AUN-QA

SELF-ASSESSMENT REPORT

MASTER OF ENGINEERING PROGRAM IN INDUSTRIAL ENGINEERING

(REGULAR PROGRAM AND SPECIAL PROGRAM)

DEPARTMENT OF INDUSTRIAL ENGINEERING,

FACULTY OF ENGINEERING,

MAHIDOL UNIVERSITY

THAILAND

LIST OF ABBREVIATIONS

AEC	ASEAN Economic Community
AUN	ASEAN University Network
B.Eng.	Bachelor of Engineering degree
B.Sc.	Bachelor of Science degree
CDC	University Curriculum Development Committee
CLOs	University Course Learning Outcomes
ELOs	Expected Learning Outcomes
FGS	Faculty of Graduate Studies, Mahidol University
FTE	Full-Time Equivalent
GPA	Grade Point Average
HR	Human Resource
IE	Industrial Engineering
IT	Information Technology
IIW	Institute of International Welding Engineer
LAN	Local Area Network
MCQ	Multiple-Choice Question Master of
M.Eng.	Engineering degree
OBE	Outcome-Based Education
OHEC	Office of Higher Education Commission, Ministry of Education, Thailand
PA	Performance Agreement
QA	Quality Assurance
SAR	Self-Assessment Report
TLA	Teaching and Learning Approaches
TOEIC	Test of English for International Communication
TQF	Thailand Qualification Framework
TRF	Thailand Research Fund
UK	United Kingdom
USA	United State of America
Wi-Fi	Local area wireless computer networking technology

TABLE OF CONTENTS

I. INTRODUCTION

Executive Summary

Master of Industrial Engineering Program is established in 2007 under the main management of Department of Industrial Engineering, Faculty of Engineering, Mahidol University. The program has been approved by Office of Higher Education Commission (OHEC), Ministry of Thailand Education (Now change to be Ministry of Higher Education, Science, Research and Innovation). In origin, the program had designed for serving the demands of industrial' employer and aligned curriculum with the UK master of industrial and operation management. Since Mahidol University promote a strategy of outcome-based education. Our program was redesigned by the alignment of MU' Graduate attributes, employers' needs, academic requirements, alumni feedback, and present student satisfaction. Core courses and elective course are more strengthening and offering to fulfill the capability of master IE' student. Facilities such as a teaching room, master student' common room, lecture equipment, laboratory equipment, IT, expertise manufacturing laboratory, library and medical services program are adequately allocated for a good learning life of a student when they are learning in Mahidol University. Academic staff and supporting staffs have performed systematically in the regulation and/or procedures of Faculty of Graduate Studies. The assessment method is improving, continually to proof that students could give all of the feedback to the program for improvement as a concreteness action. In 2017, stakeholder satisfaction from the survey were collected and consider by program committees and then revises a curriculum for matching to the specified needs. Our program has a regular program for a full-time student and a special program for a part-time student (employee in a private company). Both thesis and thematic paper are available for student selection, independently. Most of the topics of research come from annually government research demands, ministry offices, hospitals, international research network, private industrial companies. It was identified that Master IE students could perform research or thematic paper (independent study) with social demands. Student activities in soft-skill and relaxation time are also provided by the program, Faculty of Engineering and Faculty of Graduate Studies. In this report has an objective to inform that Master IE program has curricula, procedure, and activity meet requirements of AUN-QA criteria.

ORGANIZATION OF THE SELF-ASSESSMENT

This SAR is consisted of 4 main parts – I. Introduction, II. AUN-QA Criteria Requirements, III. Strength and Weakness Analysis and IV. Appendices. Introduction part consists of executive summary and overviews of university, faculty and department. The AUN-QA Criteria Requirements part is the part that reveals how our academic programs comply with the requirements. Strength and Weakness Analysis identifies both of good points and weakness for further improvement. Appendices part provides the examples of evidences or documents in support justification.

OVERVIEW OF THE UNIVERSITY, FACULTY, DEPARTMENT

Mahidol University

Mahidol University has its origin in the establishment of Siriraj Hospital in 1888 by His Majesty King Chulalongkorn (Rama V) and the hospital's medical school is the oldest institution of higher learning in Thailand, granting its first medical degree in 1893. Later becoming the University of Medical Sciences in 1943, Mahidol University was renamed with great honor in 1969 by H.M. King Bhumibol Adulyadej , after his Royal Father, H.R.H Prince Mahidol of Songkla , who is widely known as the 'Father of Modern Medicine and Public Health in Thailand'. Mahidol University originally focused on health sciences but also expanded to other fields in recent decades. Mahidol University has since developed into one of the most prestigious universities in Thailand, internationally known and recognized for the high caliber of research and teaching by its faculty, and its outstanding achievements in teaching, research, international academic collaboration and professional services.

In 2018, Mahidol University is ranked Thailand's #1 university by U.S. News & World report, UI GreenMetric World University Rankings, NTU Ranking, Times Higher Education Asia University Rankings. In 2019, Mahidol University is ranked Thailand's #1 university by QS World University Rankings, Times Higher Education World University Rankings . and Times Higher Education Emerging University Rankings.

Vision: Mahidol University is determined to be a world-class university.
Mission: To excel in health, sciences, arts, and innovation with integrity for the betterment of Thai society and the benefit of mankind.

Faculty of Engineering

The Faculty of Engineering was established in 1989, in response to Thailand's need for engineers as a newly industrialized country. The Faculty aims to produce graduates with knowledge and excellence in engineering, who value ethics and feel responsible to the profession and to society. Over the past 23 years, the faculty has shown its excellence in teaching and research in various fields of engineering including chemical, civil, computer, electrical, industrial, and mechanical engineering, as well as in interdisciplinary fields such as biomedical engineering.

The Faculty of Engineering is housed in three buildings on the Salaya Campus, comprising an area of approximately 56,000 square meters, which has been the home of many renowned faculty members. The Faculty has a full range of state-of-the-art laboratories for both teaching and research purposes. There currently are 9 undergraduate and 12 graduate programs, designed and constantly improved such that students can gain both theoretical knowledge and hands-on experience under the highest educational standards.

The Faculty of Engineering also offers international programs for international students in selected fields such as Biomedical Engineering, Computer Engineering, Chemical Engineering, Civil and Environmental Engineering, and Logistics and Engineering Management. The Faculty is well known its community contributions and educational services provided for the community and the country as a whole. With its philosophy and strong commitment to excel in engineering fields, the Faculty of Engineering has become one ofthe leading engineering faculties in Thailand and the Asia Pacific Region. And by upholding Mahidol University's philosophy and policies to be the "Wisdom of the Land", the Faculty of Engineering at Mahidol University has committed itself to provide the answer to all engineering problems of the nation, to serve both society and community with ethics and responsibility.

Vision: Interdisciplinary Research towards World Class Engineering.

Mission: To Generate Interdisciplinary World Class Engineering Innovation, Research and Academics to Develop Graduates with Systematic Thinking, Altruism and Readiness in Advancing Engineering and Technology for Better Living of Thailand Global Communities.

Department of Industrial Engineering

Department of Industrial Engineering at the Faculty of Engineering, Mahidol University was established in 1990 by the approval under the University Bureaus, Thailand. Concept of Production Engineering and classical Industrial Management was an original curricula for first generate student. At the time, Demand for industrial side was an engineer who able apply an IE knowledge on heavy industries, practically. However , when IE academic staffs finished their Ph.D. degree from UK and USA around 1990, the modern IE concept had applied for revising on smart IE. Elective courses for 4^{th} year student were categorized in 4 major groups which consisted of modern industrial management, logistic & supply chain, quality control and advanced manufacturing. According to MUIE strength of bachelor' elective courses, the great demand for master degree was called from students and employers. Then, 2017, Master of IE program was established and still performing, academically on the present. The outcomes of the program that outstanding especially a research performance on advanced management and logistic fields. Therefore, 2010, Ph.D. international program was established as Logistics and Engineering Management to serve the specified demand in a sophisticated IE field, globally. Both our M. Eng. And Ph.D. degrees have been developed curriculums with concept of the outcome-based to meet requirement of all stakeholders, continuously.

In update, 2017, Department of Industrial Engineering had initiated the tailored made program from a strong demand in the functional food and drink industry. Bachelor of engineering program of "Diary and Beverage Engineering (International Program) is the lasted program of our department.

II. AUN-QA CRITERIA REQUIREMENTS

1. EXPECTED LEARNING OUTCOMES

Programs' expected learning outcomes (ELOs) are a set of achievements that students must accomplish upon their graduation. Attainment of the ELOs is ensured by gradual imprinting of the skills on the students through a series of coursework requirements and research training of the programs along with verification via various assessment methods. The current ELOs as well as curriculum structure of our Graduate Programs in Industrial Engineering, consisting of Master degree curricula, were formulated according to the protocol briefly described as following:

Curriculum Revision Procedure

At least every 5 years, the Department of Industrial Engineering appoints a Curriculum Development Committee (CDC) consisting of representatives of academic staffs within the programs and at least 2 external committees from outside Mahidol University. The CDC drafts the programs' ELOs as well as program structure and specification in the TQF2 document format by taking into consideration: 1) internationally recognized Master degree courses in Industrial Engineering related fields 2) the feedbacks received from stakeholders and 3) the past record of our graduates' employment. The drafted curricula were presented to and approved by the departmental staff meeting before submission to the Faculty of Graduate Studies (FGS). Once submitted, FGS rechecks the documents to ensure that the revised curricula conformed with TQF requirement before handing further to a Peer Review Committee appointed by Mahidol University Council. Upon receiving comments from the Peer Review Committee, the CDC makes further revision(s) and programs get final approval by Mahidol University Council. According to the last curriculum revision process in 2018, ELOs of our graduate programs have been formulated and aligned with Mahidol University' Core Values (TQF Description is shown in the appendix) as illustrated in Table 1 below:

Table 1 ELOs of Master of Industrial Engineering, Department of Industrial Engineering, Faculty of Engineering, Mahidol University. The present curricula were last revised in 2018.

Mahidol Core Value **M: Mastery, A: Atriums, H: Harmony, I: Integrity, D: Determination, O: Originality, L: Leadership**																		
ELO of the Program (Bloom' Taxonomy)	**A, I**	**A, I**	**A, I**	**M**	**M**	**M, D**	**M, O**	**M, O**	**M, D**	**M, D**	**D**	**H, D**	**H**	**H, L**	**A, I**	**M**	**M**	**M**
	TQF																	
	1.Moral and Ethics			**2.Knowledge**			**3.Cognitive Skill**				**4.Personal Interrelation and Responsibility**					**5.Skill in Numerical Analysis, Communication and Information Technology**		
	1.1	**1.2**	**1.3**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**3.3**	**3.4**	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**5.1**	**5.2**	**5.3**
ELO 1 (Creating)	√		√								√				√			
ELO 2 (Understanding)				√												√		
ELO 3 (Applying)					√		√									√		
ELO 4 (Evaluating)						√			√	√								
ELO 5 (Applying/ Responding)		√											√	√				
ELO 6 (Applying)								√				√		√	√		√	√

1.1 The expected learning outcomes have been clearly formulated and aligned with the vision and mission of the university.

As Mahidol University has the vision to be a world class university, the concentration of the program is specifically aimed at building high quality human resources capable of conducting world class research, and applying knowledge and skills to industries. MU's core values and MU' Graduates Attributes are keywords and guidelines for creation the ELOs of the program. This covers a variety of fields related to Industrial Engineering such as Logistics and Supply Chain Management, Engineering Management, Production Engineering and Quality Engineering and Applied Manufacturing Engineering, Creative Product Development. The program takes into account "Thailand Qualification Framework for Higher Education (TQF)" to ensure that the curriculum would truly cover not only education but also ethics and moral. The alignment of our programs' ELOs is presented in Table 2.

Table 2 Alignment of Mahidol University Graduates Attributes guidelines with ELOs of our graduate programs in Master of Industrial Engineering.

Mahidol University Graduates Attributes	Matched ELOs
1.T-Shaped Breadth and Depth	ELO 2. Illustrate the principles of advanced industrial engineering appropriately and correctly
2. Globally Talented	ELO 3. Apply advanced industrial engineering knowledge to improve the production and service industries ELO 4. Analyze problems and propose solutions to solve the problems in industrial engineering applying research methodology in a systematic way
3. Socially Contributing	ELO 5. Behave as a team with others from various filed related to industrial engineering work ELO 6. Communicate, use information technology, and choose the method to effectively present the information in industrial engineering
4. Entrepreneurially Mined	ELO1. Ethically create academic works related to advanced industrial engineering field ELO 3. Apply advanced industrial engineering knowledge to improve the production and service industries ELO 5. Behave as a team with others from various filed related to industrial engineering work

1.2 The expected learning outcomes cover both subject specific and generic (i.e. transferable) learning outcomes.

Our expected learning outcomes can be differentiated into both subject-specific and generic skills. Subject-specific outcomes are knowledge and skills exclusive to the field of Industrial Engineering and Manufacturing System. Generic learning outcomes, on the other hand, are common skills universal to any subject area, such as problem-solving skills, communication, ethics, IT, leadership and teamwork, etc. The curriculum was developed by taking examples from world renown universities in the industrial engineering related fields; in particular those in the United States and United Kingdom such as Warwick University, Birmingham University, Canfield University, the University of Iowa, University at Buffalo and Ohio State University. It is a combination of coursework, research and practice. While maintaining it to be in the same standard and transferable to those in other universities around the world, the individual subject-specific courses are designed to be self-contained, that allows for students' freedom in composing the combination of courses that suits their needs, and in turn giving individual students a unique set of industrial engineering skills.

Table 3 Classification of our graduate programs' ELOs as generic or subject-specific learning outcomes.

Program ELOs	Generic ELOs	Subject-Specific ELOs
1. Ethically create academic works related to advanced industrial engineering field		√
2. Illustrate the principles of advanced industrial engineering appropriately and correctly		√
3. Apply advanced industrial engineering knowledge to improve the production and service industries		√
4. Analyze problems and propose solutions to solve the problems in industrial engineering applying research methodology in a systematic way engineering applying research methodology in a systematic way		√
5. Behave as a team with others from various filed related to industrial engineering work	√	
6. Communicate, use information technology, and choose the method to effectively present the information in industrial engineering	√	

1.3 The expected learning outcomes clearly reflect the requirements of the stakeholders

During the process of revising our graduate curricula in 2018, feedbacks from various stakeholders had been taken into consideration. We first defined our stakeholders as following: 1) academic staffs within the department/programs, 2) current students at that time, 3) alumni, 4) graduate employers and 5) Mahidol University. Opinions and comments from academic staffs and current students were collected by brainstorming and interview, respectively. Feedbacks/criticisms from alumni and employers were gathered from both questionnaires and interview. Requirements of Mahidol University on our graduate programs were received in the form of comments/feedbacks/suggestions from the Peer-Review Committee during the curriculum development process (described earlier). The programs' ELOs as well as program specification were drafted by taking into consideration all feedbacks from stakeholders and the past record of our graduates' employment *(Appendix 2, page A2)*. From the past record, most of our master's degree alumni (about 64%) have been employed in private companies. 2nd working area of a graduate master IE (23%) is government offices such as Ministry of Public Health. Business owner is one of career for our student has chosen (10%) when finished learned in course of Master IE. Continue study in Ph.D. both of Thailand and Aboard are small part (3%) of our students but most of them are an excellent research student who work intentionally with an advisor on an internal project. Thus, our master program was fundamentally designed to foster knowledge and technical skills to the students. It can be seen that an actual demand of industry is priority for improving the curricular of Master IE. Thus, the ELOs and program structure for our Master curriculum were specifically designed to produce graduates with international industrially quality to match the demand of the workforce markets. Table 4 below compares the program objectives (our term for learning outcomes) of the 2012 curricula and the present ones.

The stakeholders are defined as 1) academic staffs within the department/programs, 2) current students at that time, 3) alumni, 4) graduate employers and 5) Mahidol University. Comments and opinions from academic staffs and current students will be collected in the form of brainstorming followed by (face-to-face, teleconference and telephone interview) interview. Feedbacks or criticisms in either term of constructive and destructive are collected through questionnaires and interview. Moreover, the requirements of Mahidol University on our graduate programs will be received in the form of comments/feedbacks/suggestions from the Peer-Review Committee during the curriculum development process (curriculum revision procedure described earlier). The programs' ELOs as well as program specification were drafted by taking into consideration all feedbacks collected form stakeholders and the past record of our graduate's employment (Appendix 2 Alumni Employment). According to the past records of master alumni, more than 64 % has been employed as employee in private company. The remaining 23%, 10% and 3% were lecturer university/government employee, business owner and continuous in higher education, respectively. The ELOs and program structure for our master curriculum, therefore, were specifically designed to produce graduates with international quality to match the demand of the workforce markets. Table 4 below compares the program objectives (our term for learning outcomes) of the 2012 curricula and the present ones.

Table 4 Comparison of the 2012 and 2018 (current) program learning outcomes.

2012 Program Objectives After completion, the graduates must possess:	**2018 Program ELOs** After completion, the graduates must be able to:
1. Knowledge in frontiers of Industrial Engineering fields in theoretical and practical aspects with modern methodology. 2. Capability of researching for knowledge, experimental planning, solving research problems and producing quality research publications at the international level 3. Vision to ask important research questions and the potential to conduct independent research that leads to new findings 4. Morality and research ethics, ability to pass on knowledge in Industrial Engineering and Industrial Engineering to the society with efficiency	1. Ethically create academic works related to advanced industrial engineering field 2. Illustrate the principles of advanced industrial engineering appropriately and correctly 3. Apply advanced industrial engineering knowledge to improve the production and service industries 4. Analyze problems and propose solutions to solve the problems in industrial engineering applying research methodology in a systematic way engineering applying research methodology in a systematic way 5. Behave as a team with others from various filed related to industrial engineering work 6. Communicate, use information technology, and choose the method to effectively present the information in industrial engineering

All of the gathered feedbacks, several key suggestions/requests have led to the establishment of clearer and better learning outcomes when compared to the 2012 curricula. For example, academic staffs and alumni made the same suggestions that more emphasis should be made on training the communication skills, especially the writing aspect. Such comment gave rise to ELO #2 of the current curricula that specifies the students' ability to communicate in both oral and written English. Table 5 summarizes the mapping of stakeholders' requirements and our graduate programs' ELOs.

Table 5 Mapping of stakeholders' requirements and our graduate programs' ELOs. Scoring criteria is as following: √ √ √ = Impressed, √ √ = very satisfied, √ = satisfied

Program ELOs	Academic Staffs	Current Students	Alumni	Employers	Mahidol University
1	√ √ √	√	√	√ √ √	√ √ √
2	√ √ √	√	√ √	√	√ √ √
3	√ √ √	√	√	√ √ √	√ √ √
4	√ √ √	√	√	√ √ √	√ √ √
5	√ √ √	√	√ √	√ √ √	√ √ √
6	√ √ √	√ √ √	√ √ √	√ √ √	√ √ √

2. PROGRAM SPECIFICATION

In 2009, Office of Higher Education Commission (OHEC), Ministry of Education, enforced the Outcome-Based Education (OBE) in Thailand in the form of Thailand Qualifications Framework (TQF), which is the regulation that all academic programs must follow. Our Graduate Programs in Industrial Engineering were subsequently revised in 2016 to comply with the TQF requirement and the adjusted curricula were first applied to the students entering the programs in the first semester of academic year 2018. Program structures and specifications are portrayed in the official TQF2 documents (Program Specification, separately between M.Eng.) while course specifications are presented in the TQF3 documents (Course Specification). As all the stated documents are written in Thai language while our graduate programs are international programs, the Program Administrative Committees have summarized and translated the essential information that all students must know into English language. The English version of the program specifications for our master's programs are presented in (*Appendix 3, page A3 – A9)* together with the syllabi (summarized and translated forms of the TQF3 documents) of all required courses are presented in (*Appendix 4, page A10 – A47).*

2.1 The information in the program specification is comprehensive and up-to-date

As mentioned earlier, the detailed program specifications of our master's curricula are originally presented in Thai language as the TQF2 documents that contain a lot of information as legally required by the TQF regulation (>60 pages for M.Eng. program). Our summarized version of the program specifications in English (Appendix 3), or sometimes called "Student Manual", are thus comprehensive and up- to-date. This Student Manual are revised annually if certain areas of the specified information need to be updated. Moreover, according to the TQF regulation, the Program Administrative Committees must monitor and annually submit Program Reports (TQF7 documents) to the University. In the TQF7 documents, the overall operations of the programs (both positive and negative sides) are to be reviewed and described. Feedbacks from stakeholders, especially students and academic staffs are also recorded and kept for the next curriculum revision period. According to the rules regulated by Ministry of Education, the program curriculum must be revised at least every 5 years of operation. By the time of this SAR, the Program Administrative Committees are preparing for next round of curricula revision.

2.2 The information in the course specification is comprehensive and up-to-date

Similar to the program specifications, the course specifications are originally written in Thai language in the form of TQF3 documents. Our course syllabi *(see example in Appendix 4, page A10 – A47)* are summarized and translated (from Thai to English) versions of the original documents with only key important information presented. Thus, from an average of 8-10 pages of information per TQF3 document, our course syllabi are about 2-4 pages long. Likewise, the TQF regulation also requires that at the end of the semester, course coordinator and teaching staffs must evaluate the teaching and learning as well as assessment processes of the course by taking into accounts feedbacks from students. Strengths and weaknesses of the course are noted for future improvement. The report for each course is to be submitted as a TQF5 – Course Report document at the end of the semester. In the next academic year, new course syllabi are drafted by incorporating the areas of improvement noted from the previous academic year. Hence, it can be concluded that information in our course specifications (course syllabi) are comprehensive and up-to-date.

2.3 The program and course specifications are communicated and made available to the stakeholders

Both program and course specifications are always made available to all stakeholders, as well as to prospective students, on the web site of the Department of Industrial Engineering, Faculty of Engineering, Mahidol University at: (Please see Home Page of Master of Engineer Program) Every year, program and course specifications are also communicated to new graduate students and staffs during new student orientation.

3. PROGRAM STRUCTURE AND CONTENT

Contents and structures of our Graduate Program in Master of Industrial Engineering are presented in more detail in the Program Specification *(see Appendix 3, page A3 – A9).* Here, a brief overview of the program structures and contents are explained. Figure 1 illustrates the overall structures of our graduate programs and the paths that students can go through from new entry to exiting the programs. For international student who either final year or completed of bachelor with GPA more than 2.50 can apply the registration and shall be evaluated by the program committees by suitable interview activities such as phone or internet VDO call. For Thai student that either final year or completed of bachelor can apply the registration and shall be evaluated by the program committees with the knowledge examination of industrial engineering and interview. When all of student complete enter to the program, student can select the study program between the regular program or special program. In same time, student shall select his/her research plan between thesis (plan A) or thematic paper (Plan B).

For first year (1st and 2nd semester), the program has been designed for providing the advanced knowledge of industrial engineering by the core courses and elective courses for all study plans (Thesis plan and thematic paper plan). 24 Credits can be collected in the first year. In 2nd year, for thesis-plan student can apply a thesis for 12 credits. In case of thematic-paper plan student shall apply more 6 credits (2 elective courses) and also apply a thematic paper for 6 credits. Our program promotes the fast track student that able apply thesis in 2nd semester of 1st year to support the shot period existing.

Before the students can proceed with their graduate research, they must present thesis/independent study proposal for approval by the committee. Once the proposal is approved, the Thesis/thematic paper Advisory Committee will be appointed to provide guidance and monitor the student progress on their research. Upon completion of the research project with output achievement required by the programs, graduate students have to write and orally defend their thesis, all in English language for a dissertation. For thematic-paper plan student shall examine the comprehensive examination which consist of the knowledge of core courses of the program. By passing all the requirements, students are awarded their degree.

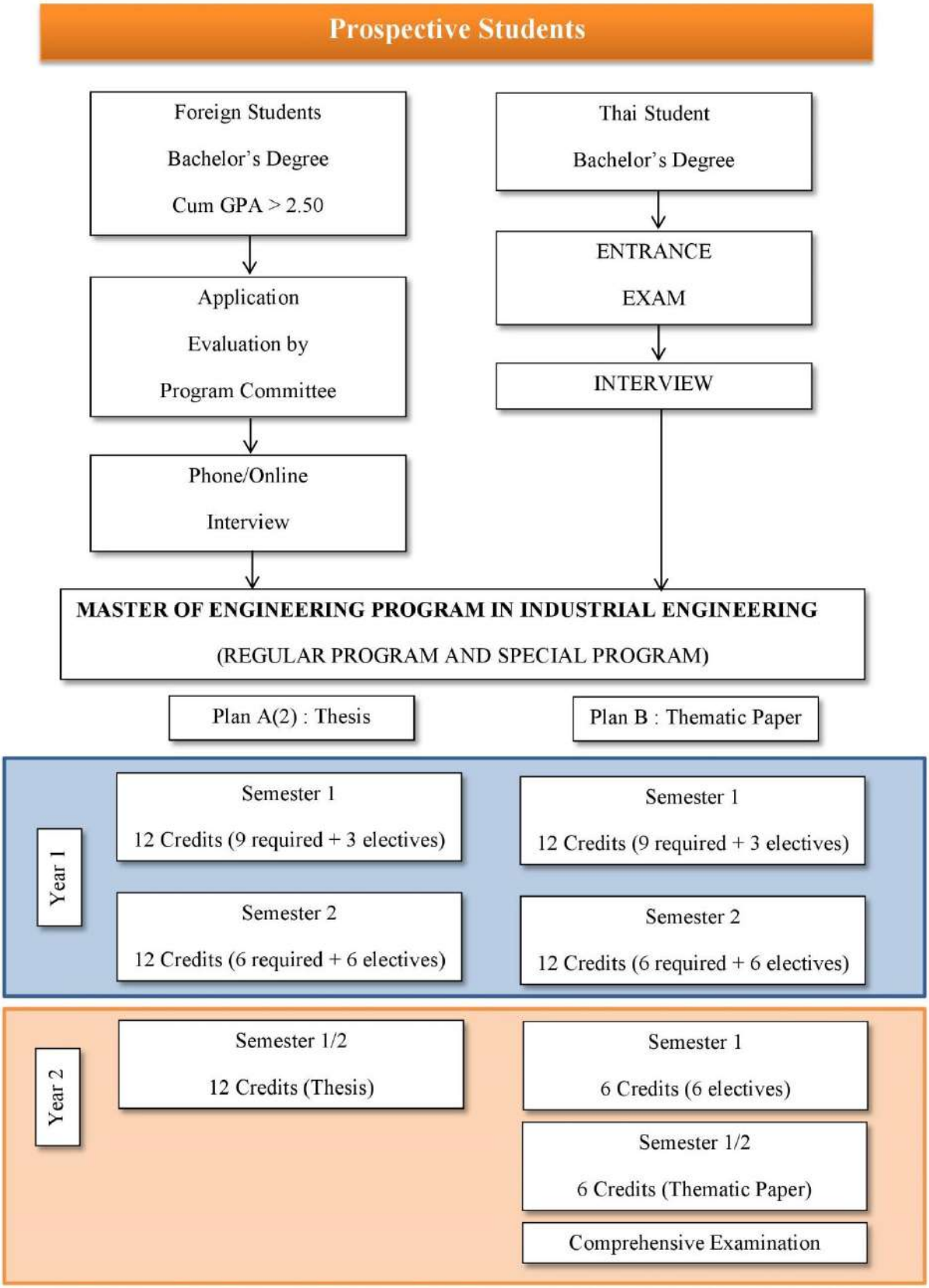


Figure 1 Diagram showing the structure of our master's programs with the paths that students can go through, from application process toward completion or termination of the degree.

3.1 The curriculum is designed based on constructive alignment with the expected learning outcomes

All the coursework as well as non-coursework activities within each curriculum have been designed to contribute, at least in part, to students' achievement of program ELOs. By integrating all teaching and learning processes along with non-coursework activities, all ELOs can be achieved. Table 6 illustrates the alignment of program ELOs and the contribution of individual courses. Table 7 further presents the assessment and key indicators for determining students' achievement of programs' ELOs.

Table 6 Matrix displaying contribution of individual required courses (plus one recommended elective course) toward achievement of program learning outcomes. Detail mapping of each course learning outcome with the programs' ELOs is presented in *(Appendix 4, page A10 – A47)*.

Subject Code	Courses	ELO1	ELO2	ELO3	ELO4	ELO5	ELO6
Basic Courses							
EGIE569	Basic Principles of Industrial Engineering	-	I	-	-	-	-
EGIE 570	Probability and Statistics	-	I	-	-	-	-
EGIE 571	Operations Research	-	I	-	-	-	-
EGIE 572	Production Planning and Control	-	I	-	-	-	-
Required Courses							
EGIE 502	System Thinking and Modeling	I	-	-	R	M	P
EGIE 504	Advanced Operations Management	-	-	R	P	-	I
EGIE505	Applied Engineering Statistics and Operations Research	-	-	R	P	-	-
EGIE 506	Innovation and Creativity for Sustainable Entrepreneurship	I	-	R	-	M	-
EGIE 507	Seminar and Research Methodology	P	-	-	-	-	P
Elective Courses (Logistics and Supply Chain Management)							
EGIE 510	Principles of Logistics and Supply Chain Management		R	P	I		
EGIE 511	Information Technology for Logistics and Supply Chains	-	R	P	I		R
EGIE 512	Management of Technology and Innovation		-	R	I	-	R
EGIE 513	Logistics and Supply Chain Performance Measurement	I	-	P	-	I	P
EGIE 514	Intelligent Systems and Decision Support Systems	-	-	R	-	-	P
EGIE 515	Inventory Management	-	-	R	-	-	P
EGIE 517	Warehouse Management	-	-	R	-	-	P
EGIE 529	Service Logistics and Supply Chain	-	-	R	-	-	P
EGIE 531	Seminar in Modern Logistics and Supply Chain Topics	-	R	-	-	R	M
EGIE 533	International Transport Logistics	-	R	-	-	R	M
EGIE 534	Statistical Methods for Reliability Engineering	-	R	P	I	-	-
EGIE 535	Information Management in Healthcare Supply Chain	I	I	-	-	-	M
EGIE 598	Hospital Logistics and Supply Chain Management	-	I	-	-	P	M
EGIE 601-605	Special Topics in Logistics and Supply Chain Management	-	-	P	R	-	-
EGIE 631	Data Mining in Industrial Engineering	-	-	-	P	-	M

Subject Code	Courses	ELO1	ELO2	ELO3	ELO4	ELO5	ELO6
Elective Courses (Engineering Management, Production Engineering and Quality Engineering)							
EGIE 521	Project Management for Engineers	-	-	P	-	M	P
EGIE 525	Six Sigma	-	R	-	-	I	-
EGIE 537	Assembly Line Balancing Principle	-	I	R	-	-	P
EGIE 606-610	Special Topics in Engineering Management, Production Engineering and Quality Engineering	-	-	-	M	-	M
EGIE 622	Quality Management	I	R	-	-	M	P
EGIE 624	Lean Production and Service Systems	-	-	R	-	-	P
Elective Courses (Applied Manufacturing Engineering and Creative Product Development)							
EGIE 540	Tools for Manufacturing Engineering	-	I	P	-	-	-
EGIE 541	Industrial Metallurgy and Advanced Materials Science	-	I	P	-	-	-
EGIE 542	Introduction to the Internet of Things and Embedded Systems	-	I	-	-	-	I
EGIE 543	Total Welding Management	-	-	P	-	-	I
EGIE 544	Manufacturing of Boiler and Pressure Vessel	I	I	-	-	-	P
EGIE 545	Principle of Manufacturing Technology Transfer	-	P	-	-	I	I
EGIE 546	Advanced Welding Processes and Control of Welded Properties	-	I	P	-	-	-
EGIE 549	Manufacturing Automation	-	-	R	-	-	P
EGIE 550	Digital Manufacturing	-	-	R	-	-	P
EGIE 590	Materials for Product and Manufacturing	-	-	R	-	-	P
EGIE 591	Manufacturing for Competitive Advantages	-	-	-	R	-	M
EGIE 592	Product and Manufacturing Development for Competitive Advantages	-	-	-	R	-	M
EGIE 616-620	Special Topics in Applied Manufacturing Engineering and Creative Product Development	I	-	-	R	-	M
EGIE 698	Thesis	M	M	M	M	R	M
EGIE 697	Thematic Paper	M	M	M	M	R	M

I = ELO is introduced & assessed P = ELO is practiced & assessed
R = ELO is reinforced & assessed M = Level of Mastery is assessed

Table 7 Assessment methods and key achievement indicators for assurance of students' attainment of the program ELOs.

ELO		Teaching and Learning Approach	Assessment
ELO 1	Ethically create academic works related to advanced industrial engineering field	• Lecture, class discussion, case studies with the assertion of examples related to code of ethics, disciplines, and punctuality during the classes in the context of the course and demonstrate good examples for students • Assign the students to be responsible for the teaching process encourage self-study without plagiarism and refer to the source of the information correctly. • Organize class activities to self-learn about the roles and responsibility as team member and team leader in group assignments course reports • Have the students sign and time in the attendance record and exam form and give a score for attending classes as part of the evaluation.	• Evaluate the student's timeliness in class attendance, examinations, assignments submissions and class activities participation. • Observe behaviors of the students while attending the activities. • Evaluate from student reports and theses or student papers
ELO 2	Illustrate the principles of advanced industrial engineering appropriately and correctly	Arrange the teaching in courses related to advanced industrial engineering in student-centered learning approach and encourage self-learning skills of the students, practice actual works or researches, as well as lectures from experienced practitioners. The teaching methods include • Lectures in courses related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Seminars and discussions related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Study visits related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Report writing and presentations of the analysis results in the assignment related to logistics and supply chain management,	Assess the students' achievement and practice from various aspects • Quizzes • Midterm and final examinations • Class assignments and reports • Students' presentation in classes • Questions and answers

ELO		Teaching and Learning Approach	Assessment
		engineering management, production and quality engineering, and applied production engineering and creative product development • Use computer programs in teaching in the courses related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Encourage researches from textbooks, teaching materials or searching for additional information related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Practice analytical thinking by questions and answers from case studies in classes related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development • Invite experts from organizations, institutions or government agencies outside the university to give suggestions and exchange knowledge and experiences related to logistics and supply chain management, engineering management, production and quality engineering, and applied production engineering and creative product development	
ELO 3	Apply advanced industrial engineering knowledge to improve the production and service industries	Arrange the teaching in courses related to advanced industrial engineering in student-centered learning approach and encourage self-learning skills of the students, practice actual works or researches, as well as lectures from experienced practitioners. The teaching methods include • Lectures • Seminars and discussion • Study visits • Report writing and presentations of the analysis results in the assignment • Use computer programs in teaching in the courses	Assess the students' achievement and practice from various aspects • Quizzes • Midterm and final examinations • Class assignments and reports • Students' presentation in classes • Questions and answers • Students theses or papers

ELO		Teaching and Learning Approach	Assessment
		• Encourage researches from textbooks, teaching materials or searching for additional information outside the classroom • Practice analytical thinking by questions and answers from case studies in classes • Invite experts from organizations, institutions or government agencies outside the university to give suggestions and exchange knowledge and experiences • Provide students chances to participate in research projects and academic services of their advisors • Attend national and international academic conferences	
ELO 4	Analyze problems and propose solutions to solve the problems in industrial engineering applying research methodology in a systematic way	Arrange the teaching in courses related to advanced industrial engineering in student-centered learning approach and encourage self-learning skills of the students, practice actual works or researches, as well as lectures from experienced practitioners. The teaching methods include • Lectures • Seminars and discussion • Study visits • Report writing and presentations of the analysis results in the assignment • Use computer programs in teaching in the courses • Encourage researches from textbooks, teaching materials or searching for additional information outside the classroom • Practice analytical thinking by questions and answers from case studies in classes • Invite experts from organizations, institutions or government agencies outside the university to give suggestions and exchange knowledge and experiences • Provide students chances to participate in research projects and academic services of their advisors • Attend national and international academic conferences	Assess the students' achievement and practice from various aspects • Quizzes • Midterm and final examinations • Class assignments and reports • Students' presentation in classes • Questions and answers • Students theses or papers
ELO 5	Behave as a team with others from various filed related to industrial engineering work	• Group discussion • Group projects and reports • Encourage group researches and learnings	• Observing students' behavior from group projects or works • Evaluate from group discussions

ELO		Teaching and Learning Approach	Assessment
		• Provide students chances to participate in research projects and academic services of their advisors • Have students do group activities and participate in the group works with various roles	• Peer review and evaluation • Observing group behavior during group discussion and presentations in classes, interaction with others as well as being able to reflect on others' idea from answering questions comprehensively and relevantly. • Observe the students' behavior and roles while attending group activities
ELO6	Communicate, use information technology, and choose the method to effectively present the information in industrial engineering	• Practice in presentation, communication and group discussions • Assign group researches and reports applying numerical analysis tools, electronic media and information technology • Report on assigned topics or case studies • Use various computer programs and teaching aids in teaching and learning process • Assign the students to attend academic conferences and seminars	• Evaluate the presentations, group discussions and communication methods • Reports and assignments • Evaluate the use of tools, programs or teaching materials in assignments • Evaluate students' theses or papers • Evaluate from the results of attending academic conferences and publication of student work in academic journals

3.2 The contribution made by each course to achieve the expected learning outcomes is clear

As presented in Table 6 above, each courses and non-coursework activities contribute at least partially toward achievement of the program ELOs. Detail for the alignment of the course objectives and contents with the program ELOs is also available in the course syllabus *(see example in Appendix 4, page A10 – A47).* It can be discerned from the Table 6 that the key learning processes contributing to achievement of the program ELOs are thesis and Thematic Paper. Thesis/Thematic Paper allow students to have a hand-on research experience, which is internationally standard way of higher education in science.

3.3 The curriculum is logically structured, sequenced, integrated and up-to-date

The present curricula are up-to-date as of the last revision in 2017. Nevertheless, improvement on missing/unclear information and/or minor change in strategic plans are made annually. Such adjustments are communicated to students and other stakeholders in terms of revised Student Manual or course syllabi on the departmental web site (Please see Home Page of Master of Engineer Program). A The coursework activities is structured from basic fundamental to advanced courses *(see detail in Appendix 3).* Briefly, our master's program emphasizes on providing core knowledge and technical skills in Industrial Engineering. The program structures were designed in a way that courses in the first year for coursework before the more advanced courses begin. The program has a flexible elective courses which were designed in 3 main sectors, specifically. They are 1) Logistics and Supply Chain Management, 2) Engineering Management, Production Engineering and Quality Engineering and 3) Applied Manufacturing and Innovative-Product Design. It allows students from different backgrounds to adjust and adapt themselves to select a research filed and an expertise career. For 1st year, student will have gathering the knowledge which comply with the 6 ELOs program under the

core courses and the elective courses. Our program has been designed the suitable courses for student be able to prepare their thesis/independent study proposal. Student can be a mastery all of ELOs (Except ELO 5 is reinforce for student does the team project) during thesis/ independent study performing before the defense state.

Thesis of our program was designed clearly of an originality research, academically. As for thematic paper (Independent study) that emphasized on an industrial problem-solving. Both of thesis and thematic paper, the student is responsible for strengthening the core competencies of the master graduates by allowing the students to practice on ethical awareness, critical thinking, survey and critically review literature, formulation of research questions and hypotheses, experimental design, grant proposal writing as well as communicating in the proposal presentation, which are skills on ELO 6 of the program. Thesis writing, and defense are the very last activity to assess the students' learning outcomes. For thematic-paper plan student, thematic paper writing, defense and compressive examination are the assessment tool for completion the learning outcome.

4. TEACHING AND LEARNING APPROACH

4.1 The educational philosophy is well articulated and communicated to all stakeholders

As mentioned the program has been design the ELOs and CLOs to aligned, Mahidol Core Values and TQF attribution which shown in table 1-7. For teaching and learning style as a Transformative education of Mahidol' Educational Philosophy that is linked on the program website (https://www.ph.mahidol.ac.th/ed/from/download/10_7_58/OBE_TE_NR.pdf), ***constructivism and connectivism*** is the main philosophy for class actives and self-study time (Inform in TQF3 on each class). Also sub-topics on each class that are revised from the student sound and or alumni (gathering from Graduate School' IT system and TQF 5) and information (gathering from questionnaires, email and direct discussion) from industrial side, government organization and international partners which are all stakeholders of the program. After grade evaluation on any semesters, the program holds the meeting for checking and discussion the variation of the output and outcome for improving the teaching and learning activities, continuously. One important agenda is stakeholder sounds which reflect or claim for each class activity and then the program committees will help together for revising and making a guideline to reach the main target of the transformative education, continuously.

4.2 Teaching and learning activities are constructively aligned to achievement of the learning outcomes

Our graduate programs employ several teaching and learning strategies to ensure the achievement of both CLOs and ELOs (see Table 6 and 7 in Criteria 3). For courses that emphasize on cognitive knowledge leading to achievement of ELO 1, 2 and 3 lectures are the main teaching approach. The elective courses which are independently selected by an individual student, provides the knowledge for complying ELO3.To train students with ability to integrate, translate and apply the knowledge, several courses also employ small group discussions/ presentations on frontier Industrial Engineering publications (distributed before class as reading assignments) with leading questions or a set of Industrial Engineering problems to promote the application of basic knowledge gained from in- class lectures (ELO 4, 5 and 6). EGIE 507, They allow students to read papers, critically evaluate and present their overall impression of the story via oral presentation. Ultimately, all students must conduct thesis/thematic paper, the process of which strengthens their knowledge, skills and life-long experience. Summary of the curriculum mapping, which demonstrates the alignment between each coursework and the program ELOs is presented in Table 6 in the Criteria 3.1. A full alignment between CLOs and programs' ELOs along with teaching and learning strategy is also listed in the course syllabi shown in Appendix 4 page A15 (Course Specifications).

4.3 Teaching and learning activities enhance life-long learning

According the curricula *(TQF 3, Appendix 3)*, regular and special plans have been designed in promoting life-long learning experiences. Regular plan is emphasized for a full-time student and offered for thesis (the originality research). Most of students which recent complete in Bachelor degree would apply in the regular plan. The students have to conduct the research in the manner of independently perform a set of experiments to answer specific research questions typically assigned by the major advisor. Along the line, they have to make adequate planning for the experimental procedure and are able to, with the guidance of the committee, solve any technical problems that may arise. Output of master's research is expected to be, as a minimum, a peer-reviewed national conference proceeding papers. However, most of academic staffs of the program encourage the output s are proceeding of international conference and

international journal, acceptable for international index, to continuous improvement the program for supporting Mahidol University to be the world class university.

For special program that designed to support the life-long learning for student who does not matching in the regular-class time (Part time) table such as an officer, an off-shore engineer, an engineer works in private company, etc. Part-time student can flexible select the class schedule by agreement with a course lecturer under completely study of 45 hours (3 credits) for each course. This is a one of strength of the program that can provide the flexible class (unofficial-time schedule) to make an opportunity for people who work in the real industry. For class attention, an offshore student and a registered student can contact to a program' staff to access the online class or rerun VDO with internet based. Registering more 6 credits of elective courses need for special for student conduct a thematic paper (Independent study). The difference between master's thesis and master's thematic paper is the applying the knowledge (ELO 1, 2 and 3) and technology for solving the problem, improvement the process, and also development in the real industry and service business of the research topic assigned to the students. Special-plan with thematic-paper students are expected to independently study and solve the actual problem which occurs in the actual industry. Analysis, creating an appropriate methodology for problem solving (ELO 4), using IT for a professional data presentation (ELO 6) are main activity of thematic paper of the program. Professional teamwork (ELO 5) in the actual working environment is a one expected outcome for the special program, even though it was set just a refaced level in TQF 3. Advisor for thematic paper who is appointed when the proposal was passed, is responsibility of continuously monitoring the study progression Sometime advisor has visited a real production line (real field) for closely accessing the problem situation and meeting with a relevant person of the proposed company or business to make sure that topic is suitable for thematic paper. It was one process for a public relation of the program through the industry to get opportunities on both sides of the program and the proposed industry. The program's staff could up-to date the present technology in the real field and be able develop a new research discipline or create a new elective course for the program as year-to-year revise. The proposed industry will automatically turn to be the stakeholder of the program that give us a valuable expected mater-student performance. Therefore, the program has an update information from a reality demand, directly.

5. STUDENT ASSESSMENT

5.1 The student assessments are constructively aligned to the achievement of the expected learning outcomes

Students' achievement of programs' ELOs are continuously assessed from time to time during the study period. Accomplishments of CLOs, which in turn aligned with the programs' ELOs, are assessed by individual courses. The programs also employ none-coursework assessments such as progress report (every semester), comprehensive examination (special program), thesis/thematic paper writing and defense, etc. Overall summary of the assessment schemes employed throughout the program duration is presented earlier in Table 7 presented in Criteria 3 above.

5.2 The student assessments including timelines, methods, regulations, weight distribution, rubrics and grading are explicit and communicated to students

Student assessments including timelines, methods, regulations, weight distribution, rubrics and grading criteria are explicitly described in the program specifications *(Appendix 3 page A3 – A9)* as well as in the course syllabus distributed to all students at the beginning of the semester/course see example in *(Appendix 4, page A10 – A47)*. Timeline for non-coursework assessments such as, thesis/thematic paper proposal presentation, comprehensive examination (special program) and defense, etc. are also addressed during new student orientation. In addition, the course syllabus for individual courses are made available both of direct issue from the program' staff and online at the Department of Industrial Engineering web site (Please see Home Page of Master of Engineer Program) for students and other stakeholders.

5.3 Methods including assessment rubrics and marking schemes are used to ensure validity, reliability and fairness of student assessment

All assessments conducted by the programs use standardized methods to ensure validity, reliability and fairness of student evaluation. For knowledge-based (core and elective) courses, assessments are typically in the form of written examination (essay questions). The only exception is EGIE 507 Seminar and Research Methodology that the exam questions are evaluated by the rubrics method. Before grading of the essay examination, instructors come up with the answer key and marking schemes. For evaluation of soft skills, assessment rubrics are used. Example of the guidelines and rubrics used for assessing student seminar is presented in Course Syllabus EGIE 507 *(Appendix 3 page A19 – A21)* . In 2019, our graduate programs have introduced more assessment rubrics to cover students' progress report, thesis/thematic paper defense.

5.4 Feedback of student assessment is timely and helps to improve learning

Several of our courses, especially those emphasizing soft skill competencies, provide immediate feedbacks to students for improvement. For examples, in the EGIE 507 seminar and research methodology courses, feedbacks on the strengths and weaknesses of students' presentations are made in both verbal and written comments at the end of the seminar. Similar approaches are implemented for certain courses that have group assignments, small group discussion or group report presentation by students. Progress report conducted every semester also allow assessment of students' progression on their thesis/thematic paper research. Immediate feedback/comments on certain aspects of the research or technical problems are provided to the students.

5.5 Students have ready access to appeal procedure

General student appeal procedure follows the rules of Mahidol University (http://www.grad.mahidol.ac.th/grad/complain/HelpLogin.php?lang=en). Specific appeals regarding the coursework or course assessment can be made directly to the instructor and/or course coordinators as explicitly stated in the course syllabus *(see example in Appendix 4 page A10 – A47)* as well as to the program director.

6. ACADEMIC STAFF QUALITY

Academic staffs in our graduate programs are an international-level quality. All staff members, from the past to present, have always been active in conducting research in the field of Industrial Engineering. Together with student training in thesis/thematic paper research, our staffs have published a lot of research articles in well-respected international peer-reviewed conference and journals annually. Information on the research areas operating by our academic staffs as well as complete lists of publication outputs, (Attached File Folder No. 6). Quality of our staff members is also reflected by numerous awards given by both local and international organizations. In addition, many of our academic staff members also serve as editorial board and/or reviewer for international-quality conference. Every year, our academic staffs are invited to deliver oral presentations at various international conference such as International Conference of Advanced Operation Research, Material Research Society and IIW International Welding Conference, etc., In this part , Development Road map for members is presented in Fig 2 as a guideline of the MU' academic staff could follow on their carrer.

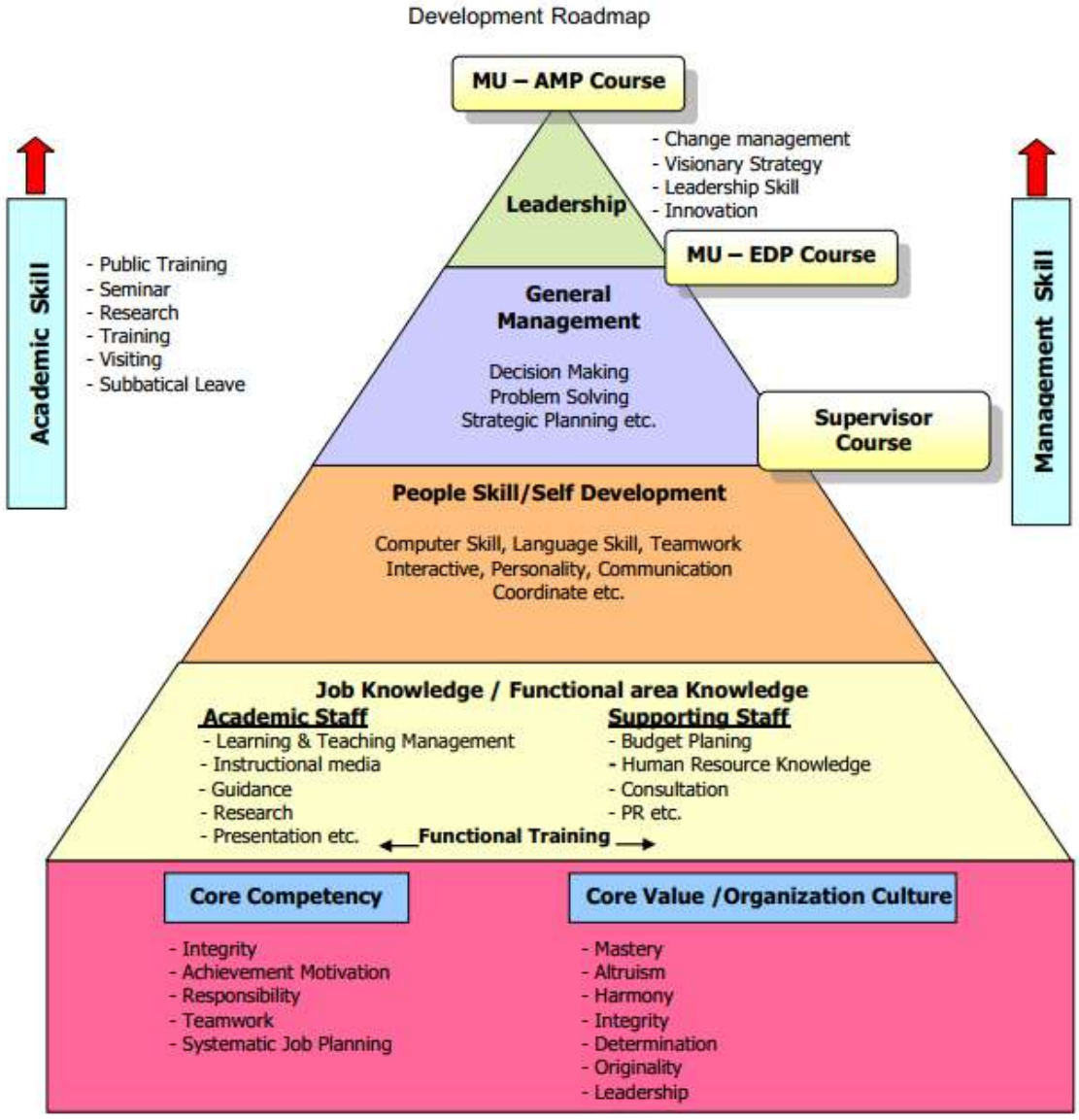


Fig 2 : Development Road map

6.1 Academic staff planning (considering succession, promotion, re-deployment, termination and retirement) is carried out to fulfill the needs for education, research and service

To ensure smooth continuity on operation of our academic programs, academic staff planning have perpetually been performed. Regulation on new staff procurement is governed by The Faculty of Engineering and Mahidol University. The HR Unit of the Administrative at The Faculty of Engineering constantly keep tracks and perform analysis on workforce capability and capacity needs. Workforce capacity is determined annually by the availability of positions while competency is defined by expertise needed by current and future curricula. Demand of new staff(s) is/are requested by individual departments/units to the Dean and compiled by the HR Unit. Approval of new staff acquisition is considered from current and future workload of the departments/academic programs, student to staff ratio, students' and customers' requirements and expectations, present and prospective required core competencies, etc. The Faculty of Engineering has set the target that the students to staffs ratio of graduate programs should not exceed 5:1. Individual departments/units are responsible for arranging the initial staff selection process before submitting the candidate's profile to The Faculty of Engineering for preapproval by the Academic Staff Recruitment Committee. Final approval of new staff hiring is carried out by Mahidol University.

At the departmental level, the Department of Industrial Engineering regularly keeps track of our academic staffs in terms of teaching load, staff to student ratio, research activities, promotion, retirement date (retirement age of 60), etc. The following circumstances are considered a trigger for arranging a new staff acquisition process: 1) there is academic staff retiring in the next 3-5 years; 2) the staff to student ratio is beyond the limit regulated by The Faculty of Engineering or by the Faculty of Graduate Studies due to excessive demands of incoming students; 3) new areas of research or teaching topics is needed according to the advancement of flexible manufacturing system, digitalized manufacturing, advanced data science for management, IoTs Production System etc. Once granted the permission by The Faculty of Engineering, the Department of Industrial Engineering (via monthly staff meeting) screens candidates' curriculum vita for their track record in terms of research competency. Candidates are then invited to give a seminar on their research work, during which prospective staffs' performances in terms of communication skills, ability to deliver knowledge to the audience as well as question- answering ability etc. are assessed (using rubric). Other areas of credentials including personality and ethical awareness are determined by direct interview and conversion after the seminar. Verdict is made in the departmental staff meeting before submitting the candidate's profile to The Faculty of Engineering and Mahidol University for approval.

In term of staff promotion, the departmental chairperson always monitor track records of our academic staffs' research outputs. Once the merit, as regulated by Mahidol University, is reached, that particular staff is encouraged to submit an application for academic promotion: from lecturer to assistant professor to associate professor and to a full professor.

6.2 Staff to student ratio and workload are measured and monitored to improve quality of education, research and service

Staff to student ratio and workloads are constantly monitored by the Program Administrative Committees to ensure optimum quality of educational training. As regulated by the Ministry of Education Announcement titled "Standard Criteria for Graduate Studies 2005," and Regulation on Graduate Education of Mahidol University, the staff to student ratio must not exceed 5:1. Our graduate programs follow the regulation and try to maintain such ratio. In projection of increasing student intakes, new staff member was recruited since 2018. Qualification, number of academic staffs and their workloads are presented in Table 8 while the staff-to-student ratio is shown in Table 9.

Table 8 Table illustrating qualification, numbers and workload (FTEs) of academic staffs within the Graduate Programs in Industrial Engineering at The Faculty of Engineering, Mahidol University, as of academic year 2018.

Category	M	F	Total		Percentage of Doctor
			Head counts	FTEs*	
Associate Professor	1	1	2	2	100
Assistant Professor	5	1	6	6	100
Lecturer	4	2	6	6	100
Total	**10**	**4**	**14**	**14**	**100**

*FTE calculation is presented in more detail in Appendix 5, page A48.

Table 9 Table illustrating staff to student ratio of the Graduate Programs in Industrial Engineering at The Faculty of Engineering, Mahidol University, during the last 5 years.

Academic Year	Total FTEs of Academic Staffs	Total FTEs of Students*	Staff-to-Student Ratio
2014	14	50	1 to 3.6
2015	14	55	1 to 3.9
2016	14	60	1 to 4.3
2017	14	60	1 to 4.3
2018	14	60	1 to 4.3

*FTE calculation is presented in more detail in Appendix 5, page A48.

6.3 Recruitment and selection criteria including ethics and academic freedom for appointment, deployment and promotion are determined and communicated

Recruitment and selection criteria are conveyed to candidate individually by any mean of communication, i.e. email, verbal, etc. This is because every year, the Department of Industrial Engineering receives a lot of applications/inquiries from various candidates for academic staff position. Every application is thoroughly screened in the monthly staff meeting and, if the candidates' profile show sufficient competency together with the department is in need of a new academic staff, the request is submitted to The Faculty of Engineering for allocation of staff position. Selection process is then carried on as described in the section 6.1 above. Once employed, the new staff has academic freedom to do his/her own research of choice. Deployment and distribution of teaching loads for academic staffs within the department is assigned by individual course by looking at the staffs' educational background. The monthly staff meeting help ensure that teaching loads are equally distributed among academic staffs. Staff promotion tracks of academic titles as regulated by the university, from lecturer to assistant professor to associate professor and to a full professor, are often communicated at both the university level, The Faculty of Engineering level and at the departmental level.

6.4 Competences of academic staff are identified and evaluated

Teaching and research competencies of academic staffs are identified during the selection process before joining the department. In addition to a strong track record of research, potential contribution of prospective staff toward teaching topics is also determined. Teaching competence of academic staffs are evaluated every semester via students' feedback on the overall course and individual instructors. Research competency is simply monitored by publication outputs for each staff. A grace period is given to newly-recruited staffs as settling a new research laboratory usually takes a few years to generate the first research output.

Moreover, the university and The Faculty of Engineering also enforce systems called Performance Agreement (PA). PA is a promise that academic staffs make to the department each year regarding the job responsibility and outputs. The department can then compile the target achievements from the academic staffs to come up with a PA with The Faculty of Engineering; the latter, in turn, make a promise to Mahidol University.

6.5 Training and developmental needs of academic staff are identified and activities are implemented to fulfill them

It is typical that newly recruited staffs do not understand rules, regulation, expected responsibility, promotion tracks, teaching philosophy, etc. Mahidol University each year organizes workshops to train/educate/provide young staffs with such information. This is to ensure that educational philosophy of the university is deployed directly to the staffs. Over the past couple of years, Mahidol University has focused on training outcome-based education (OBE) to new academic staffs during the annual workshop. Important aspects including the formulation of course learning outcomes, teaching and assessment strategies, etc. are provided. The Faculty of Engineering also offer similar retreat or workshop for new staffs but rather focuses on providing guidance for research grant hunting or helping setup research collaboration. Beginning in 2016, an annual workshop on OBE similar to that provided by the Mahidol University, is organized by The Faculty of Engineering for existing academic staffs who need to refresh their understanding on OBE concepts. Our graduate programs also provide orientation to new staffs on our graduate programs by the program director.

All of our academic staffs actively conduct research and teaching in the area of industrial engineering, modern manufacturing, industrial robotics and advanced sensors. Similar to any academic program in science and engineering around the world, learning of new knowledge and strengthening research competencies of academic staffs can be achieved by allowing staffs to attend industrial engineering, advanced operation research, manufacturing and materials processing conference, especially the international meeting. The Department of Industrial Engineering offer financial support to allow all academic staffs to attend International-level meeting once a year (individual staffs select their own conference of choice). For international conferences, the department together with Faculty of Engineering as well as Faculty of Graduate Studies offer partial travel grant for the academic staffs to attend. Number of available travel grant, depending on the available budget, is determine each year by the staff meeting.

6.6 Performance management including rewards and recognition is implemented to motivate and support education, research and service

The Department of Industrial Engineering, The Faculty of Engineering and Mahidol University realize that rewards and recognition play a key role in motivating academic staffs. Every year, Mahidol University announces many awards in recognition of academic staffs who devote themselves to the best of their duties, primarily teaching and research. Examples of such awards include: Mahidol University Prize for Excellence in Research, Mahidol University Prize for Excellence in Teaching, Outstanding Lecturer Award from Council of Mahidol University Faculty Senates, etc. In concurrent with Mahidol University, The Faculty of Engineering also announces, annually, Outstanding Staff Award in recognition of academic and supporting staffs with distinguished performances. Also available is a Publication Reward for academic staffs who publish research outputs in good-quality international journals indexed by respectable database, such as Scopus or ISI. The reward is in the form of prize money, the amount of which depends on the quality of the article and staffs' role in the authorship. In addition to the prize money, academic staffs with qualified publication records are also eligible for promotion from lecturer to assistant professor to associate professor and to the full professor, the process of which follows rules and regulations of Mahidol University.

Detail on the criteria and guideline for the academic promotion by Mahidol University can be viewed at http://www.op.mahidol.ac.th/orpr/newhrsite/HREng/careerpath/careerpath.html. To facilitate the academic promotion processes, The Faculty of Engineering offers a proofing service for the required documents/paperwork to ensure high success rate of the applications. Faculty of Engineering also makes fund available to help pay a paper for staffs who could publish their research output in the high-quality journal (Quartile 1 and 2 journals raking, for example).

6.7 The types and quantity of research activities by academic staff are established, monitored and benchmarked for improvement

The Department of Industrial Engineering always keeps track of research activities of academic staffs. Research grants and publication outputs are parts of the PA criteria. Status of research output in terms of international publications is reported monthly in the staff meeting. Summary of the number of international publications by academic staffs for each academic year is presented in Table 10 (detail list of publication is also available on the departmental web site at (Please see Home Page of Master of Engineer Program).

Table 10 Number of research output as international publications of academic staffs within the Graduate Programs in Industrial Engineering at The Faculty of Engineering, Mahidol University, in the last 5 years.

Academic Year	Number of International Publications by Academic Staffs	Number of Active Academic Staffs	No. of Publications per Academic Staff
2015	16	14	1.14
2016	15	14	1.07
2017	15	14	1.07
2018	25	14	1.79
2019		14	

7. SUPPORT STAFF QUALITY

Besides academic staffs, supporting staffs are equally important to fulfill the educational goal of our graduate programs. The Department of Industrial Engineering, The Faculty of Engineering and Mahidol University together help monitor and make adequate plans regarding supporting workforces. Number and competency of staffs involved in each missions and plans are examined annually by both the HR Unit of the Administrative and Faculty of Engineering and by individual units/departments including Department of Industrial Engineering. Table 11 – 14 below summarize the current numbers and competencies of supporting staffs associated with key facilities that play important roles in operation of our graduate programs such as library, laboratory, IT and student services.

Table 11 Number of supporting staffs (officer and laboratory) and their educational background at both departmental level and The Faculty of Engineering level along with their relevance toward the programs' teaching and learning approaches (TLA).

Affiliation of Laboratory Personnel	**Highest Educational Attainment**				**Total**	**Relevance to Program TLA**
	High Vocational Certificate	**Bachelor's**	**Master's**	**Ph.D.**		
Department of Industrial Engineering	4	2	1	-	Student training, technical guidance, equipment custodian	
Faculty of Engineering:	**-**	**-**	**1**	**1**	Student life and plan suggestion, Student training for thesis writing and publication	
Total	**4**	**2**	**2**	**1**		

Table 12 Number of library supporting staffs and their educational background at the Mahidol Library, Mahidol University along with their relevance toward the programs' TLA.

Affiliation of Library Personnel	**Highest Educational Attainment**				**Total**	**Relevance to Program TLA**
	High School	**Bachelor's**	**Master's**	**Ph.D.**		
Mahidol Library[1]	13	53	28	2	96	Book search and loan, journal and database search

[1] See https://www.li.mahidol.ac.th for list of library staffs at the Mahidol Library.

Table 13 Number of IT supporting staffs and their educational background at The Faculty of Engineering along with their relevance toward the programs' TLA.

Affiliation of IT Personnel	**Highest Educational Attainment**				**Total**	**Relevance to Program TLA**
	High School	**Bachelor's**	**Master's**	**Ph.D.**		
Mahidol Library[1]	1	14	11	0	26	Electronic resources and technical advices: eBooks, eJournals, eLibrary,eDatabase, software training, IT training and seminar
System Development and Technology Division[2]	-	2	1	0	3	Computer software and hardware technical services, network services, IT consultant
Total	1	16	12	0	29	

[1] See (Please see Home Page of Master of Engineer Program) for list of IT staffs at the Mahidol Salaya Library.
[2] See (Please see Home Page of Master of Engineer Program) for list of IT staffs at the System Development and Technology Division

Table 14 Number of student affair personnel and their educational background at both the Department of Industrial Engineering TLA.

Affiliation of Student Service Personnel	Highest Educational Attainment				Total	Relevance to Program TLA
	High School	Bachelor's	Master's	Ph.D.		
Department of Industrial Engineering[1]	-	1	4	-	5	One stop services (help facilitate processes and documentations with other responsible units i.e. Graduate Education Units, Faculty of Graduate Studies,

[1] See (Please see Home Page of Master of Engineer Program) for list of supporting staffs at the Department of Industrial Engineering

Department of Industrial Engineering, which is the parental unit of our graduate programs, 5 supporting-administrative staffs, and 6 technical staffs. The technical staffs main duty is to provide technical advises and training for new entry students regarding equipment use and research protocols. The remaining administrative and service staffs together function as a one-stop service station that facilitates students' needs in terms of formal documentations and processes involving other regulating parties such as Faculty of Engineering and Faculty of Graduate Studies. With this kind of service, students do not need to run around contacting other units by themselves to resolve their specific needs. In addition to the needs of service on paperwork and formal processes with the regulating bodies, other types of key services such as library, IT, central instrument facility (see Criteria 9 for more detail) are provided by staffs associated with The Faculty of Engineering.

7.1 Support staff planning (at the library, laboratory, IT facility and student services) is carried out to fulfill the needs for education, research and service

Similar to the academic staff planning described in the Criteria 6.1, supporting staff planning policy at The Faculty of Engineering, Mahidol University involves both top-down and bottom-up processes. Each operating unit (departments, library, central laboratory, IT facility and student services) is governed by either departmental chairperson/program director, deputy or assistant dean, who is responsible for regular monitoring of supporting staffs workload in accordance to strategic action plans of the unit. When there is an imbalance between workforce and workload, staff quitting or retirement for example, recruitment of new staffs is requested to the Dean of The Faculty of Engineering via the HR Unit. Once the request is approved, the operating unit together with the HR Unit set up a recruitment and selection process (described below in Criteria 7.2). Vice versa, the Executive Committee of The Faculty of Engineering may also devise top-down strategic plans and distribute the tasks together with allocation of new staff position to the targeted unit.

7.2 Recruitment and selection criteria for appointment, deployment and promotion are determined and communicated

The recruitment and selection criteria for appoint, deployment and promotion of the program staff are determined and communicated to the staff. However, as there is only one staff fully in charge of the program coordination, the recruitment and criteria were set and the roles of support staff are well defined since the beginning of the program. The job description is

1. Work as officer ,human resource, financial, accounting , contact and student information and promote program
2. Work as secretary for Master program
3. To contact student and answer the question for perspective student.
4. To facilitate material for lecturer
5. Another job that assign from program director
6. Contact outside organization such as university and company

The staff is working as a staff of the Faculty of Engineering, the appointment, deployment and promotion are in line with the rule and regulation of the Faculty.

Announcement of the vacant position is always made available on the announcement board and on the web site of The Faculty of Engineering. In the announcement, information on the position, job description, qualification, application process, selection method(s) are clearly presented. Examples of such job notifications can be seen at the following web sites: (https://www.eg.mahidol.ac.th/office/hr/) for announcement in Thai language. For supporting staffs to be recruited to the Department of Industrial Engineering, the departmental chairperson assigns a committee, usually includes the retiring staff in that position, to come up with the job description, exam questions (if applicable) and interview criteria.

For supporting staff career progression, the Department of Industrial Engineering and The Faculty of Engineering both follow the regulations and guidelines of Mahidol University. Detail information about the regulation and guidelines are available at the Human Resource Division web site (https://op.mahidol.ac.th/hr/). Supporting staffs can be promoted to more advanced position, for example from Practitioner to Senior Professional to Expert and to Advisory level, depending on the expertise and credentials.

7.3 Competences of support staff are identified and evaluated

Competencies of supporting staffs have been identified since the recruitment process as indicated in the qualification of applicants. Each fiscal year, similar to the academic staffs, every supporting staff member must also sign a Performance Agreement (PA) form with the head of the unit (departmental chairperson, assistant or deputy dean). Staffs are then allowed to perform their tasks and their performance are evaluated every 6 months. Strengths, weakness and areas for improvement are then provided as feedbacks to individual staffs to step up their performances.

7.4 Training and developmental needs of supporting staff are identified and activities are implemented to fulfill them

The support staff's main duties and responsibility include the coordination among internal and external stakeholders in order to ensure the smooth process of the students' studying. The Communication skill, IT skill, and administrative skills are the must. The staff has been encouraged to take English communication courses, practice in IT and attend the training/workshops related to the administrative skill enhancement. In addition, the staff are learning by doing and gaining experiences from on-the job training and supervision by the senior staff who have long experience in administrative works and coordination. The qualifications of the senior staff who are full-time staff of the Department of Industrial Engineering and give supportive and advice the program staff are as shown in list of training

List of training, courses, or workshops that the staffs have been trained

1. Research skill
2. English skill
3. IT skill
4. Budget skill

Every 6 Month (during PA check), program director has considered and discussed with supporting staff for planning their training to fulfill abilities to reach an ultimate goal of Mahidol University. Roadmap of staff development is attached in folder of criteria 7.

7.5 Performance management including rewards and recognition is implemented to motivate and support education, research and service

The performance of the support staff have been evaluated annually as per the University policy. The program staff is a university staff. So, all rules and regulation of the university are applied including guidelines and procedures for performance evaluation to all categories of personnel. The PA form

Performance Assessment of the support staff follows the University's policy.

The university has established a fair and transparent system for performance assessment in order to foster a collaborative work atmosphere and increase understanding between supervisors and subordinates.

PA Process

A key component of the university's performance assessment system is the *Performance Agreement(PA)*, which specifies performance expectations for the staff member. The PA is agreed upon between the staff member and unit before signing of the contract and becomes an integral part of the contract. The content of the agreement should be aligned with strategies objectives of the university and should encourage excellence in staff performance.

Guidelines

Assessment is conducted biannually with the result used to improve staff performance, for career development, and for consideration for salary increase, annual reward, allowance, incentives, and other human resource issues.

Assessment Criteria

(1) Performance as agreed in the PA

The performance appraisal is evaluated in relations to the PA discussed at the beginning period. The appraiser evaluates the support staff according to the Performance Agreement, which both have discussed, prior to the period of appraisal.

(2) Competency consisting of Core Competency, Functional Competency (where relevant) as well as Managerial Competency for those in management positions.

Evaluate core competencies according to the definitions provided.

(1) Integrity: moral, ethical (personally and professionally), honest, working with transparency, self–disciplined and trustworthy
(2) Achievement Motivation: commitment to meeting or exceeding existing standards as judged by the criteria of the unit or university; creativity in improving work performance; striving to achieve difficult and challenging goals that may have never been achieved before.

(3) Responsibility: dedication, responsibility, and commitment to carrying out work efficiently, including consideration for the efficient and effective use of resources and the benefit of those served as well as the organization.
(4) Teamwork: understanding one's role and responsibility as a team member, including participation in work, problem solving, and exchange of ideas and experience with other members of the team.
(5) Systematic Job Planning: ability to plan and to continuously analyze potential obstacles and risks, including the ability to verify information and check various details of one's own work and that of others.

Evaluator A committee with at least three members

Evaluation Result Excellent, Very Good, Good, Fair, Needs Improvement

Reward and recognition

The rewards and recognition are also in line with the annual announcement of the Faculty of Engineering. The staff who have got "Excellent" in the evaluation result will get the recognition announced by the Dean of the Faculty. The percentage increase of the salary will be based on the overall budget and proportion sharing calculated by the Faculty's Department of Human Resources Management.

8. STUDENT QUALITY AND SUPPORT

Our program recruits national and international students from various countries. Table 15 summarizes the admission statistics for our M.Eng. program in Industrial Engineering in terms of the number of applications and acceptances since 2015 until 2019, while Table 16 depicts the total number of students in the last 5 academic years.

Table 15 Number of student applicants vs. number admitted and enrolled in the M.Eng. Program (Regular Program) in Industrial Engineering at the Department of Industrial Engineering, Faculty of Engineering, Mahidol University over the past 5 academic years.

Academic Year	Master Degree Program Applicants			
	Number Applied	Number Offered	Number Enrolled	Ratio Applied/Enrolled
2015	28	24	17	1.6 : 1
2016	18	15	11	1.6 : 1
2017	20	19	15	1.3 : 1
2018	18	14	10	1.8 : 1
2019	7	6	5	1.4 : 1

Table 16 Number of student applicants vs. number admitted and enrolled in the M.Eng. (Special Program) Program in Industrial Engineering at the Department of Industrial Engineering, Faculty of Engineering, Mahidol University over the past 5 academic years.

Academic Year	Master's Degree Program Applicants			
	Number Applied	Number Offered	Number Enrolled	Ratio Applied/Enrolled
2018	13	7	7	1.9 : 1
2019	9	8	7	1.3 : 1

Table 17 Number of student enrolled in our master's degree program (Regular Program) over the past 5 academic years.

Academic Year	Number of Master Students (Regular Program)				Total
	1st Year	2nd Year	3rd Year	» 4th Year	
2015	17	10	18	10	55
2016	11	16	15	18	60
2017	15	11	16	18	60
2018	10	10	11	22	53
2019	5	8	5	28	46

Table 18 Number of student enrolled in our master's degree program (Special Program) over the past 5 academic years.

Academic Year	Number of Master Students (Specia Program)				Total
	1st Year	2nd Year	3rd Year	» 4th Year	
2018	7	0	0	0	7
2019	7	7	0	0	14

8.1 The student intake policy and admission criteria are defined, communicated, published and up-to-date

Admission criteria and policy for new graduate students are explicitly defined and communicated in the Program Specifications, for 1) Thai student made available on the web site (https://graduate.mahidol.ac.th/thai/prospective-students/?topic=curriculumOpened&degree=m) . In case of written exam score is lower than 40% that student shall register the special fundamental of IE course for treatment an essential basic of IE. After written and then interview by face-to-face is held by the program committee exam. A diagnosis of committee is a final judgment for a student admission. 2) International student by active recruitment, the program takes the project to Grad school to register the program for recruit students on the expected country. Face to face interview is onsite for a country and student who interests in the program can communicate with the representation of the program for curriculum, fee and scholarship. Prequalified student shall register in website (http://www.grad.mahidol.ac.th/en/prospective-students/view.php?id=3804M02G) for official admission. 3) For international student who interest the program can directly contact to the program by e-mail, social network and so on. After register on the web (http://www.grad.mahidol.ac.th/en/prospective-students/view.php?id= 3804M02G), face-to-face interview is a method for evaluation an ability of student and a diagnosis of committee is a final for a student admission.

8.2 The methods and criteria for selection of students are determined and evaluated

Selection methods and criteria are evaluated and discussed among program committee within the Department of Industrial Engineering annually after the admission period are over. For any specific issues during the admission, solutions are sought and revision to the admission process will be applied in the subsequent years. More than determining problematic issues, the overall admission processes have been continuously evaluated and possible improvement plans are made from time to time to ensure the quality of selections.

The student quality process during coursework includes interactive teaching, assignments, presentations, and examinations with individual feedback. The works of the students are promptly assessed and marked so that they can receive feedback quickly for self-improvement. Students with low performance directly receive comments, discussion, and suggestions in order to improve study performance. Students are continuously monitored from the first year until they graduate. First-year students are monitored and advised directly by the program director. From the second year onward when the students choose their own major advisor, such monitoring job is then transferred to the major advisor. The cumulative GPA required for graduation is 3.0. After the students finish all their coursework and present their thesis/thermatic paper proposal, they are required to have a progress report on their research advancement every semester. The progress report is in the form of an oral presentation on students' cumulative results to the Thesis/Thermatic paper Advisory Committee and any general audience who is interested to attend. The program director and major advisor can also monitor the student registration and progress via the online monitoring tool offered by the Faculty of Graduate Studies (http://www.grad.mahidol.ac.th/en/faculty-staff/). Every month, key issues on students' progression and situations, i.e. grades, thesis/thermatic paper proposal, overdue students, etc. are discussed among academic staffs during the departmental staff meeting. Students who fail any coursework or non-coursework activities, especially the required courses or qualifying examination, are to be closely supervised and monitored by the advisors, course coordinator, qualifying exam committee as well as by the program director.

8.3 Academic advice, co-curricular activities, student competition and other student support services are available to improve learning and employability

Academic advices are given to new coming first year students during program orientation by the program director. The program director is also responsible for providing appropriate academic advices as well as helping solve various technical issues (registration, credit transfer, financial problems, etc.) throughout the first year of study. Once the students have their own major advisor from the 2nd year onward, the advices are direct responsibility of the advisor with monitoring from the program director for the overall progress of the students. To academically motivate students, award is also made available for the first year's students taking all the coursework and achieving the highest cumulative GPA.

Besides the advisory systems, the Department of Industrial Engineering, as well as the Faculty of Engineering, organize special seminars by foreign visiting professors/researchers from time to time. Students are encouraged to attend such seminars to expand their scientific vision as well as to strengthen their motivation in research. The students can also learn how to deliver an effective oral presentation from some special seminar given occasionally by our own academic staffs. Participations in these activities help our current students to envisage the career path and promote the connection between our students and alumni.

8.4 The physical, social and psychological environment is conducive for education and research as well as personal well-being

Our program provides an education support office (the graduate lounge IE228), where students can meet to work together as well as our department office, which is located in Engineering Building 2 second floor, is where the students can contact for help and support from our department staff and faculty members. Our website (Home Page of Master of Engineer Program) has the emails and contact of all our academic and education support staff, students and alumni facilitating students to easily communicate with each other.

A learning experience, as well as research productivity, cannot last long should the students and staffs have a health problem. Should the students have sickness, an infirmary room is available with a medical doctor available for checkup and intensive care. Severe injury to students is directed to Golden Jubilee Hospital, which is located across Gate 1, Mahidol University Salaya Campus. In addition to health, the environments within the Faculty of Industrial Engineering also encourage social interactions among students and staffs. Plenty of café and self-study areas fully equipped with proper lighting, Wi-Fi hotspots and electrical outlets are available for mingling or discussion of research ideas. For those who prefer quiet and natural environments, there are also a lot of desks and benches available in the middle of the green zone.

9. FACILITIES AND INFRASTRUCTURE

Our M.Eng Program in Industrial Engineering at the Faculty of Engineering, Mahidol University aims to provide international quality of teaching and learning experiences to our graduate students. In doing so, facility and infrastructure are allocated sufficiently and efficiently by the Department of Industrial Engineering and by the Faculty of Engineering. In 2019, Department of Industrial Engineering had renovated the IEMU office to be a World-Class Engineering concept. From this result, people who is stakeholder having the impressive feeling of the continuous improvement in the teaching and student support. In addition to standard teaching facilities and environments, advanced Engineering equipment is the key facility that allows our students to conduct frontier research. In this criterion, elaboration of resources and infrastructure essential for the operation of our graduate programs are presented.

9.1 The teaching and learning facilities and equipment (lecture halls, classrooms, project rooms, etc.) are adequate and updated to support education and research

Our graduate programs employ both in- and off-departmental facilities and equipment. For our class room management, the Department of Industrial Engineering has available more than 7 classroom (fitting about 30 students per room), 7 universal-conference rooms, 1 computer suite. All the lecture rooms/halls are air-conditioned and equipped with computer terminal and LCD projectors as well as (for certain rooms) visualizer for non-computerized projection of sheet/handouts. Also available in each classroom is a white/black board and a flipped board for certain teaching strategies that require classical approaches. Typically, students in our graduate programs utilize teaching and learning facilities from the Faculty of Engineering when they are taking interdisciplinary core courses. The department of Industrial Engineering provides independent supporting room for M.Eng. and Ph.D. students. For M. Eng. Supporting room can assess 24 hour by a fingerprint scanner. In 2020, the great demand of online class had occurred form the COVID-19 crisis. Faculty had rapidly provided the big lot Wi-Fi hotspot for covering all of area in the faculty and also all room of the IEMU workshop that has been covered the MU Wi-Fi. Moreover, the department has invested the high-speed fiber-optic Wi-Fi by the internet private company to support the professor teaching in the online class, global meeting and also avoiding the over band-width problems when the user of MU Wi-Fi is full.

For laboratory equipment (for manufacturing field) in workshop, student can easily contact to the department office or direct to professor for requiring of using the equipment with the official document. Researchers, Technicians or IEMU seniors will be assigned the training activity for student by the program director or academic staffs, adequately.

9.2 The library and its resources are adequate and updated to support education and research

Our Library and Knowledge Center, Mahidol University, can be considered state-of-the-art science library. The library contains more than 41,183,939 books both in the form of hardcopy and online resources. In addition, together with Mahidol University, the library subscribes to major journals and online databases in science and medicines. With the emphasis on installation of 21st-century skills to our students, online resources play very important roles in teaching and learning processes of our graduate programs. The official web site of the Library and Knowledge Center (http://www.li.mahidol.ac.th/eng/) provides online tools for students and staffs to search the online database for literature in the forms of e-books or journal articles related to the areas of their own research from anywhere. The web site also provides links to other main online resources that can be useful to students teaching and learning. Students even can renew the loaned book from home. In case students and staffs want to obtain

research articles unavailable via our regular program subscription, they are welcomed to discuss and approach the Department of Industrial Engineering for help and support. In the 2021, the program of Master of Industrial Engineering has been invited to join the big project of the MU central library to upgrade as ***the smart library*** where is 24 hours service of book-reading zone and unit of the innovation self-study. The robotized such as Cobot-AGV for book restoring and the self-study with smart-cobot unit are the actual research product of IEMU provide for the central library. This is a continuously improvement for the student support from the program friendly cross-through the other sectors of Mahidol University to provide the smart engineering products for successful the student support.

9.3 The laboratories and equipment are adequate and updated to support education and research

The Department of Industrial Engineering possesses main 4 workshops and 5 laboratory spaces allocated to all academic staffs to conduct their research. Each laboratory has basic equipment for research in the field of conventional manufacturing, modern digitalized manufacturing, material engineering and bio-food tech laboratory. For software in the industrial engineering filed that has been provided both of management filed and manufacturing filed. The up-to-date and realizable version of software has been used in the classroom and research to get more output enhancement. Every year, the department will call the professor' demand for the new program or update and consider in the department meeting to get the conclusion for purchasing. True licensing is the policy of the University, obviously.

In addition, the department has FlexLab (Flexible Manufacturing System Laboratory) which has been established in 2018 for an industrial service and sophisticated research in welding process, material science and engineering and production in medical device. In 2020, the department has rapidly growth in the investment robot, automation and high-performance production machine. These equipment have been invested from the research funding of the program committees for supporting the research of students in the era of 4^{th} industry revolution and push the almost research state more than Technology Readiness Level: TRL4. The research outputs of the program and the department obviously shows on the publish area and it was resulted in the research funding agency provides a big grant for Master IEMU students perform their research, efficiently. List of overall laboratory equipment and facilities available within the Department of Industrial Engineering is available on the web site at: (https://www.eg.mahidol.ac.th/dept/egie-master/).

Mahdiol University had received the big funding from the government to support student who has the innovate idea can easily walk-in use the equipment to generate his/her innovation prototype and an industrial product. The Faculty of Engineering has assigned from iNT under university to build the central workshop as INOGINEER STUDIO that provide the beautiful-smart room for the universal services such typical workshop, student meeting, fab-lab activity, training, online global training and so on. Student can access in officially time or special time when they submit the requirement to the secretary desk of the studio. The studio provides the new technology machine and equipment such as more than 20 machines of 3D printing, high-precision metal 3D printing, mobile CMM, rapid 3D reverse model camera, 10 mini-CNCs, high-power laser cutting machine and plastic laser cutting to support the spare-part or the research prototypes. Recently, ***more than 50 typical products under idea of the master students of IEMU*** can be produced from this studio and also, we can proudly submit the patents.

9.4 The IT facilities including e-learning infrastructure are adequate and updated to support education and research

As mentioned in 9.1, the Internet access is readily made available to all students upon their registration. Within the Faculty of Engineering, Wi-Fi hotspots are available in most parts of the engineering area, including the Department of Industrial Engineering. Moreover, 10 Gbps local area networks (LAN) are also installed in every laboratory and staffs' office to provide high-speed access to the intranet documents. There are also computer workstations available for students and staffs. All technical issues regarding IT facilities are handled by the System Development and Technology Division. Should the students need help regrading hardware and software usage, IT staffs at both the System Development and Technology Division and Central (Salaya) Library are at hands to provide assistance.

Nowadays, Webex is officially licensing by Mahidol university, then the online class is easily accessed more than official time. Many classes of the program is high flexibly held depend on the people available time. Almost classes of the program have created the google class room and MOOC by Mahidol University development. It was satisfied by student and lecturer in the world-wide access the class room. The payment of travelling is significant reducing. Communication in the online class can activate such assignment post, news, information, direct massage and group massage as same as international university classes. Also, the program has invited the guest professor from oversea for giving the lecture is available every course by the program online concept.

9.5 The standard for environment, health and safety and access for people with special needs are defined and implemented

Mahidol University Salaya Campus is known as a green university where there are many different kinds of nature including trees and animals creating a beautiful ecosystem. Wheelchair access is possible through almost every part of the campus. Pray rooms are available for people with Islamic religion. The whole campus is also a smoke-free zone and safety is ensured by patrolling of security guard during day and night. Should any students or staffs have health issues, an infirmary room is available with medical doctor standing by during specific time of the day. For off schedule or severe health problems, they are suggested to MU Health which is located in Mahidol Learning Center (MLC). Severe injury to students is directed to Golden Jubilee Hospital, which is located across Gate 1, Mahidol University Salaya Campus.

10. QUALITY ENHANCEMENT

10.1 Stakeholders needs and feedback serve as input to curriculum design and development

As described earlier in Criteria 1.3, stakeholders needs and feedbacks serve as input to our curriculum design and development. Every year, the Committee (Academic staff and Graduate School) of Master of Industrial Engineering hold the meeting for criticizing the demand of employer and diagnosis the specified feedback from the currents student and our alumni to develop the new curriculum. Summary of steak holder needs has been shown in *(Appendix 10, page 54)*

In deep details, monthly meeting, program committee has much effort for giving the gap between the outcome target and the present status. And then we set the strategic plan for revise in a new curriculum and immediately implement if it possible on that time.

Our program often invites the visiting professor from the university network for teaching, observing and evaluating the current students that have enough of quality for advanced IE knowledge and performance on their research, internationally.

10.2 The curriculum design and development process is established and subjected to evaluation and enhancement

Our curriculum design and development process by the regulation of Mahidol University as already described in Criteria 1. Key process in the curriculum design and development that need to be evaluated and could subject to enhancement is the step of drafting Program Specification. At the end of the curricula development process in 2017, academic staffs within the graduate programs got together and provided feedbacks on such process. Possible process enhancements obtained from the meeting includes a better way to gather feedbacks from employers, i.e. by phone interview or inviting them to be part of the TQF 7, which will be applied in the next revision period.

10.3 The curriculum design and development process is established and subjected to evaluation and enhancement

As stated earlier in this SAR, our current curricula have adopted OBE as required by the TQF regulation. Parts of this framework demand that the academic program(s) must formulate and communicate TQF3 document (Course Specification) every semester that the corresponding course is offered. The course specification covers key information including teaching and learning strategies as well as student assessment schemes as presented in *(Appendix 4, page A10 – A47).* At the end of the semester, the course coordinator along with teaching staffs must review and evaluate the operation of the course and report it as a TQF5 document (Course Report). Feedbacks from both teaching staffs and students taking the course are taken into consideration and appropriate improvement mechanisms regarding teaching and learning strategies and/or assessments are planned. When the course is offered again in the subsequent year, improvement plans are incorporated and formulated as a new TQF3 document for that particular semester. The cyclic operation of TQF3 and TQF5 are a continuous process.

10.4 Research output is used to enhance teaching and learning

All of our academic staffs have been conducting research and have produced a lot of research outputs in the form of international research publications. Such research output contains novel knowledge in the field of expertise specific to individual staff members. From past to present, the outputs generated from previous students or former lab members are used as

seeding knowledge to train later generation of students. Upon joining a research group, students (as an import part of teaching and learning process especially for lab's students) are: 1) are assigned research articles related to the project, especially those published earlier from former lab members, 2) identify and compile open research questions/problems then come up with research hypotheses, 3) design experimental plans to tackle such research hypotheses, 3) if problems arise or things do not go as plan, revised action strategies are formulated. From these cyclic processes of plan-do-check-act, new discoveries are often achieved as can be envisioned by more and more research publications from our academic staffs.

More enhancement of our program that the researches (Both of thesis and thematic paper) involve in the actual industries and the ministry of the government. It is identified that master IE student performs the research under actual environment of stakeholder needs.

10.5 Quality of support services and facilities (at the library, laboratory, IT facility and student services) is subjected to evaluation and enhancement

Teaching and Learning Facilities

To ensure consistent readiness of teaching and learning processes, classroom and its facilities are subjected to monitoring and maintenance by assigned support staffs from the Faculty of Engineering. Instructor and students can also file a complaint to the Education Division if problem arises regarding lecture room facilities. Service personnel and backup equipment such, LCD projector for example, are available for immediate repair and/or replacement in case one broke down. When the years go by and the equipment needs to be replaced, the staffs responsible for equipment maintenance report to the Deputy Dean for Education to arrange replacement. For departmental facility, a supporting staff is also assigned to do similar job as that of the Faculty of Engineering's level. In case of equipment replacement, the request goes through the departmental staff meeting for approval. The Graduate Programs in Logistics and Engineering Management also conduct a yearly survey on students' satisfaction level toward teaching and learning facilities. Major comments and feedbacks related to the common facilities at the Faculty of Engineering that need immediate attention are forwarded to the Education Division for further actions.

Library Resources

As stated earlier in Criteria 9.2, the Mahidol Salaya Library keeps track and listens to all aspects of feedbacks from its customers on a regular basis (http://www.li.mahidol.ac.th/). Comments and feedbacks are taken into consideration by library staffs, under supervision of Deputy Dean for Information and Corporate Communication, for action planning on quality improvement. Every year, the library asks academic staffs in every academic program for suggestion of new books for acquisition and journal subscription that may serve as references to individual courses or research group. Subscription to the unused journals may also be terminated so that the budget can be allocated to subscribe other in-demand journals.

IT Facilities and Services

Similar to the teaching and learning facilities, the prompt assistance and maintenance are made available by the Faculty of Engineering and Mahidol University for IT services. The whole internet infrastructure, especially Wi-Fi services, and email accounts are maintained and regularly monitored by the Division of Information Technology, Mahidol University (MUIT). The Faculty of Engineering, on the other hand, takes care of the computer terminals for hardware

maintenance. Requests for technical help or maintenance service can be filed to the IT staffs at either MUIT or our faculty IT support office. At least once a year, MUIT sends email to every internet user including students and staffs requesting for feedbacks on service quality and areas for improvement. Appropriate action plans are made and implemented in the subsequent fiscal year. The comments are taken into consideration for future strategic plans for quality improvement.

10.6 The stakeholders' feedback mechanism is systematic and subjected to evaluation and enhancement

Feedbacks from stakeholders are received from different method as described earlier in the Criteria 1.3. Opinions and comments from academic staffs and current students were collected by brainstorming and interview. Feedbacks/criticisms from alumni and employers were gathered from questionnaires. The questionnaires are both in the form of regular paper sent via postal mail and an online evaluation form. The most difficult stakeholder to get feedback from is the graduate employers. From our past survey, very few employers return the questionnaire. The only crucial feedback we received was from the one employer that was invited to be a criticizing committee. After the last curriculum revision, our academic staffs together evaluated the feedback mechanisms and suggested that more active approaches such as phone interview or an open curriculum feedback hearing session may help obtain better feedback and comments.

11. OUTPUT

Since, the special plan student is 1st year for early 2019, the assessment of the output is emphasized on the regular plan student (thesis).

11.1 The pass rate and dropout rates are established, monitored and benchmarked for improvement

Our master programs always keep track of our student graduation and dropout rates. Table 19 below show the statistics of such data for master's degree programs. Our Program Administrative Committees has set a desirable target that the dropout rate should not exceed 20%. The results clearly show that the dropout rates of students from our graduate programs never exceed the target cap of 20% ever since the new curricula were effective in 2018. From data of dropout, it can be seen that most of the quitted student is 4th Year and beyond because they dose not performs thesis follow the advisor' schedule. This problem has been concerned and token a strategic plan by the program committee. A big reason of late graduate and resulted in dropout is student lately consult with an advisor. Some students had presented a proposal at 3rd or 4th year therefore it is not enough time for phase of analysis and evaluation of thesis. One selected strategic is early matching an adviser and expected student on 1st year for discussion a thesis plan. Student can prepare his/her research proposal when take a class of EGIE 507 Seminar and Research Methodology. Final of this class, preliminary research proposal will be submitted and present with program committee. An adequate presentation with a complete methodology would be requested for the proposal presentation, officially. Then, student can start his/her research activity before the 2nd year.

Number of remain students has been concerned seriously for our program. Program staff and supporting staff have an activity for remind and call them back to the process of thesis finishing, continuously. For student has a potential timeout, contact with Line application and e-mail are kept for evidence to proof that the program has keep contacting to student. The program director is responsibility of management and matching advisor for the student who has a potential dropout.

Table 19 Percentage of students completing a master's degree from our Graduate Program in Industrial Engineering and dropout rates over the past 5 academic years. Numbers in parenthesis in the Dropout columns indicate number of students dropping out.

Academic Year	Cohort Size	Number of Graduates	% Master Completion in (number)			% Dropout During (number)			
			Within 3 Year	4 Year	< 4 Year	1st Year	2nd Year	3rd Year	4th Year and Beyond
2015	55	4	3	0	1	0	0	0	4
2016	60	10	1	5	4	0	1	1	5
2017	60	7	4	1	2	1	0	0	1
2018	60	13	4	2	7	2	0	0	4
2019	58	12	7	4	1	0	0	1	3

11.2 The average time to graduation is established, monitored and benchmarked for improvement

In average, our graduate students take 3.6 years to finish their master's degree. This numbers are derived from graduates of the old curricula before revision in 2017. Recently, 4

students who are member of Flex' Lab (an example) could graduate in 2.5 years with various international proceeding and publications. It was indicated that our strategy as mentioned in 11.1 is effective way for reducing time of graduation because students are closed his/her advisor. Monthly meeting of laboratory encourages the student active perform the research and advisor can check the correctness of data and methodology, effectively.

11.3 Employability of graduates is established, monitored and benchmarked for improvement

Employment opportunity is a key factor any student considers when selecting a graduate program to study. From our record, all of the graduates from our academic programs have been employed in any position within one year after graduation. Tables 20 display the employment statistics of our master's graduates, over the last 5 academic years. we compare our employment rates to the KPI set by Mahidol University of graduate alumni achieving 80-85% employment rate within one year by 2019. It is clear that our 100% record have already exceeded the university's target. Such excellent track record of employment rates emphasize the quality of our graduate programs.

Table 20 Employment rates of our M.Sc. graduates recorded over the last 5 academic years

Academic Year	Master's Degree Graduates Employment Rates			
	Number of Graduates	Employed within 1 year after graduation	Continue for Higher Education	Unemployed
2015	4	4	0	0
2016	10	10	0	0
2017	7	6	1	0
2018	13	13	0	0
2019	12	12	0	0

11.4 The type and quantity of research activities by students are established, monitored and benchmarked for improvement

Per the requirement of our academic programs, all of the graduates must have at least 1 research publication in order for the degree to be granted. Minimum requirement for the master's degree students is a full proceeding in a national-level conference. Tables 21 summarize the number of research output in terms of proceeding and publications from our master's degree students.

Table 21 Number of publications per student in our M.Eng. program over the last 5 academic years.
*Note: cohort size in this Table include total master's students in that particular academic year

Academic Year	Number of Publications	Number of Conference Proceedings	Total Publications	Cohort Size*	Number of Publications per Student per Year
2015	0	5	5	55	0.1
2016	1	16	17	60	0.3
2017	3	10	13	60	0.2
2018	2	20	22	60	0.4
2019	3	19	22	58	0.4

11.5 The satisfaction levels of stakeholders are established, monitored and benchmarked for improvement

Stakeholders' satisfactions toward our graduate programs are monitored by many channels and mechanisms depending on the type stakeholders. Individual sections below described how each stakeholders' satisfactions are monitored. The exception is our last stakeholder as stated in the Criteria 1.3, which is Mahidol University. Mahidol University, via The Faculty of Engineering, monitors and regulates our academic programs through the PA with the Department of Industrial Engineering. The expected outcomes and outputs are specified in the PA at the beginning of each fiscal year and the final outcomes/outputs are evaluated by The Faculty of Engineering, Mahidol University. Achievement of the PA will results in increasing budget allocation to the department for better operation of the graduate programs.

Academic Staffs within the Department of Industrial Engineering

Happiness, concerns, feedbacks, opinions toward the operation of our graduate programs and of the department as a whole are discussed regularly at the monthly staff meeting. Final solution to any problem are made as a verdict from the staff meeting. Examples of such discussions/solution include allocation of budgets and criteria for supporting staffs to attend Industrial Engineering meeting abroad, teaching assignments, staffs' performance evaluation criteria, equipment needs and maintenance, student intakes and admission criteria, students' problems, etc. As there has never been any complaint filed to The Faculty of Engineering, the department considers that our most of academic staffs are generally satisfied with the operation of the programs.

Current Students

Current students have many channels of voicing their dissatisfaction. First, all students have a chance to anonymously evaluate teaching and learning processes of each courses online. Second, they can consult with the major advisor and/or program director, who can immediately help solve the problem or in turn report the situation to the monthly staff meeting for solution seeking. Third, the Line@ group Forum is a floor for all graduate students within the Department of Industrial Engineering to get together and arrange their own activities without intervention of any academic staff. In such forum, general matter regarding the academic program and department in general can be discussed, including unhappiness or dissatisfactions. Students have a chance to help seek solution together first, and, if resolution cannot be met, the issue(s) can be voiced to the departmental chairperson for further discussion in the monthly staff meeting. The fourth but perhaps the most effective channel for hearing of students' satisfaction is during brainstorming at the annual farewell and welcome party (For 2019 the party was held in the cruise Bacchus Home Resort, Pran Buri, Prachuap Khiri Khan). Student representatives gather feedbacks and comments from fellow students and deliver to academic staffs in the brainstorming session. Academic staffs listen to these comments seriously and discussion are made with the students to provide the best action plans for addressing certain weak points or areas for improvement. Last, students can also voice their satisfaction/dissatisfaction about the programs by filling out the online survey form annually gathered by the Faculty of Graduate Studies. Summary of the latest survey scores (combining data from both master's degree and doctoral degree programs) from the Faculty of Graduate Studies are presented in Table 22 below. In this Table, percentage of students scoring 4 or 5 (satisfied and very satisfied, respectively) for each question in the survey are calculated and provided as the overall student satisfaction.

Table 22 Survey results of student satisfaction toward our M.Eng. program conducted online by Faculty of Graduate Studies during the period of 2015-2019. The overall student satisfaction is counted as percentage of students scoring 4 (satisfied) or 5 (very satisfied) for each question in the questionnaires. Number of students responded to this survey was n = 25.

Evaluation Criteria	Overall Student Satisfaction (%)				
	2015	2016	2017	2018	2019
1. Structure and course contents of the program	4.25	3.82	4.20	4.20	4.10
2. Instructor of courses	4.34	3.67	4.17	4.17	4.14
3. Major advisor	4.13	3.97	4.53	4.53	4.02
4. Teaching and learning facilities	4.13	3.42	4.14	4.14	4.14
5. Student development and activities	4.35	3.47	4.17	4.17	4.24
Overall Satisfaction	4.25	3.71	4.26	4.26	4.12

Alumni

Every alumnus completed his/her degree is eligible to conduct a survey to voice their satisfaction/dissatisfaction toward our graduate programs both M.Eng. During the past 2-3 years, less than half of the students graduated from our programs returned the poll. The satisfaction levels of our alumni are displayed in Table 23 below. This evaluation results indicated that our alumni are generally satisfied with the program. However, the satisfaction of the faculty of engineering is the weakest point, receiving score of only 3.45

Table 23 Survey results of alumni satisfaction toward our M.Eng. program conducted by exit survey during the period of 2016-2019. Number of alumni responded to this survey was n = 11. Scoring criteria is as following: 5 = very satisfied, 4 = satisfied, 3 = neither satisfied nor unsatisfied, 2 = unsatisfied, 1 = very unsatisfied.

#	Queries	Overall alumni Satisfaction (%)			
		2016	2017	2018	2019
1	Engagement and Proudly Satisfaction of the Program	4.22	4.19	3.42	4.20
2	Engagement and Proudly Satisfaction of the Faculty of Graduate Studies	4.00	3.45	3.61	3.45
3	Engagement and Proudly Satisfaction of the Mahidol University	3.92	4.31	4.06	4.32
Average total score		**4.08**	**4.08**	**3.96**	**3.70**

Graduate Employers

Employers' satisfaction toward our alumni as their employees are continuously surveyed by an assistance from the Faculty of Graduate Studies. Every year, after graduates report to the Faculty of Graduate Studies about their employment information, inquiries to the graduate employers are made after 6 months period of the employment to ask the employers for their contribution on online evaluation. It turns out that very few graduate employers have participated on this evaluation. Over the past 3-4 years, only 7 employers responded to the poll without leaving any specific comments (see Appendix 9, page 52). Yet, from the survey polls, the overall satisfaction score of graduate employers toward our alumni are 4.3 out of 5. Our program committee is aware that the return rate of employer survey still needs improvement. Alternative strategies on how the employer satisfaction can be effectively gathered are being actively sought for by Program Administrative Committees.

SELF-ASSESSMENT SUMMARY

Criterion 1 - Checklist

1	Expected Learning Outcomes	1	2	3	4	5	6	7
1.1	The expected learning outcomes have been clearly formulated and aligned with the vision and mission of the university.					X		
1.2	The expected learning outcomes cover both subject specific and generic (i.e. transferable) learning outcomes				X			
1.3	The expected learning outcomes clearly reflect the requirements of the stakeholders				X			
	Overall opinion				X			

Criterion 2 - Checklist

2	Program Specification	1	2	3	4	5	6	7
2.1	The information in the program specification is comprehensive and up-to-date				X			
2.2	The information in the course specification is comprehensive and up-to-date				X			
2.3	The program and course specifications are communicated and made available to the stakeholders				X			
	Overall opinion				X			

Criterion 3 - Checklist

3	Program Structure and Content	1	2	3	4	5	6	7
3.1	The curriculum is designed based on constructive alignment with the expected learning outcomes					X		
3.2	The contribution made by each course to achieve the expected learning outcomes is clear					X		
3.3	The curriculum is logically structured, sequenced, integrated and up-to-date					X		
	Overall opinion					X		

Criterion 4 - Checklist

4	Teaching and Learning Approach	1	2	3	4	5	6	7
4.1	The educational philosophy is well articulated and communicated to all stakeholders				X			
4.2	Teaching and learning activities are constructively aligned to achievement of the learning outcomes				X			
4.3	Teaching and learning activities enhance life-long learning				X			
	Overall opinion				X			

Criterion 5 - Checklist

5	Student Assessment	1	2	3	4	5	6	7
5.1	The student assessments are constructively aligned to the achievement of the expected learning outcomes				X			
5.2	The student assessments including timelines, methods, regulations, weight distribution, rubrics and grading are explicit and communicated to students				X			
5.3	Methods including assessment rubrics and marking schemes are used to ensure validity, reliability and fairness of student assessment				X			
5.4	Feedback of student assessment is timely and helps to improve learning				X			
5.5	Students have ready access to appeal procedure				X			
	Overall opinion				X			

Criterion 6 - Checklist

6	Academic Staff Quality	1	2	3	4	5	6	7
6.1	Academic staff planning (considering succession, promotion, re-deployment, termination and retirement) is carried out to fulfill the needs for education, research and service				X			
6.2	Staff to student ratio and workload are measured and monitored to improve quality of education, research and service				X			
6.3	Recruitment and selection criteria including ethics and academic freedom for appointment, deployment and promotion are determined and communicated				X			
6.4	Competences of academic staff are identified and evaluated				X			
6.5	Training and developmental needs of academic staff are identified and activities are implemented to fulfill them				X			
6.6	Performance management including rewards and recognition is implemented to motivate and support education, research and service				X			
6.7	The types and quantity of research activities by academic staff are established, monitored and benchmarked for improvement				X			
	Overall opinion				X			

Criterion 7 - Checklist

7	Support Staff Quality	1	2	3	4	5	6	7
7.1	Support staff planning (at the library, laboratory, IT facility and student services) is carried out to fulfill the needs for education, research and service				X			
7.2	Recruitment and selection criteria for appointment, deployment and promotion are determined and communicated				X			
7.3	Competences of support staff are identified and evaluated				X			
7.4	Competences of academic staff are identified and evaluated				X			
7.5	Training and developmental needs of academic staff are identified and activities are implemented to fulfill them				X			
	Overall opinion				X			

Criterion 8 - Checklist

8	Student Quality and Support	1	2	3	4	5	6	7
8.1	The student intake policy and admission criteria are defined, communicated, published and up-to-date				X			
8.2	The methods and criteria for selection of students are determined and evaluated				X			
8.3	There is an adequate monitoring system for student progress, academic performance and workload				X			
8.4	Academic advice, co-curricular activities, student competition and other student support services are available to improve learning and employability					X		
8.5	The physical, social and psychological environment is conducive for education and research as well as personal well-being				X			
	Overall opinion				X			

Criterion 9 - Checklist

9	Facilities and Infrastructure	1	2	3	4	5	6	7
9.1	The teaching and learning facilities and equipment (lecture halls, classrooms, project rooms, etc.) are adequate and updated to support education and research					X		
9.2	The library and its resources are adequate and updated to support education and research						X	
9.3	The laboratories and equipment are adequate and updated to support education and research							X
9.4	The IT facilities including e-learning infrastructure are adequate and updated to support education and research						X	
9.5	The standard for environment, health and safety and access for people with special needs are defined and implemented						X	
	Overall opinion						X	

Criterion 10 - Checklist

10	Quality Enhancement	1	2	3	4	5	6	7
10.1	Stakeholders needs and feedback serve as input to curriculum design and development					X		
10.2	The curriculum design and development process is established and subjected to evaluation and enhancement				X			
10.3	The teaching and learning processes and student assessment are continuously reviewed and evaluated to ensure their relevance and alignment					X		
10.4	Research output is used to enhance teaching and learning						X	
10.5	Quality of support services and facilities (at the library, laboratory, IT facility and student services) is subjected to evaluation and enhancement						X	
10.6	The stakeholders feedback mechanism is systematic and subjected to evaluation and enhancement						X	
	Overall opinion					X		

Criterion 11 - Checklist

11	Output	1	2	3	4	5	6	7
11.1	The pass rate and dropout rates are established, monitored and benchmarked for improvement				**X**			
11.2	The average time to graduation is established, monitored and benchmarked for improvement				**X**			
11.3	Employability of graduates is established, monitored and benchmarked for improvement				**X**			
11.4	The type and quantity of research activities by students are established, monitored and benchmarked for improvement				**X**			
11.5	The satisfaction levels of stakeholders are established, monitored and benchmarked for improvement				**X**			
	Overall opinion				**X**			

III. STRENGTH AND WEAKNESS ANALYSIS

Summary of Strengths

- **International-referenced ELOs**

  Expected learning outcomes of our graduate programs have been formulated by integrating feedbacks from stakeholders and conforming to the international standard guidelines set by UK and USA Graduation.

- **Industrial-referenced ELOs**

  The program has been redesign the ELOs by Industrial Employer needs. Complete 3 major parts of elective course which consists of: 1) Logistics and Supply Chains 2) Industrial Management and 3) Applied Manufacturing Engineering and Creative Product Development are able applied to actual industries.

- **Flexible program structure**

  The program structures are flexible allowing multiple pathways for student entry. Also our program has 2 plans of regular(Thesis) and special (Thematic paper) plan for completion their graduation. Student can select the matching plan for themselves.

- ***Quality of academic staffs***

  Our academic staffs are capable of producing comparable international-quality research outputs to those from other institutions abroad.

- ***Research Funding***

  Our academic staffs always obtain the research funding from government, private companies and international institutes. The budget has been provided for the facility, equipment and special machine for student in research group to perform an adequate research activity.

- ***International Student***

  Our program has ASEAN students entry continues more than 7 years. Surrounding of class room and research group are international style. It seems harmony of Mahidol university surrounding and MU' driving policy. Also exchange student from German student choose Master of IE for getting many courses.

- **Measurable student outcomes/outputs**

  Student achievement of program ELOs and expected output are well defined.

- **100% employment rate**

  Almost all of our graduates are hired into the labor market within 1 year after degree completion, signifying the quality of our alumni.

Summary of Weaknesses

- **Average time to degree completion**

  The track record clearly sees that our students take significantly long period of time to complete their degree (More than 3.5 years by average).

- **Feedback gathering mechanisms**

  At this point, mechanisms for hearing feedback from two important stakeholders, alumni and employers, are still not efficient. Considerable low percentage of return rates are received each year.

Improvement Plans

- Average time to degree completion – Early matching student and advisor to fast get the research topic. 2nd semester, student shall present a related proposal in class of research methodology and seminar. A good potential student will be encouraged for examine the research proposal. During research performing, advisor and supporting staff closeup monitor and ask a student progression, officially.
- Feedback mechanisms – The Program Administrative Committee already made a plan to more direct approaches in gathering feedbacks from alumni and employers. Phone

interview and/or organizing an open session for curriculum critiques. These approaches will be implemented in the subsequent curriculum revision period.

Appendix 1

Concept of Expected Learning Outcome for Mahidol University aligned with MU core values

Core Values	21st Century Skills	TQF
M Mastery A Altruism H Harmony I Integrity D Determination O Originality L Leadership	1. Critical Thinking & Problem Solving 2. Creativity & Innovation 3. Communication & Collaboration 4. Information, Media & Technology Skills 5. Leadership & Responsibility 6. Flexibility & Adaptability 7. Initiative & Self-Direction 8. Social & Cross-Cultural Skills 9. Productivity & Accountability	1. คุณธรรม/จริยธรรม 2. ความรู้ 3. ทักษะทางปัญญา 4. ทักษะความสัมพันธ์ระหว่างบุคคลและความรับผิดชอบ 5. ทักษะการวิเคราะห์เชิงตัวเลข การสื่อสาร และการใช้เทคโนโลยี

Mahidol University
Wisdom of the Land

MU Learning Outcomes
คุณลักษณะของบัณฑิตที่พึงประสงค์

		Core Values
เป็นคนดี	1. คิดดี พูดดี ทำดี	MAHIDOL
	2. มีจรรยาบรรณ และจิตสำนึกต่อสังคม	MAHIDOL
มีปัญญา	3. เรียนรู้ตลอดชีวิต รอบรู้ รู้เท่าทันการเปลี่ยนแปลงของโลก	MAHIDOL
	4. มีภาวะผู้นำ ความคิดสร้างสรรค์และทักษะในการทำงาน	MAHIDOL
นำพาสุข	5. สร้างความสุขภายในตนเอง และขยายความสุขให้ผู้อื่นได้	MAHIDOL
	6. ยอมรับในความหลากหลาย และดำรงความเป็นไทย	MAHIDOL

Appendix 2

Relationship between TQF' Learning Outcome and MU Core Values

TQF' Learning Outcome	MU Core Values
1. Moral and Ethics	
1.1 Recognize the value of sacrifice and moral integrity	(Altruism, Integrity)
1.2 Respect in human values and human life	(Altruism, Integrity)
1.3 Respect the ethics in academics and professionals	(Altruism, Integrity)
2. Knowledge	
2.1 Define principles, theory and research in industrial engineering	(Mastery)
2.2 Apply knowledge in industrial engineering with other disciplines	(Mastery)
2.3 Analyze problems, apply tools or techniques to solve complex problems in industry	(Mastery, Determination)
3. Cognitive skills	
3.1 Illustrate systematic thinking and logically thinking	(Mastery, Originality)
3.2 Show ability in searching, gathering and interpreting data in industrial engineering	(Mastery, Originality)
3.3 Show ability in collecting knowledge as a process	(Mastery, Determination)
3.4 analyze, synthesize academic research and solve problems in industry	(Mastery, Determination)
4. Interpersonal skills and responsibility	
4.1 Responsible with assigned tasks	(Determination)
4.2 Self-development to work together with others and can solve complex problems	(Harmony, Determination)
4.3 having good relationships with others in an organization and other people	(Harmony)
4.4 Show ability to be a leader and at the same a team work appropriately to solve complex problems	(Harmony, Leadership)
4.5 Illustrate professional such as punctuality, self-responsibility toward professional, workplaces and society	(Altruism, Integrity)
5. quantitative, communicate and IT skills	

5.1 screen and analyze data in terms of mathematics and statistics to solve problems appropriately (Mastery)

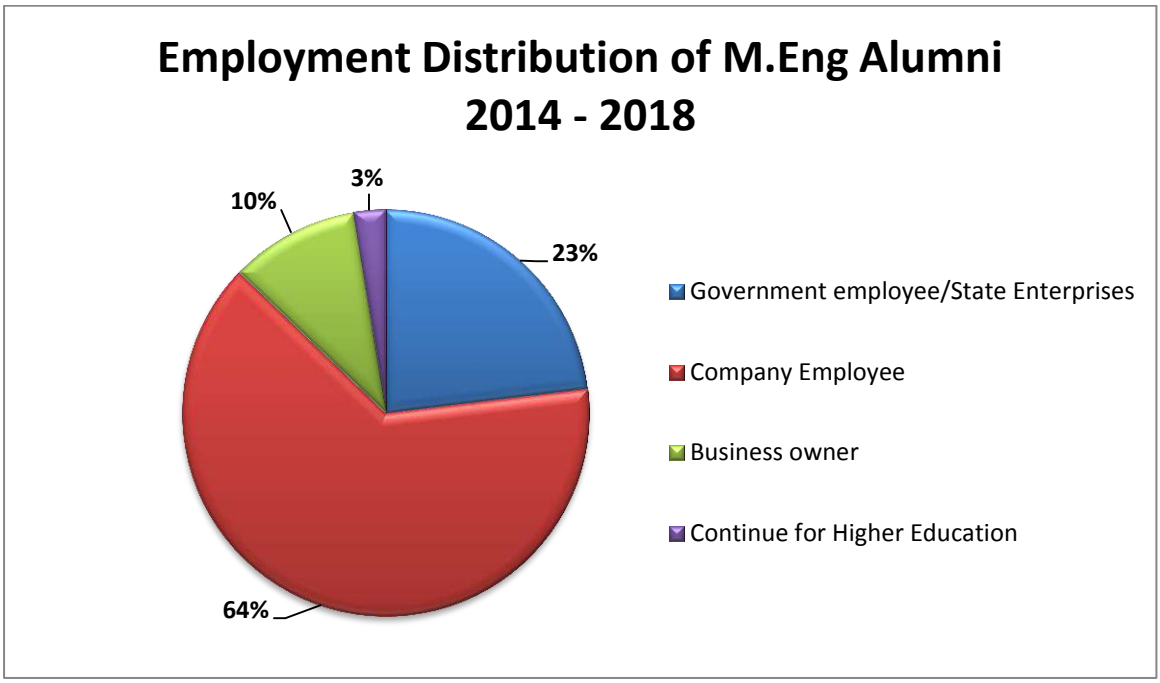
5.2 Select appropriate information technology to communicate and present information to a variety of audiences (Mastery)

5.3 Use information technology to search and collect data effectively (Mastery)

Appendix 3

Past Record of Alumni Employment
(Job Classifications)
from
Graduate Programs in Industrial Engineering Department of Industrial Engineering, Faculty of Engineering Mahidol University

Job records have been collected from alumni graduated in the year 2014 – 2018. Numbers in the pie charts indicate percentage of our graduates employed in each job categories.



Appendix 4

Program Structure and Specification
Master of Engineering Program in Industrial Engineering
(Regular Program and Special Program)
Curriculum Last Revised in 2018 for
Students Entering in Academic Year 2016

---

1. Program Title Master of Engineering Program in Industrial Engineering

(Regular Program and Special Program)

2. Name of Degree

Full name : Master of Engineering (Industrial Engineering)

Abbreviation : M.Eng. (Industrial Engineering)

3. Responsible Units

3.1 Department of Industrial Engineering, Faculty of Engineering, Mahidol University – Teaching Institution

3.2 Faculty of Graduate Studies, Mahidol University – Awarding Institution

4. Philosophy and Expected Learning Outcomes of the Program

4.1 Philosophy of the Program:

The program is designed for producing the Master of Industrial Engineering which is a good human resource has a mankind, integrity, ethic in an academic and profession. Master student has a practically knowledge and expertise that be able to analyzing, applying, integrating of multi-disciplines and technologies in field of the classical and the modern industrial engineering for the real business and industry.

4.2 Expected Learning Outcomes of the Program:

Expected Learning Outcomes or our master's degree program is adapted from the Industrial Engineering in 2011 as following

Upon completion of graduates must be able to:

4.2.1 Ethically create an academic outcome of industrial engineering.

4.2.2 Mastery in understanding the principle of industrial engineering.

4.2.3 Applicable an advanced knowledge of industrial engineering for improving the production industry and service business.

4.2.4 Analyze and solving the problems in the aspect of industrial engineering with a research methodology, systematically.

4.2.5 Professional teamwork with other fields people

4.2.6 Effectively communication, using of information technology and suitable data presentation.

5. Admission Requirements

5.1 Applicants must be studying in the final year at the bachelor level, or hold a degree in B.Eng. (any area) or a bachelor's degree in B.Sc. with GPA of at least 2.50from the institute or university which approved by the office of the Higher Education Commission or

5.2 Applicants who hold a degree in other fields with GPA of at least 2.50 from the institute or university from which approved by the office of the Higher Education Commission and having the experience in the field of industrial engineering more than 3 years.

5.3 Applicants are required to take entrance examinations arranged by the Faculty of Graduate Studies. The entrance examinations are 1) English Proficiency Test and 2) Subject-Specific Test, the letter is in English language covering general knowledge in Industrial Engineering, Industrial Engineering and

5.4 Applicants whose credentials differ from that listed in 5.1, 5.2 and 5.3 may be selected under a consideration of the program director and the dean of faculty of graduate studies.

5.5 International applicants must apply through the online system available at the Faculty of Graduate Studies (http://www.grad.mahidol.ac.th) and are exempted for entrance examination.

6. Selection Method

Applicants are selected based on academic/research credentials and/or written examination and interview according to rules and regulation of the Faculty of Graduate Studies, Mahidol University. International applicants may be subjected to phone/online interview and must provide proof of financial support during the study period to be considered for admission. Final judgment will be made under the consideration of the Administrative Program Committee in concurrence with the Dean of Faculty of Graduate Studies, Mahidol University.

7. Academic System

7.1 Semester system

Semester

7.2 Credit Assignment

The number of credits assigned to each subject is determined as follows:

7.2.1 Lecture or discussion consuming 15 hours per semester is equal to 1 credit hour.

7.2.2 Laboratory or practice consuming 30 hours per semester is equal to 1 credit hour.

7.2.3 Thesis consuming 45 hours per semester is equal to 1 credit hour.

8. Language

Thai and English is used in teaching and learning as well as in the assessment processes.

9. Registration

9.1 Students must register as full time students.

9.2 Students must register for no less than 9 credits and no more than 15 credits per regular semester, or according to program study plan.

10. Evaluation and Graduation Requirements

10.1 Evaluation

Student evaluation is in accordance with the rules and regulations of Mahidol University. (See details at http://www.grad.mahidol.ac.th)

10.2 Graduation Requirements

All master's degree students must

10.2.1 register for at least 24 credits of coursework and 12 credits of thesis. Total credits acquired must at least 36 credits. A cumulative GPA must be 3.00 or more.

10.2.2 pass the English Proficiency Examination offered by the Faculty of Graduate Studies, Mahidol University or equivalent.

10.2.3 present thesis and pass the oral thesis defense examination according to the rules and regulations of the Faculty of Graduate Studies, Mahidol University.

10.2.4 obtain at least one publication or a manuscript that has been accepted for publication as a journal article or a conference proceeding at the national or international level.

11. Library

Our Mahidol Library possesses more than 10,000 books. Many journals can be accessed online. Besides, a lot of text books and journals (in both electronic and printed formats) are available at other libraries within Mahidol University.

12. Program Structure

12.1 The number of credits required for the program

Number of credits required for the program is at least 36 credits

12.2 Curriculum Structure

The program is set according to the Ministry of Education Announcement titled "Standard Criteria for Graduate Studies 2015", with specified plan A(2) curriculum.

Basic Courses	Non	credits
Required Courses	15	credits
Elective Courses at least	9	credits
Dissertation	12	credit
Total no less than	**36**	**credit**

The program is set according to the Ministry of Education Announcement titled "Standard Criteria for Graduate Studies 2015", with specified plan B curriculum.

Basic Courses	Non	credits
Required Courses	15	credits
Elective Courses at least	15	credits
Dissertation	6	credit
Total no less than	**36**	**credit**

12.3 Course Requirements

Basic Courses	Credits (lecture-lab-self study)
EGIE569 Basic Principles of Industrial Engineering	3(3-0-6)
EGIE 570 Probability and Statistics	3(3-0-6)
EGIE 571 Operations Research	3(3-0-6)
EGIE 572 Production Planning and Control	3(3-0-6)

Required Courses	Credits (lecture-lab-self study)
EGIE 502 System Thinking and Modeling	3(3-0-6)
EGIE 504 Advanced Operations Management	3(3-0-6)
EGIE505 Applied Engineering Statistics and Operations Research	3(3-0-6)
EGIE 506 Innovation and Creativity for Sustainable Entrepreneurship	3(3-0-6)
EGIE 507Seminar and Research Methodology	3(3-0-6)

Elective Courses

(Logistics and Supply Chain Management)	Credits (lecture-lab-self study)
EGIE 510 Principles of Logistics and Supply Chain Management	3(3-0-6)
EGIE 511 Information Technology for Logistics and Supply Chains	3(3-0-6)
EGIE 512 Management of Technology and Innovation	3(3-0-6)
EGIE 513 Logistics and Supply Chain Performance Measurement	3(3-0-6)
EGIE 514 Intelligent Systems and Decision Support Systems	3(3-0-6)
EGIE 515 Inventory Management	3(3-0-6)
EGIE 517 Warehouse Management	3(3-0-6)
EGIE 529 Service Logistics and Supply Chain	3(3-0-6)
EGIE 531 Seminar in Modern Logistics and Supply Chain Topics	3(3-0-6)
EGIE 533 International Transport Logistics	3(3-0-6)
EGIE 534 Statistical Methods for Reliability Engineering	3(3-0-6)
EGIE 535 Information Management in Healthcare Supply Chain	3(3-0-6)
EGIE 598 Hospital Logistics and Supply Chain Management	3(3-0-6)
EGIE 601-605 Special Topics in Logistics and Supply Chain Management	3(3-0-6)
EGIE 631 Data Mining in Industrial Engineering	3(3-0-6)

(Engineering Management, Production Engineering and Quality Engineering)	Credits (lecture-lab-self study)
EGIE 521 Project Management for Engineers	3(3-0-6)
EGIE 525 Six Sigma	3(3-0-6)
EGIE 537 Assembly Line Balancing Principle	3(3-0-6)
EGIE 606-610 Special Topics in Engineering Management, Production Engineering and Quality Engineering	3(3-0-6)
EGIE 622 Quality Management	3(3-0-6)
EGIE 624 Lean Production and Service Systems	3(3-0-6)

(Applied Manufacturing Engineering and Creative Product Development)	*Credits (lecture-lab-self study)*
EGIE 540 Tools for Manufacturing Engineering	3(3-0-6)
EGIE 541 Industrial Metallurgy and Advanced Materials Science	3(3-0-6)
EGIE 542 Introduction to the Internet of Things and Embedded Systems	3(2-3-5)
EGIE 543 Total Welding Management	3(3-0-6)
EGIE 544 Manufacturing of Boiler and Pressure Vessel	3(3-0-6)
EGIE 545 Principle of Manufacturing Technology Transfer	3(3-0-6)
EGIE 546 Advanced Welding Processes and Control of Welded Properties	3(3-0-6)
EGIE 549 Manufacturing Automation	3(2-3-5)
EGIE 550 Digital Manufacturing	3(2-3-5)
EGIE 590 Materials for Product and Manufacturing	3(3-0-6)
EGIE 591 Manufacturing for Competitive Advantages	3(3-0-6)
EGIE 592 Product and Manufacturing Development for Competitive Advantages	3(3-0-6)
EGIE 616-620 Special Topics in Applied Manufacturing Engineering and Creative Product Development	3(3-0-6)

Note: Besides the above elective courses, students can enroll in other courses offered by graduate programs of Mahidol University with approval from the program director, major advisor, or program administrative committee.

Plan A (2) Credits (lecture-lab-self study)

EGIE 698 Thesis 12(0-36-0)

Plan B Credits (lecture-lab-self study)

EGIE 697 Thematic Paper 6(0-18-0)

Research Projects of the Program

Staff at the Department of Industrial Engineering has received many research grants from local agencies (e.g. National Science and Technology Development Agency (NSTDA), Thailand Research Fund (TRF), National Research Council of Thailand (NRCT) and overseas granting agencies and the private industries. Major research interests in the Department are:

1. Engineering Management, Production Engineering and Quality Engineering
2. Supply Chains and Logistics
3. Thailand Health Care' Logistics
4. Information Technology and IT' management
5. Design of improvement and Simulation for Production System
6. Material Evaluation and Material Processing
7. System and Management Evaluation

Course Code Explanation

Code digit system for course is follow as:
Letter EG is Faculty of Engineering
Letter IE is Department of Industrial Engineering
Digit is course of Master industrial engineering

Study Plan

Plan A(2) (Regular Program and Special Program)

Year	Summer	
	EGIE569 Basic Principles of Industrial Engineering	3(3-0-6)
	EGIE 570 Probability and Statistics	3(3-0-6)
	EGIE 571 Operations Research	3(3-0-6)
	EGIE 572 Production Planning and Control	3(3-0-6)
	Non- Credits	
1	**Semester 1**	
	EGIE 502 System Thinking and Modeling	3(3-0-6)
	EGIE505 Applied Engineering Statistics and Operations Research	3(3-0-6)
	EGIE 506 Innovation and Creativity for Sustainable Entrepreneurship	3(3-0-6)
	Elective Course	3 Credits
	Total 12 Credits	
	Semester 2	
	EGIE 504 Advanced Operations Management	3(3-0-6)
	EGIE 507Seminar and Research Methodology	3(3-0-6)
	Elective Course	6 Credits
	Total 12 Credits	

2	**Semester 1**	
	EGIE 698 Thesis	6(0-18-0)
	Total 6 Credits	
	Semester 2	
	EGIE 698 Thesis	6(0-18-0)
	Total 6 Credits	

* For student who does not have the basic knowledge of industrial engineering shall register in the summer course for preparing a suitable knowledge before 1st semester of the 1st year. Program committees have a discretion for evaluating the result of the summer course.

Plan B (Regular Program and Special Program)

Year	**Summer**	
	EGIE569 Basic Principles of Industrial Engineering	3(3-0-6)
	EGIE 570 Probability and Statistics	3(3-0-6)
	EGIE 571 Operations Research	3(3-0-6)
	EGIE 572 Production Planning and Control	3(3-0-6)
	Non- Credits	
1	**Semester 1**	
	EGIE 502 System Thinking and Modeling	3(3-0-6)
	EGIE505 Applied Engineering Statistics and Operations Research	3(3-0-6)
	EGIE 506 Innovation and Creativity for Sustainable Entrepreneurship	3(3-0-6)
	Elective Course	3 Credits
	Total 12 Credits	
	Semester 2	
	EGIE 504 Advanced Operations Management	3(3-0-6)
	EGIE 507Seminar and Research Methodology	3(3-0-6)
	Elective Course	3 Credits
	Total 12 Credits	
2	**Semester 1**	
	EGIE 697 Thematic Paper	3(0-9-0)
	Total 9 Credits	
	Semester 2	
	EGIE 697 Thematic Paper	3(0-9-0)
	Total 3 Credits	

* For student who does not have the basic knowledge of industrial engineering shall register in the summer course for preparing a suitable knowledge before 1st semester of the 1st year. Program committees have a discretion for evaluating the result of the summer course.

13. Thesis Research Proposal Presentation

In the second year of study, students must submit a document to Faculty of Graduate Studies for appointment of Thesis Proposal Committee consisting of at least 2 faculty members, one of which is student's major advisor while another one (or more) can be any academic staff either within or outside Mahidol University. After approval of thesis research proposal, this same committee will serve as Thesis Advisory Committee monitoring and providing guidance to student regarding his/her master's research.

14. Thesis Defense

Upon completion of master's research and thesis writing along with approval from Thesis Advisory Committee, students must submit a document to Faculty of Graduate Studies for appointment of Thesis Defense Committee consisting of at least 4 members: a committee chair, an external examiner and the Thesis Advisory Committee (at least 2 members). After passing the oral thesis defense, students can submit final thesis to Faculty of Graduate Studies.

15. Collaboration with Other Departments

Many of our faculty members are members of multidiscipline research centers such as Center for Excellence in Protein Structure and Function, Center for Excellence in Vectors and Vector-Borne Diseases, Center for Shrimp Molecular Industrial Engineering and Biotechnology, Center for Bioinformatics and Applied Genomics Research Unit, Consortium in Calcium and Bone Research. We also have collaborations with scientists at other research institutes and universities in Thailand and overseas.

16. Students Job Opportunities

A large number of our student alumni work as teachers in school, researchers or research assistance in research institutes, technical specialists for Industrial Engineering products, sales representative of Industrial Engineering products, or as scientists in food, pharmaceutical, cosmetic and chemical industries.

Appendix 5

Course Syllabus
EGIE 502 System Thinking and Modeling
Seminar I Academic Year 2018

Course ID and name: EGIE 502 System Thinking and Modeling
Course coordinator: Asst.Prof. Dr.Waressara Weerawat
Instructors: Asst.Prof. Dr.Waressara Weerawat
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Business process modeling, system thinking and modeling, process mapping tools, modeling construction, modeling tools, system analysis, computer modeling, performance measurement system analysis, applications of modeling in Logistics and supply chain systems

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Define the system under study and the purpose of study
2. Model a system using computer software (Arena)
3. Apply the systematic modeling approach in aiding the decision making

Constructive Alignment of CLO s and Program' s ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				
2		R	R			
3				R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction to systematic thinking using the case study	Slide Presentation/ Hands-on Exercise / Group Discussion	Class Participation	Asst.Prof. Dr.Waressara Weerawat
2	Modeling the system using computer programming	Slide Presentation / Hands-on Exercise	Class Participation	Asst.Prof. Dr.Waressara Weerawat
3	Manual Simulation modeling	Slide Presentation / Hands-on Exercise	Class Participation	Asst.Prof. Dr.Waressara Weerawat
4	Understand performance measurement from the system output report	Slide Presentation / Group Discussion	Class Participation	Asst.Prof. Dr.Waressara Weerawat
5	Quiz1– Output Report Analysis The system modeling concept: • Entity, Process, Resource, and Queue.	Slide Presentation / Hands-on Exercise	Written Exam	Asst.Prof. Dr.Waressara Weerawat
6	Simulation modeling • Multiple Input &Process	Slide Presentation / Hands-on Exercise	Class Participation	Asst.Prof. Dr.Waressara Weerawat
7	Simulation modeling • Resource Capacity & Failure, Input Analysis, Add on- Statistics Report	Slide Presentation / Hands-on Exercise	Class Participation	Asst.Prof. Dr.Waressara Weerawat

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
8	Midterm Exam		Written Exam	Asst.Prof. Dr.Waressara Weerawat
9	Project Proposal Preparation • Problem Formulation, Conceptual Flow, Process Mapping	Slide Presentation/ Group Discussion	Class Participation	Asst.Prof. Dr.Waressara Weerawat
10	Advance modeling technic I; Project Feedback I (Project Description)	Slide Presentation/ Group Discussion	Student Presentation	Asst.Prof. Dr.Waressara Weerawat
11	Advance modeling technic II; Project Feedback II (Conceptual Modeling & KPI Setting)	Slide Presentation/ Hands-on Exercise / Group Discussion	Student Presentation	Asst.Prof. Dr.Waressara Weerawat
12	Quiz 2 – Advance Modeling III; Scenario Analysis • Multiple comparison (PAN, OPT Quest)	Slide Presentation/ Hands-on Exercise / Group Discussion	Written Exam	Asst.Prof. Dr.Waressara Weerawat
13	Output Analysis II ; Project Feedback II (Performance Measure, Statistics Analysis)	Slide Presentation/ Hands-on Exercise / Group Discussion	Student Presentation	Asst.Prof. Dr.Waressara Weerawat
14	Output Performance Analysis in decision making	Slide Presentation/ Hands-on Exercise / Group Discussion	Class Participation	Asst.Prof. Dr.Waressara Weerawat
15	Final Project Presentation		Student Presentation	Asst.Prof. Dr.Waressara Weerawat

Assessment Criteria

Class participation	20%
Written Exam	20%
Midterm Exam	30%
Final Project	30%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, and F based on the distribution of students' scores from the whole course with this following grading criteria.

A	86% - 100%
B+	81% - 85%
B	71% - 80%
C+	61% - 70%
C	51% - 60%
F	0% - 50%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors immediately either by direct contact or email.

Course Syllabus
EGIE 504 Advanced Operations Management
Seminar I Academic Year 2018

Course ID and name: EGIE 504 Advanced Operations Management
Course coordinator: Asst.Prof. Dr.Thanakorn Naenna
Instructors: Asst.Prof. Dr.Thanakorn Naenna
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Improve productivity and quality standards in production or service systems. important concepts include advanced production planning, supply chain management, maintenance and reliability, inventory management, and moral and ethics of industrial engineer

Course Learning Outcomes (CLOs)

1. Ethically create researches or literature reviews of advanced operations management.
2. Understand theory and principles of advanced operations management.
3. Apply knowledge of advanced operations management to improve production and service industries
4. Analysis industrial problems and effectively propose solutions by using concepts of advanced operations management.
5. Develop team works and collaborate with industrial engineering professionals.
6. Effectively communicate, use of information technology and present data of advanced operations management.

Const ruct ive Ali gnm ent of CLO s and P rogram' s ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I					
2		M				
3			R			
4				R		
5					R	
6						R

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction to operation management	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
2	Competitiveness, strategy, and productivity	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
3	Forecasting	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
4	Product and service design	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
5	Strategic capacity planning for product and service	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
6	Process selection and facility layout	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
7	Work design and measurement	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
8	Project Presentation I	Presentation and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
9	Location planning and analysis	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
10	Management of quality	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
11	Quality control	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
12	Aggregate planning and master scheduling	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
13	Inventory management	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
14	Supply chain management	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
15	Project Presentation II	Presentation and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna

Assessment Criteria

Grading Criteria for EGIE505

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Attendance/participation	10%
Individual Project I	20%
Group Project II	30%
Final Project	40%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 505 Applied Engineering Statistics and Operations Research
Seminar II Academic Year 2018

Course ID and name: **EGIE 505 Applied Engineering Statistics and Operations Research**
Course coordinator: Asst.Prof. Dr.Thanakorn Naenna
Instructors: Asst.Prof. Dr.Thanakorn Naenna
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Develop and use mathematical and statistical models to solve quantitative decision problems in industrial engineering. Key concepts include linear programming, integer programming, network models, analysis of variance, regression analysis, and nonparametric statistics

Course Learning Outcomes (CLOs)

1. Ethically create basic researches or literature reviews of applied engineering statistics and operations research.
2. Understand theory and principles of applied engineering statistics and operations research.
3. Apply knowledge of applied engineering statistics and operations research to improve production and service industries
4. Analysis industrial problems and effectively propose solutions by using concepts of applied engineering statistics and operations research.
5. Develop team works and collaborate with industrial engineering professionals.
6. Effectively communicate, use of information technology and present data of applied engineering statistics and operations research.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I					
2		M				
3			R			
4				R		
5					R	
6						R

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction to advanced operations research	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
2	Network model I	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
3	Network Model II	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
4	Integer programming I	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
5	Integer programming II	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
6	Nonlinear programming I	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
7	Nonlinear programming II	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
8	Project Presentation I	Presentation and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
9	Dynamic programming I	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
10	Dynamic programming II	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
11	Dynamic programming III	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
12	Metaheuristic I	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
13	Metaheuristic II	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
14	Metaheuristic III	Lecture and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna
15	Project Presentation II	Presentation and class discussion	Examination, feedback	Asst.Prof.Dr. Thanakorn Naenna

Assessment Criteria

Grading Criteria for EGIE505

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Attendance/participation	10%
Individual Project I	20%
Group Project II	30%
Final Project	40%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 506 Innovation and Creativity for Sustainable Entrepreneurship
Semester I Academic Year 2018

Course ID and name: EGIE 506 Innovation and Creativity for Sustainable Entrepreneurship
Course coordinator: Asst.Prof.Dr. Ronnachai Sirovetnukul
Instructors: Asst.Prof.Dr. Ronnachai Sirovetnukul
Lect.Dr.Jirapan Liangrokapart
Asst Prof.Dr.Soranat Raibhu
Industrial Engineering Department, Faculty of Engineering, Mahidol University
and guest lecturers from industries and public organization
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

This course provides the process of venture screening and the steps to birth a new venture, the attributes for success a moral and ethical entrepreneur, creative and strategic thinking, innovation, business plan, resource planning and supplement, risk management, intellectual property and business laws, critical management, case studies and best practices for creative and innovative products and services.

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Explain the concept of sustainable entrepreneurship and creativity.
2. Develop new products, process, and services which are different from the current one.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1		R				
2	I	R	R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction, Project assignment (Innovative plastic products) and Business plan / model	Lecture	Project assignment	Asst.Prof.Dr. Ronnachai Lect.Dr.Jirapan
2	How to be a successful and sustainable entrepreneur / Process to identify profitable business and start new innovative business	Lecture	Individual Report and Project assignment	A guest lecturer from industry or public organization
3	How to market innovative products	Lecture	Individual Report and Project	A guest lecturer from industry or public organization

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
4	Business Potential Realization (Strategic Thinking)	Lecture	Individual Report and Project	A guest lecturer from industry or public organization
5	Creativity Idea Generation and Workshop	Lecture	Individual Report and Project	A guest lecturer from industry or public organization
6	Case studies and success stories in launching innovative products/service I	Lecture and Site Visiting	Individual Report and Project	A guest lecturer from industry
7	Visiting a Company	Lecture and Site Visiting	Individual Report and Project	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat
8	Intellectual property and Business Law	Lecture	Individual Report and Project	A guest lecturer from industry or public organization
9	Idea Selection and Presentation	Workshop and Presentation	Project assignment	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat
10	Risk and Crisis Management	Lecture	Individual Report and Project	A guest lecturer from industry or public organization
11	Entrepreneurial Finance	Lecture	Individual Report and Project	A guest lecturer from industry or public organization
12	Visiting Innovation Company or Public Organization	Site Visiting	Individual Report	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat
13	Case studies and success stories in launching innovative products/service II	Lecture	Individual Report and Project	A guest lecturer from industry
14	Final project report and presentation	Project Presentation	Project Report and Presentation	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat
15	Final project report and presentation	Project Presentation	Project Report and Presentation	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat
16	Final project report and presentation	Project Presentation	Project Report and Presentation	Asst.Prof.Dr. Ronnacha Lect.Dr.Jirapan Asst Prof.Dr.Soranat

Assessment Criteria

Grading Criteria for EGIE 506

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%

C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 0%

Course evaluation

Class Participation	20%
Final Project and Presentation	50%
Individual Report	30%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 507 Seminar and Research Methodology
Seminar II Academic Year 2018

Course ID and name: EGIE 507 Seminar and Research Methodology
Course coordinator: Assoc.Prof.Dr.Thananya Wasusri, Assoc. Prof. Dr.Duangpun Singkarin
Instructors: Assoc.Prof.Dr.Thananya Wasusri, Assoc. Prof. Dr.Duangpun Singkarin
Dr. Eakkachai Warinsirirak
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

1. Course Goals

After finishing the course, students will be able to
1.1 Define research methodology, tools and techniques to conduct research
1.2 apply tools and techniques to collect data and solve research problems
1.3 apply reserch methdology to solve real life problems

2. Objectives of Course Development/Revision/Course Learning Outcomes (CLOs)

2.1. Course Objectives

This course is to develop students with ability to apply research methodology on their thematic study, thesis and to solve a real life problem in the future. Students will be able to define how to develop research questions, research objectives and how to apply research methodoloy to solve the research questions. Students will define ethics in research and workplaces. Moreover, problems or issues in the fields of Industrial Engineering will also be discussed to support students to conduct their research.

2.2 Course-Level Learning Outcomes (CLOs)

Students will be able to :

CLOs	PLOs	TQF
CLO1 Define research methodology, tools and techniques	PLO1 Ethically create academic works related to advanced industrial engineering field	2.1,2.3,2.4
CLO2 Demonstrate ethics in research and workplaces		1.1,1.2,1.3
CLO3 Develop a research proposal		3.3,3.4,4.4,5.2
CLO4 Deliver a quality presentation using appropriate media or technology	PLO6 : Communicate, use information technology, and choose the method to effectively present the information in industrial engineering	5.2

3. Course Description

The study of research methodology: Tools and Techniques. Systematic data gathering and problems solving. Academic seminar including Thailand or international plant visit. Discussion and presentation of the probable thesis or special project topics related to manufacturing, engineering management, operation management, logistics and supply chain management

4. **Number of Hours per Semester**

Lectures (hours)	**Laboratory/Field Trip (hours)**	**Self-study (hours)**
45 hours/semester (3 hours x 15 weeks)	0 hour/semester	90 hours/semester (6 hours x 15 weeks)

5. Number of Hours per Week for Individual Advice

Instructor provides academic counseling and guidance to an individual at least one hour/week via appoinments.

6. Development of Student Learning Outcomes

The couse is to develop students' ability in research methodology to support their thematic study or thesis and at the same time to solve a real life problem that may take place in workplaces. At the end of the course, students will be able to :

CLO1 Define research methodology, tools and techniques
CLO2 Demonstrate ethics in research and workplaces
CLO3 Develop a research proposal
CLO4 Deliver a quality presentation using appropriate media or technology

7. Methods to support and evaluate students' learning outcomes

CLOs	Teaching strategies				Evaluation strategies			
	Lecture	Case study	Workshop	Formative assessment	Assignment /Quiz	Research proposal	Presentation	Class participation
CLO1	/	/		/	/	/		
CLO2	/	/		/	/			/
CLO3			/	/		/		
CLO4				/			/	

8. Teaching plan

Week	Topics	Number of hours			Activity /media	Instructor
		In-class actitity	lab	Self-study		
1	Introduction to research	3	0	6	case study /MS PowerPoint/discussion	TW
2	What is Research Methodology ?	3	0	6	Case study /MS PowerPoint/discussion (Assign a research proposal assignment)	TW
3	Formulating research question	3	0	6	MS PowerPoint	DS
4	Research literature review & Reading	3	0	6	MS PowerPoint	DS
5	Empirical Research method	3	0	6	MS PowerPoint : Assignment on data collection and analysis is given	DS
6	Analysing Data I	3	0	6	MS PowerPoint	DS
7	Research Analysis and Interpretation	3	0	6	MS PowerPoint/Discussion on the data analysis assignment given	TW
8	Research Ethics	3	0	6	MS PowerPoint/Quiz	TW
9	Workshop on researh proposal	3	0	6	Workshop/formative/Students present Assignment on data	TW

Week	Topics	Number of hours			Activity /media	Instructor
		In-class actitity	lab	Self-study		
					collection and analysis	
10	Seminar – System dynamics :	3	0	6	MS PowerPoint/case study	TW
11	Seminar – Signal and Image Processing	3	0	6	MS PowerPoint/Discussion	EW
12	Seminar – Welding and Joining of Materials	3	0	6	MS PowerPoint/Discussion	EW
13	Seminar –logistics and supply chain	3	0	6	MS PowerPoint/Discussion	TW
14	Seminar – Healthcare logistics and supply chain	3	0	6	MS PowerPoint/Discussion	TW
15	Research Presentation	3	0	6	MS PowerPoint/Discussion	TW/DS
	รวมจำนวนชั่วโมงตลอดภาคการศึกษา	45	0	90		

9. Evaluation Plan for Learning Outcome

9.1 Measurement ad Evaluation for Learning Outcome

a. Formative Assessment

The instructors observe the interaction of students during the demonstration, workshop and discussion of information related to the topic to evaluate the learning progress of all students.

b. Summarive Assessment

(1) Evaluation methods and weight

Course Learning Outcomes	Assessment method weight				Weight Percentage (%)
	Assignment /Quiz	Research proposal	Presentation	Class participation	
CLO1 Define research methodology, tools and techniques		20%			20%
CLO2 Demonstrate ethics in research and workplaces	10%			10%	20%
CLO3 Develop a research proposal		50%			50%
CLO4 Deliver a quality presentation using appropriate media or technology			10%		10%
Total	**10%**	**70%**	**10%**	**10%**	**100%**

(2) Grading system

Research proposal, presentation, quiz, assignment and class participaton are evaluated based on rubrics as shown in the appendix.

After completion of the evaluation process, each student is assigned a criterion-referenced grade exhibited in the table below. Evaluation and achievement will be justified according to Faculty and University Code, conducted by grading system of A, B+, B, C+, C, D+, D and F. This course is compulsory. Students are requiared to get at least B in order to fulfill the requirement of the program.

Assessment Standard	Grading Criteria	Performance
Excellent	A	Students show excellent ability to analyze and critically synthesize all aspects of the course as outlined in course objectives. They have extensive knowledge to fulfill the course objectives and develop their own solutions based on skills acquired from the course.
Good	B+ B	Students show evidence of knowing how to apply appropriate concepts and theories to handle related case examples.
Marginal	C+ C	Students know how to apply concepts and theories to address related issues as outlined in course objectives, but are marginally familiar with how to integrate skills and knowledge to handle complex cases or problems.
Does Not Meet Expectation	D+ D F	Students show lack of understanding in concepts and theories as outlined in course objectives, and are able to handle only simple problems, still with errors.

(3) Re-examination (if any) None

(4) Appeal of students

Students can appeal according to grading result. They must submit a written and signed appeal form personally to the academic affair unit. It is not allowed to assign another person to appeal on one's behalf. The written appeal form is then sent to the Head of Department. The final decision is transferred for approval by the faculty committee. The student will be then informed about the result of appeal.

10. Required Text

Thai

ธนัญญา วสุศรี "เอกสารประกอบการสอน รายวิชา วศอก ๕๐๗ การสัมมนาและระเบียบวิธีวิจัย", ๒๕๖๔.

English

Kothari C.R. Research methodology methods and techniques. New Delhi : New Age International (P) LtD , 2004.

Jonker J., Pennink B.W. The essence of research methodology: a concise guide for Master and PhD students in management science. Germany : Springer, 2010.

Yin R. Applications of case study research. United States of America : SAGE Publications , 2012.

Taylor S.J., Bogdan R., DeVault M. Introduction to Qualitative Research Methods : A Guidebook and Resource. Canada : John Wiley & Sons.Inc , 2015.

11. Suggested Materials

สุธีระ ประเสริฐสรรพ์. สนุกกับงานวิจัย. กรุงเทพฯ : สำนักงานกองทุนสนับสนุนการวิจัย ; 2556.

Eisenhardt K.M. Building theories from case study research. Academy of management review 1989 ; 14, 4 : 532-50.

Flynn et al. Empirical research methods in operations management, Journal of operations management 1990.

12. Other materials

-

Evaluation and Improvement of Course Management

1. Strategies for effective course evaluation by students

Evaluation of instrutor and course through Mahidol University E-Evaluaton System at least one week prior to class end. The evaluation topics should be accounted for the relevant program learning outcomes.

2. Evaluation strategies in teaching methods

Evaluated both by direct and indirect instrument for student performance and student participation and evaluation (Section 5).

3. Improvement of teaching methods

The program committee and instructors revise and improve teaching and learning by reviewing the student evaluation. The student learning outcomes' problems will also be discussed and solved in the Department of Industrial Engineering's meeting.

4. Evaluation of students' learning outcomes

The program committee will verify students' learning outcomes based on students scores from class participation, project, assignment, presentation, and written examination.

5. Review and improvement plan for course effectiveness

The program committee review course effectiveness in achieving learning outcomes using student evaluation outputs to determine further development plan.

Rubrics for EGIE 507 Seminar and Research Methodology

Rubrics	Level 3 Excellent	Level 2 Good	Level 1 Marginal	Level 0 Does not meet expectation
1. Introduction (20%)				
Criterion 1.1 Introduction	Define a comprehensive overview of the context, background, and the significance of the study.	Define an overview of the context, background and the important of the study.	Define an overview of the context, background and the important of the study, but lack of some information.	Unable to meet level 1
	Demonstrate a clear, concise and of the research problem/topic. The research problem is clearly connected with the research question/objective.	Demonstrate a clear, concise and of the research problem/topic. The research problem is connected with the research question/objective.	Demonstrate a little vague research problem/topic. The research question/objective is defined.	
2. Literature review (20%)				
Literature review	Demonstrate a clear analysis and criticize of each topic area relevant to research questions.	Demonstrate a clear analysis of each topic area relevant to research questions.	Demonstrate a basic overview of each topic area relevant to research questions.	Unable to meet level 1
3. Research Methodology (20%)				
Criterion 3.1 Research methodology	Demonstrate an effective understanding and knowledge in the application of relevant research methodology, techniques and analysis.	Demonstrate Satisfactory knowledge and understanding in the application of relevant research methodology, techniques and analysis.	Demonstrate basic knowledge and understanding in the application of relevant research methodology, techniques and analysis.	Unable to meet level 1
Criterion 3.2 Response to question capability	Demonstrate thorough well understanding of the question. Answers given based on theory, facts and	Demonstrate adequate understanding of the question. Answers given based on theory and facts.	Demonstrate understanding of the question. Answers given based on facts. Not all parts of the question are	

Rubrics	Level 3 Excellent	Level 2 Good	Level 1 Marginal	Level 0 Does not meet expectation
	reasonable argument. All parts of the question are effectively answered.	All parts of the question are answered.	answered.	
4. Student participation and responsibility (10%)				
Demonstrate participation and responsibility				
Criterion 4.1 Participation and responsibility	Student initiates contributions more than once in each recitation. Comments always insightful & constructive; uses appropriate terminology. Student is always on time to attend the class and submit assignments or reports	Student initiates contribution once in each recitation. Comments usually insightful & constructive; mostly uses appropriate terminology. Student is about 90% on time to attend the class and submit assignments or reports. If there is something that can cause a delay, the instructor will be informed.	Student initiates contribution at least in half of the recitations Comments are sometimes constructive, with occasional signs of insight. Student does not use appropriate terminology; comments not always relevant to the discussion. Students is about 80% on time to attend the class and submit assignments or reports. If there is something that can cause a delay, the instructor will be informed.	Unable to meet level 1
5. Ethical practices (10%)				
Demonstrate and comply with ethical practices				
Criterion 1.1 Comply with university ethics, rules and discipline Comply with university ethics, rules and discipline	Fully comply with university ethics, rules and discipline; can be a role model in these manners.	Comply with university ethics, rules and discipline.	Basically comply with university ethics, rules and discipline.	Unable to meet level 1
Criterion 1.2 Ethics in workplace and social	Demonstrate an indepth awareness of social and ethical responsibilities and	Demonstrate most of awareness of social and ethical responsibilities and	Demonstrate basically awareness of social and ethical responsibilities and	Unable to meet level 1

Rubrics	Level 3 Excellent	Level 2 Good	Level 1 Marginal	Level 0 Does not meet expectation
Identify the potential outcomes of ethical practices in workplace and social	their important to various stakeholders; Identify the potential outcomes of ethical practices.	their important to various stakeholders; Identify the potential outcomes of ethical practices.	their import to various stakeholders; Identify some of the potential outcomes of ethical practices.	
6. Oral Communication (20%)				
Deliver a quality presentation using appropriate media or technology				
Criterion 6.1 Content and Organization Use relevant contents to convey understanding to audiences	Demonstrate thoroughly comprehensive understanding of the presented contents and arguments relevant to the topic presented. Present information in logical and interesting sequence which audience can follow. Answer all questions clearly and logically.	Demonstrate good understanding of the presented contents and some arguments relevant to the topic presented. Present information in logical and interesting sequence which audience can follow. Answer most of questions clearly and logically.	Demonstrate some understanding of the topic presented. Present information in logical sequence which audience can follow. Answer basic questions clearly.	Unable to meet level 1
Criterion 6.2 Voice and manner Proper use of voice and manner to engage audiences	Demonstrate an excellence in presentation with engaging audiences and making them inspired. Use appropriate body language and clear voice. Perform as a spokeperson.	Demonstrate a good presentation with engaging audiences, use proper words , body language and clear voice for the presentation.	Demonstrate some ability in presentation with engaging audiences, use proper words and clear voice for the presentation.	Unable to meet level 1

Rubrics	Level 3 Excellent	Level 2 Good	Level 1 Marginal	Level 0 Does not meet expectation
Criterion 6.3 Use of media Use proper tools and techniques for presentation	Demonstrate excellence in using media or tools for presentation that are appropriate with audiences and the presented contents. Show excellence in using graphics or infographics that explain and reinforce key contexts.	Demonstrate an ability in using media or tools for presentation that are appropriate with audiences and the presented contents. Show an ability in using graphics or infographics that explain and reinforce key contexts.	Demonstrate some ability in using media or tools for presentation that are appropriate with audiences and the presented contents. Show some ability in using graphics or infographics that explain and reinforce key contexts.	Unable to meet level 1

Course Syllabus
EGIE 513 Logistics and Supply Chain Performance Measurement
Seminar I Academic Year 2018

Course ID and name: EGIE 513 Logistics and Supply Chain Performance Measurement
Course coordinator: Lect.Dr.Jirapan Liangrokapart
Instructors: Lect.Dr.Jirapan Liangrokapart
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Importance of logistics and supply chain performance measurement, steps for measuring performance, type of performance indicators, family of measures, unit of measurement, applications in performance measurement, data collection and distribution, performance display, strategic planning, balanced scorecard, presentation, interpretation and implementation, SCOR model, performance measurement in industries

Course Learning Outcomes (CLOs)

1. Understand the importance of Logistics and Supply Chain Performance Measurement
2. Know the relationship between business process and performance measurement
3. Understand how to select measures, measurement techniques, and methods.
4. Know process to measure Logistics and Supply Chain Performance and analyze the performance efficiently.
5. Compare performance of different units or companies and make suggestions to improve the performance

Constructive Alignment of CLO's and Program's ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1		I				
2		I				
3	I		P			
4			P	P		
5					R	R

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction Performance Measurement Key concepts and Definitions	Lecture/Seminar	Examination, Class participation & feedback	Lect.Dr.Jirapan Liangrokapart
2	Types of Performance measures Example of Performance	Lecture/Seminar/ case studies	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
3	Performance Measurement and a Family of Measures	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
4	Performance Measurement Hierarchies and Units of Measurement	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
5	Performance Measurement	Lecture/Seminar/ Company visit	Examination, feedback	Lect.Dr.Jirapan Liangrokapart

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
6	Performance Measurement tools and Implementation	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
7	Performance Measurement Collection and Distribution	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
8	Logistics KPIs in the industries	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
9	Strategy maps and the Balanced scorecard Case studies	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
10	Midterm exam		Examination	Lect.Dr.Jirapan Liangrokapart
11	Performance Measurement in the industry	Lecture/Seminar/ company visit	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
12	Business Process and Performance Interpretation and Action	Lecture/Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
13	Efficiency Measurement: Putting it all together Examples of research papers	Lecture/Seminar/ case studies	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
14	SCOR Model and supply chain	Lecture/Seminar/ case studies	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
15	Performance benchmarking Case studies	Lecture/Seminar/ case studies	Examination, feedback	Lect.Dr.Jirapan Liangrokapart
16	Final Project Presentation: Performance Measurement in different industries	Seminar	Examination, feedback	Lect.Dr.Jirapan Liangrokapart

Assessment Criteria

Grading Criteria for EGIE 513

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Class participation and paper assignments:	30%
Mid-term Examination:	30%
Final Project:	40%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 521 Project Management for Engineers
Seminar II Academic Year 2018

Course ID and name: EGIE 521 Project Management for Engineers
Course coordinator: Asst.Prof. Dr.Tuangyot Supeekit
Instructors: Asst.Prof. Dr.Tuangyot Supeekit
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Project evaluation and selection, project life cycle and development, project definition, organization for project management, estimating project time and costs, developing project time plan, project cost and quality planning, project risk management, measuring and controlling of a project, supply chain issues in project management, project audit and project closure

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:
1. Differentiate projects from other operations.
2. Plan and manage projects in terms of cost, time, scope, and risk.
3. Apply project management tools and techniques to plan and manage a project or to handle a situation.
4. Apply all tools and techniques to a real project

Constructive Alignment of CLO s and Program's ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				
2		R	R		M	
3			R	R	M	R
4	I		R	R		R

Course Schedule:

Week	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Introduction to project management and selection of a project	Lecture, class discussion	Q&A	Tuangyot
2	Alignment of projects with organization strategy	Case led discussion	Q&A, Group assignment	Tuangyot
3	Project definition and initial planning	Lecture, class discussion	Q&A, Group assignment	Tuangyot
4	Project organization and cost estimation	Class discussion	Q&A, Group assignment	Tuangyot
5	Developing a project time plan	Lecture, practice	Exam	Tuangyot
6	Developing a project time plan under uncertainty	Lecture, practice	Assignment	Tuangyot
7	Resource scheduling	Lecture, practice	Assignment and Exam	Tuangyot
8	Reducing project time and cost	Lecture, practice	Exam	Tuangyot
9	Project monitoring and control	Lecture, class discussion	Exam	Tuangyot
10	Project risk management	Student research, self-study	Students' presentation	Tuangyot
11	Supply chain issues in project management	Student research, self-study	Students' presentation	Tuangyot

Week	Topic	Teaching & Learning Strategy	Assessment	Instructor
12	Project evaluation and closing	Student research, self-study	Students' presentation	Tuangyot
13	MS Project Practice	Case, Practice MS Project	MS Project Assignment	Tuangyot
14	MS Project Practice	Case, Practice MS Project	MS Project Assignment	Tuangyot
15	Student's project presentation	Student research and presentation	Students' presentation	Tuangyot

Assessment Criteria

- Discussion participation 15%
- Assignments 25%
- Student presentation 20%
- Final Examinations 30%
- MS Project Assignment 10%

Students must receive a score of 60% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the distribution of students' scores from the whole course.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 541 Industrial Metallurgy and Advanced Materials Science
Seminar I Academic Year 2018

Course ID and name: EGIE 541 Industrial Metallurgy and Advanced Materials Science
Course coordinator: Lect.Dr.Eakkachai Warinsiriruk
Instructors: Lect.Dr.Eakkachai Warinsiriruk
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Basic of metals manufacturing, steel classifications, alloying elements effect, advanced high strength steel, steel for modern construction, TMCP steels, materials for cryogenic tanks, stainless steel, nickel and nickel alloy, titanium alloy, light alloy (aluminum and magnesium alloy), common nonferrous, polymer science, magnetic materials, Material selection

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Describe the basic of metal manufacturing, phenomena of material processing, phase diagram and phase transformation.
2. State the mechanism of metal strengthening, alloying elements effect and material degradation.
3. Describe properties of common steel and advanced steel, TMCP steel, materials for cryogenic tanks and stainless steel.
4. Describe the properties of nonferrous and state a suitable application for each metal.
5. Describe the properties of polymer and state the application for 6 common polymers.
6. Describe phenomena of magnetic and classify the magnetic material.
7. State the common procedure for material selection for industrial' manufacturing and R&D. Also state the quality control of incoming material to ensure the customer requirements.

Constructive Alignment of CLO s and Program' s ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				P
2			R			P
3				R		P
4						P
5						P
6				R		P
7	I				M	P

Course Schedule:

Week #	Topic	Teaching & Learning	Assessment	Instructor
1	Introduction	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
2	Solidification and Crystal Structure	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
3	Strengthening Mechanism	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
4	Mechanical Properties	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
5	Phase Diagram	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk

Week #	Topic	Teaching & Learning	Assessment	Instructor
6	Phase Transformation	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
7	Steel Manufacturing and Common Steel	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
8	TMCP Steel and modern steel	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
9	Stainless steel	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
10	Nonferrous materials I	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
11	Nonferrous Materials II	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
12	Corrosion	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
13	Polymer and Its application	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
14	Magnetic Material	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
15	Final Exam & Presentation	-	Exam	Lect.Dr.Eakkachai Warinsiriruk

Assessment Criteria

Grading Criteria

A	100% - 90%
B+	89% - 75%
B	74% - 50%
C+	49% - 35%
C	34% - 15%

Midterm Examination	40%
Final Examination	40%
Report	20%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 542 Introduction to the Internet of Things and Embedded Systems
Seminar II Academic Year 2018

Course ID and name: EGIE 542 Introduction to the Internet of Things and Embedded Systems
Course coordinator: Lect.Dr.Kiattisak Sritrakulchai
Instructors: Lect.Dr.Kiattisak Sritrakulchai
Credits: 3 (2-3-5)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

The basic of internet of things (IoT) connecting any equipment of household appliances or tools and any machine in industrial, communicating oninternet system, the principle and method of using sensors mounted on the equipmentfor reading measured data from ambient conditions and interfacing with microcontroller for controlling and transferring data over internet network wireless network system, the principle and components for embedded systems and peripheral devices, the communication of machine to machine, the programming for data management and processing

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Explain the development process of IoT(Internet of Things) system for devices or machines.
2. Explain the principles and patterns of IoT system.
3. Develop IoT system for devices or machines to be able to communicate each other over the internet.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				
2		R				
3	I		R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Basic devices and tools for IoT technology	Lecture and Laboratory for introduction to hardware and software basic tools	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
2	Internet Connectivity(Ethernet and WiFi)	Lecture and Laboratory for interfacing practice(Ethernet and WiFi) with Controller	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
3	Communication Protocols(HTTP)	Lecture and Laboratory for using HTTP protocols for communication over the internet	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
4	Communication Protocols(MQTT)	Lecture and Laboratory for using MQTT protocols for communication over the internet	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
5	Prototypes(Complex Flow:Node-RED)	Lecture and Laboratory for applying the fundamental tools and HTTP protocol communication to IoT	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
6	IoT Patterns(Realtime Clients)	Lecture and Laboratory for applying the MQTT protocol communication to motion detective sensor for IoT.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
7	IoT Patterns(Remote Control)	Lecture and Laboratory for controlling devices with android smart phone over MQTT Protocol.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
8	IoT Patterns(On-Demand Clients)	Lecture and Laboratory for receiving data from sensor devices and transferring to HTTP server.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
9	IoT Patterns(Web Apps)	Lecture and Laboratory for getting data on HTTP server for display on Web Apps.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
10	IoT Patterns(Location Aware)(1)	Lecture and Laboratory for using GPS Location detection sensor.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
11	IoT Patterns(Location Aware)(2)	Lecture and Laboratory for display GPS location data on Map server.	Examination, feedback	Lect.Dr.Kiattisak Sritrakulchai
12	IoT Patterns(Machine to Human)(1)	Lecture and Laboratory for reading data from proximity sensor and sending to MQTT broker.	Examination, project	Lect.Dr.Kiattisak Sritrakulchai
13	IoT Patterns(Machine to Human)(2)	Lecture and Laboratory for managing IoT data related to humans	Examination, project	Lect.Dr.Kiattisak Sritrakulchai
14	IoT Patterns(Machine to Machine)	Lecture and Laboratory for developing conservative energy system using Machine to Machine	Examination, project	Lect.Dr.Kiattisak Sritrakulchai
15	Iot Platform	Lecture and Laboratory for developing soil humidity control system using IoT platform Xively	Examination, project	Lect.Dr.Kiattisak Sritrakulchai

Assessment Criteria

Grading Criteria for EGIE 542

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Attendance/participation	5%
Written Exam	30%
Practical Exam	15%
Final Project	50%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 543 Total Welding Management
Seminar II Academic Year 2018

Course ID and name: EGIE 543 Total Welding Management
Course coordinator: Lect.Dr.Eakkachai Warinsiriruk
Instructors: Lect.Dr.Eakkachai Warinsiriruk
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

The management traditional view of welding, principle of the total welding management system, the welder support system, the four critical functions and their key results areas, the managerial steps, implement and sustain

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. State the tools for the welding management and implement the welder support system.
2. Discuss how to use the concept of the total welding management in the actual situation.

Const ruct ive Ali gnm ent of CLO s and P rogram' s ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				P
2			R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	General Perspectives for Welding Work	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
2	Management Requirement	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
3	Profit Approaching for Welding Improvement	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
4	5 Activities Principle	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
5	Case Study Submit	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
6	Case Study: Sturcture Project 1	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
7	Case Study: Sturcture Project 2	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
8	Phase 1: Survey and Evaluate the Process Process	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
9	6 Steps for Welding Management	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
10	Phase 2: Planing and Set a Goal	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
11	Phase 3: Implementation and Mantain	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
12	Case: Study: Boiler and Pressure Vessel	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
13	Case Study: Automotive Industry	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
14	Presentration	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
15	Presentration	-	Exam	Lect.Dr.Eakkachai Warinsiriruk

Assessment Criteria

Grading Criteria

A	100% - 90%
B+	89% - 75%
B	74% - 50%
C+	49% - 35%
C	34% - 15%

Midterm Examination	40%
Final Examination	40%
Report	20%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 544 Manufacturing of Boiler and Pressure Vessel
Seminar I Academic Year 2018

Course ID and name: EGIE 544 Manufacturing of Boiler and Pressure Vessel
Course coordinator: Lect.Dr. Eakkachai Warinsiriruk
Instructors: Lect.Dr. Eakkachai Warinsiriruk
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

The recognition of insurance system, BPV code and standards, introduction to pressure vessel design, fabrication, procedure, Quality Assurance (QA) of manufacture

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Describe the organization of insurance system for boiler and pressure vessel design and manufacturing.
2. State the activity of qualification for welding procedure and performance and specify the essential variables for each part.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R	R			
2			R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Couse Introduction and BPV code and standards	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
2	Code Standard and Specification	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
3	ASME organization	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
4	Introduction Pressure Vessel Design	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
5	ASME Sec VIII Division 1 (I)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
6	ASME Sec VIII Division 1 (II)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
7	ASME Sec VII Part A	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
8	ASME Sec V	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
9	Fabrication Procedure I (Material Receiving)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
10	Fabrication Procedure II (Cutting and Storage)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
11	Welding Processes and Welding Variables	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
12	ASEM Sec IX: Procedure Qualification	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
13	ASME Sec IX: Performance Qualification	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
14	Inspection and Test Plan (ITP)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
15	Final Exam	-	Exam	Lect.Dr.Eakkachai Warinsiriruk

Assessment Criteria

Grading Criteria

A	100% - 90%
B+	89% - 75%
B	74% - 50%
C+	49% - 35%
C	34% - 15%

Midterm Examination	40%
Final Examination	40%
Report	20%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 546 Advanced Welding Processes and Control of Welded Properties
Seminar I Academic Year 2018

Course ID and name: EGIE 546 Advanced Welding Processes and Control of Welded Properties
Course coordinator: Lect.Dr. Eakkachai Warinsiriruk
Instructors: Lect.Dr. Eakkachai Warinsiriruk
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Welding processes and aligned processes, welding materials and metallurgical aspects, strength and toughness of welded joints, residual stress and distortion, fatigue of welded joints, high temperatures and creep of welded joints, design of tubular joints, pipes and pressure vessels, weld defects, failure and welding codes, weld testing and qualification, analysis and design of welded joint

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Describe the aligned processes of welding and cutting. Also state the advantages for 5 common processes in the real applications.
2. Describe the metallurgical properties and distortion under effect of welding processes.
3. Calculate the simple design of welded joints.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R	R			
2		R	R	R	M	P
3		R	R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Course Introduction	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
2	Aligned Processes of Welding and Cutting	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
3	5 Commons Welding Processes (I)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
4	5 Commons Welding Processes (II) and Welding Automation	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
5	Welding Metallurgy (I)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
6	Welding Metallurgy (II)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
7	Introduction of NDE	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
8	Introduction of Fitness for Service	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
9	Structural Steel Fabrication	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
10	BPV Fabrication	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
11	Distortion and Residual Stress (I)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
12	Distortion and Residual Stress (II)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
13	Weld Design (I)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
14	Weld Design (II)	Power Point, Q&A, Discussion	Q&A, Homework	Lect.Dr.Eakkachai Warinsiriruk
15	Final Exam	-	Exam	Lect.Dr.Eakkachai Warinsiriruk

Assessment Criteria

Grading Criteria

A	100% - 90%
B+	89% - 75%
B	74% - 50%
C+	49% - 35%
C	34% - 15%

Midterm Examination	40%
Final Examination	40%
Report	20%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 550 Digital Manufacturing
Seminar I Academic Year 2018

Course ID and name: EGIE 550 Digital Manufacturing
Course coordinator: Lect.Dr.Kiattisak Sritrakulchai
Instructors: Lect.Dr.Kiattisak Sritrakulchai
Credits: 3 (2-3-5)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: First semester
Prerequisite: None

Course Description:

Principle of digital manufacturing for modern industries with using Computer Aided Design Manufacturing and Engineering (CAD/CAM/CAE) technology, 3D solid and surface modeling design, assembly design, drafting generation for standard views including explode view for assembly model, strength and failure analysis of products with simulating workload similar to actual environment, effects of factors and variables for machining parts and generating NC code with CNC machine, principle of rapid prototype and rapid tooling, computer aid process planning

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Explain the principal of Digital Manufacturing using CAD/CAM/CAE technology for developing products into the industry.
2. Create three dimension model of products using Solid modelling and Surface modelling(CAD) , Manufacturing process of products and Analysis engineering.
3. Develop and design products with Digital Manufacturing using CAD/CAM/CAE technology.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				
2		R	R			P
3			R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	The principal of digital manufacturing using CAD/CAM/CAE technology.	Lecture and Laboratory for introduction to CAD program and basic tools	Feedback, Examination	Lect.Dr.Kiattisak Sritrakulchai
2	Create 3D modeling for parts of a product using solid modelling	Lecture and Laboratory for practice creating 3D part modeling from dimension part	Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
3	Apply 3D solid modeling and advanced technique for creating 3D part modeling from the real part shape(1).	Lecture and Laboratory for creating 3D part modeling from the real part shape(1).	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
4	Apply 3D solid modeling and advanced technique for creating 3D part modeling from the real part shape(2).	Lecture and Laboratory for creating 3D part modeling from the real part shape(2).	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
5	Create product assembly, composition techniques and assembly analysis.	Lecture and Laboratory for practice creating product assembly by composition techniques(constraint, crash	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
6	Assembly analysis and Kinematics analysis of the product	Lecture and Laboratory for assembly analysis and analyzing kinematics on the	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
7	Create detail drawing, explode assembly drawing and Bill of Materials.	Lecture and Laboratory for practice creating detail drawing and explode assembly and Bill	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
8	Create 3D modeling for parts of a product using surface modelling	Lecture and Laboratory for practice creating 3D part modeling using surface modeling from dimension	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
9	Apply 3D surface modeling and advanced technique for creating 3D part modeling from the real part shape(1).	Lecture and Laboratory for practice creating 3D part modeling using surface modeling from the real part	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
10	Apply 3D surface modeling and advanced technique for creating 3D part modeling from the real part shape(2).	Lecture and Laboratory for practice creating 3D part modeling using surface modeling from the real part	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
11	Structure Analysis and Failure Critical point.	Lecture and Laboratory for practice analyzing structure and finding failure critical point.	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
12	Create machining operation process for 3 Axis CNC milling.	Lecture and Laboratory for practice creating machining operation process and defining basic parameter.	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
13	Effective factors for machining operation for CNC milling and NC-Code Generation.	Lecture and Laboratory for practice setting effective factors based on the surface part quality and NC-Code	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai
14	The elementary of Prototype Fabrication using Rapid Prototype technology.	Lecture and Laboratory for introduction of hardware and software tools and prototype fabrication process.	Examination	Lect.Dr.Kiattisak Sritrakulchai
15	Apply CAD technology to STL model creation for prototype Fabrication using 3D printing.	Lecture and Laboratory for practice creating and preparing STL model process for	Practice results, Project, Examination	Lect.Dr.Kiattisak Sritrakulchai

Assessment Criteria

Grading Criteria for EGIE 550

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Attendance/participation	5%
Written Exam	30%
Practical Results	15%
Final Project	50%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 590 Materials for Product and Manufacturing
Semester II Academic Year 2018

Course ID and name: EGIE 590 Materials for Product and Manufacturing
Course coordinator: Asst.Prof. Dr.Soranat Raibhu
Instructors: Asst.Prof. Dr.Soranat Raibhu
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Role of materials in product development, materials in modern society, value addition and cost reduction by material selection, relation between materials, manufacturing, product design, and product application, concept of material selection, material database and knowledgebase

Course Learning Outcomes (CLOs)

1. Understand and discussing the roles of materials in product and manufacturing
2. Understand and discussing the impacts of materials in society
3. Understand and discussing the importance of applicability, value and cost in material selection
4. Apply knowledge in material selection and solving material problem

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1		R			M	
2	I	R				
3		R	R		M	
4			R	R		P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Syllabus Introduction to the course	Lecture, discussion, case study, formative assessment	Written Exam	Asst.Prof.Soranat Raibhu
2	Role of material in product development Project topic selection	Lecture, discussion, case study, formative assessment	Written Exam	Asst.Prof.Soranat Raibhu
3-4	Social impact of materials & case study 1st project discussion	Lecture, discussion, case study, formative assessment	Written Exam Project	Asst.Prof.Soranat Raibhu
5-6	Material and manufacturing process 2nd project discussion	Lecture, discussion, case study, formative assessment	Written Exam Project	Asst.Prof.Soranat Raibhu
7	Material utilizations and applications	Lecture, discussion, case study, formative assessment	Written Exam Project	Asst.Prof.Soranat Raibhu
8	Material characteristics and properties	Lecture, discussion, case study, formative assessment	Written Exam Assignment	Asst.Prof.Soranat Raibhu
9	Midterm examination week			Asst.Prof.Soranat Raibhu

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
10-11	Production definition in relation to material characteristics and properties 3rd project discussion	Lecture, discussion, case study, formative assessment	Written Exam Assignment Project	Asst.Prof.Soranat Raibhu
12	Material selection & case study	Lecture, discussion, case study, formative assessment	Written Exam Project	Asst.Prof.Soranat Raibhu
13	Material testing and evaluation	Lecture, discussion, case study, formative assessment	Written Exam	Asst.Prof.Soranat Raibhu
14	Material selection tools	Lecture, discussion, case study, formative assessment	Written Exam	Asst.Prof.Soranat Raibhu
15	Special topic in materials	Lecture, discussion, case study, formative assessment	Assignment Project	Asst.Prof.Soranat Raibhu
16	Final project discussion	Discussion	Project	Asst.Prof.Soranat Raibhu
17	Final examination			Asst.Prof.Soranat Raibhu

Assessment Criteria

Grading Criteria for EGIE 590

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 0%

Assignment	10%
Project	45%
Written examination	45%

After completion of the evaluation process, each student is assigned a criterion-referenced grade (as shown in the table below).Evaluation and achievement will be justified according to Faculty and University code, conducted by grading system of A, B+, B, C+, C, D+, D and F.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 598 Hospital Logistics and Supply Chain Management
Seminar II Academic Year 2018

Course ID and name: **EGIE 598 Hospital Logistics and Supply Chain Management**
Course coordinator: Lect.Dr.Jirapan Liangrokapart
Instructors: Lect.Dr.Jirapan Liangrokapart
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Logistics and supply chain management in hospital, research topics in healthcare supply chain, risk management and cost reduction, inventory management and distribution system, customer relationship management and performance measurement, internal and external supply chains, group purchasing organization, international standard and lean, distributors, information technology and decision support system, organizational design in healthcare supply chain

Course Learning Outcomes (CLOs)

1. Understand the Hospital Logistics and Supply Chain Management
2. Suggest guideline for supply chain improvement to enhance service quality and reduce total costs

Constructive Alignment of CLO's and Program's ELO s

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	I				
2			R	P	R	R

Course Schedule:

Week #	Topic	Teaching & Learning	Assessment	Instructor
1	Introduction on Logistics and Supply Chain Management and Changes in the Healthcare Industry	Lecture/Seminar	Examination, Class participation &feedback	Dr. Jirapan Liangrokapart
2	Interesting topics on Healthcare Supply Chain	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
3	Inventory Management and Distribution Management in Hospitals	Lecture/Seminar	Examination, feedback	Dr. Jirapan Liangrokapart
4	Business Process Management and Lean Concept Application in Hospitals	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
5	Pharmaceutical Supply Chain and Risk Management	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
6	Internal and External Hospital Supply Chain Management	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
7	Distribution Center	Lecture/Seminar/ Company visit	Examination, feedback	Dr. Jirapan Liangrokapart
8	Business Intelligence for decisions	Lecture/Seminar	Examination, feedback	Dr. Jirapan Liangrokapart
9	Medical Informatics and its role in Hospital Supply Chain	Lecture/Seminar	Examination, feedback	Dr. Jirapan Liangrokapart

Week #	Topic	Teaching & Learning	Assessment	Instructor
10	Information Technology and Decision Support System in Hospital Supply Chain	Lecture/Seminar	Examination, feedback	Dr. Jirapan Liangrokapart
11	Group Purchasing Organization	Lecture/Seminar	Examination, feedback	Dr. Jirapan Liangrokapart
12	Role of Distribution Center	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
13	Customer Relationship Management in hospital and How to measure the performance	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
14	International Standard and examples of research in Healthcare Logistics and Supply	Lecture/Seminar/ case studies	Examination, feedback	Dr. Jirapan Liangrokapart
15	Final Project presentation	Seminar	Examination, feedback	Dr. Jirapan Liangrokapart
16	Final Examination		Examination	Dr. Jirapan Liangrokapart

Assessment Criteria

Grading Criteria for EGIE 513

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Class participation:	20%
Student case project:	40%
Final Examination:	40%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Course Syllabus
EGIE 601 Railway Operations and Signaling
Seminar II Academic Year 2018

Course ID and name: EGIE 601 Railway Operations and Signaling
Course coordinator: Asst.Prof. Dr.Waressara Weerawat
Instructors: Asst.Prof. Dr.Waressara Weerawat
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Basic terms and definitions, safe train separation, fixed block system, lineside signals, manual block systems, automatic block systems, interlocking routes, point locking, flank protection, overlaps, interlocking systems, control tables, Automatic Train Protection (ATP) systems, ETCS levels

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:
1. Understand the fundamental elements and principles of signalling systems
2. Join signal planning teams under guidance of experienced signal engineers
3. Establish interlocking control tables for simple examples of low complexity

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R				
2		R	R			
3				R	M	P

Course Schedule:

Lesson #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Characteristics of railway systems, elements of railway infrastructure	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
2	Basic operating terms	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
3	Principles of train separation, fixed block operation	Slide Presentation/ Group Discussion	Class Participation/ Quiz	Dr.Waressara Weerawat, Dr.Joern Pachl
4	Introduction to Traffic control	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
5	Traffic control experience	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
6	Manual and automatic block systems	Slide Presentation/ Group Discussion	Class Participation/ Quiz	Dr.Waressara Weerawat, Dr.Joern Pachl
7	Safety criteria for interlocking routes	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
8	Flank protection and overlaps	Slide Presentation/ Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl

Lesson #	Topic	Teaching & Learning Strategy	Assessment	Instructor
9	Introduction to interlocking control	Slide Presentation/ Group Discussion	Class Participation/ Quiz	Dr.Waressara Weerawat, Dr.Joern Pachl
10	Interlocking control experience	Laboratory session	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
11	Interlocking systems, control tables	Slide Presentation / Group discussion	Daily Quiz, Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
12	Representing interlocking criteria in control tables	Laboratory session / Group Discussion	Class Participation, laboratory task sheet/ Quiz	Dr.Waressara Weerawat, Dr.Joern Pachl
13	Introduction to Automatic Train Protection	Slide Presentation / Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
14	ETCS levels and modes	Slide Presentation / Group Discussion	Class Participation	Dr.Waressara Weerawat, Dr.Joern Pachl
15	Final laboratory session	Laboratory session / Group Discussion	Class Participation/ Final written Exam	Dr.Waressara Weerawat, Dr.Joern Pachl

Assessment Criteria

Class participation/ in class exercises	30%
Quiz	40%
Final Project	30%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, and F based on the distribution of students' scores from the whole course with this following grading criteria.

A	86 - 100%
B+	81 - 85%
B	71 - 80%
C+	61 - 70%
C	51 - 60%
F	0 - 50%

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors immediately either by direct contact or email.

Course Syllabus
EGIE 624 Lean Production and Service Systems
Seminar II Academic Year 2018

Course ID and name: EGIE 624 Lean Production and Service Systems
Course coordinator: Lect. Gunn Kanatarntip
Instructors: Lect. Gunn Kanatarntip
Credits: 3 (3-0-6)
Curriculum: Master of Engineering Program in Industrial Engineering
Semester offering: Second semester
Prerequisite: None

Course Description:

Concept and philosophy of lean manufacturing, lean manufacturing versus traditional manufacturing, tools, techniques, and constraints, human resource, organization, and other infrastructures for the success of implementation and sustainability of lean manufacturing, lean manufacturing in relation to the whole stream of business activities, practical lean manufacturing system

Course Learning Outcomes (CLOs)

Upon completion of this course, students are able to:

1. Understand and explain the concept and philosophy of lean manufacturing versus traditional manufacturing.
2. Understand and explain the principle of lean tools to remove wastes.
3. Develop Lean Roadmap and implementation plan.

Constructive Alignment of CLOs and Program's ELOs

CLOs	ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6
1	I	R	R	R		
2		R	R			
3	I		R	R	M	P

Course Schedule:

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
1	Course Introduction	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
2	Concept and Philosophy of Lean Manufacturing	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
3	Lean Assessment and Lean Metrics	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
4	Lean Tools #1.1	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
5	Lean Tools #1.2	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
6	Lean Tools #2.1	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
7	Lean Tools #2.2	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
8	Lean office	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
9	Lean for service operation	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip

Week #	Topic	Teaching & Learning Strategy	Assessment	Instructor
10	Lean Transformation Framework	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
11	Lean Transformation Model and Road Map	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
12	Human Resourse issues for Lean Implementation	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
13	Change Management	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
14	Implementation and Sustainability of Lean Manufacturing	Lecture and Discussion with sharing experiences	Examination, Feedback	A.Gunn Kanatarntip
15	Assignment Presentation and Discussion	Discussion with Cases presented	Examination, Feedback	A.Gunn Kanatarntip

Assessment Criteria

Grading Criteria for EGIE 624

A	100% - 80%
B+	79% - 75%
B	74% - 70%
C+	69% - 65%
C	64% - 60%
D+	59% - 55%
D	54% - 50%
F	49% - 15%

Attendance/participation	10%
Written Exam	40%
Final Project	50%

Students must receive a score of 50% or more to pass the course. Student's achievement will be graded using symbols: A, B+, B, C+,C, D+, D and F based on the Grading Criteria.

Appeal Procedure

Should the students have any appeal regarding the assessments or grade, inquiry can be made to the instructors and/or the course coordinator immediately either by direct contact, telephone or email.

Appendix 6

FTEs Calculations

FTE of academic staff

FTE of our academic staff is calculated based on the assumption that the main job responsibility of the academic staff is teaching. For fulltime faculty members, the teaching workload of 1 FTE academic staff is equal to approximately 3 courses per semester. The teaching workload will be less if the academic staff do some other work including research/consulting projects/student supervision/community service/ and others in compensation. For the full-time faculty members, one faculty member is responsible for teaching/research supervision and other academic jobs with relevant to the program-in-charge. Therefore, 1 full-time faculty can be counted as 1 FTE faculty member.

For visiting/adjunct faculty members or guest lecturers who do not have a full-time assignment for the program, the FTE calculation is in a proportion of the 1 FTE. For example, for an adjunct faculty who teaches 1 course for the program, it is counted 0.33 FTE. For faculty teaches less than 1 course, it is counted in proportion of the 0.33 FTE. The number of FTE faculty members is shown in Table 1

Table 1 The number of FTE faculty members

Academic Year	Total FTEs of Academic Staffs
2014	14
2015	14
2016	14
2017	14
2018	14

FTE of Full-Time Students

FTE of full-time graduate students is calculated based on the fact that the program is a full-time program. No matter which semester they are in, all students are required to enroll full-time either coursework or thesis/dissertation. Hence, one full-time student enrolling for the program can be counted as 1 FTE. There is no part-time student in the program. The number of FTE students is shown in Table 2

Table 2 The number of FTE students

Academic Year	Students (M.Eng.)			
	1st Year	2nd Year	3rd Year onward	Total FTEs
2014	15	18	17	50
2015	17	10	28	55
2016	11	16	33	60
2017	15	11	34	60
2018	17	10	33	60

Appendix 7

Rubric Assessment Scheme for Student Interview

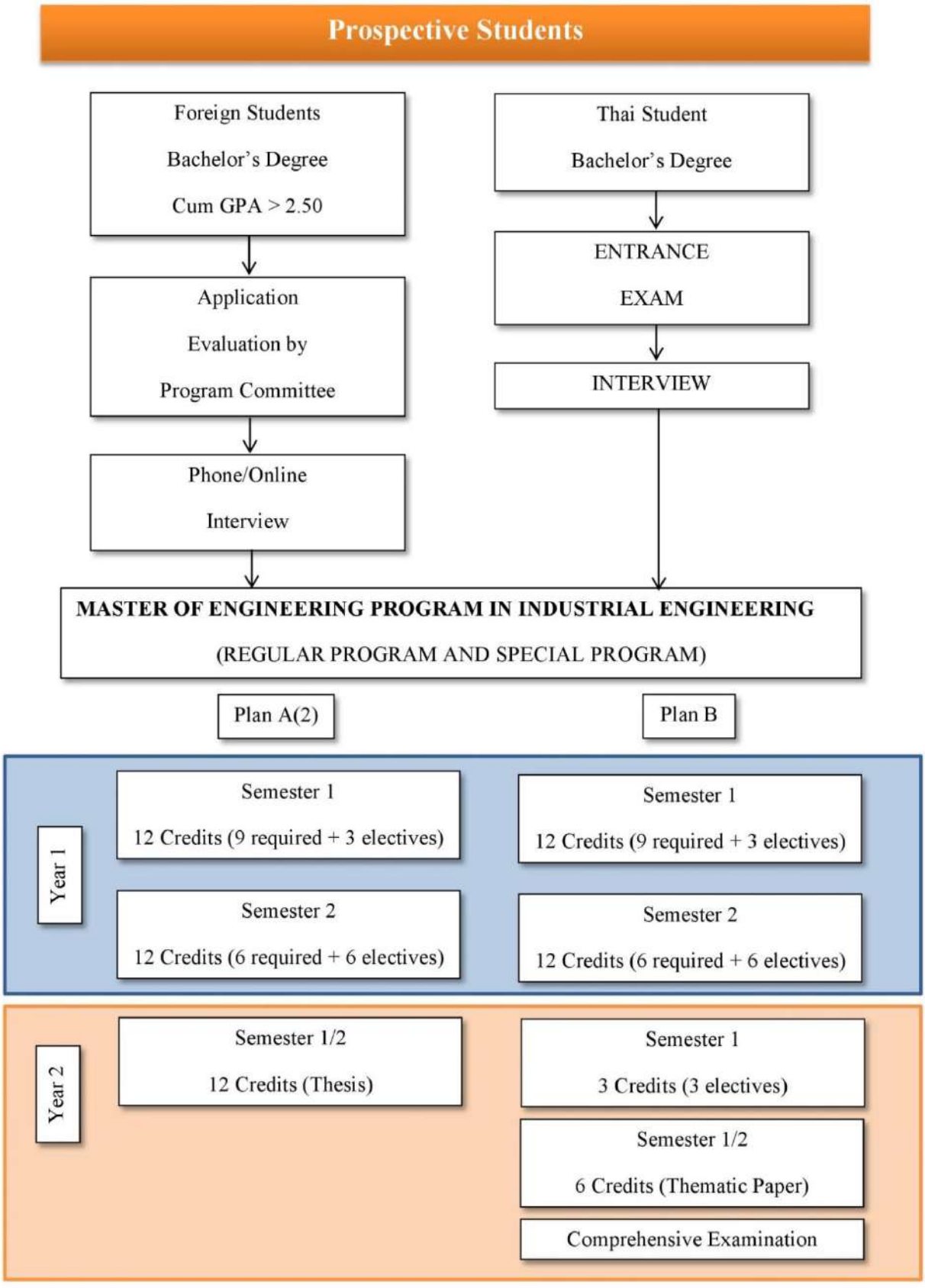
Example of rubric assessment of prospective students during an interview process. Academic staffs participating in the interviewing process provide individual evaluation. However, final rubric score must be consensus scoring after staff discussion.

The Standard Evaluation Method used for Interview of Industrial Engineering Graduate Students						
Selection criteria is divided into three categories (weight)						
1)	An average GPA, (CV)	10%				
2)	Written exam	50%	more than 25% is passed			
3)	Interview	40%	more than 25% is passed			
	Evaluation criteria for Interview that will be used by BC Staff (Rubric Scores)					
		5	4	3	2	1
1)	English Conversation	Excellent	Good	Fair	Low	can not communicate
2)	General Information (Resposibility)	(4) + Financial Management	Direct experience	some experience	never help family	no information
	Or Life Skill/Goal	to be researcher or lecturer	related to Science	no idea	never plan	never know
3)	Scholar	got scholarship	apply for Fac.SC	possible for any	never know	no chance
4)	General Knowledge (biochem)	Excellent	Good	Fair	incorrect	can not explain
5)	Senior Project in General	(4) + detail and draw conclusion	(3) + main concept	Know Topic + Advisor	Know Topic	no information
6)	Research Objective(s)	Clear/Accurate/Hypothesis	Clear and accurate	Clear objective(s)	Objective(s)	no information
7)	Explanation of specific method	Clear/Accurate/Precision	Clear and accurate	Clear explanation	General	can not explain
8)	Results	(4) + Evalution or Discussion	(3) + Analysis	Solve problem	not or Achieve	can not explain

Note: Candidate from B.Eng. and B.Sc. and Other Bachelor (Who has an experience in IE field more than 3 year) have to be

1. Average GPA more than 35%
2. Written exam more than 25% (score 55 of 110)
3. In case candidate has a written exam score lesser than 25% (<55 of 110). An Interview activity is dominated for priority to qualify an ability of candidate. Decision Result from Program, Committee is a final entry of student.
4. Interview more than 35% or all three parts are more than 50%

Appendix 8


Prospective Students
Foreign Students
Bachelor's Degree
Cum GPA > 2.50
Application
Evaluation by
Program Committee
Phone/Online
Interview
Thai Student
Bachelor's Degree
ENTRANCE
EXAM
INTERVIEW
MASTER OF ENGINEERING PROGRAM IN INDUSTRIAL ENGINEERING
(REGULAR PROGRAM AND SPECIAL PROGRAM)
Plan A(2)
Plan B
Year 1
Semester 1
12 Credits (9 required + 3 electives)
Semester 2
12 Credits (6 required + 6 electives)
Semester 1
12 Credits (9 required + 3 electives)
Semester 2
12 Credits (6 required + 6 electives)
Year 2
Semester 1/2
12 Credits (Thesis)
Semester 1
3 Credits (3 electives)
Semester 1/2
6 Credits (Thematic Paper)
Comprehensive Examination

Appendix 9

SURVEY ON STUDENT'S SATISFACTIONS TOWARD TEACHING AND LEARNING FACILITIES

Master of Engineering Program
Industrial Engineering (regular program and special program),
Department of Industrial Engineering Mahidol University

Please indicate your satisfactions in terms of quantity and quality of the following infrastructures and facilities within the Master of Engineering Program in Industrial Engineering (regular program and special program).

Facilities/Infrastructures	Satisfaction Levels			Comments/Things for Improvement
	Very satisfied (3)	Adequate (2)	Inadequate (1)	
1. Lecture rooms and facilities (i.e. projectors, screens, white/black board, air-conditioners, etc.)				
2. Lab, Equipment				
3. Library services (including online resources i.e. ejournal, databases, etc.)				
4. IT facilities (computer resources, LAN/wifi coverage etc.)				
5. Supporting staffs (in the department in terms of paperwork and official document processes, financial matter, advice, etc.)				

Survey Results:

Number of students participated = 14
1. Lecture rooms and facilities = 57.1% (very satisfied)
2. Lab, Equipment = 57.1% (very satisfied)
3. Library services = 57.1% (Adequate)
4. IT facilities = 64.3% (Adequate)
5. Supporting staffs = 64.3% (very satisfied)

Comments/Things for Improvement

- Please keep this good quality
- WIFI need to be improved
- You have done a great job.
- I suggest department to check wifi adapter in master room. It doesn't work well and it can't connect well for another student's computer. So I was very hard to do research in master room. Thank you.

Appendix 10

Employers' Satisfaction Surveys

Master of Engineering Program
Industrial Engineering (regular program and special program),
Department of Industrial Engineering Mahidol University

Cumulative Results from 2017 - 2018

Graduate Characteristics	Scores
Number of Employers Participated	**7**
Mahidol Identity	
1. Generosity and willingness to help others	4.7
2. Caring of common benefits	4.9
Technical Abilities	
1. Master of his/her own field	3.7
2. Applying knowledge in work process	4.3
3. Knowledge transfer	4.1
4. Ability to work effectively and manage good performance	4.3
5. Applying up-to-date knowledge in working process improvement	4.6
Intelligence and Knowledge	
1. Analytical Thinking, decision making and problem solving	4.3
2. Systematic planning of work process	4.9
3. Creativity	4.0
4. Work under-stress	4.3
5. Being enthusiastic in continuous learning	4.4
Integrity and Personality	
1. Good behavior	4.3
2. Integrity and tolerance	4.6
3. Compliance of the organization	3.9
4. Polite and Role Model	4.1
5. Professional ethics	4.3
6. Social responsibility and self-interest	4.6

Leadership and Teamwork	
1. Leadership	4.3
2. Emotional control	4.1
3. Volunteer	4.6
4. Teamwork	4.6
5. Positive attitudes	4.3
6. Accept the consequences of their actions.	4.3
7. Time management	4.3
Generic Skills	
1. Systematic analysis	4.1
2. Oral and written communication skills	4.0
3. Language literacy	4.1
4. Computer literacy	4.4
5. Information seeking and management	4.7
Overall Employer Satisfaction	4.3

Appendix 11

Stakeholders needs from Industrial Engineering year 2017

	Academic staff	Current Student	Alumni	Employer	MU
ELO 1	√ √ √	√	√	√ √ √	√ √ √
ELO 2	√ √ √	√	√ √	√	√ √ √
ELO 3	√ √ √	√	√	√ √ √	√ √ √
ELO 4	√ √ √	√	√	√ √ √	√ √ √
ELO 5	√ √ √	√	√ √	√ √ √	√ √ √
ELO 6	√ √ √	√ √ √	√ √ √	√ √ √	√ √ √
1. Logistics and Supply Chain Management	√ √ √	√ √ √	√ √ √	√ √ √	
2. Engineering Management, Production Engineering and Quality Engineering	√ √ √	√ √ √	√ √ √	√ √ √	
3. Applied Manufacturing Engineering and Creative Product Development	√ √ √	√ √ √	√ √ √	√ √ √	

Scoring criteria is as following: √ √ √ = Impressed, √ √ = very satisfied, √ = satisfied