Doctor of Philosophy Program

In Computer Science and Information Systems (International Program)

Revised Program 2020

Name of Institution   National Institute of Development Administration

Responsible Agency   Graduate School of Applied Statistics

Section 1. General Information

1. **Name of Program**

   Name in Thai :   หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาวิทยาการคอมพิวเตอร์และระบบสารสนเทศ (หลักสูตรนานาชาติ)

   Name in English : Doctor of Philosophy Program in Computer Science and Information Systems (International Program)

2. **Name of Degree**

   Full Name :   ปรัชญาดุษฎีบัณฑิต (วิทยาการคอมพิวเตอร์และระบบสารสนเทศ)

                   Doctor of Philosophy (Computer Science and Information Systems)

   Abbreviated Name : ปร.ด.(วิทยาการคอมพิวเตอร์และระบบสารสนเทศ)

                   Ph.D. (Computer Science and Information Systems)

3. **Major**

   1. Computer Science

   2. Information Systems

4. **Number of credits in the curriculum**

   Plan 1(1.1)   48 credits

   Plan 2(2.1)   54 credits

5. **Characteristic of the Program**

   5.1 **Characteristic**

   Doctorate degree according to the standard of higher education program

   5.2 **Medium of Instruction**

   English

   5.3 **Admissions**

   Open for Thai and International graduates with a master's degree in Computer Science, Information Systems Management, Computer Engineering, and Information Technology or in the related fields, having a good command of English, graduated from the institutes both domestic and abroad, which have been accredited by the Commission on Higher Education (CHE)

   5.4 **Cooperation with Other Institutes**

   Educational Institutes and Universities with collaboration agreements.

   5.5 **Presenting the Degree to the Graduates**

   The same degree will be provided for both majors.

6. **Curriculum Status and the Consideration for Approval / Endorsement of the Curriculum**

   - Improved Curriculum 2020 offered at the first semester,academic year 2020

   - Approved by The 5/2019 Academic Council meeting on August 28, 2019.

   - Approved by NIDA Council

7. **Readiness in Publishing the Curriculum with Quality and Standards**

   The curriculum is ready to be published with quality and standards according to Qualification Standards in the academic year 2022

8. **Professionals to undertake after graduation**

   8.1 Scholars / professors in educational institutions

   8.2 Researchers in computer and information technology

   8.3 Executives on information technology and information systems management in both public and private organizations

9. Name, Identification Number, ID Card, Position and Qualifications of the Instructors Responsible for the Curriculum

Name-Family Name	ID Card Number	Degrees	Institute of Attainment
Assoc.Prof. Dr. Surapong Auwatanamongkol	xxxxxxxxxxxx	Ph.D.(Computer Science) M.S. (Information and computer Science) B.E. (Electrical Engineering)	Southern Methodist University, USA.(1990) Georgia Institute of Technology, USA.(1982) Chulalongkorn University , Thailand.(1978)
Assoc.Prof. Dr. Ohm Sornil	xxxxxxxxxxxx	Ph.D.(Computer Science and Applications) M.S. (Computer Science) B.E. (Electrical Engineering)	Virginia Polytechnic Institute and State University, USA. (2001) Syracuse University, USA. (1997) Kasetsart University, Thailand.(1993)
Assist.Prof. Dr. Pramote Kuacharoen	xxxxxxxxxxxx	Ph.D.(Electrical and Computer Engineering) M.E. (Computer and System Engineering) M.S. (Computer and Systems Engineering) B.S. (Computer and System Engineering) in 1995.	Georgia Institute of Technology, USA. (2004) Rensselaer Polytechnic Institute, USA.(1996) Georgia Institute of Technology, USA. (2001) Rensselaer Polytechnic Institute, USA.(1995)

10. Place for Studying

Class rooms and places for studying of the National Institute of Development Administration and Graduate School of Applied Statistics, 118 Serithai Road, Klongjan, Bangkapi, Thailand 10240.

11. External Circumstances or Developments that Need to be Taken Into Consideration in Planning the Curriculum

The rapid advancement of Computer Science and Information technology, especially in the areas of Artificial Intelligent, Data Science and Deep technology, contributes to the changes, opportunities and threats to the economy and society. Thailand must be prepared to cope with such changes. The strategic goals of the country's policies on information and digital technology have, therefore, been set for the development of many of qualified human resources and researchers in the related fields to accommodate the situation.

12. Impact of Item 11 on the Development of the Curriculum and Its Relevance to the Mission of the Institute

12.1 Curriculum Development

Based on the external circumstances in Item 11, it is necessary to develop a curriculum to produce graduates with a doctorate in Computer Science and Information Systems with good knowledge in the advanced techology and ability to do research and apply knowledge to practical. The graduates must be good moral persons according to the policies and vision of the NIDA in producing the knowledgable graduates with ethics.

12.2 Relevant to the Mission of the Institution

The curriculum is consistent with the mission of the Institute, that is to produce doctorate graduates with knowledge and virtue who will be the leaders in the development of both the economy and society of the country.

13. Relationship with Other Programs Offered in Other Schools / Departments of the Institute

13.1 Courses / Subjects in the Curriculum being offered by other Schools / Departments

English as remedial courses under the School of Language and Communication of NIDA

13.2 Courses / Subjects in this Curriculum that are available for Other Curriculums

Other students from other curriculums of the institution can choose to take all courses offered in the curriculum. Taking such courses must conform to the requirements of the curriculums, must receive the approval from advisor and instructor.

13.3 Administration

Lecturers responsible for the curriculum must coordinate with the representatives from other schools in relevant to subject matter, class schedule / examination schedule and in compliance with the standard for doctoral qualifications in Computer Science and Information Systems.

Section 2. Specific Information of the Curriculum

1. Philosophy, Importance and Objectives of the Curriculum

1.1 Philosophy

At present information technology plays major role for Thailand development. However, the country is in shortage for personnel in Information Technology, especially computer science and information system specialists. Therefore, the main objective of this doctoral program is to produce these needed Information Technology personnel.

1.2 Objectives

1.2.1 To produce graduates with expertise on both theoretical foundations and applications of computer science and information systems.

1.2.2 To produce computer science and information systems personnel at the Ph.D. level to fulfill the demand that increases rapidly in these areas.

1.2.3 To enhance Thailand capability to conduct research by producing researchers in the areas of computer science and information systems.

1.2.4 To produce graduates with good knowledge and high ethics, that will take part in the country development.

2. Development Plans

Development/Adjustment Plans	Strategies	Evidences/Indicators
- Improving the curriculum to meet the standards specified by CHE	- Developing the curriculum according to the standards specified by CHE	- Curriculum documents. - Curriculum evaluation reports
- Improving the curriculum to meet the needs of the markets and changes in information technology	- Curriculum evaluation on a regular basis - Tracking the changing needs of the markets and changes in the fields.	- Report on the evaluation of the satisfaction of the employers of the graduates - Satisfaction in the skills, knowledge, the ability to work of the graduates.

Section 3. Educational Management System, Implementation and the Structure of the Curriculum

1. Educational Management System

1.1 System

It is the bi-semester educational systems with credits. The first semester begins on the first week of August (19 weeks) and the second semester begins on the first week of December (19 weeks). A summer semester is between June and July month about 8 weeks. All requirements are in accordance with the regulation of the National Institute of Development Administration concerning the Education.

1.2 Summer Session Studying

Summer Session Studying is subject to the consideration of the lecturer responsible for the curriculum

1.3 Comparable Credits in the Bi-semester System

None

2. Implementation of the Curriculum

2.1 Studying Period

Semester 1   August–December

Semester 2   January–May

Summer Session   June-July

2.2 Qualifications of the Applicants

2.2.1 Must be graduated with master degree in Computer Science, Computer Engineering, Information Technology, Information System Management or related science from an institution accredited by CHE.

2.2.2 Have good academic records and good command of English, both written and verbal.

2.3 Obstruction of the New Students

Students applying to study in the program have English TOEFL or IELT score less than the requirements.

2.4 Strategies to resolve problems / limitations of the student in Item 2.3.

Students need to learn the supplementary English courses according to the institute requirements.

2.5 Plans for Student Admission and Graduates within 5 Years

Number of the Students	Academic Year									
	2020		2021		2022		2023		2024	
	1.1	2.1	1.1	2.1	1.1	2.1	1.1	2.1	1.1	2.1
Number of Admission	2	3	2	3	2	3	2	3	2	3
Accumulated Number	-	-	4	6	4	7	4	8	4	8
Number of Graduates	-	-	-	-	2	2	2	2	2	3

Plan 1 (1.1) 48 Credits

Year	Academic 2020	Academic 2021	Academic 2022	Academic 2023	Academic 2024
Year 1	2	2	2	2	2
Year 2	-	2	4	4	4
Total	2	4	4	4	4
Estimated graduate students	-	-	2	2	2

Plan 2 (2.1) 54 Credits

Year	Academic 2020	Academic 2021	Academic 2022	Academic 2023	Academic 2024
Year 1	3	3	3	3	3
Year 2	-	3	6	7	8
Total	3	6	7	8	8
Estimated graduate students	-	-	2	2	3

2.6 Budget as Planned

The budget will be provided by the government and revenue of the National Institute of Development Administration.

Estimated expend of student per year	Regular Program
A student per year	110,000 Baht

2.7 Studying Methodology

- ☑ Classroom
- ☐ Distant study via publications
- ☐ Distant study via the broadcast media
- ☐ Distant study via E-learning
- ☐ Distant study via the internet
- ☐ Others (specify)

2.8 Education Equivalence Credits Transfer, Courses and Enrollment into Higher Education Institutions.

Guidelines for Education Equivalence Credits Transfer are based on the regulations of the National Institute of Development Administration concerning education and/or the notification of the Graduate School of Applied Statistics.

3. Curriculum and Instructors.

3.1 Curriculum

3.1.1 Number of Credits

Plan 1 (1.1) Focuses on research, no requirement for courses, a total of 48 credits.

Plan 2 (2.1) Research and course requirements, a total of 54 credits.

3.1.2 Curriculum Structure

Courses	Plan 1 (1.1) Focuses on research, no requirement for courses	Plan 2 (2.1) Research and courses requirements
Remedial courses	3-9 credits (Non-credit)	3-9 credits (Non-credit)
Core courses	-	6 credits
Major courses	-	6 credits
Elective courses (minimum)	-	6 credits
Thesis	48 credits	36 credits
Total not less than	**48 credits**	**54 credits**

3.1.3 Courses

(1) Remedial Courses (Non credit)

LC 6000   Advanced Reading and Writing in English for Graduate Studies   3 Credits

LC 4003   Advanced Integrated English Language Skill Development   3 Credits

CI 4009   Research Methods in Computer Science and Information Systems   3 Credits

Note : - Students can be exempted from taking these remedial courses based on NIDA's and the school's education regulation.

(2) Core Courses (6 credits for Plan 2 (2.1) students)

CI 7901   Advanced Database   3 Credits

CI 8901   Seminar in Advanced Topics in Computer Science and   3 Credits
            Information Systems

(3) Major Courses (6 credits for Plan 2 (2.1) students)

Major in Computer Science

CI 7902   Design and Analysis of Algorithms   3 Credits

CI 7903   Advanced Computer Architectures   3 Credits

Major in Information Systems

CI 7904   Management for Information Systems   3 Credits

CI 7905   Information System Assessment   3 Credits

(4) Elective Courses (6 credits for Plan 2 (2.1) students)

CI 7906	Advanced Computer Networks	3 credits
CI 7907	Artificial Intelligence	3 Credits
CI 7908	Machine Learning	3 Credits
CI 7909	Advanced Artificial Intelligence	3 Credits
CI 7910	Deep Learning	3 Credits
CI 7911	Cognitive Systems	3 Credits
CI 7912	Intelligent Robotics	3 Credits
CI 7913	Big Data Analytics	3 Credits
CI 7914	Natural Language Processing and Text Analytics	3 Credits
CI 7915	Image Analytics	3 Credits
CI 7916	Cloud Computing	3 Credits
CI 7917	Blockchain: Smart Contracts and Decentralized Applications	3 Credits
CI 7918	Internet of Things	3 Credits
CI 7919	Augmented Reality and Virtual Reality	3 Credits
CI 7920	Computer Graphics and Animation	3 Credits
CI 7921	Computer Vision	3 Credits
CI 7922	Wireless and Mobile Communications	3 Credits
CI 7923	Parallel Computing	3 Credits
CI 7924	Compiler Construction	3 Credits
CI 7925	Combinatorics and Graph Theory	3 Credits
CI 7926	Theory of Computation	3 Credits
CI 7927	Cryptography	3 Credits
CI 7928	Information Systems Auditing	3 Credits
CI 7929	Software Design and Architectures	3 Credits
CI 7930	Digital Transformation	3 Credits
CI 7931	Agile Information Systems Development	3 Credits
CI 7932	Information Systems Performance Measurement	3 Credits
CI 7933	Cyber Security and Information Security Management	3 Credits
CI 7934	Information Security Risk Management	3 Credits
CI 7935	Human Computer Interaction Management	3 Credits
CI 7936	Software Testing	3 Credits
CI 8902	Readings in Computer Science and Information Systems	3 Credits
CI 8903-8910	Selected Topics in Computer Science and Information Systems	3 Credits
CI 9000	Independent Study	3 Credits

Remark : - The Elective courses also include other graduate courses offered by the school or others in NIDA (To register for these courses, students must receive approvals from his/her advisor)

- Elective courses opened in each semester will be selected by the school and the institute.

(5) Dissertation

CI 9900	Dissertation	36, 48 Credits

3.1.4 Study Plan

Plan 1 (1.1) Dissertation only

1st Semester of the 1st Year

LC 6000	Advanced Reading and Writing in English for Graduate Studies	3 Credits *
CI 9900	Dissertation	6 Credits
Total		**6 Credits**

2nd Semester of the 1st Year

LC 4003	Advanced Integrated English Language Skill Development	3 Credits *
CI 9900	Dissertation	6 Credits
Total		**6 Credits**

Following semesters

CI 9900	Dissertation	36 credits
Total		**48 Credits**

Remark   * Non credit

Study plan can be changed depending on suitability

Plan 2 (2.1) Dissertation and coursework

1st Semester of the 1st Year

LC 6000	Advanced Reading and Writing in English for Graduate Studies	3 Credits *
CI xxxx	Core course	3 Credits
CI xxxx	Core course	3 Credits
CI xxxx	Major course	3 Credits
Total		**9 Credits**

2nd Semester of the 1st Year

LC 4003	Advanced Integrated English Language Skill Development	3 Credits *
CI xxxx	Major course	3 Credits
CI xxxx	Elective course	6 Credits
Total		**9 Credits**

1ˢᵗ Semester of the 2ⁿᵈ Year

CI 9900	Dissertation	<u>6 Credits</u>
Total		**6 Credits**
Following semesters		
CI 9900	Dissertation	<u>30 Credits</u>
Total		**30 Credits**

Remark　　* Non credit

　　　　　　Study plan can be changed depending on suitability

3.1.5 Course Description

LC 6000 Advanced Reading and Writing in English for Graduate Studies　　　3(3–0–6)

　　　　Review of essential reading and writing strategies required to read and write academic English. Course contents include work on sentence structures, vocabulary and recognition of major thought relationships in paragraphs, as well as practice in reading and writing academic English

LC 4003 Advanced Integrated English Languages Skill Development　　　3(3–0–6)

　　　　Course contents and teaching activities focus on the integrated skills of listening, speaking, reading and writing with a particular emphasis on academic writing. Students will also work in small groups, practicing paper presentation techniques, precise writing, and research writing.

CI 4009 Research Methods in Computer Science and Information Systems　　　3(3–0–6)

　　　　Introduction to research areas in computer science and information systems, qualitative and quantitative methods of research, research project writing and presentation, statistical analysis and experimental design techniques, literature searches and reviews, and research ethics.

CI 7901 Advanced Database　　　3(3–0–6)

　　　　Transaction processing, query optimization, concurrency control, database recovery, distributed databases, big data systems, NoSQL databases, data warehousing, data mining, web and semi-structured database, search engines.

CI 7902 Design and Analysis of Algorithms   **3(3–0–6)**

   Complexity of algorithms, analysis of algorithm complexity, divide-and-conquer algorithms, amortized analysis, Advanced priority queues, disjoint sets, graph algorithms, greedy algorithms, dynamic programming, Geometic Algorithms, NP-Completeness problems, approximation algorithms.

CI 7903 Advanced Computer Architectures   **3(3–0–6)**

   Computer models and architectures, parallel computing, pipeline computer architectures, VLIW architecture, superscalar processor architecture, SIMD computer architectures, MIMD computer architecture, interconnection networks.

CI 7904 Management for Information Systems   **3(3–0–6)**

   Organization and management concepts, organization analysis, organization strategie setting, knowledge management, competencies, performance evaluation for selecting, use, and management of Information Systems and also Information Technology, business process design and development, organisation culture and environment.

CI 7905 Information Systems Assessment   **3(3–0–6)**

   IS auditing framework, roles and competencies of IS auditors, areas of auditing, IS performance and efficiency, IS testing, application development cost and management, application service life cycle.

CI 7906   Advanced Computer Networks   **3(3–0–6)**

   Network architecture, enterprise network design and implementation, high availability, wired and wireless quality of service, device and network virtualization, network infrastructure including layer 2, layer 3 and wireless, routing concepts, network assurance, network security, network automation.

CI 7907 Artificial Intelligence   **3(3–0–6)**

   Uninformed Search, Informed Search, Constraint-Satisfaction Problems, Decision Making using Game Theory, Logic, Probability and Uncertainty, Utility and Value of Information, Decision Trees, and Applications.

CI 7908   Machine Learning   **3(3–0–6)**

   Bayes decision theory, supervised learning, unsupervised learning, regression, classification, clustering, association rule learning, reinforcement learning, ensemble learning, artificial neural networks, dimensionality reduction

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7909   Advanced Artificial Intelligence   **3(3–0–6)**

Intelligent agents, problem solving, learning from examples, reinforcement learning, planning, uncertain knowledge, probabilistic reasoning, belief systems, natural language processing, robotics

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7910   Deep Learning   **3(3–0–6)**

Convolutional neural networks, recurrent neural networks, deep belief network, deep Boltzmann machine, autoencoders, representation learning, structured probabilistic models for deep learning

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7911   Cognitive Systems   **3(3–0–6)**

Theories and models on cognition, emotion and personality in combination with methods for evaluation and testing, development and learning, memory and prospection, knowledge and representation, social cognition, cognitive robotics

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7912   Intelligent Robotics   **3(3–0–6)**

Behavior-based embodied artificial intelligence, kinematics and inverse kinematics, geometric reasoning, motion planning, mapping, and manipulation, as well as dynamics, biologically inspired and biomimetic robotics, distributed robotics and intelligence, and some philosophical questions pertaining to the nature of intelligence in the physical world.

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7913 Big Data Analytics   **3(3–0–6)**

Large-scale machine learning methods. Exploratory Data Analysis. Examining the MapReduce and Hadoop architectures. Predictive Analytics with Big Data. Categorizing Data with Classification Techniques. Assessing model performance. Detecting Patterns in Complex Data with Clustering and Link Analysis. Discovering connections with Link Analysis. Capturing important connections with Social Network Analysis. Leveraging transaction data to yield recommendations and association rules. Meeting the challenge of large data sets when searching for rules. Methods to optimize the analytics based on different hardware platforms. Challenges of Big Data, especially on the ongoing Linked Big Data issues which involves graphs, graphical models, spatio-temporal analysis, cognitive analytics, etc.

CI 7914   Natural Language Processing and Text Analytics   **3(3–0–6)**

Methods for organizing, summarizing and analyzing large collections of unstructured and lightly-structured text to discover interesting patterns, extract useful knowledge, and support decision making that can be generally applied to arbitrary text data in any natural language with minimum human effort. Concepts and principles of major statistical and Natural Language Processing techniques. Advanced topics, including schema analysis, classical content analysis, content dictionaries, word-based analysis, and semantic network analysis.

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7915   Image Analytics   **3(3–0–6)**

Fundamental concepts of analyzing and extracting information from 2D digital images. Topics in this course include, but not limited to, image sensors, data structures for 2D digital images, basic image processing and visual feature extraction, image searching, image-based object recognition, machine learning for image inputs, basic video analytics, and recent applications of image analytics in business. All are taught by hand-on practices using standard image analytics libraries or tools.

Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7916 Cloud Computing   **3(3–0–6)**

Cloud computing design and architectures, cloud infrastructures and service models, virtualization, cloud services and platforms, cloud applications, software defined networks, cloud storage, programming models, cloud security.

CI 7917   Blockchain: Smart Contracts and Decentralized Applications   **3(3–0–6)**

Technical aspects of blockchain technology, distributed ledgers, cryptocurrencies, and smart contracts. Basic of cryptography, Merkle tree, mining, proof of work, proof of stake, economics security and privacy, digital assets, decentralized applications development, Hyperledger.

CI 7918   Internet of Things   **3(3–0–6)**

IoT architecture, IoT protocols, sensors, actuators, microcontroller, IoT Cloud infrastructure, performance, privacy and security in IoT, Fog computing, applications of IoT: connected vehicle, smart city, IoT implementation, IoT analytics and big data.

CI 7919 Augmented Reality and Virtual Reality   **3(3–0–6)**

This course introduces borderlines between 2D and 3D worlds, and between real and virtual worlds. Students will learn how these borderlines can be crossed, diminished or eliminated by combining knowledge of mathematics, multimedia, artificial intelligence, image processing, computer vision, and computer graphic. The course includes, but not limited to, basic pinhole camera models, camera calibration, 3D computer vision, VR/AR/MR-specific visualization, 3D interaction techniques, recent advances in VR/MR/AR, and other interesting issues. All are taught by hand-on practices using standard programming libraries or tools, action-based research and discussion, and first-hand experience sharing from outsider guests or practitioners.

CI 7920   Computer Graphics and Animation   **3(3–0–6)**

This course is an introduction to 3D computer graphics. The course will cover both basic theory in mathematics, 3D computer graphics, and how to program for graphic applications using OpenGL. Topics include 3D transformations, camera setting, modeling techniques, rendering techniques, texturing, basic animation and physically-based animation. The programming workshop (Lab) will be also provided as a boot camp for students to gain a basic knowledge of OpenGL for the programming assignments. There will also be guest lectures to give students an overview of computer graphics in research and in business.

CI 7921 Computer Vision   **3(3–0–6)**

Image formation, Camera Imaging Geometry, Feature Detection and Matching, Stereo Vision, Motion Estimation and Tracking, Object Recognition, Deep Learning in Computer Vision
Prerequisite: CI 7907 Artificial Intelligence or consent of the instructor

CI 7922 Wireless and Mobile Communications   **3(3–0–6)**

Principled introduction to wireless and Mobile communications, wireless data transmission, radio frequency communications and propagation characteristics, antenna systems. Network architecture and security in WPANs, WLANs, WMANs and WWANs.
Prerequisite :   CI 7906   Advanced Computer Networks or Instructor Consent

CI 7923 Parallel Computing   **3(3–0–6)**

Survey of parallel computer architectures, models of parallel computation, and interconnection networks. Parallel algorithm development and analysis. Programming paradigms and languages for parallel computation. Different approaches to writing parallels software for shared–memory and message–passing paradigms. Example applications. Performance measurement and evaluation. Design and implementation of efficient and effective thread packages, communication mechanisms, process management, virtual memory, and file systems for scalable parallel processing

Prerequisite: CI 7903 Advanced Computer Architectures or Instructor Consent.

CI 7924 Compiler Construction   **3(3–0–6)**

Theory and practice in compiler construction, lexical and syntax analysis, basic theory on context-free languages and parsing, machine code generation and optimization, automatic parser generation, compiler writing, and extendible compilers.

CI 7925 Combinatorics and Graph Theory   **3(3–0–6)**

Enumeration, generating function, recurrence relations, counting numbers, inclusion-exclusions, graphs and their applications, Euler tours, Hamiltonian cycles, bipartite, connectivity, set covering, graph coloring, network flow problems

Prerequisite: CI 7902 Design and Analysis of Algorithms or Instructor Consent.

CI 7926 Theory of Computation   **3(3–0–6)**

Deterministic finite state automata, nondeterministic finite state automata, regular language, push-down automata, context-free language, normal forms of context-free language, Turing machine, context-sensitive language, language hierarchy.

CI 7927 Cryptography   **3(3–0–6)**

Theory, foundations, and applications of modern cryptography, number theory and its applications, Primarily testing, public–key and discrete–log cryptosystem, one–way functions, pseudo-randomness, zero–knowledge proofs, multiparty cryptographic protocols, practical

CI 7928   Information Systems Auditing   **3(3–0–6)**

The nature of IS auditing and how IS audits are undertaken. The course starts with an overview of the IS audit process and notion of controls, it then examines the key assurance tasks most relevant to the contemporary role of IS Auditors. The course then explores several IS Audit frameworks and methodologies and the role of IS auditors in the statutory audit. The course concludes with an examination of the ethics and professionalism in IS audit.   The course focuses primarily on the Internal Audit perspective and examines in detail each of the areas that IS auditors operating in the internal audit context will face.

CI 7929   Software Design and Architectures   **3(3–0–6)**

Object oriented concept, unified process, unified model language, requirement engineering, use-case modeling, object-oriented analysis and design by using activity diagram, sequence diagram, class diagram, component diagram and software architecture.

CI 7930   Digital Transformation   **3(3–0–6)**

Integrate technological and managerial aspects of information technology, define the information, facilitate new coordination and communication within and across entities, enable new organizational forms, change the information environment underlying the business. The role of information technology (IT) in corporate strategy with specific attention paid to the Internet, disruptive technology, agile concept. Action plan to bring information technology to use, business continuity plan, organizational culture, human resource development plan, laws and regulations.

CI 7931 Agile Information Systems Development   **3(3–0–6)**

Information systems development life cycle, Philosophy of agile methods, agile approaches such as extreme programming, scrum, Agile developer practices and principles, Agile project management. Business process and business process management, business process performance, relationships among various of business processes, business process design and development based on agile concept, user interface design, software development life cycle. Application testing, Application development cost and management, organization culture and working environment.

CI 7932 Information Systems Performance Measurement   **3(3–0–6)**

Basic characteristics of Information Systems, efficiency and performance evaluation of Information Systems concepts, Perceived usefulness, identifying functions and processes, Easy-to-Use of Information Systems, evaluation method and key performance indicators that align with mission, vision, strategy, and organization culture. Foundational knowledge of all five phases of the service lifecycle.

CI 7933   Cyber Security and Information Security Management   **3(3–0–6)**

Threat environment, security planning and policy, introductory cryptography, secure network, access control, firewall, data security, threat analysis, computer forensics, network intrusion analysis, data and event analysis, incident and disaster response, ISO/IEC 27001 standard.

Prerequisite :   CI 7906   Advanced Computer Networks or Instructor Consent

CI 7934 Information Security Risk Management   **3(3–0–6)**

Foundation in risk management and economic value, standard risk management approaches for identifying, analyzing, and responding to risk, tools and methodologies for metrics to monitor risk management. How to apply a finite set of resources on information security, how to prioritize information security risks, analyze the costs and benefits of investments security decisions and how to calculate the return on investment.

CI 7935 Human Computer Interaction Management   **3(3–0–6)**

Theory and practice of human computer interface, framework or procedures for creating usable and useful design and systems, tangible user interfaces both physical interaction and computational media, how to design, enabling technologies, and measuring and evaluating interface quality.

CI 7936 Software Testing   **3(3–0–6)**

Software validation and verification, software testing concepts, unit testing, integration testing, user acceptant testing, non-function testing, software testing and evaluation between computer and users, defect report and analysis, defect monitoring, moral in software test process.

CI 8901 Seminar in Advanced Topics in Computer Science and Information Systems   **3(3–0–6)**

This course is to provide students the insights into advanced topics in computer science and information systems. The students must complete term papers and present them to the class.

CI 8902 Readings in Computer Science and Information Systems   **3(0–0–9)**

This course intends to allow a student who is preparing a dissertation proposal or is interested in a particular research topic to read academic papers under instructors' supervision. The student must present an analytical report on the topic to the supervisor.

CI 8903-8910 Selected Topics in Computer Science and Information Systems   **3(3–0–6)**

Study in topics different from courses in the regular curriculum, under the school's approval.

CI 9000 Independent Study   **3(0–0–9)**

Students select an independent study topic which must be approved by the instructor and students must submit a term paper.

CI 9900   Dissertation   **36-48 credits**

3.2 Title, name – surname, ID number and academic degree of staffs

    3.2.1 Program's Responsible Staffs

Title / Name - Surname	ID No.	Degree	Major	Institute
Assoc.Prof Dr. Surapong Auwatanamongkol	xxxxxxxxxxxxx	Ph.D.	Computer Science	Southern Methodist University, U.S.A.
		M.S.	Information and Computer Science	Georgia Institute of Technology, USA.
		B.E.	Electrical Engineering	Chulalongkorn University, Thailand.
Assoc. Prof. Dr. Ohm Sornil	xxxxxxxxxxxxx	Ph.D.	Computer Science and Applications	Virgina Technic Institute and State University, USA.
		M.S.	Computer Science	Syracuse University, USA.
		B.E.	Electrical Engineering	Kasetsart University, Thailand.
Assist. Prof.Dr.Pramote Kuacharoen	xxxxxxxxxxxxxxx	Ph.D.	Electrical and Computer Engineering	Georgia Institute of Technolory, USA.
		M.E.	Computer and System Engineering	Rensselaer Polytechnic Institute, USA.
		M.S.	Computer and Systems Engineering	Georgia Institute of Technology, USA.
		B.S.	Computer and System Engineering	Rensselaer Polytechnic Institute, USA.

    3.2.2 Fulltime Program Members

Title / Name - Surname	ID No.	Degree	Major	Institute
Assoc.Prof Dr. Surapong Auwatanamongkol	xxxxxxxxxxxxx	Ph.D.	Computer Science	Southern Methodist University, U.S.A.
		M.S.	Information and Computer Science	Georgia Institute of Technology, USA.

Title / Name - Surname	ID No.	Degree	Major	Institute
		วศ.บ.	วิศวกรรมไฟฟ้า	จุฬาลงกรณ์ มหาวิทยาลัย ประเทศไทย
Asso. Prof Dr.Waraporn Jirachiefpattana	xxxxxxxxxxxx	Ph.D.	Computing and Information systems	Monash University, Australia.
		M.S.	Administrative Science	The George Washington University, USA.
		ศศ.บ.	สถิติ	มหาวิทยาลัยธรรมศาสตร์
Assoc. Prof. Dr. Ohm Sornil	xxxxxxxxxxxx	Ph.D.	Computer Science and Applications	Virgina Technic Institute and State University, USA.
		M.S.	Computer Science	Syracuse University, USA.
		B.E.	Electrical Engineering	Kasetsart University, Thailand.
Asst.Prof Dr.Nithinant Thammakoranonta	xxxxxxxxxxxx	Ph.D.	Industrial Management	Clemson University, U.S.A.
		M.S.	Business	Virginia Commonwealth University, USA.
		สถ.บ.	สถิติ	จุฬาลงกรณ์ มหาวิทยาลัย
Assist. Prof.Dr.Pramote Kuacharoen	xxxxxxxxxxxxx	Ph.D.	Electrical and Computer Engineering	Georgia Institute of Technolory, USA.
		M.E.	Computer and System Engineering	Rensselaer Polytechnic Institute, USA.
		M.S.	Computer and Systems Engineering	Georgia Institute of Technology, USA.
		B.S.	Computer and System Engineering	Rensselaer Polytechnic Institute, USA.

Title / Name – Surname	ID No.	Degree	Major	Institute
Asst.Prof Dr.Sukanya Suranauwarat	xxxxxxxxxxxx	Ph.D.	Computer Science and Communication Engineering	Kyushu University, Japan.
		M.E.	Computer Science and Communication Egnineering	Kyushu University, Japan.
		B.E.	Computer Science and Communication Engineering	Kyushu University, japan.
Asst. Prof Dr.Sutep Tongngam	xxxxxxxxxxxx	Ph.D.	Computer Science	Illinois Institute of Technology, USA.
		M.S.	Computer Science	Towson University, USA.
		บธ.ม.	บริหารธุรกิจ	จุฬาลงกรณ์ มหาวิทยาลัย
		วศ.บ.	วิศวกรรม คอมพิวเตอร์	จุฬาลงกรณ์ มหาวิทยาลัย ประเทศ ไทย
Asst.Prof.Dr.Pramote Luenam	xxxxxxxxxxxxxx	Ph.D.	Information Systems	University of Maryland, Baltimore County, USA.
		M.S.	Information Systems	University of Maryland at Baltimore County, USA.
		บธ.ม.	การจัดการ	มหาวิทยาลัยเกษตร ศาสตร์ ประเทศไทย
		วท.ม.	วิทยาการ คอมพิวเตอร์	จุฬาลงกรณ์ มหาวิทยาลัย ประเทศ ไทย
		วศ.บ.	ชลประทาน	มหาวิทยาลัย เกษตรศษสตร์ ประเทศไทย

Title / Name – Surname	ID No.	Degree	Major	Institute
Asst. Prof. Dr.Thitirat Siriborvornratanakul	xxxxxxxxxxxx	Ph.D.	Computer Engineering	The University of Tokyo, Japan
		M.E.	Electronic Engineering	The University of Tokyo, Japan
		วศ.บ.	วิศวกรรม คอมพิวเตอร์	จุฬาลงกรณ์ มหาวิทยาลัย ประเทศไทย
Asst. Prof Dr.Tanasai Sucontphunt	xxxxxxxxxxxx	Ph.D.	Computer Science	University of Southern California, USA.
		M.S.	Computer Science	University of Southern California, USA.
		วท.ม.	วิทยาการ คอมพิวเตอร์	มหาวิทยาลัยมหิดล ประเทศไทย
		วศ.บ.	วิศวกรรม อุตสาหการ	จุฬาลงกรณ์ มหาวิทยาลัย ประเทศไทย

3.2.3 Invited Lectures/Special Lecturer

There will be invited lecturers/special lecturers occasionally both from public and private sector nationally and internationally.

4. Elements on Field Experience (Internship or Cooperative Education)

None

5. Requirements for Project Work or Research

5.1 Brief Description

Students must propose a dissertation topic within 1-2 semesters after passing the qualification examination. After receipt of approval on the dissertation topic, the students must register 3-6 credits of the dissertation per semester. Only for the last semester before graduation, the students can register the remaining credits.

5.2 Learning standards

The work of the dissertation must be published in the international journals listed in recognized international databases.

5.3 Duration

The 2nd academic year onward

5.4 Number of Credits

    Plan 1 (1.1)   48 credits

    Plan 2 (2.1)   36 credits

5.5 Preparatiom

    Students should begin developing a dissertation topic starting from the 1st semester of registration as a student under the guidance of a thesis advisor.

5.6 Evaluation Process

    Students must present the dissertation proposal and get approval from their dissertation committee, report dissertation progress every semester, and pass dissertation final examination with the appointment of an external examiner according to the criteria of the institute.

Section 4. The Learning Outcomes, Teaching Strategies and Evaluation

1. **Special Features Development of the Students**

Special Features	Strategies/Activities of the Students
- Analytical and problem solving skills	- Use problem-based and research-based learning methods
- Research skills and life long learning capabilty	- Assign research project and independent study to students
- Presentation Skills in both writing and speaking	- Providing seminar and progress report in writing and oral presenatations

2. **Development of the Learning Outcomes on Each Aspect**

    2.1 Ethics

    2.1.1 Learning outcomes

    (1) Being disciplined, and responsibility toward profession and society

    2.1.2 Teaching strategies for moral and ethics learning development

    Setting corporate culture to instill the students with discipline, for instance, emphasizing on class attendance on time. They are to be honest, such as not committing fraud in examination or copying someone else's homework, etc. In addition, every instructor may add moral and ethical issues in course syllabuses.

    2.1.3 Strategies for moral and ethics learning assessment

    Assessment can be performed on timeliness of the students in class attendance, submitting the assignment within the given date, involvement in activities, amount of fraudulent acts in the examinations, and responsibilities to duties as assigned

    2.2 Knowledge

    2.2.1 Learning outcomes

    (1) Have knowledge and deep understanding of the principles and theories of the fields as well as can apply their knowledge, skill and the right tools to solve problems in the related fields.

2.2.2 Teaching strategies for learning development on the knowledge.

Use teaching methods in various ways by focusing on theoretical and practical applications that are up-to changes in computer science and information systems, and according to the nature of the course.

2.2.3 Strategic evaluation of learning on the knowledge

Assessment of achievement and performance of students in various ways, such as:

(1) Subtests

(2) Mid-term and final examinations

(3) Evaluation of the student's report

(4) Qualification examination

(5) Dissertation proposal examination

(6) Dissertation final examination

2.3 Intellectual skill

2.3.1 Learning Outcomes

(1) Ability on Systematic and critical thinking

(2) Ability to conduct research, interpret, and summarize the new findings of the research as well as apply the knowledge and skill to solve problems in the related fields.

(3) Ability to acquire and learn new knowledge independently.

2.3.2 Teaching strategies used in the learning development of intellectual skills

(1) Case study

(2) Discussion

(3) Independent study

(4) Research Project

2.3.3 Strategic evaluation on learning results on intellectual skills

Evaluation of the learning results can be done based on actual works and performance of the students i.e. evaluation on the presentation in the class, test or interview.

2.4 Interpersonal skill and responsibilities

2.4.1 Learning Outcomes

(1) Able to work well and coordinate with others

(2) Responsible for the work assigned to them.

2.4.2 Teaching strategies used in the development on interpersonal relationships skills and responsibilities

Using instruction with assignment for a work group, that has to coordinate with others, or to collect data from interviews with expert people.

2.4.3 Evaluation strategies of learning on interpersonal relationships skills and responsibilities

Evaluate the behavior and performance of students in group presentation in class, and observation of behavior manifested in the activities.

2.5 Skills in communication, numerical analysis and information technology

2.5.1 Learning outcomes

(1) Able to communicate effectively both orally and in writing as well as

selecting appropriate presentation media

2.5.2 Teaching strategies used in the development of student skills in communication, numerical analysis and information technology

Arrange learning activities in the course for students to analyze various scenarios and realistic situations so that they can offer appropriate solutions, learn techniques in applying information technology in a variety of situations

2.5.3 Evaluation strategies of learning outcomes on skills in communication, numerical analysis and information technology

(1) Evaluate from student presentations that use information technology tools, or mathematics and related statistics

(2) Evaluate the ability to explain the reasons on using various tools and from discussion of case studies that were presented to classes

3. Curriculum Mapping

        The learning outcomes of the curriculum (As defined in Section 4, Clause 2) can be mapped onto the standard of learning outcomes defined by Thailand Quality Framework (TQF) as follows

1. Ethics	ELO 1: Being disciplined, and responsibility toward profession and society.
2. Knowledge	ELO 2: Have knowledge and deep understanding of the principles and theories of the fields as well as can apply their knowledge, skill and the right tools to solve problems in the related fields.
3. Intellectual Skill	ELO 3: Ability on Systematic and critical thinking. ELO 4: Ability to conduct research, interpret, and summarize the new findings of the research as well as apply the knowledge and skill to solve problems in the related fields. ELO 5 : Ability to acquire and learn new knowledge independently.
4. Interpersonal Skill and Responsibility	ELO 6: Able to work well and coordinate with others. ELO 7: Responsible for the work assigned to them.
5. Skills in communication, numerical analysis and implementation of information technology	ELO 8: Able to communicate effectively both orally and in writing as well as selecting appropriate presentation media.

        Following table shows how each course is responsible to what learning outcomes (As defined in Section 4, Clause 2), indicating what is the primary responsibility or a secondary one