius Institute) ซึ่งมีจุดมุ่งหมายเพื่อให้การศึกษาเกี่ยวกับภาษาจีน และวัฒนธรรมจีนอันจะนำไปสู่ความเข้าใจอันดีระหว่างสองประเทศ สถาบันขงจื๊อจะมีฐานะเป็นองค์กรในกำกับมหาวิทยาลัยที่มีการบริหารจัดการเป็นอิสระพึ่งตนเองได้ และไม่หวังผลกำไร หาก Hanban ให้ความเห็นชอบในการจัดตั้ง สถาบันขงจื๊อ มหาวิทยาลัยเทคโนโลยีสุรนารี จะได้รับทุนสนับสนุนเบื้องต้น ประมาณ 100,000 เหรียญอเมริกัน พร้อมด้วยตำรา หนังสือเรียนประกอบสื่อมัลติมีเดียจำนวน 3,000 เล่ม สำหรับจัดตั้งห้องสมุด และครูผู้สอนภาษาจีนอีก 2 คน โดย Hanban เป็นผู้รับผิดชอบค่าตอบแทน ส่วนการจัดกิจกรรมต่าง ๆ จะได้รับการสนับสนุนเป็นรายกิจกรรมต่อปี เป็นเวลา 5 ปี

ในการนี้ ท่านอธิการบดีมหาวิทยาลัยกุ้ยโจว Professor Dr. Chen Shuping ได้เดินทางมาเจรจากับ มทส เพื่อเตรียมการขอจัดตั้งสถาบันขงจื๊อมหาวิทยาลัยเทคโนโลยีสุรนารี ครั้งแรกเมื่อวันที่ 21-22 กรกฎาคม 2549 ด้วยตนเอง และล่าสุดเมื่อวันที่ 18-25 มีนาคม 2550 ได้ส่ง Professor Dr. Wang Zhiyun คณบดี College of Foreign Languages เป็นตัวแทนท่านอธิการบดีมาทำงานร่วมกับ ผู้ช่วยศาสตราจารย์ ดร.ศิริลักษณ์ อุสาหะ ตัวแทนประสานงานฝ่าย มหาวิทยาลัยเทคโนโลยีสุรนารี เพื่อเตรียมการขอจัดตั้งสถาบันขงจื๊อ มหาวิทยาลัยเทคโนโลยีสุรนารี ต่อ Hanban รายละเอียดดังแนบ

จึงเรียนมาเพื่อโปรดพิจารณาให้ความเห็นชอบการขอจัดตั้งสถาบันขงจื๊อ มหาวิทยาลัยเทคโนโลยีสุรนารี และดำเนินการต่อไป

(ผู้ช่วยศาสตราจารย์ ดร.ศิริลักษณ์ อุสาหะ)
ผู้แทนฝ่าย มทส

③ เรียน หน. สสว.
เพื่อโปรดพิจารณาดำเนินการ

(รองศาสตราจารย์ ดร. เสาวณีย์ รัตนพานี)
รองอธิการบดีฝ่ายวิชาการ

④ มอบงานเลขานุการ
(เพื่อดำเนินการ)
2 เม.ย. 50
(นางสาวจันทนา พรหมศิริ)
หัวหน้าส่วนส่งเสริมวิชาการ

② เรียน รองฯ วิชาการ
เพื่อโปรดนำเสนอสภาวิชาการ
พิจารณาเห็นชอบต่อไป
30/3/50

รายละเอียดการจัดตั้งสถาบันขงจื๊อมหาวิทยาลัยเทคโนโลยีสุรนารี
(ยึดเกณฑ์และแนวปฏิบัติที่กำหนดโดย Hanban)

ความเป็นมา

เมื่อวันที่ 21-22 กรกฎาคม 2549 อธิการบดี มหาวิทยาลัยกุ้ยโจว Professor Dr. Chen Shuping ได้เดินทางมาเจรจากับท่านอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี เรื่องการจัดตั้งสถาบันขงจื๊อมหาวิทยาลัยเทคโนโลยีสุรนารี (Confucius Institute at SUT) เพื่อส่งเสริมการศึกษาภาษาจีนและวัฒนธรรมจีน อันจะนำไปสู่การเสริมสร้างความเข้าใจและความสัมพันธ์อันดีระหว่างสองประเทศ The Office of Chinese Language Council International (Hanban) จะให้ทุนสนับสนุนครั้งแรกเพื่อการจัดตั้งประมาณ 100,000 เหรียญอเมริกัน พร้อมด้วยตำรา หนังสือเรียนประกอบสื่อมัลติมีเดียจำนวน 3,000 เล่มสำหรับจัดตั้งห้องสมุด และครูผู้สอนภาษาจีนอีก 2 คน โดย Hanban เป็นผู้รับผิดชอบค่าตอบแทน ส่วนการจัดกิจกรรมต่าง ๆ จะได้รับการสนับสนุนงบประมาณเป็นรายกิจกรรมต่อปี เป็นเวลา 5 ปี ทั้งนี้ทั้งสองมหาวิทยาลัยจะต้องร่วมกันยื่นแบบสมัครขอจัดตั้งสถาบันขงจื๊อตามเกณฑ์และแนวปฏิบัติที่ Hanban กำหนดไปยัง Hanban ณ กรุงปักกิ่ง โดยฝ่ายไทยต้องดำเนินการผ่านสถานทูตจีนในประเทศไทย

จากการเจรจาครั้งแรก อธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี เห็นชอบในหลักการ และมอบให้ ผศ.ดร. ศิริลักษณ์ อุสาหะ นำชมสถานที่ที่เทคโนธานี ซึ่งจะใช้เป็นสำนักงานของสถาบันขงจื๊อ มหาวิทยาลัยเทคโนโลยีสุรนารี ห้องสมุด และห้องเรียน ฝ่ายจีนคือ มหาวิทยาลัยกุ้ยโจว ได้กลับไปศึกษารายละเอียดความร่วมมือหลายประการ และประสานงานกับ มทส อย่างต่อเนื่อง

- ล่าสุดวันที่ 18-25 มีนาคม 2550 มหาวิทยาลัยกุ้ยโจวได้ส่ง Prof.Dr. Wang Zhiyun คณบดี College of Foreign Languages เป็นตัวแทนอธิการบดีมาทำงานร่วมกับฝ่าย มทส เพื่อเตรียมเอกสารการสมัครให้สอดคล้องกันทั้งสองมหาวิทยาลัย การดำเนินการสมัครควรทำอย่างเร่งด่วน เพราะต้องแข่งขันกับหลายประเทศ

- ในช่วงเวลาดังกล่าว ผศ.ดร. ศิริลักษณ์ อุสาหะ ตัวแทนศูนย์กิจการนานาชาติ Ms.Yanling Hua พร้อมด้วย Prof.Dr. Wang Zhiyun ได้ไปศึกษาดูงานสถาบันขงจื๊อที่ มหาวิทยาลัยมหาสารคาม และมหาวิทยาลัยขอนแก่น และได้เข้าพบประธานหอการค้านครราชสีมา เพื่อสอบถามความต้องการเบื้องต้น ซึ่งได้รับการตอบรับ และการสนับสนุนอย่างดียิ่ง

ลักษณะของสถาบัน

สถาบันขงจื๊อ มทส (Confucius Institute at SUT) จะเป็นหน่วยงานในกำกับของมหาวิทยาลัยเทคโนโลยีสุรนารีที่มีการบริหารจัดการเป็นอิสระ พึ่งตนเองได้และไม่หวังผลกำไร สถาบันฯ เกิดขึ้นด้วยความร่วมมือระหว่าง มทส กับ มหาวิทยาลัยกุ้ยโจว ภายใต้การสนับสนุนทางการเงินเป็นเบื้องต้นในการจัดตั้งจาก The Office of Chinese Language Council International (Hanban) ณ กรุงปักกิ่ง

วัตถุประสงค์ของสถาบัน

1. เพื่อให้การศึกษาเกี่ยวกับภาษาและวัฒนธรรมจีนในภูมิภาคตะวันออกเฉียงหนือตอนล่าง
2. เพื่อเป็นหน่วยงานรับผิดชอบในการจัดการเรียนการสอนภาษาจีน โดยร่วมมือกับสาขาวิชาภาษาอังกฤษ สำนักวิชาเทคโนโลยีสังคม มหาวิทยาลัยเทคโนโลยีสุรนารี และมหาวิทยาลัยกุ้ยโจว จัดการอบรมภาษาจีนและวัฒนธรรมจีนสำหรับนักเรียน นักศึกษา และประชาชนทั่วไป ตามหลักสูตรที่พัฒนาขึ้นตามมาตรฐานการศึกษาของจีน
3. เป็นศูนย์ทดสอบความรู้ความสามารถทางภาษาจีนตามมาตรฐานแห่งชาติของจีน (The Chinese Proficiency Test) หรือเรียกย่อ ๆ ว่า HSK
4. เป็นตัวกลางประสานงานกับศูนย์ / สำนัก / คณะวิชา ของ มหาวิทยาลัยเทคโนโลยีสุรนารี และมหาวิทยาลัยกุ้ยโจว หรือหน่วยงานอื่น ในการเสริมสร้างความร่วมมือทางวิชาการ การวิจัย ธุรกิจ การท่องเที่ยวและอื่น ๆ
5. เพื่อเป็นศูนย์ข้อมูลและให้คำแนะนำเกี่ยวกับการศึกษา เศรษฐกิจ และสังคมของจีน เช่น การศึกษาต่อ เจรจาธุรกิจ และท่องเที่ยวในประเทศสาธารณรัฐประชาชนจีน รวมทั้งการแปลเอกสาร การทำหน้าที่ล่าม การจัดประชุมทางวิชาการ และการจัดกิจกรรมทางวัฒนธรรม เพื่อส่งเสริมความเข้าใจอันดีระหว่างสองประเทศ

การบริหารสถาบัน

สถาบันขงจื๊อ มหาวิทยาลัยเทคโนโลยีสุรนารี จะบริหารงานภายใต้การกำกับดูแลของคณะกรรมการบริหารสถาบัน ประกอบด้วย

1) อธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี และอธิการบดีมหาวิทยาลัยกุ้ยโจว เป็นที่ปรึกษา
2) รองอธิการบดีมหาวิทยาลัยเทคโนโลยีสุรนารี และรองอธิการบดีมหาวิทยาลัยกุ้ยโจว เป็นประธานและรองประธานตามลำดับ
3) คณบดีที่เกี่ยวข้องและ/หรือผู้แทนผู้บริหารมหาวิทยาลัยเทคโนโลยีสุรนารี และมหาวิทยาลัยกุ้ยโจว ฝ่ายละ 3 คน เป็นกรรมการ
4) ผู้อำนวยการสถาบันขงจื๊อ (ฝ่ายไทย) เป็นกรรมการและเลขานุการ
5) รองผู้อำนวยการสถาบันขงจื๊อ (ฝ่ายจีน) เป็นกรรมการและผู้ช่วยเลขานุการ

กิจกรรม

1. จัดหลักสูตรอบรมภาษาจีนระดับต้น ระดับกลาง และระดับสูง สำหรับนักเรียน นักศึกษา และบุคคลทั่วไป
2. จัดหลักสูตรอบรมภาษาจีนเฉพาะด้าน เช่น ภาษาจีนสำหรับครู นักธุรกิจ เลขานุการ มัคคุเทศก์ อื่น ๆ ตามความต้องการของผู้เรียน

3. จัดการสอบวัดความสามารถทางภาษาจีนด้วยข้อสอบ HSK Test หรือการสอบอื่น ๆ เพื่อรับรองความสามารถทางภาษาจีน
4. ในอนาคตอาจจะเปิดหลักสูตรภาษาจีนระดับปริญญาร่วมกับสำนักวิชาเทคโนโลยีสังคม และมหาวิทยาลัยกุ้ยโจว
5. สนับสนุนการแลกเปลี่ยนและพัฒนาบุคลากรผู้สอนภาษาจีนของทั้งสองมหาวิทยาลัย
6. สนับสนุนการแลกเปลี่ยนนักศึกษา การฝึกงานสหกิจศึกษา และ/หรือการศึกษาดูงานในประเทศจีน
7. ผลิตตำราและสื่อการเรียนการสอนภาษาจีนสำหรับผู้เรียนภาษาจีนเป็นภาษาต่างประเทศ
8. สนับสนุนการศึกษาค้นคว้าวิจัยที่เกี่ยวข้องกับภาษาและวัฒนธรรม และประเทศจีน
9. ให้คำปรึกษาสำหรับนักศึกษาที่ต้องการไปศึกษาต่อที่ประเทศจีน
10. เป็นตัวกลางสนับสนุนการแลกเปลี่ยนกิจกรรมทางการศึกษา ธุรกิจ และวัฒนธรรม อันจะนำไปสู่การสร้างความเข้าใจและความสัมพันธ์ที่ดีระหว่างสองประเทศ
11. จัดการประชุมสัมมนาทางวิชาการที่เกี่ยวข้องกับภาษาและวัฒนธรรมจีน

การเตรียมการของ มทส เพื่อขอจัดตั้งสถาบันขงจื้อ

1. จัดหาสถานที่สำหรับเป็นสำนักงานสถาบัน ห้องสมุด, ห้องโสตทัศนูปกรณ์ และห้องเรียน 3-5 ห้อง
2. เจ้าหน้าที่บริหารงานทั่วไป ประจำสถาบัน (มหาวิทยาลัยขอนแก่นมีเจ้าหน้าที่ 2 คน แยกเป็นเจ้าหน้าที่บริหารงานทั่วไป 1 คน และเจ้าหน้าที่การศึกษา 1 คน โดยเจ้าหน้าที่ทั้ง 2 คน เป็นพนักงานของมหาวิทยาลัย)
3. เครื่องอำนวยความสะดวกประจำสำนักงานเท่าที่จำเป็น เช่น คอมพิวเตอร์, พริ๊นเตอร์ โทรศัพท์ ฯลฯ

ประโยชน์ที่คาดว่าจะได้รับ

1. มีสถาบันสอนภาษาที่ได้รับการรับรองมาตรฐานจากรัฐบาลจีน สำหรับจัดการเรียนการสอนภาษา และวัฒนธรรมจีนแก่นักศึกษา มทส และบุคคลภายนอกในภาคตะวันออกเฉียงเหนือตอนล่าง
2. มีศูนย์ทดสอบความสามารถทางภาษาจีนที่ได้มาตรฐาน
3. มีศูนย์ฝึกอบรมครูผู้สอนภาษาจีนที่ได้รับการรับรองมาตรฐานจากรัฐบาลจีน อันจะส่งผลให้การจัดการเรียนการสอนภาษา และวัฒนธรรมจีนทั้งใน มทส จังหวัดนครราชสีมา และจังหวัดอื่นในเขตภาคตะวันออกเฉียงเหนือตอนล่าง มีประสิทธิภาพยิ่งขึ้น

4. สามารถเปิดสอนภาษาจีนระดับประกาศนียบัตร ระดับปริญญาตรี ทั้งแบบ Joint Degree หรือ Double degrees หรือระดับบัณฑิตศึกษา ร่วมกับมหาวิทยาลัยกุ้ยโจว
5. มีแหล่งข้อมูลและให้บริการข้อมูลด้านการศึกษาภาษา วัฒนธรรมจีน และด้านอื่น ๆ เกี่ยวกับประเทศจีน
6. มีศูนย์ประสานงานความร่วมมือระหว่างหน่วยงานหรือองค์กรต่าง ๆ ของทั้งสองประเทศ ตลอดจนจัดกิจกรรมเพื่อส่งเสริมความสัมพันธ์และความเข้าใจอันดีต่อกัน

แผนการดำเนินงาน

1. ขอความเห็นชอบการขอตั้งสถาบันขงจื๊อ มทส จากมหาวิทยาลัย
2. เตรียมเอกสารประกอบการขอจัดตั้ง (หาก มทส เห็นชอบให้จัดตั้ง)
   - หนังสือขอจัดตั้งหรือ Letter of Proposal (ดำเนินการแล้ว)
   - ข้อตกลงความร่วมมือระหว่างสองสถาบัน (**รอร่าง**จากมหาวิทยาลัยกุ้ยโจว)
   - ประวัติ มทส การบริหารงาน การดำเนินงาน คุณภาพการจัดการเรียนการสอน ลักษณะเด่นของ มทส รายงานประจำปี และแผนการพัฒนามหาวิทยาลัย (อยู่ระหว่างการดำเนินการร่วมกับส่วนแผนงาน)
   - แผนผังสถานที่ตั้งสถาบันขงจื๊อ มทส หรือ Floor Plan (เทคโนธานีดำเนินการแล้ว)
   - ความต้องการเรียนภาษาจีนในปัจจุบัน และอนาคต (ดำเนินการแล้ว)
   - หนังสือรับรองสถาบันหรือแสดงความเป็นนิติบุคคลของ มทส (อยู่ระหว่างการประสานงานกับฝ่ายนิติกร มทส)
3. ยื่นเอกสารประกอบการขอจัดตั้งสถาบันขงจื๊อ มทส (ตามข้อ 2) ต่อ Hanban ผ่านสถานทูตจีนประจำประเทศไทย (ฝ่ายจีนโดยมหาวิทยาลัยกุ้ยโจว ได้ส่งเอกสารให้ Hanban เรียบร้อยแล้ว)
4. ดำเนินการจัดตั้งสถาบันขงจื๊อ มทส (หากได้รับอนุมัติจาก Hanban)

เอกสารประกอบวาระที่ 4.5

ข้อตกลงความร่วมมือ
ระหว่าง
มหาวิทยาลัยเทคโนโลยีสุรนารี
กับ บริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ

โดยที่มหาวิทยาลัยเทคโนโลยีสุรนารี และบริษัท น้ำตาลมิตรผล จำกัด ตระหนักถึงประโยชน์และความสำคัญของการร่วมมือระหว่างสถาบันการศึกษาและบริษัทธุรกิจเอกชน ในด้านการศึกษาและพัฒนาบุคลากร การบริหารจัดการองค์ความรู้ และการวิจัย ที่เกี่ยวข้องกับอุตสาหกรรมอ้อยและน้ำตาล อุตสาหกรรมการผลิตไฟฟ้าพลังงานชีวมวล อุตสาหกรรมเอทานอล และอุตสาหกรรมต่อเนื่องที่เกี่ยวข้อง รวมถึงกิจกรรมที่เชื่อมโยงซึ่งจะส่งผลต่อการพัฒนาชุมชนท้องถิ่นและการเพิ่มศักยภาพในการแข่งขันระดับประเทศ ดังนั้นจึงเห็นควรให้กำหนดข้อตกลงความร่วมมือเพื่อให้การดำเนินโครงการบรรลุผลตามความมุ่งหมาย จึงลงนามภายใต้หลักการและแนวทางการปฏิบัติดังนี้

ข้อ 1. วัตถุประสงค์

1.1 เพื่อความร่วมมือในการพัฒนาบุคลากรขอมหาวิทยาลัยเทคโนโลยีสุรนารี กับ บริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ รวมถึงนักศึกษา เกษตรกร และบุคลากร ด้านอุตสาหกรรมที่ เกี่ยวข้องดังกล่าวอย่างต่อเนื่อง

1.2 เพื่อเสริมสร้างความร่วมมือด้านการการศึกษาและวิจัยและ การบริหารจัดการองค์ความรู้ร่วมกัน

1.3 เพื่อพัฒนางานด้านอุตสาหกรรมเกษตรในท้องถิ่น โดยเฉพาะอุตสาหกรรมอ้อยและน้ำตาล อุตสาหกรรมการผลิตไฟฟ้าพลังงานชีวมวล อุตสาหกรรมเอทานอล และอุตสาหกรรมต่อเนื่องที่เกี่ยวข้อง ให้เกิดประสิทธิภาพสูงสุด และสามารถแข่งขันในตลาดได้อย่างยั่งยืนและต่อเนื่อง

1.4 เพื่อความร่วมมือในการสร้างเครือข่ายการประชาสัมพันธ์ขององค์กรทั้งสองฝ่าย

ข้อ 2. การดำเนินงาน

เพื่อให้บรรลุวัตถุประสงค์ข้างต้น ทั้งสองฝ่ายจึงร่วมมือกันจัดตั้งคณะกรรมการประสานงานการดำเนินงานซึ่งประกอบด้วยตัวแทนจากมหาวิทยาลัยเทคโนโลยีสุรนารี และบริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ เป็นคณะกรรมการประสานการดำเนินงาน

ข้อ 3. ให้คณะกรรมการฯประสานการดำเนินงานตามข้อ 2. มีหน้าที่ความรับผิดชอบ ดังนี้

3.1 กำหนดนโยบายและแนวทางการปฏิบัติงานร่วมกัน รวมทั้งการประสานงานกับหน่วยงานหรือสถาบันอื่นที่มีเป้าประสงค์สอดคล้องกับวัตถุประสงค์ของคณะกรรมการฯ

3.2 ควบคุม กำกับ ดูแล ให้การปฏิบัติงานเป็นไปตามนโยบายและวัตถุประสงค์ที่กำหนดไว้

3.3 ติดตามและประเมินผลการปฏิบัติงาน

ข้อ 4. ขอบข่ายความร่วมมือ

4.1 บริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ

4.1.1 ส่งเสริม สนับสนุน และอำนวยความสะดวกในการฝึกงาน ฝึกอบรมและจัดหาข้อมูลเพื่อทำกรณีศึกษาพิเศษและสนับสนุนการศึกษาดูงานภาคสนามสำหรับบุคคลากรและนักศึกษาที่สนใจงานด้านอ้อยและน้ำตาล อุตสาหกรรมการผลิตไฟฟ้าพลังงานชีวมวล อุตสาหกรรมเอทานอล และอุตสาหกรรมต่อเนื่องที่เกี่ยวข้อง

4.1.2 ส่งเสริมและสนับสนุนนักศึกษาโครงการสหกิจเข้าเรียน หรือฝึกอบรมกับบริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ

4.1.3 สนับสนุนด้านสถานที่และเครื่องมือวิทยาศาสตร์ที่มีอยู่ เพื่อดำเนินโครงการวิจัยที่มหาวิทยาลัยเทคโนโลยีสุรนารี โดยทั้ง 2 ฝ่ายเห็นควรดำเนินการร่วมกัน

4.1.4 สนับสนุนโครงการวิจัย ที่มีความร่วมมือระหว่างภาครัฐและเอกชนในอุตสาหกรรมอ้อยและน้ำตาลและอุตสาหกรรมต่อเนื่องที่เกี่ยวข้องกัน

4.2 มหาวิทยาลัยเทคโนโลยีสุรนารี

4.2.1 สนับสนุนให้บุคลากรของบริษัทฯตลอดจนบุตรหลานเกษตรกร ได้มีโอกาสเข้ารับการศึกษาเพิ่มเติมในสาขาวิชาที่จะเป็นประโยชน์ ต่อการพัฒนาในสายอาชีพของบุคคลดังกล่าว

4.2.2 สนับสนุนงานด้านวิชาการและงานด้านวิจัย เพื่อพัฒนาอุตสาหกรรมอ้อยและน้ำตาล อุตสาหกรรมการผลิตไฟฟ้าพลังงานชีวมวล อุตสาหกรรมเอทานอล และอุตสาหกรรมต่อเนื่องที่เกี่ยวข้อง หรืองานด้านวิจัยอื่นๆ ที่ทั้ง 2 ฝ่ายเห็นควรดำเนินการร่วมกัน

4.2.3 สนับสนุนด้านสถานที่และเครื่องมือวิทยาศาสตร์ที่มีอยู่ เพื่อสะดวกให้นักวิจัย สามารถทำการค้นคว้าในโครงการพิเศษได้ตามความเหมาะสม ทั้งนี้ให้เป็นไปตามเกณฑ์ของมหาวิทยาลัย

4.2.4 ให้ความร่วมมือในการพัฒนาบุคลากรของบริษัทฯ เกษตรกร และบุคลากรของอุตสาหกรรมที่เกี่ยวข้องดังกล่าวโดยความเห็นชอบของทั้งสองฝ่าย

4.3 การสร้างเครือข่ายประชาสัมพันธ์

(ท่านรองฯ รับไปดูแลและปรึกษาส่วนประชาสัมพันธ์)

4.5 สิทธิและผลประโยชน์

(ท่านรองฯ รับไปดูแลและปรึกษานิติกร)

ข้อ 5 สิทธิและผลประโยชน์ที่เกิดจากการดำเนินโครงการร่วมกัน

ข้อตกลงนี้มีผลบังคับใช้ นับตั้งแต่วันที่ .... เป็นต้นไป เป็นเวลา 5 ปี และการแก้ไขข้อตกลงหรือการขยายเวลาจะกระทำได้โดยความยินยอมของทั้งสองฝ่าย

....	....
	(นายกฤษฎา มนเทียรวิเชียรฉาย)
	รองผู้จัดการใหญ่สายงานบริหาร
มหาวิทยาลัยเทคโนโลยีสุรนารี	บริษัท น้ำตาลมิตรผล จำกัด และบริษัทในเครือ