WISDOM *for* Sustainable Development

The Council of National Institute of Development Administration
has approved this curriculum
at the Meeting No.10/2022 on October 19, 2022
Educational Service Division, NIDA

หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาโลจิสติกส์อัจฉริยะและการจัดการโซ่อุปทาน (หลักสูตรนานาชาติ) หลักสูตรปรับปรุง 2023

Doctor of Philosophy Program in Smart Logistics and Supply Chain Management (International Program) Program Revision 2023

Graduate School of Applied Statistics
National Institute of Development Administration

Doctor of Philosophy Program in Smart Logistics and Supply Chain Management
(International Program) Program Revision 2023

Name of Institution National Institute of Development Administration
Responsible Agency Graduate School of Applied Statistics

Part 1 Program Title & Course Management System

1. Program Title

Name in Thai: หลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาโลจิสติกส์อัจฉริยะและการจัดการโซ่อุปทาน (หลักสูตรนานาชาติ)

Name in English: Doctor of Philosophy Program in Smart Logistics and Supply Chain Management (International Program)

2. Title of Degree and Program

Name in Thai: ปรัชญาดุษฎีบัณฑิต (โลจิสติกส์อัจฉริยะและการจัดการโซ่อุปทาน)
ปร.ด. (โลจิสติกส์อัจฉริยะและการจัดการโซ่อุปทาน)

Name in English: Doctor of Philosophy (Smart Logistics and Supply Chain Management)
Ph.D. (Smart Logistics and Supply Chain Management)

3. Major subject or area of expertise

None

4. Curriculum Format

4.1 Format PhD program in line with the Standard Criteria for Graduate Programs 2022.

4.2 Language used in the program: English

4.3 Admission Open for Thai and International graduates with a master's degree in Logistics Management, Supply Chain Management, Business and Administration, Economics, Industrial Engineering, Applied Statistics, Applied Mathematics, Engineering Management, System Engineering, Business Analytics and Data Science, 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 Council of National Institute of Development Administration's Approval.

4.4 Collaboration with other institutions Educational Institutes and Universities with collaboration agreements.

4.5 Degree Conferral Upon completion of program requirements, graduates will be awarded the Doctor of Philosophy (Smart Logistics and Supply Chain Management)

5. The Status and the Approval of the Program

Doctor of Philosophy (Smart Logistics and Supply Chain Management) (International Program) revised program 2023 revise from Doctor of Philosophy (Logistics Management) (International Program) new program 2021

The program will open for admission in use from the 1st semester of academic year 2023.

The Academic Council's approval in the meeting No.9/2022 on September 20, 2022.

The NIDA Council's approval in the meeting No.10/2022 on October 19, 2022.

6. Learning & Teaching Location

All teaching will be conducted at National Institute of Development Administration, 148 Seri Thai Road, Bangkapi, Bangkok 10240, Thailand.

7. Relations (if any) to other curricula in any other school/college of NIDA

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

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

7.2 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.

7.3 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 Smart Logistics and Supply Chain Management.

Remarks: Conditions for taking English language courses are in accordance with the announcement of the Institute.

8. Course Management System

8.1 System It is the bi-semester educational systems with credits. The first semester begins on the first week of August (15 weeks) and the second semester begins on the first week of January (15weeks). The summer semester is between June and July month about 8 weeks. All requirements are in accordance with the regulations of the National Institute of Development Administration concerning Education.

8.2 Summer Semester Arrangement Summer session studying is subject to the consideration of the lecturer responsible for the curriculum

8.3 Credit Accumulation in Bi-Semester System None

8.4 Date-Time of the Learning & Teaching Activities

1st Semester	August – December
2nd Semester	January – May
Summer Semester	June – July

8.5 Classroom Session Patterns

Classroom sessions are set up in two patterns as follows:

- On-site classrooms on weekends
- Online classroom via IT systems, both synchronously and asynchronously. comprises no more than 20% of the total course instruction.

9. The 5-Year Plan on Student Intake and Expected Number of Graduates Per Year

Year	Academic 2023	Academic 2024	Academic 2025	Academic 2026	Academic 2027
Year 1	5	5	5	5	5
Year 2	-	5	5	5	5
Year 3	-	-	5	5	5
Year 4	-	-	-	5	5
Total	5	10	15	20	20
Estimated graduate students	-	-	-	5	5

10. Planned Budget

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

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

11. Qualifications of Applicants

11.1 Must be graduated with master degree in Logistics and Supply Chain Management, Supply Chain Management, Business and Administration, Economics, Industrial Engineering, Applied Statistics, Applied Mathematics, Engineering Management, System Engineering, Business Analytics and Data Science, or in the related fields, and graduated from the institutes both domestic and abroad, which have been accredited by the Council of National Institute of Development Administration's approval.

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

12. Possible Professions after Graduation

12.1 Scholars / professors in educational institutions

12.2 Researchers in logistics and supply chain management

12.3 Professionals and Executives in logistics and supply chain management in both public and private organizations

Part 2 Curriculum Design

1. Philosophy of Program

Logistics is crucial for Thailand's economic development and is a top priority in the country's 20-year National Strategy (2018-2037). The Action Plan on Thailand Logistics Development 2023-2027, aligned with the UN's Sustainable Development Goals and other frameworks, is highlighted in the Thirteenth National Economic and Social Development Plan (2023-2027) and the National Strategy (2017-2036). The growing complexity and demand in logistics require a substantial and skilled workforce, particularly those with advanced analytical skills. The main objective of this PhD program is to produce specialists in logistics management and provide the necessary knowledge and research to address future complexities. Logistics is, thus, undergoing a significant transformation driven by data and analytics. Incorporating these skills into a PhD curriculum offers several advantages:

1) *In-depth Knowledge in Logistics and Supply Chain*: Industries need professionals who can analyze data to optimize supply chains. A PhD program with logistics analytics will prepare graduates for success in this high-demand field.

2) *Research & Innovation*: Logistics analytics offers opportunities for groundbreaking research in areas like descriptive, predictive, and prescriptive analytics. PhD graduates can advance smart logistics that leverage technology to manage physical and virtual supply chains. In addition, they possess the ability to successfully communicate with their team, the research community, and the general public.

3) *Technological Advancement*: Integrating *smart logistics* and data analytics bridges conventional logistics with technological progress. Smart Logistics refers to the integration of advanced technologies and data-driven strategies to optimize and automate the logistics and supply chain processes. PhD graduates will be well-positioned to advance technology in logistics and automation.

This curriculum provides students with ample analytics and technical resources to enhance their study and research skills. These skills are essential for addressing the growing complexity and dynamic nature of logistics and supply chain difficulties in the industry.

2. Objectives of the Program

The program aims to develop graduates who:

2.1 Posses the in-depth knowledge and can use advanced technological applications to address the challenges in logistics and supply chain management,

2.2 Possess the ability to conduct the research that extends the knowledge of logistics and supply chain management and related technological disciplines,

2.3 Possess the ethic, discipline, responsibility, and concept of sustainable development goals toward the research work and profession, and

2.4 Possess the effective communication skills for research and professional purposes.

3. Curriculum Development: Design and Process

Designing a PhD curriculum involves a systematic process that integrates various steps to ensure that educational goals are met effectively. This process includes conducting surveys, designing the program, and reviewing the curriculum. The information is briefly explained as follows:

3.1 Needs Assessment through Surveys

We conducted an online survey targeted among prospect students, educators, and industry professionals in the logistics and supply chain industries and universities. The objective of the survey is to understand what knowledge and skills your target learners need and what learners hope to achieve and help tailor the curriculum accordingly.

The online survey was created using the Google Form survey platform and sent electronically. The poll was disseminated within the networks of logistics people, such as alumni and their employers, educators in universities, and logistics companies. It consists of the needs, gap assessment questions, and opinion toward the PhD program. The 162 responses including 14 current students, 73 graduated alumni, 10 university lecturers, 65 employees in logistics and related field were received. The results can be summarized as follows:

1) A little over 40% of the respondents have experience in supply chain, logistics, and transportation. Roughly 16% come from the retail and wholesale sectors, 20% are from

the agriculture and food and beverage industries, and 8% are from the education sectors. About half of the respondents (48%) are the organizational leader or in middle level management positions. The respondents include the current and alumni of the master program, the employer and employee in logistics industries, the educators, and others who are interested in the PhD program.

2) Most responders said they will utilize the knowledge and abilities they learned in the program in their career or management. A portion of the participants intend to pursue their academic careers, particularly in universities where educators are needed to hold a PhD degree.

3) The majority of respondents (94%) state that in order to improve their performance and support the organization's competencies, they need to have analytical and quantitative skills. Similarly, as they are future-ready abilities, computer, IT, and smart logistics are needed to improve graduate performance.

4) They also believe that soft skills, such as English, are essential for their PhD studies and for usage in coordination, negotiation, and communication with international organizations.

The survey results show that a PhD program that can meet the needs of both industries and prospects is necessary. Graduates are expected to have excellent quantitative and analytical capabilities, which they may use for industry or academic research in the future, as well as to leverage these abilities to enhance organizational performance.

3.2 Curriculum Development and Comments from the External Committees

After analyzing the survey data and the capability and competencies of the faculty staffs and the master program that currently offers in the faculty, the courses are developed by focusing on the most critical skills and knowledge based on the identified needs. The program learning outcomes are formulated accordingly. The draft curriculum was initially developed and reviewed by the external committees.

The external committees are included: 1) The potential employers from Thailand Post Co., Ltd. and Bangkok Airways PCL. 2) the educator and professor from Sirindhorn International Institute of Technology (SIIT) 3) The director of supply chain management, DHL Co., Ltd.

Some suggestions made by the external committee to improve the draft curriculum include: 1) offering English courses to help students adjust to the language since textbooks and instruction are in English; 2) connecting the program to businesses and allowing students to learn from real-world case studies of business issues; 3) connecting the program to the sustainable development goals (SDGs), which are the direction of the future; and 4) connecting the program to emerging technologies and innovations in logistics, particularly smart logistics.

3.3 Revision to Accommodate the Technological Changes

The rapid evolution of technology and the advent of modern logistics necessitate a shift in curriculum focus from only logistics management to smart logistics and supply chain management. This transition is critical to equip students with the skills and knowledge required to thrive in the modern and future logistics landscape. The ability to manage the supply chain effectively gives students a comprehensive understanding of the supply chain, which serves as the main business engine. The update was made concurrently with the master's program, and it may make it easier for recent master's graduates to enroll in our course of study.

The program learning outcomes (PLOs) and courses are established and created after the opinions of stakeholders are gathered and reviewed by the NIDA academic committee and subject matter experts. It might guarantee that the program has undergone an evaluation in compliance with academic standards.

4. Program Learning Outcomes (PLO)

The program learning outcomes (PLO) are as follows:

Program Learning Outcomes (PLOs)	
1. In-depth Knowledge in Logistics and Supply Chain	PLO 1: Demonstrate the depth knowledge in logistics and supply chain management. PLO 2: Apply the analytical knowledge and advanced technological applications to solve the logistics and supply chain management problems and issues effectively.

Program Learning Outcomes (PLOs)	
2. Research Skills	PLO 3: Be able to critically evaluate current research and research techniques. PLO 4: Conduct the research that extends the knowledge of logistics and supply chain management and related technological disciplines.
3. Ethical and Sustainability Orientation	PLO5: Demonstrate ethic, discipline, responsibility, and concept of sustainable development goals toward the research work and profession.
4. Effective Communication	PLO6: Demonstrate proficient oral and written communication skills and choose suitable presentation mediums for research and professional purposes.

5. The table shows the relationship between the Objectives of Program and the Expected Learning Outcomes (ELO) of Program.

Objectives of Program	4 Domains of Learning	Program Learning Outcomes (PLO)
2.1 Possess the in-depth knowledge and can use advanced technological applications to address the challenges in logistics and supply chain management.	1. Knowledge	PLO 1: Demonstrate the depth knowledge in logistics and supply chain management PLO 2: Apply the analytical knowledge and advanced technological applications to solve the logistics and supply chain management problems and issues effectively.
2.2 Possess the ability to conduct the research that extends the knowledge of logistics and supply chain management and related technological disciplines.	2. Skills	PLO 3: Be able to critically evaluate current research and research techniques. PLO 4: Conduct the research that extends the knowledge of logistics and supply chain management and related technological disciplines.

Objectives of Program	4 Domains of Learning	Program Learning Outcomes (PLO)
2.3 Possess the ethic, discipline, responsibility, and concept of sustainable development goals toward the research work and profession.	3. Ethics	PLO5: Demonstrate ethic, discipline, responsibility, and concept of sustainable development goals toward the research work and profession.
2.4 Possess the effective communication skills for research and professional purposes	4.Character	PLO6: Demonstrate proficient oral and written communication skills and choose suitable presentation mediums for research and professional purposes.

Part 3 Program Structure, Courses & Credits

1. Number of Credits

Plan 2 (2.1) Research and course requirements, a total of 60 credits.

2. Program Structure

Courses	**Plan 2 (2.1)** Research and courses requirements
Remedial courses	6-12 credits (Non-credit)
Core courses	12 credits
Elective courses (minimum)	6 credits
Dissertation	42 credits
Total not less than	**60 credits**

4. Courses

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

Choose at least 6 credits (2 Courses) upon the consideration of the lecturer responsible for the curriculum.

LSCM 6701	Data Analytics and Decision Models	3 Credits
LSCM 6901	Inventory Management Analytics	3 Credits
LSCM 6902	Smart Logistics and Warehouse Automation	3 Credits
LSCM 6903	Transportation and Network Analytics	3 Credits
LSCM 6904	Supply Chain Analytics and Optimization	3 Credits

Remark: 1. The condition on exemption in English courses is in accordance with the condition of the curriculum of English course for graduate students.

2. The exemption in remedial courses of the school is in accordance with the announcement of the school / the institute.

Core Courses (12 credits)

LSCM 7950	Stochastics Process in Logistics and Supply Chain Management	3 Credits
LSCM 7951	Logistics Network Optimization	3 Credits
LSCM 7952	Research Methodology and Statistics for Logistics Management	3 Credits
LSCM 7953	Doctoral Seminar	3 Credits

Elective Courses (6 credits)

LSCM 7901	Supply Chain Risk Management	3 Credits
LSCM 7902	Advanced Project Management	3 Credits
LSCM 7903	Advanced Logistics Simulation	3 Credits
LSCM 7904	Advanced Spatio-Temporal Data Analysis	3 Credits
LSCM 7905	Advanced Revenue Management	3 Credits
LSCM 7906	Managing Big Data in Logistics Management	3 Credits
LSCM 7907	Applied Machine Learning in Logistics Management	3 Credits
LSCM 7908	Qualitative Research	3 Credits
LSCM 7909	Multi-Criteria Decision Making and Analytics	3 Credits
LSCM 7910	Advanced Production System Analytics	3 Credits
LSCM 7911	Sustainable Logistics and Supply Chain Management	3 Credits
LSCM 7912	Directed Studies	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.

Dissertation

LSCM 9900 Dissertation 42 Credits

5. Lesson Plan

Plan Dissertation and coursework

1st Semester of the 1st Year

LC 6000	Advanced Reading and Writing in English for Graduate Studies	3 Credits*
LSCM 6701	Data Analytics and Decision Models	3 Credits*
LSCM 6901 or	Inventory Management Analytics or	3 Credits*
LSCM 6902	Smart Logistics and Warehouse Automation	3 Credits*
LSCM 7950	Stochastics Process in Logistics and Supply Chain Management	3 Credits
LSCM 7952	Research Methodology and Statistics for Logistics Management	3 Credits
	Total	**6 Credits**

***** Noncredit course

2nd Semester of the 1st Year

LC 4003	Advanced Integrated English Language Skill Development	3 Credits*
LSCM 6903	Transportation and Network Analytics or	3 Credits*
or LSCM 6904	Supply Chain Analytics and Optimization	3 Credits*
LSCM 7951	Logistics Network Optimization	3 Credits
LSCM xxxx	Elective course	3 Credits
	Total	**6 Credits**

***** Noncredit course

1st Semester of the 2nd Year

LSCM 7953	Doctoral Seminar	3 Credits
LSCM xxxx	Elective course	3 Credits
Qualification Examination: students have to register to take a qualification examination after this semester.		
	Total	**6 Credits**

2nd Semester of the 2nd Year

LSCM 9900	Dissertation	6 Credits
	Total	**6 Credits**

1st Semester of the 3rd Year

LSCM 9900	Dissertation	6 Credits
	Total	**6 Credits**

2nd Semester of the 3rd Year

LSCM 9900	Dissertation	6 Credits
	Total	**6 Credits**

1st Semester of the 4th Year

LSCM 9900	Dissertation	12 Credits
	Total	**12 Credits**

2nd Semester of the 4th Year

LSCM 9900	Dissertation	12 Credits
	Total	**12 Credits**

5. Course Description

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

The topics of this course are as follows: a review of essential reading and writing strategies required to read and write academic English, work on sentence structures, vocabulary, and recognition of major thought relationships in paragraphs, practice in reading and writing academic English.

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

The topics of this course are as follows: building integrated listening, speaking, reading, and writing skills with a particular emphasis on academic writing, work in small groups to practice paper presentation techniques, precise writing, and research writing.

LSCM 6701 Data Analytics and Decision Models 3(3–0–6)

The topics of this course are as follows: fundamentals of data analysis, decision/optimization models, and their applications. The computer packages and programming to analyze the problem and find a solution, applications in logistics problems, decision making under uncertainty and introduction to Monte Carlo simulation are included in this course.

LSCM 6901 Inventory Management Analytics 3(3–0–6)

The topics of this course are as follows: inventory classification and deterministic inventory models with constant and time-varying demands, stochastic inventory models, single-period and finite-horizon models, stochastic lead-time models, serial systems, multi-echelon inventory systems. Risk pooling analysis, reserved area and fast-pick area (FPA) in warehouse design, computer packages and programming to analyze inventory problems and find solutions and case studies.

LSCM 6902 Smart Logistics and Warehouse Automation 3(3–0–6)

The topics of this course are as follows: logistics automation, warehouse automation, automation software and components, applications of machine learning and artificial intelligence in logistics and supply chain problems, smart contract and blockchain in supply chain management, big data analytics, predictive analytics, and demand sensing.

LSCM 6903 Transportation and Network Analytics 3(3–0–6)

The topics of this course are as follows: transportation management, transportation modes, and transportation cost analysis, and mathematical models for transportation networks, including transportation problems, transshipment problem, vehicle routing problem, facility location models. The method for solving the problem uses a computer program and programming, computer packages and programming to analyze transportation problems and find solutions and case studies are included in this subject.

LSCM 6904 Supply Chain Analytics 3(3–0–6)

The topics of this course are as follows: supply chain and supply chain management. Strategic fit to business, demand forecast, aggregate planning, supply chain uncertainty and its impact on business costs, supply chain cost reduction under uncertainty, push- and pull-supply chain management, models for pricing and contracts, Bullwhip effect, supplier relationship management, computer packages and programming to analyze supply chain problems and find solutions and case studies.

LSCM 7950 Stochastics Process in Logistics and Supply Chain Management 3(3–0–6)

The topics of this course are as follows: applied stochastic models, discrete- and continuous-time stochastic processes, Poisson processes, Renewal processes, Markov chains and Markov decision processes, probabilistic models for decision making in logistic and supply chain management, stochastic inventory models and queueing models.

LSCM 7951 Logistics Network Optimization 3(3–0–6)

The topics of this course are as follows: graph theory and connectivity analysis, network efficiency and network science for local and global scales in a network, non-Linear optimization, traffic assignment methods, Dial Stoch, User Equilibrium and Stochastic User Equilibrium, logistics network design and multimodal network analysis, additional applications in real logistics networks.

LSCM 7952 Research Methodology and Statistics for Logistics Management 3(3–0–6)

The topics of this course are as follows: empirical research methods for logistics management, controlled experiments, surveys, archival analysis, Ethnographic action research, research question formulation, data analysis with qualitative and quantitative methods, research design and statistical analyses, report and publish work for academic journals, research on human subjects, research ethics and case studies.

LSCM 7953 Doctoral Seminar 3(3–0–6)

The topics of this course are as follows: individual development of a research proposal, preparing the research outline, literature review, research designs, data collection, techniques, and analytical methods and presenting research ideas to the research committee and other researchers.

LSCM 7901 Supply Chain Risk Management 3(3–0–6)

The topics of this course are as follows: critical aspects of risk, trends of risks affecting the supply chain, the goal of risk management in the supply chain, approaches to risk management and Identifying risks, risk analysis, response to risk, network view of risk, creating resilient supply chains, business continuity management.

LSCM 7902 Advanced Project Management 3(3–0–6)

The topics of this course are as follows: definition of a project. Project life cycle, organizational structures, project selection, evaluation approaches, project communications, project planning and cost estimating, work breakdown structure, scheduling techniques, e.g., PERT and CPM, quality, and risk management.

LSCM 7903 Advanced Logistics Simulation 3(3–0–6)

The topics of this course are as follows: static simulation, discrete event simulation, applications of simulation in logistics, business and production problems, data analysis for simulation outputs, verification and validation of situation models, design of experiment for simulation, simulation models by using a computer program, programming API in the simulation tool.

LSCM 7904 Advanced Spatio-Temporal Data Analysis 3(3–0–6)

The topics of this course are as follows: introduction to Spatio-temporal data analysis. geographical information system (GIS) and business analytics, sampling spatial data, point pattern analysis, spatially continuous data analysis, spatial regression, map and Spatio-temporal data visualization, computer packages and programming to analyze Spatio-temporal problems and managing Spatio-temporal big data.

LSCM 7905 Advanced Revenue Management 3(3–0–6)

The topics of this course are as follows: quantitative models for revenue management (RM), single-resource and network capacity controls, overbooking models, price optimization, RM practices in airlines, hotels, automobile rental companies, and other related service industries, stochastic revenue management models and case studies.

LSCM 7906 Managing Big Data in Logistics Management 3(3–0–6)

The topics of this course are as follows: overview applications of Big Data, fundamental platforms such as Hadoop, Spark, and other tools such as IBM System G for Linked Big Data, data storage methods and how to upload, distribute and process Big Data, HDFS, HBase, and KV stores, document database and graph database, handling analytics algorithms on different platforms, visualization issues on Big Data analytics.

LSCM 7907 Applied Machine Learning in Logistics Management 3(3–0–6)

The topics of this course are as follows: machine learning classification, data and data preprocessing, data exploration, decision trees, Bayes classifiers. K-nearest neighbor classifiers, neural networks, support vector machines, logistic regression, dimension reduction, clustering algorithms, association rule analysis, business analytics and data science applications.

LSCM 7908 Qualitative Research 3(3–0–6)

The topics of this course are as follows: philosophical foundations and applications of qualitative research methods interview, observations, video and tape recording, and fieldwork, qualitative data analysis, including critical incident technique, phenomenology, grounded theory, discourse analysis, and narratology, case study, participative action research, ethnography, feminism, mixed methods, qualitative research writing and presentation, ethics for qualitative research.

LSCM 7909 Multi-Criteria Decision Making and Analytics 3(3–0–6)

The topics of this course are as follows: introduction to multi-criteria decision making (MCDM), MCDM methods, MCDM under uncertainty, quantification of qualitative data for MCDM problems, fuzzy MCDM, MCDM practices in logistics and supply chain management problems and other related industries.

LSCM 7910 Advanced Production System Analytics 3(3–0–6)

The topics of this course are as follows: the use of operations and events data and technologies in the manufacturing industry to optimize supply chains, production system fundamental, production planning, operation scheduling for a single machine, job shop and flow shop scheduling, advance scheduling problems, statistical control is fundamental, advanced statistical analysis for production control and reliability analysis for a production system.

LSCM 7911 Sustainable Logistics and Supply Chain Management 3(3–0–6)

The topics of this course are as follows: the environmental issues in the logistics and supply chain to support UN Sustainable Development Goals (SDG), focusing on green logistics, and efficient energy consumption in the logistics sector, measure and minimize the ecological impact of logistics activities, pollution and emission from freight transportation, a sustainable balance of economic and environmental efficiency, use of advanced technology and equipment to minimize environmental damage during operations.

LSCM 7912 Directed Studies 3(0–0–12)

The topics of this course focus on logistics management topics related to a student's research project. A student is required to provide a summary report and consultation work with his/her advisor.

LSCM 9900 Dissertation 42 Credits

Each student conducts research on a particular topic under an advisor's consultation and attends courses as suggested by the advisor. Students must summit a dissertation proposal, research progress reports, and take a final examination.