Bachelor of Science

in Information and Communication Technology (ICT)

(International Program)

2018 Revision

Faculty of Information and Communication Technology

Mahidol University

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Program specification

Bachelor of Science

in Information and Communication Technology (ICT)

2018 Revision

Name of Institution: Mahidol University

Campus/Faculty/Department   Faculty of Information and Communication Technology

Section 1. General Information

1. **Program title**

    Thai: วิทยาศาสตรบัณฑิต สาขาวิชา Information and Communication

    Technology (นานาชาติ)

    English: Bachelor of Science Program in Information and Communication

    Technology (International Program)

2. **Degree title**

    Full Title   Thai   : วิทยาศาสตรบัณฑิต สาขาวิชา Information and Communication

Technology

                 English : Bachelor of Science in Information and Communication Technology

    Abbreviated Thai   : วท.บ. (Information and Communication Technology)

                 English : B.Sc. (Information and Communication Technology)

3. **Major or minor subjects (if any)**

    None

4. **Total number of credits**

    129 credits

5. **Program characteristics**

    5.1 **Program type:** 4-year full-time undergraduate program (International program)

5.2 Program domain: Academic program

5.3 Language of Instruction: English

5.4 Recruitment: Both Thai and non-Thai students with good English skills

5.5 Cooperation with other institutions: Credits transferring is applicable according to the regulations announced by Mahidol University

5.6 Degree conferment: One degree

6. **Program status and program approval**

   6.1 The revision year: 2018

   6.2 The revision of the program is expected to take effect in Semester 1/2018

   6.3 Deliberated and endorsed by the University Academic Committee in the ..../.... meeting on ....

   6.4 Deliberated and endorsed by the University Committee in the ..../.... meeting on ....

   6.5 Deliberated and endorsed by the University Council in the ..../.... meeting on ....

   6.6 Approved by Office of the Higher Education Commission .... date ....

7. **The Ability to implement/promote the program**

   Academic Year 2020 (2 years after the revision)

8. **Possible careers for the graduates**

   (1) Computer scientist

   (2) System analyst and designer

   (3) Programmer

   (4) Web developer

   (5) Software developer

   (6) Multimedia developer

   (7) Database system administrator

   (8) Network system administrator

   (9) IT manager

   (10) Network manager

   (11) E-Business manager

   (12) IT expert in organizations

   (13) Data scientist

   (14) Cyber security system manager

   (15) Startup business in ICT and its application

Degree ☑ Bachelor ☐ Master ☐ Ph.D.   Information and Communication Technology
TQF2 Bachelor of Science in Information and Communication Technology (International Program)

9. List of the program faculty members

No	Name-Surname	Title	Degree	Publications in the past 5 years
1	Dr. Jarernsri L. Mitrpanont	Assoc. Prof.	Ph.D. (Computer Science) Oklahoma State University : 1993 M.Sc. (Applied Mathematics) Mahidol University : 1983 B.Sc. (Physics), Mahidol University : 1980	Mitrpanont J, Roungsuriyaviboon J, Sathapornwatanakul T, Sawangphol W, Kobayashi D, Haga J. Extending MedThaiVis-Thai medical research visualization to SAGE2 display walls. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017 (Best Paper Award).
2	Dr.Pattanasak Mongkolwat	Lecturer	Ph.D. (Computer Science) Illinois Institute of Technology : 1996 M.Sc. (Computer Science) McNeese State University : 1991 B.Sc. (Computer Science) University of the Thai Chamber of Commerce : 1988	Owolabi M, Ogbole G, Akinyemi R, Salaam K, Akpa O, Mongkolwat P, and et al. Development and reliability of a user-friendly multicenter phenotyping application for hemorrhagic and ischemic stroke. Journal of Stroke and Cerebrovascular Diseases 2017 Jul;11:2662-70.
3	Ms. Pagaporn Pengsart	Lecturer	M.Sc. (Computer Science) Mahidol University: 1996 B.Sc. (Computer Science) Mahidol University: 1992 B.Sc. (Medical Technology) Honors. 2 Mahidol University : 1989	Pengsart P, Belo ARX, Vaz JX, Marques JBS, Junior E. ADFS Authentication for Healthcare System. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017.

No	Name-Surname	Title	Degree	Publications in the past 5 years
4	Dr. Pawitra Chiravirakul	Lecturer	Ph.D. (Computer Science) University of Bath: 2015 M.Sc. (Software Systems Engineering) University College London: 2010 B.Sc. (ICT) honors. 1 Mahidol University : 2008	Rakfukfon K, Siraphaibool S, Rattanadechaphitak S, Chiravirakul P. MySRT management system for senior project document repository and tracking. In: Proceedings of the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.
5	Dr.Wudhichart Sawangphol	Lecturer	Ph.D. (Information Technology) Monash University : 2017 MIT Honours (Software Engineering and Data Management) Monash University : 2012 B.Sc. (ICT) honors. 1 Mahidol University : 2008	Mitrpanont J, Roungsuriyaviboon J, Sathapornwatanakul T, Sawangphol W, Kobayashi D, Haga J. Extending MedThaiVis-Thai Medical Research Visualization to SAGE2 Display Walls. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017.

10. **Venue to conduct the study**

Faculty of Information and Communication Technology, Mahidol University, Salaya campus

11. **External contexts or developments affecting program planning**

   11.1 Economic contexts or developments

This improvement and revision of the curriculum follow the objectives in the Twelfth National Economic and Social Development plan (2017-2036). The plan focuses on moving towards digital economy. The economy driven by creativity and innovation while its industry is gearing towards full automation. This industrial revolution poses not only opportunities and but also threats. Subsequently, it is necessary for any institute and organization to be aware of and to be ready for

such technological impacts. Since Thailand adopted digital economy as its key policy for the development of the country, IT workforce becomes an important resource for driving the country towards the new economy. Thus, the learning and teaching of advanced technologies must be emphasized in order to produce quality IT workforce according to the national strategic plan.

11.2 Social and cultural contexts or developments

Presently, affordability and accessibility of advanced technologies and computers have significantly increased. Mobile devices are no longer an accessory but they have become a necessary tool. Computers are used everywhere in a variety of applications. Wi-Fi and high-speed internet allow a quick access to an immense amount of information. The nature of a communication without boundary affects the society and people's everyday life to a great extent. This may cause moral issues and ethical wrongdoing. Computer scientists and specialists in information technology are needed to ensure a smooth transition into the era of information technology. They are key persons who can properly and professionally adapt and integrate new hardware and software development to the Thai culture and social lifestyle. At the same time, they can transfer their knowledge to others, raising awareness and increasing an understanding of technological effects that conform to the conduct of ICT profession both morally and ethically.

12. **Impacts of No. 11.1 and 11.2 on the program development and its relevance to the missions of the institute**

    12.1 Impacts on the development of the program

An emergence of advanced technologies greatly impacts economical growth and social developments. Consequently, there is an urgent need for a number of experts in information and communication technology who can attend the full potentials of IT innovations and businesses. The faculty aims at producing ICT professionals who possess not only a strong academic knowledge but also an ability to apply the skills practically. Graduates are expected to possess morality, ethics, and practice based on the code of conduct of ICT profession, and conformed to the visions and policies of Mahidol University.

12.2 Relevance to the missions of the Institute

The faculty has the following missions:

1. Produce ICT professionals who are highly competent internationally and possess morality and good work ethics.

2. Develop an ICT curriculum that meets international standard.

3. Develop ICT research and innovations.

4. Transfer, apply, and adapt ICT knowledge to the society.

Revision of the curriculum of the Faculty of Information and Communication Technology corresponds to the missions of the faculty and of Mahidol University to the excellence in teaching and research. The goal is to produce highly skilled graduates in information and communication technology who are proficient in English, have morally good attitudes and exercise professional work ethics conforming to the code of conduct of ICT profession. Furthermore, graduates are expected to realize and understand the social impacts of borderless communication, trends of innovations and cultural transfers especially towards changes in people's behaviors, attitudes, and core values. Possessed the above characteristics, graduates are trained to be able to adapt ICT knowledge to the benefits of the society nationally and internationally.

13. **Cooperation with the other programs within the Institute (if any)**

   13.1 **Course groups or courses offered by other programs or other academic units**

   - Courses that are taught by the Faculty of Science:

SCCH100	Integrated Chemistry	3 (3 – 0 – 6)
SCBI109	Integrated Biology	3 (3 – 0 – 6)

   - Courses that are taught by the Faculty of Social Sciences and Humanities:

SHSS103	Man and Society	2 (2 - 0 - 4)
SHSS107	Society and Health	2 (2 - 0 - 4)
SHHU108	Human Relations and Self Development	2 (2 - 0 - 4)
SHHU116	Comparative Culture	2 (2 - 0 - 4)

- Courses that are taught by The College of Music:

  MSMS107   Film Appreciation   2 (2 - 0 - 4)

  MSID101   Music Appreciation   2 (2 - 0 - 4)

The program uses English as an instruction medium and because advanced knowledge and new innovations in ICT often come from aboard, proficiency in the English language is a crucial element for the success of the graduates, especially business communications with foreign companies both in and outside of the country. In response to this necessity, the faculty offers English courses desired and taught by native English instructors to promote and to foster an intensive English language learning environment that is both efficient and effective. Additionally, the program includes basic courses in science, mathematics, and statistics. These subjects are the fundamental principles for systematic problem solving and analytical skills, as well as the basis for an integration of ICT into real applications especially in industry, business, and management.

13.2 Course groups or courses offered to other programs

None

13.3 Coordination

- The curriculum committee assigns course coordinator for each course.

- The curriculum committee collaborates with others faculties such as Faculty of Social Science and Humanities and Faculty of Science, etc. to teach in general education courses.

- The curriculum committee employs English native speakers to teach in English courses.

- The curriculum committee collaborates with external experts from other universities and institutes such as National Electronics and Computer Technology Center (NECTEC), KASIKORN Business-Technology Group (KBTG), ATOS company, AGODA for knowledge sharing and transferring activities.

- The curriculum committee assesses and monitors the quality of the program.

Section 2. Program Specific Information

1. **Philosophy, significance, and objectives of the program**

   1.1 Philosophy

   The Bachelor of Science in Information and Communication Technology (International program) aims at producing leading ICT graduates who possess high caliber in advanced knowledge, creativity, research and development, and practical skills, as well as having 21st Century skills and capable to use English in professional careers and deriving new knowledge. The program aims to develop ICT professionals who are proficient in ICT and ready for the current market demands to answer the national strategy (i.e. Thailand 4.0). The graduates are required to complete a capstone project. They can apply their knowledge and skills to solve a real-world problem. Practically, project based learning and active learning have been applied within the program to encourage students to be able to gain ICT experiences and develop life-long learning skills. Graduates are expected to possess high competency in the competitive workforce of the fast-growing generation of technology and globalization. The teaching and learning processes are based on student centered approach. The core theory is instructed by instructors to build a strong background of knowledge that enable students to construct their own knowledge and skills (Student-Centered; Constructivism and Essentialism Blending). These processes are enhanced with extra-curriculum activities (e.g. project-based learning) to build up problem solving skills

   1.2 Main objectives of the program

       1.2.1 Program Objectives

           1. Produce ICT professional graduates who are highly competent in computer science, and information and communication technology, as well as, general science, social science, humanities, and economics.

           2. Produce ICT professional graduates who have capabilities to analyze, design, and implement computer software.

3. Produce ICT professional graduates who aware of integrity, ethics, and IT-related law.

4. Produce ICT professional graduates who are capable in problem solving and critical thinking.

5. Produce ICT professional graduates who equipped with 21st Century skills and be able to use English for their profession and gain extra knowledge.

2. **Plan for development and revision**

Revision/Development Plan	Strategies	Evidence/Indicator
- The revision must conform to the international standards of the IT-related curriculum framework e.g., ACM and IEEE - The revision must conform to national frameworks defined by OHEC, Thailand - The revision must adopt the international standard in curriculum development and management framework i.e., AUN-QA	- Revise the curriculum every five years to cope with changing of technologies. - Collect feedbacks and requirements from stakeholders every two years - Support the faculty staff to gain new knowledge	- The course evaluation report - The feedbacks from the curriculum assessment process - The stakeholder satisfaction report - The satisfaction of employers towards the graduates

- The revision must address needs from stakeholders. - Establish an approach to enhance the quality of the faculty staff		

3.   Expected Learning Outcomes (LOs)

The Curriculum Management Committee defines two categories of the program's learning Outcomes: 1. Program Learning Outcomes: PLOs (i.e. Expected Learning Outcomes: ELOs), 2. Stream Learning Outcomes: SLOs. The former category (i.e. PLOs) is an outcome that all students can achieve through the program while the later (i.e. SLOs) is based on a student's interest and capabilities. SLOs also aim to increase capabilities of high performance students.

Program–Level Learning Outcomes: PLOs

PLO1: Effectively communicate the basic knowledge of computer science, mathematics, science, social science, humanities, healthy living, economic and finance with other people.

PLO2: Use systematic approaches by critically thinking at multiple levels of abstraction and solving problems under the context in which a computer system (will) operates (ICT disciplinary skills).

PLO3: Demonstrate abilities to study and work both independently and collaboratively.

PLO4: Recognize the individual, social, and ethical responsibilities of a professional working in ICT-related disciplines.

PLO5: Demonstrate effective command of the English language for professional communication.

Stream Learning Outcomes: SLOs

SLO6: Use knowledge and skills in one of the selective tracks related to ICT career paths to a wide range of applications in real world. The selective tracks include Computer Science, Databases and Intelligent Systems, E-Business Systems, Multimedia Systems, Software Engineering, Health Information Technology, Computer Network, and Management Information Systems.

SLO7: Apply computer science knowledge and skills to scope, design, and implement ICT-based solutions to more open problems with the awareness of advanced technologies.

SLO8: Carry out research practices in ICT-based topics under a supervision of experienced researchers with the awareness of cutting-edge technologies.

SLO9: Carry out professional practices and skills to learn and work beyond classroom.

SLO7 – SLO9 aim to enhance students' experiences in terms of national/international competitions, research activities based on their interests.

Section 3. Educational Management System,
Curriculum Implementation and Structure

1. **Educational Management System**

　1.1　**System**

　　A bimester system, with two regular semesters and one special semester (also called the "summer semester") in an academic year.

　1.2　**Summer session**

　　Summer session is offered depending on Program Faculty Members consideration

　1.3　**Credit equivalent to semester system**

　　Credits transferring is applicable according to the regulations announced by Mahidol University

　1.4　**Course Exempt**

　　Course exemption is applicable according to the regulations announced by Faculty of ICT, Mahidol University and Program Faculty Members consideration

2. **Program Implementation**

　2.1　**Teaching schedule**

　　Typical semester schedule:

　　　1st Semester　　　　　　: August to December

　　　2nd Semester　　　　　 : January to May

　　　Summer semester　　　 : June to August

　　Typical class hours:

　　　Monday – Friday during official hours (09:00 – 16:00)

　　　Some classes and laboratory activities may be held outside of these typical hours and possibly during weekends.

　2.2　**Qualifications of prospective students**

　　1.　Graduated and hold a high-school (Grade 12) diploma or its equivalent certificate in the science and mathematics program.

2. Pass the entrance examination and meet the requirements as regulated by the Office of the Higher Education Commission or pass an entrance examination conducted under the supervision of the Faculty of Information and Communication Technology, Mahidol University, which includes a written examination and/or an interview. Additionally, academic performances and grades in high-school, as well as examination scores are considered according to the rules and regulations in the student selection methods of the Faculty of Information and Communication Technology, Mahidol University.

3. International students or applicants who graduated high-school (Grade 12) or equivalent from foreign country must have a certification letter from the Ministry of Education and must pass the selection process determined by the Faculty of Information and Communication Technology, Mahidol University.

4. Applicants who are not in the science and mathematics program in their high-school studies must pass the condition 2 as stated above.

5. Applicants must have a stable physical and mental health for studying in the program

In addition, the Faculty have offered an "ICT Accelerated Program" for ICT Young Talents to provide an opportunity to high school students or equivalents who have a strong potential and passion in technology and want to study in the program in advance. Some high schools have been involved such as Mahidol Wittayanusorn School and Kanjanapisek Wittayalai Nakhon Pathom School. In the near future, there will be High School Talented Students from foreign countries as well. In this program, the Program Faculty Members have appointed lecturers from the Faculty to teach specific courses (i.e., Fundamental of Programming) to talented high school students. If the students are interested in the ICT program, they can transfer the credit from the ICT Accelerated Program. So that they can study in more advanced courses.

2.3 Problems that new students encounter when they start the program (predictions)

- Students have different levels of basic knowledge or insufficient basic knowledge from their high school study.

- Students need to adjust themselves to be familiar with university study. Particularly, they must be more responsible for their learning, and decision making.

- Students may have difficulties in understanding lecture or in communicating with colleagues, staff, or lecturers in English. In addition, some students might not have any computer science background before such as basic computer programming language.

- Students have to manage their time appropriately to not only studying but also joining several extra-curriculum activities organized by Faculty of ICT and outsides.

- Students have insufficient funding.

2.4 Strategies to solve problems in No. 2.3

The ICT program has the strategies to solve the problems in No. 2.3 as follow

1. The ICT program provides a pre-sessional program called "ICT Preparatory Program" for new students. This program aims to lay a foundational skills and knowledge in English, Mathematics, and Science for studying in the ICT program and get them accustomed to university and English environment lecture. This program is available before the first semester of the first year of the program.

2. The program evaluates students' English proficiency and classifies students into several levels such as fundamental, intermediate, and advanced levels. To improve English skills of students who are in the fundamental and intermediate levels, additional lectures/classes about English communication skill (listening, speaking, reading and writing) and presentation skill are provided.

3. The program provides an academic advisor for each student. Advisor is responsible for monitoring the student's academic progress and providing consultations to the student.

4. The program sets up a support system with a group of advisors called "Student Success Support System" or "4S" to help students with weak academic results and

other non-academic problems. They are responsible for providing guidance about study plan and consultation in other areas.

5. The program has several activities between lecturers and students to improve the collaboration and team work skills

6. The program provides laboratory hours to improve practical skills

7. The funding and scholarship from Mahidol University and outsides are announced.

2.5 Five-Year-Plan for recruitment and graduation of students

Year	Number of students in each academic year				
	2018	2019	2020	2021	2022
Year 1	180	180	180	180	180
Year 2		180	180	180	180
Year 3			180	180	180
Year 4				180	180
Cumulative number of students	180	360	540	720	720
Expected Number of graduates				180	180

2.6 Education delivery modes

Education delivery mode is classroom-based according to the regulation of Mahidol University on Undergraduate Study.

2.7 Transfer of credits, courses and cross institution registration

These can be carried out if approved by the Program Faculty Members and the Administrative Board of Faculty of ICT, and followed the requirements in the regulation of Mahidol University on Undergraduate Study and other related regulations by OHEC.

3. Program and Lecturers

3.1 Program

This program required 4 years or less to graduate but no more than 8 years.

3.1.1 Number of credits   no less than 129 credits

3.1.2 Program structure

a. General Education Courses	**no less than**	**30**	**Credits**
Social Science and Humanities		8	Credits
Science and Mathematics		9	Credits
Languages		12	Credits
Health and Physical Education		1	Credits
b. Subject Specific Courses	**no less than**	**93**	**Credits**
Core courses		12	Credits
Required Courses		69	Credits
Elective Courses		12	Credits
c. Free Electives Courses	**no less than**	**6**	**Credits**

3.1.3 Courses

1) Meaning of the Letters and Digits in a Course Code:

A course code consists of 4 letters and 3 digits (total of 7 characters).

(1) The meaning of the first 4 Letters is divided into two parts as follow:

- 1st and 2nd letters are the abbreviation of the faculty offering the course

  IT = Faculty of Information and Communication Technology

  SC = Faculty of Science

  SH = Faculty of Social Sciences and Humanities

  MS = College of Music

- 3th and 4th letters are the abbreviation of courses/ department/ branch/ group of courses/ projects offering the course

CS	= Computer Science	BI	= Biology
GE	= General Education	MS	= Music
LG	= Languages	HU	= Humanities
ID	= Interdisciplinary	SS	= Social Science

(2) The meaning of the last 3 digits is as follow:

The numbers start with 1, 2, 3, and 4 (1xx, 2xx, 3xx, and 4xx) represent the courses offering in the undergraduate program

2) List of courses by program structure

A. General Education Courses   **no less than 30 Credits**

- **Social Science and Humanities**   **8 Credits**

Take at least 4 courses (8 credits) from the list below.

Number of credits (Lecture – Laboratory – Self-study)

*SHSS	103	Man and Society	2 (2 – 0 – 4)
*SHSS	107	Society and Health	2 (2 – 0 – 4)
*SHHU	108	Human Relations and Self Development	2 (2 – 0 – 4)
*SHHU	116	Comparative Culture	2 (2 – 0 – 4)
*ITGE	101	Problem Solving Techniques	2 (1 – 2 – 3)
*ITGE	301	Communication Strategies in Professional Life	2 (2 – 0 – 4)

* The course that is already offered.

- **Science and Mathematics**   **9 Credits**

Take all the following courses to earn at least 9 credits.

Number of credits (Lecture – Laboratory – Self-study)

*SCCH	100	Integrated Chemistry	3 (3 – 0 – 6)
*SCBI	109	Integrated Biology	3 (3 – 0 – 6)
*ITCS	161	Physical Science and Computation	3 (3 – 0 – 6)

* The course that is already offered

- **Languages**   **12 Credits**

Take at least 6 courses (12 credits) from the list below.

Number of credits (Lecture – Laboratory – Self-study)

*ITLG	101	Technical English I	2 (1 – 2 – 3)
*ITLG	102	Technical English II	2 (1 – 2 – 3)
ITLG	103	Technical English III	2 (1 – 2 – 3)
ITLG	104	Elementary German I	2 (1 – 2 – 3)
ITLG	105	Elementary German II	2 (1 – 2 – 3)

Number of credits (Lecture – Laboratory – Self-study)

ITLG	106	Elementary Japanese I	2 (1 – 2 – 3)
ITLG	107	Elementary Japanese II	2 (1 – 2 – 3)
ITLG	108	Elementary Chinese I	2 (1 – 2 – 3)
ITLG	109	Elementary Chinese II	2 (1 – 2 – 3)
ITLG	110	Elementary Chinese III	2 (1 – 2 – 3)
*ITLG	201	Reading Skills	2 (1 – 2 – 3)
*ITLG	202	Public Speaking and Presentation	2 (1 – 2 – 3)
*ITLG	301	Business Writing	2 (1 – 2 – 3)
*ITLG	302	Academic Writing	2 (1 – 2 – 3)
ITLG	303	Listening & Speaking I	2 (1 – 2 – 3)
ITLG	304	Listening & Speaking II	2 (1 – 2 – 3)
ITLG	305	Advanced Reading	2 (1 – 2 – 3)
ITLG	306	Special Topics in Reading and Writing	2 (1 – 2 – 3)

The course that is already offered

- **Health and Physical Education**   **1 Credits**

Choose one of the following courses and take at least 1 credit. These courses are offered by College of Music or other faculties.

Number of credits (Lecture – Laboratory – Self-study)

*MSMS	107	Film Appreciation	2 (2 – 0 – 4)
*MSID	101	Music Appreciation	2 (1 – 2– 3)
*ITGE	141	Digital Photography	1 (0 – 2 – 1)
*ITGE	142	Digital Drawing and Painting	1 (0 – 2 – 1)
ITGE	143	Dancing for Social and Health	1 (0 – 2 – 1)
ITGE	144	Beginning Golf	1 (0 – 2 – 1)

The course that is already offered

Note Students may take other general education courses in social science and humanities group, science and mathematics group, and language group that offered by Mahidol University. However, they have to request for an approval by Program Faculty Members.

B. Subject Specific Courses   **no less than 93 Credits**

• **Core courses**   **12 Credits**

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	125	Applied Statistics for Computing	3 (3 – 0 – 6)
*ITCS	175	Advanced Mathematics I for Computer Science	3 (3 – 0 – 6)
*ITCS	306	Numerical Methods	3 (3 – 0 – 6)
*ITCS	320	Discrete Structures	3 (3 – 0 – 6)

The course that is already offered

• **Required courses**   **69 Credits**

Number of credits (Lecture – Laboratory – Self-study)

ITCS	201	Fundamentals of Programming	3 (2 – 2 – 5)
ITCS	209	Object Oriented Programming	3 (2 – 2 – 5)
*ITCS	211	Introduction to Digital Systems	3 (3 – 0 – 6)
ITCS	212	Web Programming	3 (2 – 2 – 5)
*ITCS	222	Computer Organization and Architecture	3 (3 – 0 – 6)
*ITCS	231	Data Structures and Algorithm Analysis	3 (3 – 0 – 6)
*ITCS	241	Database Management Systems	3 (3 – 0 – 6)
*ITCS	323	Computer Data Communication	3 (3 – 0 – 6)
*ITCS	335	Introduction to E-business Systems	3 (3 – 0 – 6)
ITCS	337	Human Computer Interaction	3 (3 – 0 – 6)
*ITCS	343	Principles of Operating Systems	3 (3 – 0 – 6)
*ITCS	361	Management Information Systems	3 (3 – 0 – 6)
*ITCS	371	Introduction to Software Engineering	3 (3 – 0 – 6)

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	381	Introduction to Multimedia Systems	3 (3 – 0 – 6)
*ITCS	402	Computer and Business Ethics	3 (3 – 0 – 6)
*ITCS	414	Information Storage and Retrieval	3 (3 – 0 – 6)
*ITCS	420	Computer Networks	3 (3 – 0 – 6)
*ITCS	424	Wireless and Mobile Computing	3 (3 – 0 – 6)
*ITCS	443	Parallel and Distributed Systems	3 (3 – 0 – 6)
*ITCS	451	Artificial Intelligence	3 (3 – 0 – 6)
*ITCS	461	Computer and Communication Security	3 (3 – 0 – 6)
*ITCS	491	Senior Project I	3 (0 – 6 – 3)
*ITCS	492	Senior Project II	3 (0 – 6 – 3)

The course that is already offered

- **Elective courses**   **12 Credits**

Program offer 8 tracks: - Databases and Intelligent Systems, Multimedia Systems, E-Business Systems, Computer Networks, Software Engineer, Computer Science, Health Information Technology, and Management Information System. Some courses may be covered by more than one track. Students must select their track before taking any elective courses. They can choose their track once they are in the second semester of their third year. They have to take 4 courses (12 credits) from courses in each track as shown in the following list.

(1) Databases and Intelligent Systems

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	413	Database Design	3 (3 – 0 – 6)
*ITCS	431	Software Design and Development	3 (3 – 0 – 6)
*ITCS	452	Knowledge-Based Systems	3 (3 – 0 – 6)
*ITCS	453	Data Warehousing and Data Mining	3 (3 – 0 – 6)
*ITCS	455	Natural Language Processing	3 (3 – 0 – 6)

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	456	Machine Learning and Intelligent Systems	3 (3 – 0 – 6)
*ITCS	457	Decision Support and Business Intelligent Systems	3 (3 – 0 – 6)
*ITCS	476	Digital Image Processing	3 (3 – 0 – 6)
*ITCS	495	Special Topics in Databases and Intelligent Systems	3 (3 – 0 – 6)

* The course that is already offered

(2) Multimedia Systems

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	481	Computer Graphics	3 (3 – 0 – 6)
ITCS	484	Computer Animation	3 (2 – 2 – 5)
*ITCS	485	Multimedia Information Systems	3 (3 – 0 – 6)
*ITCS	486	Multimedia Data Technologies	3 (3 – 0 – 6)
*ITCS	487	Multimedia Authoring and Production	3 (3 – 0 – 6)
*ITCS	488	Multimedia Development and Deployment	3 (3 – 0 – 6)
*ITCS	496	Special Topics in Multimedia Systems	3 (3 – 0 – 6)

* The course that is already offered

(3) E-Business Systems

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	431	Software Design and Development	3 (3 – 0 – 6)
*ITCS	433	Production, Supply Chain and Logistics Management	3 (3 – 0 – 6)
*ITCS	435	Business Decision Analysis	3 (3 – 0 – 6)
*ITCS	438	E-Business Modeling and Development	3 (3 – 0 – 6)
*ITCS	439	E-Customer Relationship Management	3 (3 – 0 – 6)
*ITCS	453	Data Warehousing and Data Mining	3 (3 – 0 – 6)
ITCS	457	Decision Support and Business Intelligent Systems	3 (3 – 0 – 6)
*ITCS	494	Special Topics in Electronic Business	3 (3 – 0 – 6)

* The course that is already offered

(4) Computer Networks

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	422	Local Area Networks	3 (3 – 0 – 6)
*ITCS	423	Telecommunication	3 (3 – 0 – 6)
*ITCS	428	Network Programming	3 (3 – 0 – 6)
*ITCS	429	Computer Forensics	3 (3 – 0 – 6)
*ITCS	465	Network Management	3 (3 – 0 – 6)
*ITCS	493	Special Topics in Computer Networks	3 (3 – 0 – 6)

The course that is already offered

(5) Software Engineer

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	379	Practical Software Engineering	3 (3 – 0 – 6)
*ITCS	431	Software Design and Development	3 (3 – 0 – 6)
*ITCS	471	Software Requirement Analysis and Specification	3 (3 – 0 – 6)
*ITCS	472	Software Metrics	3 (3 – 0 – 6)
*ITCS	473	Software Quality Assurance and Testing	3 (3 – 0 – 6)
*ITCS	490	Special Topics in Software Engineering	3 (3 – 0 – 6)

The course that is already offered

(6) Computer Science

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	331	Organization of Programming Languages	3 (3 – 0 – 6)
*ITCS	413	Database Design	3 (3 – 0 – 6)
*ITCS	425	Algorithms	3 (3 – 0 – 6)
*ITCS	431	Software Design and Development	3 (3 – 0 – 6)
*ITCS	440	Principles of Compiler Design	3 (3 – 0 – 6)
ITCS	447	Embedded Systems and Internet of Things	3 (3 – 0 – 6)

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	453	Data Warehousing and Data Mining	3 (3 – 0 – 6)
*ITCS	475	Mathematical Programming	3 (3 – 0 – 6)
*ITCS	481	Computer Graphics	3 (3 – 0 – 6)
*ITCS	498	Special Topics in Computer Science	3 (3 – 0 – 6)

The course that is already offered

(7) Health Information Technology

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	403	Introduction to Healthcare Systems	3 (3 – 0 – 6)
*ITCS	404	Information Technology for Healthcare Services	3 (3 – 0 – 6)
*ITCS	405	Information Models and Healthcare Information Standards	3 (3 – 0 – 6)
*ITCS	407	Practical Healthcare Management	3 (2 – 2 – 5)
*ITCS	409	Special Topics in Healthcare Systems	3 (3 – 0 – 6)
*ITCS	453	Data Warehousing and Data Mining	3 (3 – 0 – 6)

The course that is already offered

(8) Management Information System

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	364	Knowledge Management	3 (3 – 0 – 6)
*ITCS	365	Information Systems Analysis and Design	3 (3 – 0 – 6)
*ITCS	366	Enterprise Architecture	3 (3 – 0 – 6)
*ITCS	367	IT Infrastructure Management	3 (3 – 0 – 6)
*ITCS	368	Information and Business Process Management	3 (3 – 0 – 6)
ITCS	408	Special Topics in Management Information Systems	3 (3 – 0 – 6)
*ITCS	439	E-Customer Relationship Management	3 (3 – 0 – 6)
*ITCS	453	Data Warehousing and Data Mining	3 (3 – 0 – 6)
*ITCS	457	Decision Support and Business Intelligent Systems	3 (3 – 0 – 6)

The course that is already offered

To increase an opportunity for the current students to enroll in new courses, any students who are admitted before academic year 2018 (student ID 6088XXX or below) can choose new courses in this revised program 2018.

C. Free Electives Courses   **no less than 6 Credits**

Students can choose free elective courses according to the following conditions

1. Choose from free electives courses offered by Faculty of ICT, Mahidol University

2. Choose from any undergraduate courses offered by other department or any graduate courses offered by Mahidol University. These courses must be taught in English and approved by student's advisor, lecturer(s), and Program Faculty Members.

3. Choose from any undergraduate or graduate courses from other universities that taught in English and have MOU with Mahidol University. This must be done under consideration of Program Faculty Members

Free Electives Courses

- **Free electives courses**   **6 Credits**

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	159	Software Lab for Basic Scientific Problem Solving	1 (0 – 2 – 1)
*ITCS	176	Advanced Mathematics II for Computer Science	3 (3 – 0 – 6)
ITID	273	Digital Accounting	3 (2 – 2 – 5)
*ITID	274	Basic Accounting	3 (3 – 0 – 6)
*ITID	275	Economics	2 (2 – 0 – 4)
*ITID	276	Management	2 (2 – 0 – 4)
*ITID	277	Digital Marketing	2 (2 – 0 – 4)
*ITCS	391	Computer Network Lab	1 (0 – 2 – 1)
*ITCS	392	Multimedia Systems Lab	1 (0 – 2 – 1)

Number of credits (Lecture – Laboratory – Self-study)

*ITCS	393	Database Systems Lab	1 (0 – 2 – 1)
*ITCS	398	Cooperative Education	6 (0 – 30 – 15)
*ITCS	399	Internship	3 (0 – 20 – 10)
*ITCS	437	Project Management and Practice	3 (3 – 0 – 6)
ITCS	445	Data Science	3 (3 – 0 – 6)
ITCS	463	Modern Enterprise Resource Planning in Organization	3 (2 – 2 – 5)
*ITCS	497	Independent Study	3 (3 – 0 – 6)
ITCS	499	Cloud Computing Systems, Services and Applications	3 (3 – 0 – 6)

The course that is already offered

3.1.4 Recommended study plans

year	Semester 1				Semester 2			
1	SCBI	109	Integrated Biology	3	SHSS	103	Man and Society	2
	SHHU	116	Comparative Culture	2	SCCH	100	Integrated Chemistry	3
	ITCS	320	Discrete Structures	3	ITCS	211	Introduction to Digital Systems	3
	ITCS	175	Advanced Mathematics I for Computer Science	3	ITCS	161	Physical Science and Computation	3
	ITGE	101	Problem Solving Techniques	2	ITCS	209	Object Oriented Programming	3
	ITCS	201	Fundamentals of Programming	3	ITLG	201	Reading Skills	2
	ITLG	101	Technical English I	2	ITCS	125	Applied Statistics for Computing	3
					ITGE	141	Digital Photography	1
			Total	18			Total	20

TQF2 Bachelor of Science in Information and Communication Technology (International Program)

Year	Semester 1				Semester 2			
2	ITLG	102	Technical English II	2	ITLG	202	Public Speaking and Presentation	2
	ITCS	306	Numerical Methods	3	ITCS	323	Computer Data Communication	3
	ITID	276	Management	2	ITCS	381	Introduction to Multimedia	3
	ITCS	241	Database Management Systems	3			Systems	
	ITCS	222	Computer Organization and	3	ITCS	343	Principle of Operating Systems	3
			Architecture		ITCS	212	Web Programming	3
	ITCS	231	Data Structures and Algorithm Analysis	3	ITGE	301	Communication Strategies in	2
	ITCS	159	Software Lab for Basic Scientific	1			Professional Life	
			Problem Solving		ITCS	335	Introduction to E-business Systems	3
			Total	17			Total	19
Year	Semester 1				Semester 2			
3	ITLG	301	Business Writing	2	ITLG	302	Academic Writing	2
	ITCS	371	Introduction to Software Engineering	3	ITCS	424	Wireless and Mobile Computing	3
	ITCS	414	Information Storage and Retrieval	3	ITCS	461	Computer and Communication	3
	ITCS	420	Computer Networks	3			Security	
	ITCS	451	Artificial Intelligence	3	ITCS	337	Human Computer Interaction	3
	ITCS	443	Parallel and Distributed Systems	3	ITCS	391	Computer Network Lab	1
	ITCS	361	Management Information Systems	3	ITCS	XXX	Elective course (Track)	3
					ITCS	XXX	Elective course (Track)	3
			Total	20			Total	18
Year	Semester 1				Semester 2			
4	ITCS	402	Computer and Business Ethics	3	ITCS	492	Senior Project II	3
	ITID	277	Digital Marketing	2	ITCS	XXX	Free elective course*	
	ITCS	XXX	Elective course (Track)	3				
	ITCS	XXX	Elective course (Track)	3				
	ITCS	491	Senior Project I	3				
			Total	14			Total	3

Free elective courses that focusing on Cutting-edge technology from collaborative institutions and organizations (both national and international level)

3.1.5 Curriculum mapping between courses and expected learning outcomes

See Appendix 4

3.1.6 Course description

A. General Education Courses　　　　　　　　　　**no less than 30 Credits**

- **Social Science and Humanities**

Number of credits (Lecture – Laboratory – Self-study)

SHSS 103 Man and Society　　　　　　　　　　　　　2 (2 – 0 – 4)

Prerequisite : None

Co-requisite : None

Man as a social member; structure and evolution of social human; economical, legislative, political, governmental and environmental systems; socio-culture change and their impacts; adaptation and living in society culture

SHSS 107 Society and Health　　　　　　　　　　　　2 (2 – 0 – 4)

Prerequisite : None

Co-requisite : None

Social and cultural diversity as products of the modernized society; culture and political economic structure; pluralism of cultures, beliefs, behavior, values, identity, and ways of life among different social groups in Thai and world society; influences of social, economic, political, historical, cultural

SHHU 108 Human Relations and Self Development　　　　2 (2 – 0 – 4)

Prerequisite : None

Co-requisite : None

Principles and methods of cultivating human relations and self-development according to Buddhist perspective; for example, methods to develop a good relationship among colleagues and members in society, the art of teamwork, the administration according to the Buddhist

teachings, the cultivation of the right view and working ethos, Buddhist meditation, and the art of public speaking

SHHU 116   Comparative Culture   2 (2 – 0 – 4)

Prerequisite   : None

Co-requisite   : None

Principles and basic concepts in human communication, the relation between language, culture and communication, contemporary communication situation analysis in the present society; appropriate communicative skills in thinking, speaking, listening, reading and writing

ITGE   101   Problem Solving Techniques   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

Necessary skills for life-long learning; basic problem solving skills and techniques; problem identification and inductive reasoning; Plan-Do-Check-Act in problem solving; algorithm design and verbal reasoning; learning and practicing the effective use of analytical skills; setting up learning targets; defining the problems; searching for fact and information; distinguishing between data and fact; knowledge gathering skills; thinking creatively and laterally; problem-based, puzzle-based, and project-based learning; experiments, evaluations, and presentations

ITGE   301   Communication Strategies in Professional Life   2 (2 – 0 – 4)

Prerequisite   : None

Co-requisite   : None

Communication skills in listening, speaking, reading and writing; communication in small groups, large groups and in the public; rapport building with other people in the society including subordinates, supervisors, and colleagues; appropriate communication ways including email, telephone, and social network; building effective network; basic socialization; negotiation and

persuasion; leading the meeting in a professional way; learning negotiation techniques, and presentation tips

- **Science and Mathematics**   **no less than 8 Credits**

Number of credits (Lecture – Laboratory – Self-study)

SCCH 100   Integrated Chemistry   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

History of chemistry, the discovery of atoms and molecules, properties of elements and formation of compounds; natural phenomena related to the behavior and properties of molecules in gaseous, liquid and solid states; chemical reactions in daily life and factors influencing the reactions; natural compounds and modern materials with designed properties; study of the energy formations from chemical reactions, science development and its impact on living things, environment and medicine; the problem solving in science and technology development

SCBI   109   Integrated Biology   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Living cells and their functions, energy of life, gene and heredity, molecular genetics, genetic engineering and biotechnology, evolution: change in live over time, origin of life and evolution from single-cell life to human beings, origin of new species and biodiversity of life on earth, interaction of life and environment, environmental problems and conservation biology

ITCS   161   Physical Science and Computation   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Applying computers to help solve computational problems in physical sciences such as physics, chemistry, biology, geology and environmental science; an analysis and solving mathematical

and scientific problems using computation models; using software developed for mathematical and scientific computation; creation of virtual world that represents a physical world; study of human being's relationship to the digital world; modeling physical systems using software and hardware that can sense and respond to the real world environment

- **Languages**   **no less than 12 Credits**

Number of credits (Lecture – Laboratory – Self-study)

ITLG   101   Technical English I   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

English language skills for university level course work; emphasis on basic communication skills in listening and speaking; basic grammar and reading comprehension skills; vocabulary related to computers and information technology

ITLG   102   Technical English II   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

English language skills for university level course work; emphasis on basic skills in reading and writing; writing short articles and technical reports; intermediate grammar; vocabulary related to computers and information technology

ITLG   103   Technical English III   2 (1 – 2 – 3)

Prerequisite   : ITLG 102

Co-requisite   : None

English language skills for university level course work; emphasis on the Common European Framework of Reference for Languages (CEFR) B2 level skills in reading and writing;

writing short articles and technical reports; intermediate grammar; vocabulary related to computers and information technology

ITLG   104   Elementary German I   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

A practice of basic usage of the German language: listening, speaking, reading, and writing, with an emphasis on basic communication skill in listening and speaking; basic grammar and reading comprehension skills; basic conversations for everyday life; vocabulary related to computer and information technology

ITLG   105   Elementary German II   2 (1 – 2 – 3)

Prerequisite   : ITLG 104

Co-requisite   : None

A practice of basic usage of German language: listening, speaking, reading, and writing, with emphasis on basic reading and writing skills; writing short articles and technical reports; intermediate grammar; vocabulary and basic conversation related to computer and information technology

ITLG   106   Elementary Japanese I   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

A practice in reading and writing Hiragana and Katakana characters, elementary Japanese grammatical structures in listening, speaking, reading and writing; Japanese vocabulary and syntactic structures used in daily life; Japanese vocabulary and basic conversations related to computer and information technology

ITLG   107   Elementary Japanese II   2 (1 – 2 – 3)

Prerequisite   : ITLG 106

Co-requisite   : None

A practice in listening, speaking, reading and writing more Japanese characters, more complex Japanese structures and grammar, quantifiers of nouns, adverbs, conjunctions, conjugation of verbs, simple sentences and some others; Japanese vocabulary and basic conversations related to computer and information technology

ITLG   108   Elementary Chinese I   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

Mandarin Chinese phonology: vowels, consonants, and tones; the Pinyin phonetic alphabet; basic Chinese writing principles; the study of at least 300 Chinese characters; practice of listening, speaking, reading, and writing based on basic vocabulary used in the simple context of daily life; simple sentence structures and patterns

ITLG   109   Elementary Chinese II   2 (1 – 2 – 3)

Prerequisite   : ITLG 108

Co-requisite   : None

Basic vocabulary and simple sentence structures in Chinese; compound sentences; practice of listening, reading, and writing with emphasis on the topics related to computer and information technology; the study of at least 350 more Chinese characters

ITLG   110   Elementary Chinese III   2 (1 – 2 – 3)

Prerequisite   : ITLG 109

Co-requisite   : None

Listening, conversation, reading, and writing skills used in the simple context of daily life and topics related to computer and information technology; emphasizing in correct pronunciation, idiom, and grammar

ITLG   201   Reading Skills   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

Reading principles and practices; computer and ICT related vocabulary; semi-technical vocabulary; Basic concepts in reading comprehension; effective reading strategies; understanding of sentence structures; word meaning from context for getting main ideas and details; techniques in reading various materials such as textbooks, novels, newspaper, business reports and research articles

ITLG   202   Public Speaking and Presentation   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

Basic English pronunciation; principles of effective speaking such as relaxation, breath control, articulation, resonance and projection; presentation skills including preparation, audio and visual aids, overcoming stress, gestures, handling questions and answers; practice in delivering an oral presentation in front of the class in general topics and in ICT related topics

ITLG   301   Business Writing   2 (1 – 2 – 3)

Prerequisite   : ITLG 102 and ITLG 201

Co-requisite   : None

Strategies and techniques for writing in English; different writing formats in one paragraph; usage of words and vocabularies; structure and forms of writing for different objectives; Practice of writing ICT reports

ITLG   302   Academic Writing   2 (1 – 2 – 3)

Prerequisite   : ITLG 102 and ITLG 201

Co-requisite   : None

     Writing reports, professional articles, technical papers, abstracts and research papers with attention to appropriateness of vocabulary, idioms, style, register and genre; practice of writing technical ICT reports

ITLG   303   Listening and Speaking I   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

     Practice of English in everyday use including basic listening skills and pronunciation; study of the culture related to given social functions, with the aim of helping students gain confidence in verbal communication in English

ITLG   304   Listening and Speaking II   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

     Practice of English in everyday use at a more advanced and formal level; pronunciation and listening practice through longer and more complex dialogues and passages; cultural awareness to increase communication ability

ITLG   305   Advanced Reading   2 (1 – 2 – 3)

Prerequisite   : ITLG 201

Co-requisite   : None

     Reading principles and practices; academic, computer and ICT related vocabulary; technical vocabulary; advanced concepts in reading comprehension such as inference, fact/opinion, source credibility, purpose, and interpretation of figures, facts, and data; effective reading strategies; understanding of paragraph and essay structures; word meaning from the

context for getting main ideas and details; techniques in reading various materials found from the Internet, academic sources, and literary works

ITLG   306   Special Topics in Reading and Writing   2 (1 – 2 – 3)

Prerequisite   : ITLG 305

Co-requisite   : None

Special topics in English reading and writing with a focus on the interpretation, analysis and criticism of ideas encountered in either academic readings across the curriculum and Internet media sources, test preparation materials, or literary works such as novels; topics can be varied depending on interests of instructors or students

● **Health and Physical Education no less than 1 Credits**

Number of credits (Lecture – Laboratory – Self-study)

MSMS   107   Film Appreciation   2 (2 – 0 – 4)

Prerequisite   : None

Co-requisite   : None

The definitions, role and functions of films; survey into genres, film styles, history of films, and development in both eastern-western cinematographic worlds as well as films in Thailand; elements of film creation; films exploration; principles of aesthetic evaluation in films

MSID   101   Music Appreciation   2 (1 – 2 – 3)

Prerequisite   : None

Co-requisite   : None

The understanding of the evolution of western and global music cultures, considering both their forms and their social and economic foundations, leading to the better understandings of other music cultures as well as the comparison and the future of Thailand's music cultures

ITGE   141   Digital Photography   1 (0 – 2 – 1)

Prerequisite   : None

Co-requisite   : None

      Camera equipments and components; lenses and flash; how camera works; focal length and aperture; digital camera and human eyes; pixels and resolution; photo editing; tones and contrast; luminosity and color; image sharpening; digital image interpolation; color management and printing

ITGE   142   Digital Drawing and Painting   1 (0 – 2 – 1)

Prerequisite   : None

Co-requisite   : None

      Theory and practice of designing and drawing lines; drawing of a variety of shapes such as geometric shapes and natural shapes; perspective drawing; theory of colors; color cycle; techniques of painting; practice of basic drawing and painting by hands; the use of graphical software; production of creative graphics; applications of drawing and painting to several forms of media such as publishing, video and animation

ITGE   143   Dancing for Social and Health   1 (0 – 2 – 1)

Prerequisite   : None

Co-requisite   : None

      Learning basic dancing skills and exercising via dancing; applying dancing related activities to be an exercise in the daily habit; history, scope, and the important of dancing; direction of movement in dancing; practice and manners in dancing; basic dancing skills; current popular dancing styles; understanding of rhythm and applying rhythm to dancing

ITGE   144   Beginning Golf   1 (0 – 2 – 1)

Prerequisite   : None

Co-requisite   : None

Physiological, psychological, and social benefits of golf; Basic terms, rules, history, and etiquette related to the game of golf; the equipment and attire used in golf; grip and stance fundamentals; the basic mechanics involved in the set-up, swing, and contact point for each area of golf (driving, chipping, putting); the cooperative skills necessary for preparing and playing a round of golf on a course

B.　Subject Specific Courses　　　　　　　　no less than 93 Credits
- Core courses　　　　　　　　　　　no less than 12 Credits

Number of credits (Lecture – Laboratory – Self-study)

ITCS　125　Applied Statistics for Computing　　　　　　3 (3 – 0 – 6)

Prerequisite　: None

Co-requisite　: None

Probability and properties; conditional probability; independence of events; Baye's rule; random variables; discrete and continuous probability functions; expected values and variances; probability functions; sampling distributions; estimation and hypothesis testing; contingency tables; simple linear regression and correlation; applying statistical techniques for solving computing problems using statistical packages

ITCS　175　Advanced Mathematics I for Computer Science　　　3 (3 – 0 – 6)

Prerequisite　: None

Co-requisite　: None

Limits; continuity; differentiation; derivatives of functions; techniques of integration; improper integrals; vector addition; vector multiplication; scalar product; cross product; vector valued functions; parametric equations; matrices; determinants; systems of linear equations; Euclidean space; eigenvalues and eigenvectors; applying mathematics to solve computing problems

ITCS 306   Numerical Methods   3 (3 – 0 – 6)

Prerequisite : None

Co-requisite : None

Introduction to numerical methods; mathematical background; solving nonlinear equations; solving a system of linear equations; curve fitting and interpolation; numerical differentiation; numerical integration; ordinary differential equations; initial-value problems; boundary-value problems; mathematical software used for numerical computation

ITCS 320   Discrete Structures   3 (3 – 0 – 6)

Prerequisite : None

 Co-requisite : None

Sets; functions; relations; basic logic and Boolean algebra; proof techniques such as direct proofs, proof by counter example, proof by contradiction; mathematical induction; well orderings; basic counting such as Pigeonhole Principle; permutations and combinations; recurrence relations; graphs and trees; finite state machines and regular expressions

- **Required courses**   **no less than 69 Credits**

Number of credits (Lecture – Laboratory – Self-study)

ITCS 201   Fundamentals of Programming   3 (2 – 2 – 5)

Prerequisite : None

Co-requisite : None

Structured programming, problem-solving techniques, development and implementation of basic algorithms in a procedure-oriented language; a systematic approach to the design and construction of computer programs; fundamentals of high-level, block-structured languages including arrays, procedures, parameters, recursion; basic data structures; Hands-on practice

ITCS   209   Object Oriented Programming   3 (2 – 2 – 5)

Prerequisite   : ITCS 201

Co-requisite   : None

Concepts of object-oriented programming; encapsulation and information hiding; classes and subclasses; inheritance and overriding; polymorphism; class hierarchies; internal representations of objects and method tables; Hands-on practice

ITCS   211   Introduction to Digital Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 201

Co-requisite   : None

Introduction to logic design; concepts in digital systems; binary systems; Boolean algebra and logic gates; Karnaugh maps and its simplification; combinational circuit; sequential circuit; digital hardware realization; microprocessor structure and programming

ITCS   212   Web Programming   3 (2 – 2 – 5)

Prerequisite   : ITCS 209 and ITCS 241

Co-requisite   : None

Fundamental mechanism and components of the internet and web; formats and structures of the languages used to develop webs; web page creation; the techniques of writing script programs working at client and server sides; web development tools; program for simulating a web server; system development for accessing the database; applications of object-oriented programs to web development; Hands-on practice

ITCS   222   Computer Organization and Architecture   3 (3 – 0 – 6)

Prerequisite   : ITCS 211

Co-requisite   : None

Organization and architecture of the computer systems; basic components of computers; data representation; Assembly Language; the memory system organization and architecture; the

memory hierarchy and interleaving; cache memory; virtual memory; the input and output systems; the storage systems; CPU design; additional computing units; the implementation of data paths and control unit; multiprocessor architecture

ITCS   231   Data Structures and Algorithm Analysis   3 (3 – 0 – 6)

Prerequisite   : ITCS 209

Co-requisite   : None

Basic data structures such as stacks, queues, lists, arrays, strings, trees, sets and graphs; design and evaluation of algorithms for manipulating data structures such as searching, sorting and hashing; brute-force algorithms; greedy algorithms; divide-and-conquer; backtracking; heuristics; pattern matching and string matching algorithms

ITCS   241   Database Management Systems   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Basic database management; data models; database design cycles; relational database design; data normalization; data organization in normalized forms; data description languages; data query; data consistency; data recovery and synchronization control; data security; data integrity and reliability

ITCS   323   Computer Data Communication   3 (3 – 0 – 6)

Prerequisite   : ITCS 222

Co-requisite   : None

Basic concepts of data communication; OSI model; signal characteristics; encoding and modulating; the transmission of the digital data; the communication interface device; communication media; data multiplexing; error detection and correction; data link control; switching; point-to-point protocol (PPP); Integrated services digital network (ISDN); x.25; frame relay; ATM; SONET/SDH; networking and internetworking devices

ITCS　335　Introduction to E-business Systems　　　　　　　3 (3 – 0 – 6)

Prerequisite　: None

Co-requisite　: None

　　　Structured programming; problem-solving techniques; the development of electronic commerce fundamentals; e-business models; value chain analysis; technology architectures for electronic business; supply chain management; consumer behavior within the electronic environment; legal and ethical issues; privacy and security of the electronic information

ITCS　337　Human Computer Interaction　　　　　　　　3 (3 – 0 – 6)

Prerequisite　: None

Co-requisite　: None

　　　Principles of graphical user interfaces; graphical user interfaces toolkits; interaction styles and techniques including screen design, layout, color, fonts, labeling and visual programming; HCI tools; multimedia and web communication; human-centered development and evaluation; human performance models: perception, movement, cognition, culture, communication, and organizations; accommodating human diversity; principles of good design and good designers; engineering tradeoffs; introduction to usability tests

ITCS　343　Principles of Operating Systems　　　　　　　3 (3 – 0 – 6)

Prerequisite　: ITCS 222 and ITCS 231

Co-requisite　: None

　　　Basic principles of operating systems; computer resource management; process management and scheduling; multitasking and multiprocessing systems; synchronization; deadlocks; mutual exclusion; memory management: segmentation and paging; virtual memory; protection; sharing; access control; file and I/O systems

ITCS　361　Management Information Systems　　　　　　　3 (3 – 0 – 6)

Prerequisite　: None

Co-requisite　: None

Concepts in the administration of the information system functions in organizations; the enhancement of management with computers; the management system development; planning and budgeting; analysis, design, implementation and operation; success factors including privacy, ethics, job security, job changes; information security; measurement of operating performance; ethics in the management information systems; business process engineering and information technology between organizations such as electronic data interchange and electronic commerce

ITCS	371	Introduction to Software Engineering	3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Software engineering foundations and concepts; requirements management; procedures of software development; standards models for software engineering model construction; software engineering model analysis; basic object-oriented design; fundamentals of software project management

ITCS	381	Introduction to Multimedia Systems	3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Multimedia tools; web hypermedia; communication; categorization and architectures of information: hierarchies and hypermedia; Information retrieval and human performance; web search; usability of database query languages; models of color, fonts, texts, images, and sound; natural language processing; overview of the multimedia information systems; tools and processing on mobile devices; data compression; computer animation

ITCS	402	Computer and Business Ethics	3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Roles and impact of the computer usage in the society, school, and workplace; computer abuse; computer crime; privacy and anonymity; intellectual property and legal issues; professional social responsibility and globalization; computer ethics fallacies; computer game fallacy; law abiding; public comment and privacy rights; software piracy and plagiarism; Hacker's fallacy and ethics; free and open information fallacy; hacking and hacktivism; ethics codes of conduct and resources; the internet architecture board; Computer Ethics Institute (CEI); organizational ethics plan of action; social implications of computers

ITCS   414   Information Storage and Retrieval   3 (3 – 0 – 6)

Prerequisite   : ITCS 231

Co-requisite   : None

Concepts, principles, techniques, and mechanism of information storage and retrieval; retrieval modeling; Boolean model; inverted index; tolerant retrieval techniques; index construction; term weighting; vector model; scoring and ranking; retrieval documents; main components of the information retrieval system; retrieval evaluation; relevant feedback; query expansion; XML retrieval; vector space classification; matrix decomposition; Latent Semantic Indexing; web search basics

ITCS   420   Computer Networks   3 (3 – 0 – 6)

Prerequisite   : ITCS 323

Co-requisite   : None

History and evolution of computer networks and the Internet; types and standards of computer networks particularly packet-switched network and circuit-switched network; specific characteristics of different types of computer networks; mechanisms of each layer of the Internet including path discovery and computer addressing in the Internet, the stability improvement via the use of TCP and UDP in the communication, and the development of software applications

running on top of TCP and UDP; applications of the network systems and the security in computer networks

ITCS   424   Wireless and Mobile Computing   3 (3 – 0 – 6)

Prerequisite   : ITCS 323

Co-requisite   : None

History, evolution, and compatibility of wireless standards; characteristics of wireless and mobile computing; wireless LAN; mobile IP; mobile aware applications; mobile data access; basic programming for mobile devices; principles of communication in mobile phones; security in wireless LAN; performance of wireless and mobile computing

ITCS   443   Parallel and Distributed Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 343 and ITCS 201

Co-requisite   : None

Concepts of the parallel and distributed systems; parallel and distributed architecture and examples; communication and synchronization mechanisms; parallel programming in MPI (Message passing interface); message passing mechanism; parallel algorithms such as parallel sorting, parallel searching; performance evaluation and load balancing; cluster and the GRID computing system; cloud computing and applications

ITCS   451   Artificial Intelligence   3 (3 – 0 – 6)

Prerequisite   : ITCS 231

Co-requisite   : None

History and evolution of artificial intelligence; Fundamental concepts, principles   and techniques of artificial intelligence; searching methods; solving problems by solution searching; symbolic computation; expert systems; uncertainty handling in the expert systems; the intelligent systems; computational intelligence techniques; fuzzy logic; neural networks; genetic algorithms; case studies of artificial intelligence applications

ITCS   461   Computer and Communication Security   3 (3 – 0 – 6)

Prerequisite   : ITCS 343 and ITCS 420

Co-requisite   : None

Introduction to the security systems, encryption, cryptanalysis, data encryption standard; cryptographic techniques and protocols in communication; applications of cryptography regarding management; the public key systems, digital signatures, file security systems; penetration of the database systems

ITCS   491   Senior Project I   3 (0 – 6 – 3)

Prerequisite   : Advisor's consideration

Co-requisite   : None

Topics of undergraduate-level project in Information and Communication Technology with the approval of senior project advisors; writing a senior project proposal; presenting senior project proposal

ITCS   492   Senior Project II   3 (0 – 6 – 3)

Prerequisite   : ITCS 491 and advisor's consideration

Co-requisite   : None

Topics of undergraduate-level project in Information and Communication Technology with the approval of a senior project advisors; developing a proposed project; writing a final senior project document; defending a senior project

- **Elective Courses**   **no less than 12 Credits**

Number of credits (Lecture – Laboratory – Self-study)

ITCS   331   Organization of Programming Languages   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite　　: None

　　Fundamental principles and techniques in the design and implementation of modern programming languages; lauguages definition structure; programming language processing; data types and structures; control structures and data flow; storage management; syntax and translation; programming language paradigms including procedural, functional, object-oriented and logic languages; language concepts including values, bindings, types, and modules

ITCS　364　Knowledge Management　　　　　　　　　　　　　　3 (3 – 0 – 6)

Prerequisite　　: ITCS 361

Co-requisite　　: None

　　Introduction to knowledge management: definitions, concepts and applications; the nature of knowledge; knowledge management solutions; organizational impacts of knowledge management; factors influencing knowledge management; knowledge management assessment of an organization; knowledge management technologies such as artificial intelligence and digital libraries; preserving and applying human expertise and knowledge-based systems; using past history explicitly as knowledge and case-based systems; Knowledge elicitation and converting tacit knowledge to explicit; discovering new knowledge and data mining; text KM and text mining; knowledge discovery systems; knowledge capture systems such as concept maps, process modeling, RSS, Wikis methods; the knowledge sharing systems such as ontology, categorization and classification tools, XML-based tools; the knowledge application systems; conclusion and future of knowledge management

ITCS　365　Information System Analysis and Design　　　　　　　3 (3 – 0 – 6)

Prerequisite　　: None

Co-requisite　　: None

　　Information system development strategies; problem identification and feasibility studies; information requirements determination; requirement analysis and logical specification; logical design and physical design; program development and testing

ITCS   366   Enterprise Architecture   3 (3 – 0 – 6)

Prerequisite   : ITCS 361

Co-requisite   : None

Design, selection, implementation and management of the enterprise IT solutions; applications and infrastructure suitable for the business; frameworks and strategies for infrastructure management; system administration; data and information architecture; content management; legacy system integration; system consolidation; software selection; total cost of ownership; IT investment analysis; risk management and security; IT auditing with compliance standards

ITCS   367   IT Infrastructure Management   3 (3 – 0 – 6)

Prerequisite   : ITCS 361

Co-requisite   : None

IT infrastructure components; computer and system architecture; network architecture; services and capabilities of IT infrastructure in an organization; knowledge and skills on hardware and system software technologies; design of systematic processes; decision for selecting software solutions for a particular IT infrastructure and system limitations; techniques and roles to deal with several levels of vendors; internet-based options; computer and network security; business continuity; roles of infrastructure in regulatory compliance

ITCS   368   Information and Business Process Management   3 (3 – 0 – 6)

Prerequisite   : ITCS 361

Co-requisite   : None

Methods and techniques to analyze, design, implement, automate, and evaluate business process; the structure of the Business Process Management (BPM) life cycle; an analysis of the organization performance from a process perspective; redesign processes using value-focused techniques; design workflows; simulation of new process designs; process analytics applications using dashboards; core concepts in data and information management; identifying organization

business requirements and business flows; conceptual and relational data modeling; verification of the structure with normalization techniques and development of a database application; an assessment of the efficiency and effectiveness of an organization from a process perspective; process improvement; roles of technology in supporting corporate processes; design and develop applications to bridge the gap between business and information process

ITCS   379   Practical Software Engineering   3 (3 – 0 – 6)

Prerequisite   : ITCS 371

Co-requisite   : None

Practice of software development using a standard process of software engineering: requirement analysis, software design, software construction, software testing, software quality assurance, software project planning and management

ITCS   403   Introduction to Healthcare Systems   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

An overview, organization, and roles in the healthcare systems for information technology professionals; healthcare organizations in primary, secondary, and tertiary settings; Health policy; financing in the health systems; medical terminologies; disease processes and classifications; clinical process and decision making; pharmaceutical products and other treatment interventions; ambulatory healthcare services and management; hospital services and management; emergency health services; records of clinical care documents; roles of healthcare professionals; evidence-based medicine and healthcare knowledge management; population health and epidemiology; health data collection and analysis; complexity of healthcare, information needs, and roles of technologies and information management in healthcare

ITCS   404   Information Technology for Healthcare Services   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

An overview of information technology applications in the healthcare services; development and management of the information systems in healthcare; the information systems and process improvement; the hospital information system; clinical laboratory system; the database design in healthcare applications; clinical information systems including admit, discharge, transfer (ADT) systems, electronic health records, computerized provider order entry (CPOE) systems, clinical decision support systems, the medical imaging applications, and the departmental information systems; the management information systems in healthcare organizations; e-health including health information exchange and telehealth; information privacy and security in healthcare

ITCS   405   Information Models and Healthcare Information Standards   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Healthcare information management and information models; interoperability and information standards in healthcare; standard development process and organizations; types of models; Common Information Model (CIM) and reference models; Unified Modeling Language (UML) and Extensible Markup Language (XML); overview of important healthcare information standards including the Health Level Seven (HL7), Standard Reference Information Model (RIM), standard Clinical Document Architecture (CDA), standard Continuity of Care Record (CCR), Continuity of Care Document (CCD), Integrating the Healthcare Enterprise (IHE), and standard Digital Imaging and Communications in Medicine (DICOM); standards of information in pharmacy and nursing; terminologies and vocabularies in healthcare, including Systematized Nomenclature of Medicine (SNOMED)

ITCS   407   Practical Healthcare Management   3 (2 – 2 – 5)

Prerequisite   : ITCS 403

Co-requisite   : None

Practicing and applying knowledge on the healthcare systems; visiting and observing healthcare places such as hospitals, health units and health institutes; studying various healthcare systems for analyzing the requirements of users such as physicians, nurses, health officers and patients; design and prototype implementation of healthcare related software and system; management, the development and distribution of healthcare related to knowledge

ITCS   408   Special Topics in Management Information Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 361

Co-requisite   : None

Recent advanced knowledge and techniques in the management information systems; modern practical deployment in the management information systems in industries; other related topics that can be varied depending on the interests of faculties and students

ITCS   409   Special Topics in Healthcare Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 403

Co-requisite   : None

Recent advanced knowledge and techniques in the healthcare systems; knowledge management; dimensions, factors and significant components in learning regarding the issues of the health service systems; IT in knowledge management; practical deployment of IT in the healthcare systems; other related topics that can be varied depending on the interests of faculties and students

ITCS   413   Database Design   3 (3 – 0 – 6)

Prerequisite   : ITCS 241

Co-requisite   : None

Relational theory, data semantics and physical design; storage and file structures; indexed files; hashed files; signature files; B-trees; performance tuning and database efficiency such as buffering and prefetching; query processing algorithms and optimization; design of crash recovery and concurrency control systems

ITCS　422　Local Area Networks　　　　　　　　　　　　　　　3 (3 – 0 – 6)

Prerequisite　: ITCS 420

Co-requisite　: None

Architecture, components, and connection models of local area networks; standards of local area networks; cable types used in local area networks; accessing techniques; accessing contention and token usage; local area network protocols; fiber channel and network backup; local area network connection and interfaces; components and types of virtual local area networks; local area networks within an organization; tools for designing and solving problems in local area networks; benefits of applications in local area networks

ITCS　423　Telecommunication　　　　　　　　　　　　　　　　3 (3 – 0 – 6)

Prerequisite　: ITCS 420

Co-requisite　: None

Basic principles of telecommunication technology and the telephone network, and the legal, economic, and regulatory environment of the telecommunication industry; the role of new technologies such as microwaves, mobile communication technologies, computer communications, and cable television; common carrier laws and the economics of natural monopoly as the basis for the regulations of the telecommunication industry; issues of competition, monopoly and technical standards; spectrum allocation and management; international communications and trans-border data flow; changes in the new technologies and the impact on regulations

ITCS   425   Algorithms   3 (3 – 0 – 6)

Prerequisite   : ITCS 320

Co-requisite   : None

Advanced data structures; combinatorics and countable discrete structures; string matching algorithms; backtracking; spanning tree algorithm; graph traversal; graph algorithms; greedy algorithm; dynamic programming; computational geometry

ITCS   428   Network Programming   3 (3 – 0 – 6)

Prerequisite   : ITCS 420

Co-requisite   : None

Concepts of remote procedure calls; Network programming to communicate between clients and servers using sockets via TCP and UDP protocols; IP address and machine naming; secure writing of network programs; electronic mail sending and receiving; Java network programming concepts such as remote method invocation (RMI), and Microsoft winsocks

ITCS   429   Computer Forensics   3 (3 – 0 – 6)

Prerequisite   : ITCS 461

Co-requisite   : None

Principles of computer forensics; ethics and laws related to computer forensics; forensic methodology and process; data acquisition; hard disk forensics; forensic software tools; investigating Windows and Linux machines; network forensic; email and internet forensics; live evidence collection on Windows and Linux; incident response

ITCS   431   Software Design and Development   3 (3 – 0 – 6)

Prerequisite   : ITCS 371

Co-requisite   : None

Principles of software design and software architecture; methodologies and techniques of designing the software system architecture; requirement analysis of software design; design patterns; efficiency factor analysis of software design; software evolution

ITCS   433   Production, Supply Chain and Logistics Management   3 (3 – 0 – 6)
Prerequisite   : ITCS 335
Co-requisite   : None

The philosophy and tools of the production management strategies; emerging management concepts such as lean production and total quality management; production analysis and planning; control of the production systems; Customer service and order processing; inventory planning; warehouse management system; Inventory availability; inventory turnover; Inventory forecasting; inventory replenishment; efficient order quantities; supply chain engineering; supply chain scoreboard; procurement analysis; supplier partnerships; Efficient logistics; efficient transportation planning; shipment planning, mode and carrier selections; order picking systems; shipping and packaging

ITCS   435   Business Decision Analysis   3 (3 – 0 – 6)
Prerequisite   : ITCS 125, ITCS 335 and ITCS 241
Co-requisite   : None

Bidding problems; influence problems; role of the decision analysis cycle and model sequencing; assessing the quality of decisions; framing decisions; decision hierarchy; strategies for alternative development; decision diagrams; biases in assessment; developing and using evocative and assessed knowledge maps; interpretation of sensitivity analysis; the use of approximations; values of joint information, options, flexibility, bidding, corporate risk attitude, risk sharing and allocation; decisions involving health and safety

ITCS   438   E-Business Modeling and Development   3 (3 – 0 – 6)
Prerequisite   : ITCS 335

Co-requisite   : None

Core business processes and organizational structures that enable industrial and service enterprises to an e-business model; the identification and deployment of appropriate technologies to elements of E-business; motivation to drive business actions to the marketplace, supply chains and lifestyles of e-world; development of various e-business models; financial operations to support the development of e-business

ITCS   439   E-Customer Relationship Management   3 (3 – 0 – 6)

Prerequisite   : ITCS 335

Co-requisite   : None

Concepts of customer relationship management; critical success factors in business development and customer-supplier retention in the context of business-to-business marketing; transparency and speed of the Internet that add opportunities and threats to the customer relationship management; comparison of the traditional and electronic customer relationship management

ITCS   440   Principles of Compiler Design   3 (3 – 0 – 6)

Prerequisite   : ITCS 231

Co-requisite   : None

Fundamental concepts and history of programming languages; terminology: programming language processors and program translators; compiler and interpreter; tombstone diagram; syntactic analysis: scanning and parsing; contextual analysis: identification and type checking; run-time organization; code generation; interpreter and interpretation

ITCS   447   Embedded Systems and Internet of Things   3 (3 – 0 – 6)

Prerequisite   : ITCS 211, ITCS 343 and ITCS 420

Co-requisite   : None

Roles of software and hardware in designing the embedded systems; design components including hardware and software architectures, design methodologies and tools, and communication protocols; design specification and modeling, hardware components and platforms, software organization, embedded and real-time operating systems, interfacing with external environments using sensors and actuators, and communication in distributed embedded systems; Advanced topics such as energy management, safety and reliability, and security; case-studies of real-world systems such as biomedical devices, smart cards, RFID, networked sensors, personal computing devices, home appliances and electronics, and mobile robotics

ITCS   452   Knowledge-Based Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 241 and ITCS 451

Co-requisite   : None

Concepts, components and architecture of knowledge-based systems; formats, methods, and techniques in explaining knowledge bases; machine representation of judgmental knowledge and uncertain relationships; inference on inexact knowledge bases; rule-based systems principles, advantages, and limitations; Automated planning systems; knowledge acquisition and explanation producing techniques

ITCS   453   Data Warehousing and Data Mining   3 (3 – 0 – 6)

Prerequisite   : ITCS 241 and ITCS 451

Co-requisite   : None

Concepts and components of data warehouses; architecture of data warehousing system; data warehousing design and development; OLAP technology; data mining concepts; data mining process; data preparation for data mining; data mining techniques including market basket analysis, mining association rules, data classification, data clustering, and data mining applications

ITCS   455   Natural Language Processing   3 (3 – 0 – 6)

Prerequisite   : ITCS 451

Co-requisite   : None

Introduction to natural language processing; syntactic predictions such as tokenization, part-of-speech tagging, and parsing; representation of text; Language modeling; semantic analysis and applications such as document classification; dependency parsing; natural language generation; machine translation; conversational agents; recent advance in NLP

ITCS   456   Machine Learning and Intelligent Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 451

Co-requisite   : None

Fundamentals of machine learning; Bayes' decision theory; supervised learning; learning decision trees; learning via neural networks; learning via genetic algorithms; reinforcement Learning; unsupervised learning; clustering; evaluation and comparison among learning algorithms; applications of learning techniques for developing the intelligent systems

ITCS   457   Decision Support and Business Intelligent Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 241 and ITCS 451

Co-requisite   : None

Concepts, components and architecture of decision support and the business intelligent systems; decision theory; Decision models; database administration for decision support and business intelligent systems; qualitative and quantitative model implementation; data warehouses and knowledge management; design and analysis of the business intelligent systems; tools used to develop business intelligent systems; cases studies and business applications of the decision support systems

ITCS   465   Network Management   3 (3 – 0 – 6)

Prerequisite   : ITCS 422

Co-requisite   : None

Network management architectures and applications; network management standards and models; SNMP (Simple Network Management Protocol) protocol consisting of SMI (Structure of Management Information), ASN.1 (Abstract Syntax Notation One) and MIB (Management Information Base), and SNMP versions; RMON (Remote Monitoring) protocol; network management functions including configuration, fault, performance, security, and accounting management; network management tools, systems and applications; web-based network management; XML-based network management; policy- and business-based management

ITCS   471   Software Requirement Analysis and Specification   3 (3 – 0 – 6)
Prerequisite   : ITCS 371
Co-requisite   : None

Domain Engineering; techniques for discovering and elicitation requirements; languages and models for representing requirements; analysis and validation techniques including needs, goals, and use case analysis; requirements in the context of system engineering; specifying and measuring external qualities: performance, reliability, availability, safety, and security; specifying and analyzing requirements for various types of systems: embedded systems, consumer systems, web-based systems, business systems, systems for scientists and other engineers; resolving feature interactions; requirements documentation standards; traceability; human factors; requirements in the context of agile processes; requirements management

ITCS   472   Software Metrics   3 (3 – 0 – 6)
Prerequisite   : ITCS 371
Co-requisite   : None

Description and definition of software metrics; theorem of software metrics construction; software metrics modeling; efficiency measurement of software products; efficiency measurement of software process; software metrics management and usage

ITCS   473   Software Quality Assurance and Testing   3 (3 – 0 – 6)

Prerequisite   : ITCS 371

Co-requisite   : None

      Software quality assurance process; avoidance of errors and other quality problems; inspection and reviews; testing, verification and validation technique; process assurance versus product assurance; quality process standards; product and process assurance; problem analysis and reporting; statistical approaches to quality control

ITCS   475   Mathematical Programming   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

      Linear programming; integer linear programming; zero-one integer programming; branch and bound algorithms; dynamic programming; transportation problem; traveling salesman problem; optimization on networks such as shortest path problem and minimum spanning tree problem; network scheduling problems

ITCS   476   Digital Image Processing   3 (3 – 0 – 6)

Prerequisite   : ITCS 451

Co-requisite   : None

      Fundamentals of image processing; Programming and software tools for image processing; image display; basic image processing; image geometry; image enhancement; image restoration; image segmentation; representation and description; object recognition; image compression; color image processing

ITCS   481   Computer Graphics   3 (3 – 0 – 6)

Prerequisite   : ITCS 201 and ITCS 231

Co-requisite   : None

Basic principles for computer graphics; 2D and 3D graphical image synthesis; principles of displaying objects in 3D; computation of visualized surfaces; light and shades; light and color in image synthesis; synthesis of surface mapping, shadows, curves, and areas; writing graphics software on video display interfaces

ITCS   484   Computer Animation   3 (2 – 2 – 5)

Prerequisite   : None

Co-requisite   : None

Concepts and theories in computer animation; concepts and theories in lighting and processing; key-frame animation; camera animation; scripting system; motion capture; procedural animation; deformation; guidelines for presenting through story boards; applications of 3D program; object model formation; object crafting in different granularities; character animation; material and surface setting; surface covering or touching on models; rendering; simple scene formation and composite

ITCS   485   Multimedia Information Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 381

Co-requisite   : None

Definition and basic principles of the multimedia systems; models and standards of multimedia files; data compression techniques; file storage and transfer over networks; the multimedia systems on web; voice content based access; digital sound distribution; multimedia data retrieval; distributed multimedia systems; roles of software companies towards the multimedia business; user-oriented interactive TV; video conferencing; video on demand; multimedia software for education and industry; multimedia archive and electronic library

ITCS   486   Multimedia Data Technologies   3 (3 – 0 – 6)

Prerequisite   : ITCS 381

Co-requisite   : None

Sound and audio; image and graphics; animation and video; multimedia standards of audio, music, graphics, image, telephony, video and TV; capacity planning and performance issues; input and output devices such as scanners, digital camera, touch screens, voice activated devices, synthesizers, and storage standards including optical disks, CD and DVD; multimedia servers and file systems; tools to support multimedia system development

ITCS   487   Multimedia Authoring and Production   3 (3 – 0 – 6)
Prerequisite   : ITCS 381
Co-requisite   : None

Concepts and components in designing the multimedia systems; multimedia production; design fundamentals and design philosophy, 2D animation, 3D animation; writing storyboard framework; designing and techniques for 2D animation; designing and techniques for 3D animation; audio editing and techniques; video editing and techniques; procedures after the multimedia production; development and integration of different multimedia data; multimedia product evaluation; media editors; authoring; multimedia data streams and structures; capture; representation and transformation; spaces and domains; data compression and encoding

ITCS   488   Multimedia Development and Deployment   3 (3 – 0 – 6)
Prerequisite   : ITCS 381
Co-requisite   : None

Interactive ability of multimedia with users and applications in education, business, industry and entertainment; software tools used to produce interactive multimedia with users; main characteristics of software and products; content-based analysis; multi-modal integration and interfaces; comparison between single machine-based and internet-based multimedia; procedures in multimedia development; quality of service; appropriate usage of multimedia

ITCS   490   Special Topics in Software Engineering   3 (3 – 0 – 6)
Prerequisite   : ITCS 371

Co-requisite   : None

   Recent advanced techniques in software engineering such as software construction, software maintenance, software evolution, software configuration management, software process improvement and other related topics that can be varied depending on the interests of faculties and students

ITCS 493 Special Topics in Computer Networks   3 (3 – 0 – 6)

Prerequisite   : ITCS 420

Co-requisite   : None

   Recent advanced techniques in computer network technologies; special topics in advanced computer networks, security systems and their applications; for examples, next generation networks, new imminent threats and prevention mechanism; other related topics that can be varied depending on the interests of faculties and students

ITCS 494 Special Topics in Electronic Business   3 (3 – 0 – 6)

Prerequisite   : ITCS 335

Co-requisite   : None

   Recent advanced techniques in e-business model and technologies; special topics in the advanced e-business systems and their applications; for examples, social networking with e-business, and raising web site ranks via search engine optimization; other related topics that can be varied depending on the interests of faculties and students

ITCS 495 Special Topics in Databases and Intelligent Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 241 and ITCS 451

Co-requisite   : None

   Recent advanced techniques in the database design and its applications; modern techniques in the intelligent systems; other related topics that can be varied depending on the interests of faculties and students

ITCS   496   Special Topics in Multimedia Systems   3 (3 – 0 – 6)

Prerequisite   : ITCS 381

Co-requisite   : None

Recent advanced techniques in multimedia data management and multimedia technologies; interesting topics of the multimedia applications such as e-learning and information visualization; other related topics that can be varied depending on the interests of faculties and students

ITCS   498   Special Topics in Computer Science   3 (3 – 0 – 6)

Prerequisite   : ITCS 231

Co-requisite   : None

Special topics in computer science such as novel algorithms, security and privacy in new applications, high performance computing, novel computing model and new technology in computer science; other related topics that can be varied depending on the interests of faculties and students

C. Free elective courses   no less than 6 Credits

Number of credits (Lecture – Laboratory – Self-study)

ITCS   159   Software Lab for Basic Scientific Problem Solving   1 (0 – 2 – 1)

Prerequisite   : None

Co-requisite   : None

Introduction to problem solving skills using software tools; software tools for mathematics and numerical computation; software tools for graphics and visualization presentation; database software tools for handling scientific data; examples of scientific software applications

ITCS   176   Advanced Mathematics II for Computer Science   3 (3 – 0 – 6)

Prerequisite   : ITCS 175

Co-requisite   : None

Functions of several variables; partial derivatives; cylindrical and spherical coordinates; complex variables; ordinary differential equations of first and second order; linear and non-linear first order differential equations; second order and higher order differential equations; applications of differential equations

ITID   273   Digital Accounting   3 (2 – 2 – 5)
Prerequisite   : None
Co-requisite   : None

Basic Accounting theory; international principles and practices for accounting cycle; to obtain earning statement, statement of financial and statement of cash flows; measurement, evaluation and reporting of the effects on organizational planning, controlling and business decision making; using the Accounting and Financial Information Management System for Digital Accounting as one of the ERP system in modern organizations

ITID   274   Basic Accounting   3 (3 – 0 – 6)
Prerequisite   : None
Co-requisite   : None

Accounting theories; principles and practices for obtaining earnings statement, statement of financial and statement of cash flows; measurement, evaluation and reporting of assets and their effect on earnings determination; measurement, evaluation and reporting of liabilities; stockholders equity and their effect on earnings determination; leases, pensions and other employee retirement benefits, deferred income taxes and earnings per share; international differences in accounting

ITID   275   Economics   2 (2 – 0 – 4)
Prerequisite   : None
Co-requisite   : None

Concept and assumptions of economics; consumers and demands; producers and supplies, producing factors, costs, losing opportunity; analysis of demands and supplies; ways to cut costs and increase maximum profit; concept of marketing; business competition and market structure; pricing strategy; floating prices; oil price; monopoly; business transaction for marketing; business cycle; fiscal policy; income tax; value added tax; local tax; monetary policy; interest rates; inflation and deflation; pricing index; capital market; saving options, dividend, profit speculation, gross domestic product, economic growth, income distribution; financial and banking system; trade and investment between countries; exchange rates; effects of currency appreciation and depreciation; local economics; household account; saving plan; personal account and spending plan; analysis of daily situation and decision

ITID   276   Management   2 (2 – 0 – 4)

Prerequisite   : None

Co-requisite   : None

Basic management principles and skills; Resource and time management; teams and groups; quality in the team; delegation; managing people; oral communication and presentation skills; project planning

ITID   277   Digital Marketing   2 (2 – 0 – 4)

Prerequisite   : None

Co-requisite   : None

Product management; product definition and differences; product brand; up-market and down-market; mass and niche market; product life cycle; price management; price strategies; determinants of price; communication management; advertising; promotional tools; sponsorships TV advertising; product placement; street-level promotion celebrity endorsement; communication tools; sales promotion; public relation; product distribution; wholesaler; retailer; electronic commerce; ethics in marketing and advertising; applications of IT for marketing

ITCS 391   Computer Network Lab   1 (0 – 2 – 1)

Prerequisite   : ITCS 420

Co-requisite   : None

Practices in applying a variety of techniques and tools for setting up and testing a computer network; network components and installation; network configuration; router and switch configuration; IP address allocation; domain name server installation and services; network commands on the Windows and Linux operating systems; email installation and configuration; wireless network installation; traffic capture and analysis; software usage for network security; adoption of new network technologies according to the interest of faculties and students

ITCS 392   Multimedia Systems Lab   1 (0 – 2 – 1)

Prerequisite   : ITCS 381

Co-requisite   : None

Practices on applying a variety of techniques for developing multimedia systems; development of web interfaces; 2D image creation; putting special effects on 2D images; adaptation and scaling for web graphics; published media and video; image processing software; audio and video encoding; writing software for creating animation; adoption of new technology in the multimedia system and the interest of faculties and students

ITCS 393   Database Systems Lab   1 (0 – 2 – 1)

Prerequisite   : ITCS 241

Co-requisite   : None

Practices on applying the database management techniques to solve real problems including performance tuning of database systems, query optimization, indexing of database systems, and operations of the database system components; efficient design of large database systems; data model usage

ITCS   398   Cooperative Education   6 (0 – 30 – 15)

Prerequisite   : Adviosor's consideration

Co-requisite   : None

A practice at a government agency or a private company having ICT department and working on a topic for cooperative education related to information and communication technology with the approval of an advisor, and having the duration of practice of at least 1 semester

ITCS   399   Internship   3 (0 – 20 – 10)

Prerequisite   : Advisor's consideration

Co-requisite   : None

An internship at a government agency or a private company having the ICT department and working on a topic related to the information and communication technology with the approval of an advisor

ITCSI   437   Project Management and Practice   3 (3 – 0 – 6)

Prerequisite   : None

Co-requisite   : None

Project planning; project management tools; managing the system life cycle; cost estimation and project scheduling; human resource management; factors influencing productivity and success; productivity metrics; key performance index for project efficiency and effectiveness; project evaluation; determining skill requirements and staffing of the project; cost-effectiveness analysis; reporting and presentation techniques; effective management in both behavioral and technical aspects; change management and planning; option analysis and risks; release and configuration management; development of software projects; software contracts and intellectual property; case studies of real industrial projects

ITCS   445   Data Science   3 (3 – 0 – 6)

Prerequisite   : ITCS 241 and ITCS 451

Co-requisite   : None

An introduction to data science and its related technology; handling data including data representation, data understanding, data cleansing, data transformation, dimension reduction, high dimensional data, and data visualization; machine Learning models including regression, classification, and clustering methods; evaluation methodologies; data Analytics and its case study; project based learning for Data Science process from problem understanding to deployment

ITCS   463   Modern Enterprise Resource Planning in Organization   3 (2 – 2 – 5)

Prerequisite   : ITCS 201

Co-requisite   : None

The management information systems; information systems to organization objectives; organization structure and management; representation and analysis of system structure; systems information and decision theory; information system applications; system selection and evaluation

ITCS   497   Independent Study   3 (3 – 0 – 6)

Prerequisite   : Advisor's consideration

Co-requisite   : None

An in-depth study of specific topics in information and communication technology that a student selects in consultation with and completed under the supervision of an instructor

ITCS   499   Cloud Computing Systems, Services and Applications   3 (3 – 0 – 6)

Prerequisite   : ITCS 420

Co-requisite   : None

Introduction to cloud computing; cloud computing architecture; key components of cloud computing; cloud storage; types of cloud computing services; cloud computing security; related

standards for the cloud computing systems; cloud management; principles of web services and service-oriented architecture (SOA); cloud based application development using web services

4. **Field Experience Courses (Internship or Cooperative Education)**

The internship and cooperative education courses were added as part of free elective courses. The main objective is to allow students to gain more knowledge and experience from the real working environment. This is aligned with the requirements and suggestions from the employers and ICT alumni. In accordance with that purpose, the faculty have coordinated with many leading ICT companies and organizations from private sector, government, and state enterprise to increase opportunities for students especially during the summer of the third year. After the internship, the Faculty collects the evaluation from both companies and students. In case the students cannot register the internship or cooperative courses, the students can register in other free elective courses.

4.1 **Course Objectives**

1) To learn and improve skills by working in the real world environment

2) To apply and integrate knowledge from different subjects appropriately to solve problems in the real world setting

3) To practice teamwork and communication skills

4) To understand and adapt to companies practice disciplinary and culture

5) To communicate and present innovative and useful ideas for the assigned tasks

4.2 **Time frame**

During study in Year 3 and Year 4

4.3 **Study Schedule**

Depends on each organization/institution and Program Faculty Members' consideration

4.4 **Preparation**

1) Students send a request form to the academic division to enroll in ITCS398 Cooperative Education or ITCS399 Internship or ITCS497 Independent Study

2) Program Faculty Members assign academic advisor for a student to give an advice, monitor, and support during the field experience

3) Students select an organization or institution that they want to join

4) Students make a summary report and present to their advisor.

4.5 Assessment

Academic advisor and employer(s) evaluate students' performance based on the expected learning outcomes. The results of these courses are classified into three levels: Unsatisfactory (U), Satisfactory (S), and Outstanding (O).

5. Requirements on project and research

Topics of undergraduate-level project in Information and Communication Technology should be related to how to apply computer technologies and ICT to solve the real world problems. These problems may be directly related to the computer science areas or related to some specific group of users. Students should emphasize their area of expertise such as Computer Science, Database and Intelligent Systems, Multimedia Systems, Computer Network, Electronic Business Systems, Health Information Systems, Information System Management, or Software Engineering. Each topic aims to implement a computer system or application for variety of businesses such as teaching and learning, education, travel, healthcare, transportation, or culture. The project is classified into two types which are application based and research based projects. The application based projects focus on the completeness and usefulness of the project. While the research based projects focus on introduction of research methodologies to support computer science and ICT areas. Each project can have about 2 to 4 students. They have to present their project proposal, submit the progress report, and present their progress to the committee at the end of the first semester to receive the approval and feedback about the project. In the second semester, they have to present their progress to the committee, ICT lecturers, and other students during the poster exhibition. Finally, toward the end of the second semester, they have to defense their final work to the committee for the official approval. All groups have to submit the senior project documentation in the correct format within the deadline.

5.1 Course description

Undergraduate-level projects in Information and Communication Technology that students are interested in and can apply their knowledge to solve the real world problems. The projects must have the well-defined scope which that they can successfully finish their work within the provided time frame.

5.2 Standard learning outcomes

Students should be able to work as a team. Students can select and use appropriate programming languages and tools to develop their projects. For application based project, the projects should be a complete system or a prototype that can be used for further development. For research based project, the students should be able to write and publish research papers from their work. Students should be able to present their work in English as well as writing a senior project documentation in English.

5.3 Time frame

During study in Semester 1 and Semester 2 in Year 4

5.4 Number of credits

6 Credits

5.5 Preparation

The program provides information about the projects through e-learning and website. The information includes topics of all projects along with the advisor's name and students' name, important dates to submit and present projects, and the complete example of projects for referencing.

5.6 Assessment

Advisor(s) evaluates students' performance based on their progress during three phases which are Proposal Presentation, Poster Presentation and Project Defense Oral Presentation. During each phase, students must present their project and demonstrate how to use the system with at least three committees (including their advisor). In addition, the native English lecturers provide feedbacks about the senior project documentation.

Section 4. Learning Outcomes, Teaching Strategies, and Assessment Strategies

1.   **Development of Students' Special Characteristics**

Special Characteristics	Strategy or Student Activity
1. Have a great personality, be professional, have a great presentation skill and strong communication skill (in English)	• Guide students about appropriate manner such as how to dress properly during official events as follow by the Mahidol University regulation • Teach students several techniques for public presentation and allow them to practice during class presentation as well as extra curriculums activities at the Faculty • Use English in all courses to integrate English into students' daily routine
2. Have leadership, discipline, and responsibility, be punctual, be a good team player, always be ambitious and thirsty for knowledge, have self-development and career development.	• Have several team-based assignment and term projects (including senior projects) • Set up rules/regulations and encourage students to have discipline with that rules such as be in class on-time • Assign open-end assignments which require students to research and self-study on the tools and software. Assign them to make a presentation to share their knowledge.
3. Have professional ethic	• Provide information about Computer-related Crime Act and demonstrate example of real use cases
4. Contribute to society	• Support activities that beneficial to the society

2. **Mapping describing learning outcomes, teaching and learning methods, and student assessment methods**

Teaching and learning methods and student assessment methods that aligned with ELOs and SLOs were defined by the Program Faculty Members as shown below.

Learning Outcomes	Teaching and Learning Methods	Assessment Methods
PLO1: Effectively communicate the basic knowledge of computer science, mathematics, science, social science, humanities, healthy living, economic and finance with other people.	● Interaction-based Lecture ● Discussion ● Cooperative Learning ● Experience-based case study (Discovery Learning) ● Inquiry-based Learning	● Quiz ● Examination ● Assignment Evaluation ● Report Evaluation ● Presentation Evaluation
PLO2: Use systematic approaches by critically thinking at multiple levels of abstraction and solving problems under the context in which a computer system (will) operates (ICT disciplinary skills).	● Interaction-based Lecture ● Lab ● Cooperative Learning ● Experience-based case study (Discovery Learning) ● Coaching ● Project-based learning (Expeditionary learning)	● Quiz ● Examination ● Assignment Evaluation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation
PLO3: Demonstrate abilities to study and work both independently and collaboratively.	● Interaction-based Lecture ● Discussion ● Cooperative Learning ● Experience-based case study (Discovery Learning) ● Inquiry-based Learning ● Project-based learning (Expeditionary learning)	● Observation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation ● Self-Assessment

Learning Outcomes	Teaching and Learning Methods	Assessment Methods
PLO4: Recognize the individual, social, and ethical responsibilities of a professional working in ICT-related disciplines.	● Interaction-based Lecture ● Discussion ● Cooperative Learning ● Experience-based Case Study (Discovery Learning) ● Inquiry-based Learning ● Project-based Learning (Expeditionary Learning)	● Observation ● Assignment Evaluation ● Project Evaluation ● Critique Evaluation ● Participation Assessment ● Self-Assessment
PLO5: Demonstrate effective command of the English language for professional communication.	● Interaction-based Lecture ● Lab ● Discussion ● Cooperative Learning ● Coaching	● Quiz ● Examination ● Observation ● Assignment Evaluation ● Essay Evaluation ● Presentation Evaluation ● Critique Evaluation
SLO6: Use knowledge and skills in one of the selective tracks related to ICT career paths to a wide range of applications in real world. The selective tracks include Computer Science, Databases and Intelligent Systems, E-Business Systems, Multimedia Systems, Software Engineering, Health Information Technology, Computer Network, and Management Information Systems.	● Interaction-based Lecture ● Lab ● Discussion ● Cooperative Learning ● Experience-based Case Study (Discovery Learning) ● Inquiry-based Learning ● Coaching ● Project-based Learning (Expeditionary Learning)	● Quiz ● Examination ● Observation ● Assignment Evaluation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation ● Self-Assessment

Learning Outcomes	Teaching and Learning Methods	Assessment Methods
SLO7: Apply computer science knowledge and skills to scope, design, and implement ICT-based solutions to more open problems with the awareness of advanced technologies.	● Discussion ● Cooperative Learning ● Experience-based Case Study (Discovery Learning) ● Inquiry-based Learning ● Coaching ● Project-based Learning (Expeditionary Learning)	● Observation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation
SLO8: Carry out research practices in ICT-based topics under a supervision of experienced researchers with the awareness of cutting-edge technologies.	● Discussion ● Cooperative Learning ● Experience-based Case Study (Discovery Learning) ● Inquiry-based Learning ● Coaching ● Project-based Learning (Expeditionary Learning)	● Observation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation
SLO9: Carry out professional practices and skills to learn and work beyond classroom.	● Discussion ● Cooperative Learning ● Experience-based Case Study (Discovery Learning) ● Inquiry-based Learning ● Coaching ● Project-based Learning (Expeditionary Learning)	● Observation ● Report Evaluation ● Project Evaluation ● Presentation Evaluation ● Critique Evaluation ● Participation Assessment ● Self-Assessment ● Internship Evaluation

Note Lecturers may use other teaching and learning methods and other assessment methods beyond the methods in the provided table. However, those methods must be aligned with the program educational philosophy (Student Centered, Constructivism, and Essentialism)

Section 5: Student Assessment Criteria

1. **Regulations and criteria for grading**

   The student assessment and graduation are followed the academic regulation of Mahidol University for Bachelor Degree study (year 2009 and year 2017)

   Grade letters and meaning of the assessments are shown below

   (1) Letter with level

Grade	Achievement	Level Value
A	Excellent	4.00
B+	Very Good	3.50
B	Good	3.00
C+	Fairly Good	2.50
C	Fair	2.00
D+	Poor	1.50
D	Very Poor	1.00
F	Fail	0.00

   (2) Letter without level

Grade	Achievement
AU	Audit
O	Outstanding
S	Satisfactory
T	Transfer of Credit
U	Unsatisfactory
I	Incomplete
P	In Progress
X	No Report
W	Withdrawal

A student's status is determined after the first two regular semesters. A student is considered to be in a regular status when his/her cumulative GPA is 2.00 or higher. A student whose cumulative GPA falls below 2.00 is in the probation status as follows:

High probation status: the cumulative GPA is 1.80 or higher

Low probation status: the cumulative GPA is 1.50 or higher, but less than 1.80

Students who fall into one of the following categories will be dismissed from the program.

- Students with a cumulative GPA below 1.50.

- Students with a cumulative GPA below 1.80 for two consecutive semesters.

- Students with a cumulative GPA below 2.00 for four consecutive semesters.

- Students who have repeatedly violated the university rules and regulations governing student conducts including: plagiarism of assignments, cheating during examinations, drug use, damage to the university's properties or reputation, gambling, stealing and other inappropriate behaviors

2. **Verification of the standards of student achievements**

Program Faculty Members verify the student achievements during two phases: before graduation and after graduation.

2.1 **Verification of student achievement before graduation**

- Lectures of each course assess students according to the teaching and assessment plan

- Students evaluate teaching and learning at the course level

- Every semester, students' performance and evaluation scores are reported to the head of Program Faculty Members and Deputy Dean for Academic Administrator.

- Institution has internal quality assurance standard process to verify student achievements

2.2 Verification of student achievement after graduation

- The Faculty monitors employability of graduates by using the survey of graduate study and employment recorded within 1 year after graduation (every three months after students graduated.)

- For employers, the Faculty collects the satisfactory towards our graduates annually through the survey and focus group.

- The Faculty conducts the survey of career developments of graduates.

- The Faculty survey the usefulness of the knowledge acquired from the special tracks.

- The students' products that published to the public; for example, innovation system for real world problem or the innovation prize from external organization

- The Faculty receive feedbacks and comments from the external experts in program/curriculum assessment. The feedbacks and suggestions from lecturers regarding students' preparedness and self-development.

3. **Graduation Requirements**

3.1 Students can qualify for Bachelor of Science in Information and Communication Technology (International Program) when they satisfy the following criteria:

(1) Fulfill the subjects in accordance with the program curriculum which has the minimum requirements of 129 credits including a minimum of 30 credits of general education courses, a minimum of 93 credits of specific education courses and a minimum of 6 credits of free elective courses. Students need to pass an English Exam, with minimum level of English of TOEFL PBT 525/CBT 196/ IBT 70/IELTS 5.5/TOEIC 620 or Pass the ICT exit exam.

(2) Have the cumulative grade point average of at least 2.00 at the completion of the program.

(3) Spend less than 8 years of study

(4) Have no debt obligations with Mahidol University

(5) Have honor of students

(6) Follow the announcement by Program Faculty Members

3.2 To recognize the outstanding achievements, students who maintain a high scholastic GPA are eligible for graduation with the following honors. *First Class Honor:* Earn a cumulative GPA of 3.50 or higher. *Second Class Honor:* Earn a cumulative GPA of 3.25 or higher, but less than 3.50. Never receive an 'F', 'W' or 'I' grade for any course. Never regrade any course. Complete all the required courses within 4 years since initial registration.

3.3 To request for graduation, students must meet the following requirements.

(1) Be students who registered and received passing grade in all courses as required in the program study plan

(2) Pass the requirement of core courses and core activities as required by the Faculty and Mahidol University

(3) Pass the English proficiency requirement required by the Faculty.

(4) Students who satisfy with requirement (1) and (2) can submit a request form for graduation to the Office of Registrar within the deadline provided by the University. Otherwise, they will not be considered to graduate within that academic semester.

4. **Student Appeal**

(1) Follow the Mahidol University Regulation about student discipline year 2010 Section 3.

(2) All ICT students have channels to appeal the course assessment, teaching methods, or any requests by filling the General Request form (available at the Faculty's reception desk and online at https://www.ict.mahidol.ac.th/en/?page_id=3625) and submitting the form to academic affair of the Faculty of ICT.

Section 6: Academic Staff Development

1. **Preparatory activities for new academic staff members**
    (1) Have an orientation for new lecturers to introduce how to be professional lecturer and provide information about the policy of the Faculty and University.
    (2) Support new lecturers to actively expand their knowledge and experience in teaching and research.
    (3) Arrange the teaching load in which new lecturers will be co-teaching with experienced lecturers. So that, senior lecturers can support and advise new lecturers about teaching method in a particular course.

2. **Knowledge and skills development for academic staff**
    2.1 **Teaching and evaluation skills development**
    (1) Give a lecture, seminar or workshop about teaching and learning management including teaching, measurement, and assessment techniques.
    (2) Evaluate teaching skills and record them after class. Analyze the result to improve teaching skills.
    (3) Support academic staff to do research in the area of education

    2.2 **Academic and professional career development**
    (1) Encourage academic staff to participate in academic services such as developing a service and passing on their knowledge to the society.
    (2) Encourage academic staff to conduct more research and use their research publications in their teaching method.
    (3) Support academic staff to participate in several events such as academic services, conference both national and international.

Appendix 1

1. **Program Learning Outcomes (PLOs), Stream Learning Outcomes (SLOs), and Sub-Learning Outcomes (SubLOs)**

<u>Table Appendix 1.1</u>   PLOs, SLOs, and SubLOs

PLOs	SubLOs
PLO1 Effectively communicate the basic knowledge of computer science, mathematics, science, social science, humanities, healthy living, economic and finance with other people.	1.1 List concepts related to the context of learned issues/topics to others. 1.2 Exemplify concepts related to the context of learned issues/topics to others. 1.3 Explain concepts related to the context of learned issues/topics to others.
PLO2 Use systematic approaches by critically thinking at multiple levels of abstraction and solving problems under the context in which a computer system (will) operates (ICT disciplinary skills).	2.1 Identify problems related to ICT subject matter. 2.2 Identify possible solutions of given problems using computer software/hardware technologies with awareness of limitations and constraints. 2.3 Implement a solution using computer software/hardware technologies to solve given problems.
PLO3 Demonstrate abilities to study and work both independently and collaboratively.	3.1 Identify reliable sources of required information and knowledge. 3.2 Discuss knowledge from self-studying. 3.3 Use self-studied knowledge to solve problems. 3.4 Demonstrate abilities to work as a team and manage projects.
PLO4 Recognize the individual, social, and ethical responsibilities of a professional working in ICT-related disciplines.	4.1 Demonstrate honesty, integrity, responsibility, morality, and accountability. 4.2 Identify the code of ICT-related ethics (e.g. policy, law). 4.3 Express the awareness of business, social, security, professional, and ICT-related ethics.

PLOs	SubLOs
PLO5 Demonstrate effective command of the English language for professional communication.	5.1 Use correct English grammar and appropriate vocabulary for communication at university level. 5.2 Demonstrate abilities to communicate in English language for everyday life. 5.3 Effectively convey ICT-related concept and knowledge in English in working environment.
SLO6 Use knowledge and skills in one or more of the selective tracks related to ICT career paths to a wide range of applications in real world. The selective tracks include Computer Science, Databases and Intelligent Systems, E-Business Systems, Multimedia Systems, Software Engineering, Health Information Technology, Computer Network, and Management Information Systems.	6.1 Identify the knowledge in the selected tracks. 6.2 Discuss the knowledge in the selected tracks. 6.3 Select and use techniques&methods from the selected tracks to solve track-related problems.
SLO7 Apply computer science knowledge and skills to scope, design, and implement ICT-based solutions to more open problems with the awareness of advanced technologies.	7.1 Identify possible solutions of the problems using computer software/hardware. technologies with awareness of advanced technologies. 7.2 Select and implement an appropriate solution that is competitive in the university level.
SLO8 Carry out research practices in ICT-based topics under a supervision of experienced researchers with the awareness of cutting-edge technologies.	8.1 Comprehend a given research problem. 8.2 Survey existing solutions that solve the given research problems. 8.3 Analyze, design, and develop solutions for research problems. 8.4 Evaluate the solutions. 8.5 Prepare a research paper for publication.

PLOs	SubLOs
SLO9 Carry out professional practices and skills to learn and work beyond classroom.	9.1 Use ICT professional skills to work in organizations such as business, government, or academic institutes.
	9.2 Identify learning gaps.
	9.3 Set learning goals.
	9.4 Prepare learning plan to address the gaps.

2.   Relationship between PLOs & SLOs and desired graduates' attributes of Mahidol
      University

<u>Table Appendix 1.2</u> Relationship between PLOs & SLOs and desired graduates attributes of
              Mahidol University

Learning Outcomes / 4 MU Graduate Attributes	PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
T-Shaped Breath & Depth	✓	✓			✓	✓			
Globally Talented							✓	✓	✓
Socially Contributing				✓			✓		
Entrepreneurially Minded			✓						

Appendix 2

1.   Curriculum Mapping

<u>Table Appendix 2.1</u> Curriculum Mapping

Course Code and Name	Number of Credits	Learning Outcomes (LOs)								
		Program Learning Outcomes					Stream Learning Outcomes			
		PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
A. General Education Courses 30 Credits										
Social Science and Humanity 8 Credits										
1 SHSS 103 Man and Society	2(2-0-4)	I			I					
2 SHSS 107 Society and Health	2(2-0-4)	I			I					
3 SHHU 108 Human Relations and Self Development	2(2-0-4)	I		I	I					
4 SHHU 116 Comparative Culture	2(2-0-4)	I		I	I					
5 ITGE 101 Problem Solving Techniques	2(1-2-3)	I	I	I				I	I	I
6 ITGE 301 Communication Strategies in Professional Life	2(2-0-4)	R		I		R				I
Science and Mathematics 9 Credits										
1 SCCH 100 Integrated Chemistry	3(3-0-6)	I								
2 SCBI 109 Integrated Biology	3(3-0-6)	I								
3 ITCS 161 Physical Science and Computation	3(3-0-6)	I								
Language 12 Credits										
1 ITLG 101 Technical English I	2(1-2-3)					I				
2 ITLG 102 Technical English II	2(1-2-3)					R				
3 ITLG 103 Technical English III	2(1-2-3)					R				
4 ITLG 104 Elementary German I	2(1-2-3)	I				I				
5 ITLG 105 Elementary German II	2(1-2-3)	I				R				
6 ITLG 106 Elementary Japanese I	2(1-2-3)	I				I				
7 ITLG 107 Elementary Japanese II	2(1-2-3)	I				R				

Course Code and Name		Number of Credits	Learning Outcomes (LOs)								
			Program Learning Outcomes					Stream Learning Outcomes			
			PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
8	ITLG 108 Elementary Chinese I	2(1-2-3)	I				I				
9	ITLG 109 Elementary Chinese II	2(1-2-3)	I				R				
10	ITLG 110 Elementary Chinese III	2(1-2-3)	I				R				
11	ITLG 201 Reading Skills	2(1-2-3)					I			I	
12	ITLG 202 Public Speaking and Presentation	2(1-2-3)	I				R				
13	ITLG 301 Business Writing	2(1-2-3)					R				
13	ITLG 302 Academic Writing	2(1-2-3)	R				M/A			R	
14	ITLG 303 Listening and Speaking I	2(1-2-3)	I				R				
15	ITLG 304 Listening and Speaking II	2(1-2-3)	I				R				
16	ITLG 305 Advanced Reading	2(1-2-3)					M				
17	ITLG 306 Special Topics in Reading and Writing	2(1-2-3)					R				
	Health and Physical Education 1 Credits										
1	MSMS 107 Film Appreciation	2(2-0-4)		I							
2	MSID 101 Music Appreciation	2(1-2-3)		I							
3	ITGE 141 Digital Photography	1(0-2-1)	I	I							
4	ITGE 142 Digital Drawing and Painting	1(0-2-1)	I	I							
5	ITGE 143 Dancing for Social and Health	1(0-2-1)		I							
6	ITGE 144 Beginning Golf	1(0-2-1)		I							
B. Subject Specific Courses 93 Credits											
	Core courses 12 Credits										
1	ITCS 125 Applied Statistics for Computing	3(3-0-6)	I							I	
2	ITCS 175 Advanced Mathematics I for Computer Science	3(3-0-6)	I	I							
3	ITCS 306 Numerical Methods	3(3-0-6)	I								
4	ITCS 320 Discrete Structures	3(3-0-6)	I								
	Required Courses 69 Credits										
1	ITCS 201 Fundamentals of Programming	3 (2-2-5)	I	I					I	I	
2	ITCS 209 Object Oriented Programming	3 (2-2-5)	I	I					I	I	
3	ITCS 212 Web Programming	3 (2-2-5)	R	R					I		I

	Course Code and Name	Number of Credits	Learning Outcomes (LOs)								
			Program Learning Outcomes					Stream Learning Outcomes			
			PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
4	ITCS 211 Introduction to Digital Systems	3(3-0-6)	I	I							
5	ITCS 222 Computer Organization and Architecture	3(3-0-6)	I	I							
6	ITCS 231 Data Structures and Algorithm Analysis	3(3-0-6)	I	I							
7	ITCS 241 Database Management Systems	3(3-0-6)	I	I							
8	ITCS 323 Computer Data Communication	3(3-0-6)	R	R							
9	ITCS 335 Introduction to E-business Systems	3(3-0-6)	R	R	I	I		I			R
10	ITCS 337 Human Computer Interaction	3(3-0-6)	R	R	R	R			I		R
11	ITCS 343 Principle of Operating Systems	3(3-0-6)	R	R							
12	ITCS 361 Management Information Systems	3(3-0-6)	R	R	R			I			
13	ITCS 371 Introduction to Software Engineering	3(3-0-6)	R	R	R			I	R	R	
14	ITCS 381 Introduction to Multimedia Systems	3(3-0-6)	R	R				I			
15	ITCS 402 Computer and Business Ethics	3(3-0-6)	R			M					
16	ITCS 414 Information Storage and Retrieval	3(3-0-6)	R	R							
17	ITCS 420 Computer Networks	3(3-0-6)	R	R				I			
18	ITCS 424 Wireless and Mobile Computing	3(3-0-6)	R	R				I			
19	ITCS 443 Parallel and Distributed Systems	3(3-0-6)	R	R							
20	ITCS 451 Artificial Intelligence	3(3-0-6)	R	R				I			
21	ITCS 461 Computer and Communication Security	3(3-0-6)	R	R		R					
22	ITCS 491 Senior Project I	3(0-6-3)	M	M	M	M	M	M	M	M	
23	ITCS 492 Senior Project II	3(0-6-3)	M/A	M/A	M/A	M/A	M/A	M/A	M/A	M/A	

	Specialty 8 Track Courses 12 Credits										
	(1) Database and Intelligent Systems										
1	ITCS 413 Database Design	3(3-0-6)	R	R				R	R	R	
2	ITCS 431 Software Design and Development	3(3-0-6)	R	R	R			R	R		
3	ITCS 452 Knowledge-Based Systems	3(3-0-6)	R	R				M/A	R	R	
4	ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R				R	R	R	
5	ITCS 455 Natural Language Processing	3(3-0-6)	R	R				M	M		
6	ITCS 456 Machine Learning and Intelligent Systems	3(3-0-6)	R	R				R	M	R	
7	ITCS 457 Decision Support and Business Intelligent Systems	3(3-0-6)	R	R				M	R	R	
8	ITCS 476 Digital Image Processing	3(3-0-6)	R	R				M			
9	ITCS 495 Special Topics in Databases and Intelligent Systems	3(3-0-6)	M	M				M	M	M	
	(2) Multimedia Systems										
1	ITCS 481 Computer Graphics	3 (3-0-6)	R	R				R	R	R	
2	ITCS 484 Computer Animation	3 (2-2-5)	R	R	R	R		M	M	R	
3	ITCS 485 Multimedia Information Systems	3(3-0-6)	R	R				R			
4	ITCS 486 Multimedia Data Technologies	3(3-0-6)	R	R				R			
5	ITCS 487 Multimedia Authoring and Production	3(3-0-6)	R	R				R	R		
6	ITCS 488 Multimedia Development and Deployment	3(3-0-6)	R	R				R			
7	ITCS 496 Special Topics in Multimedia Systems	3(3-0-6)	M	M				M	M	M	
	(3) Electronic Business Systems										
1	ITCS 431 Software Design and Development	3(3-0-6)	R	R	R			R	R	R	
2	ITCS 433 Production, Supply Chain and Logistics Management	3(3-0-6)	R	R	R			R	M	R	
3	ITCS 435 Business Decision Analysis	3(3-0-6)	M	M	M	M		M	M	M	
4	ITCS 438 E-Business Modeling and Development	3(3-0-6)	R	R				M			
5	ITCS 439 E-Customer Relationship Management	3(3-0-6)	R	R				R	R	R	
6	ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R				R	R	R	
7	ITCS 457 Decision Support and Business Intelligent Systems	3(3-0-6)	R	R				M	R	R	
8	ITCS 494 Special Topics in Electronics Business	3(3-0-6)	M	M				M	R	R	

TQF2 Bachelor of Science in Information and Communication Technology (International Program)

	(4) Computer Networks										
1	ITCS 422 Local Area Networks	3(3-0-6)	R	R				R	R	R	
2	ITCS 423 Telecommunication	3(3-0-6)	R	R		R		R		R	
3	ITCS 428 Network Programming	3(3-0-6)	R	R				M	M	R	
4	ITCS 429 Computer Forensics	3(3-0-6)	R	R		M		M			
5	ITCS 465 Network Management	3(3-0-6)	M	M	M			M	M	M	
6	ITCS 493 Special Topics in Computer Networks	3(3-0-6)	M	M				M	R	R	
	(5) Software Engineering										
1	ITCS 379 Practical Software Engineering	3(3-0-6)	M	M				M	M	M	
2	ITCS 431 Software Design and Development	3(3-0-6)	R	R	R			R	R	R	
3	ITCS 471 Software Requirement Analysis and Specification	3(3-0-6)	R	R				M	R	R	
4	ITCS 472 Software Metrics	3(3-0-6)	R	R				R	R	R	
5	ITCS 473 Software Quality Assurance and Testing	3(3-0-6)	R	R				M	R	R	
6	ITCS 490 Special Topics in Software Engineering	3(3-0-6)	M	M				M	R	R	
	(6) Computer Science										
1	ITCS 331 Organization of Programming Languages	3(3-0-6)	R	R				R		R	
2	ITCS 413 Database Design	3(3-0-6)	R	R				R	R	R	
3	ITCS 425 Algorithms	3(3-0-6)	R	R				M	R	R	
4	ITCS 431 Software Design and Development	3(3-0-6)	R	R	R			R	R	R	
5	ITCS 440 Principles of Compiler Design	3(3-0-6)	M	M				M		M	
6	ITCS 447 Embedded Systems and Internet of Things	3(3-0-6)	R	R				M	M		
7	ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R				R	R	R	
8	ITCS 475 Mathematical Programming	3(3-0-6)	R	R				R		R	
9	ITCS 481 Computer Graphics	3 (3-0-6)	R	R				R	R	R	
10	ITCS 498 Special Topics in Computer Science	3(3-0-6)	M	M				M	R	R	
	(7) Health Information Technology										
1	ITCS 403 Introduction to Healthcare Systems	3(3-0-6)	R	R				R	R	R	
2	ITCS 404 Information Technology for Healthcare Services	3(3-0-6)	M	M		M		M	M	M	
3	ITCS 405 Information Models and Healthcare Information Standards	3(3-0-6)	R	R		R		R		R	

4	ITCS 407 Practical Healthcare Management	3(2-2-5)	M	M		R			M/A	M	R	
5	ITCS 409 Special Topics in Healthcare Systems	3(3-0-6)	M	M					M	R	R	
6	ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R					R	R	R	
	(8) Management Information Systems											
1	ITCS 364 Knowledge Management	3(3-0-6)	R	R					R	R	R	
2	ITCS 365 Information Systems Analysis and Design	3(3-0-6)	M	M					M	M	M	
3	ITCS 366 Enterprise Architecture	3(3-0-6)	R	R		R			R	R	R	
4	ITCS 367 IT Infrastructure Management	3(3-0-6)	R	R					R	R	R	
5	ITCS 368 Information and Business Process Management	3(3-0-6)	R	R					R	R	R	
6	ITCS 408 Special Topics in Management Information Systems	3(3-0-6)	R	R					M	R	R	
7	ITCS 439 E-Customer Relationship Management	3(3-0-6)	R	R					R	R	R	
8	ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R					R	R	R	
9	ITCS 457 Decision Support and Business Intelligent Systems	3(3-0-6)	R	R					M	R	R	
C. Free Electives Courses 6 Credits												
	Free Electives Courses 6 Credits											
1	ITCS 159 Software Lab for Basic Scientific Problem Solving	1(0-2-1)	I	I								
2	ITCS 176 Advanced Mathematics II for Computer Science	3(3-0-6)	M	R								
3	ITID 273 Digital Accounting	3(2-2-5)	I									
4	ITID 274 Basic Accounting	3(3-0-6)	I									
5	ITID 275 Economics	2(2-0-4)	R									
6	ITID 276 Management	2(2-0-4)	I									
7	ITID 277 Digital Marketing	2(2-0-4)	R									
8	ITCS 391 Computer Network Lab	1(0-2-1)	R	R								
9	ITCS 392 Multimedia Systems Lab	1(0-2-1)	R	R								
10	ITCS 393 Database Systems Lab	1(0-2-1)	R	R								
11	ITCS 398 Cooperative Education	6(0-30-15)										M/A
12	ITCS 399 Internship	3(0-20-10)										M/A

13	ITCS 437 Project Management and Practice	3(3-0-6)	R	I	R	R					
14	ITCS 445 Data Science	3(3-0-6)	R	R				R	R	R	
15	ITCS 463 Modern Enterprise Resource Planning in Organization	3 (2-2-5)	R	R		R		R			
16	ITCS 497 Independent Study	3(3-0-6)			M						M/A
17	ITCS 499 Cloud Computing Systems, Services and Applications	3(3-0-6)	R	R				R	R	R	

I : Introduced   R : Reinforced and opportunity to practice
M : Mastery   A : Assessment evidence collected

Table Appendix 2.2 Curriculum Mapping according to program structure

Course Code and Name	Number of Credits	Learning Outcomes (LOs)								
		Program Learning Outcomes					Stream Learning Outcomes			
		PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
Year 1, Semester 1										
1 SCBI 109 Integrated Biology	3(3-0-6)	I								
2 SHHU 116 Comparative Culture	2(2-0-4)	I		I	I					
3 ITCS 320 Discrete Structures	3(3-0-6)	I								
4 ITCS 175 Advanced Mathematics I for Computer Science	3(3-0-6)	I	I							
5 ITGE 101 Problem Solving Techniques	2(1-2-3)	I	I	I				I	I	I
6 ITCS 201 Fundamentals of Programming	3 (2-2-5)	I	I					I	I	
7 ITLG 101 Technical English I	2(1-2-3)					I				
Year 1, Semester 2										
1 SHSS 103 Man and Society	2(2-0-4)	I			I					
2 SCCH 100 Integrated Chemistry	3(3-0-6)	I								
3 ITCS 211 Introduction to Digital Systems	3(3-0-6)	I	I							
4 ITCS 161 Physical Science and Computation	3(3-0-6)	I								
5 ITCS 209 Object Oriented Programming	3 (2-2-5)	I	I					I	I	
6 ITLG 201 Reading Skills	2(1-2-3)					I			I	

Course Code and Name	Number of Credits	Learning Outcomes (LOs)								
		Program Learning Outcomes					Stream Learning Outcomes			
		PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
7 ITCS 125 Applied Statistics for Computing	3(3-0-6)	I							I	
8 ITGE 141 Digital Photography	1(0-2-1)	I	I							
Year 2, Semester 1										
1 ITLG 102 Technical English II	2(1-2-3)					R				
2 ITCS 306 Numerical Methods	3(3-0-6)	I								
3 ITID 276 Management	2(2-0-4)	I								
4 ITCS 241 Database Management Systems	3(3-0-6)	I	I							
5 ITCS 222 Computer Organization and Architecture	3(3-0-6)	I	I							
6 ITCS 231 Data Structures and Algorithm Analysis	3(3-0-6)	I	I							
7 ITCS 159 Software Lab for Basic Scientific Problem Solving	1(0-2-1)	I	I							
Year 2, Semester 2										
1 ITLG 202 Public Speaking and Presentation	2(1-2-3)	I				R				
2 ITCS 323 Computer Data Communication	3(3-0-6)	R	R							
3 ITCS 381 Introduction to Multimedia Systems	3(3-0-6)	R	R				I			
4 ITCS 343 Principle of Operating Systems	3(3-0-6)	R	R							
5 ITCS 212 Web Programming	3 (2-2-5)	R	R					I		I
6 ITGE 301 Communication Strategies in Professional Life	2(2-0-4)	R		I		R				I
7 ITCS 335 Introduction to E-business Systems	3(3-0-6)	R	R	I	I		I			R
Year 3, Semester 1										
1 ITLG 301 Business Writing	2(1-2-3)					R				
2 ITCS 371 Introduction to Software Engineering	3(3-0-6)	R	R	R			I	R	R	
3 ITCS 414 Information Storage and Retrieval	3(3-0-6)	R	R							
4 ITCS 420 Computer Networks	3(3-0-6)	R	R				I			
5 ITCS 451 Artificial Intelligence	3(3-0-6)	R	R				I			

Course Code and Name	Number of Credits	Learning Outcomes (LOs)								
		Program Learning Outcomes					Stream Learning Outcomes			
		PLO1	PLO2	PLO3	PLO4	PLO5	SLO6	SLO7	SLO8	SLO9
6 ITCS 443 Parallel and Distributed Systems	3(3-0-6)	R	R							
7 ITCS 361 Management Information Systems	3(3-0-6)	R	R	R			I			
Year 3, Semester 2										
1 ITLG 302 Academic Writing	2(1-2-3)	R				M/A			R	
2 ITCS 424 Wireless and Mobile Computing	3(3-0-6)	R	R				I			
3 ITCS 461 Computer and Communication Security	3(3-0-6)	R	R		R					
4 ITCS 337 Human Computer Interaction	3(3-0-6)	R	R	R	R			I		R
5 ITCS 391 Computer Network Lab	1(0-2-1)	R	R							
Specialty 8 Track Courses										
6 ITCS 431 Software Design and Development	3(3-0-6)	R	R	R			R	R	R	
7 ITCS 453 Data Warehousing and Data Mining	3(3-0-6)	R	R				R	R	R	
8 ITCS 481 Computer Graphics	3 (3-0-6)	R	R				R	R	R	
9 ITCS 486 Multimedia Data Technologies	3(3-0-6)	R	R				R			
10 ITCS 439 E-Customer Relationship Management	3(3-0-6)	R	R				R	R	R	
11 ITCS 422 Local Area Networks	3(3-0-6)	R	R				R	R	R	
12 ITCS 423 Telecommunication	3(3-0-6)	R	R		R		R		R	
13 ITCS 472 Software Metrics	3(3-0-6)	R	R				R	R	R	
14 ITCS 413 Database Design	3(3-0-6)	R	R				R	R	R	
15 ITCS 403 Introduction to Healthcare Systems	3(3-0-6)	R	R				R	R	R	
16 ITCS 367 IT Infrastructure Management	3(3-0-6)	R	R				R	R	R	
17 ITCS 368 Information and Business Process Management	3(3-0-6)	R	R				R	R	R	
18 ITCS 398 Cooperative Education	6(0-30-15)									M/A
19 ITCS 399 Internship	3(0-20-10)									M/A
20 ITCS 497 Independent Study	3(3-0-6)			M						M/A

No	Course	Credit	1	2	3	4	5	6	7	8
Year 4, Semester 1										
1	ITCS 402 Computer and Business Ethics	3(3-0-6)	R			M				
2	ITID 277 Digital Marketing	2(2-0-4)	R							
Specialty 8 Track Courses										
3	ITCS 457 Decision Support and Business Intelligent Systems	3(3-0-6)	R	R				M	R	R
4	ITCS 473 Software Quality Assurance and Testing	3(3-0-6)	R	R				M	R	R
5	ITCS 433 Production, Supply Chain and Logistics Management	3(3-0-6)	R	R	R			R	M	R
6	ITCS 405 Information Models and Healthcare Information Standards	3(3-0-6)	R	R		R		R		R
7	ITCS 447 Embedded Systems and Internet of Things	3(3-0-6)	R	R				M	M	
8	ITCS 428 Network Programming	3(3-0-6)	R	R				M	M	R
9	ITCS 484 Computer Animation	3 (2-2-5)	R	R	R	R		M	M	R
10	ITCS 365 Information Systems Analysis and Design	3(3-0-6)	M	M				M	M	M
11	ITCS 495 Special Topics in Databases and Intelligent Systems	3(3-0-6)	M	M				M	M	M
12	ITCS 496 Special Topics in Multimedia Systems	3(3-0-6)	M	M				M	M	M
13	ITCS 379 Practical Software Engineering	3(3-0-6)	M	M				M	M	M
14	ITCS 440 Principles of Compiler Design	3(3-0-6)	M	M				M		M
15	ITCS 404 Information Technology for Healthcare Services	3(3-0-6)	M	M		M		M	M	M
16	ITCS 465 Network Management	3(3-0-6)	M	M	M			M	M	M
17	ITCS 435 Business Decision Analysis	3(3-0-6)	M	M	M	M		M	M	M
18	ITCS 491 Senior Project I	3(0-6-3)	M	M	M	M	M	M	M	M
Year 4, Semester 2										
1	ITCS 492 Senior Project II	3(0-6-3)	M/A	M/A	M/A	M/A	M/A	M/A	M/A	M/A

I : Introduced R : Reinforced and opportunity to practice
M : Mastery A : Assessment evidence collected

Appendix 3

Bibliography of Program Faculty Members

1. **Name**: Assoc. Prof. Dr. Jarernsri L. Mitrpanont

Degree	Field of Study	University/Institution	Year of Graduation
B.Sc.	Physics	Mahidol University	1980
M.Sc.	Applied Mathematics	Mahidol University	1983
Ph.D.	Computer Science	Oklahoma State University	1993

Department   Faculty of Information and Communication Technology, Mahidol University

Research Interests

Database Systems, Artificial Intelligence, Knowledge-based Systems, Decision Support Systems

Academic Publications

- **Research Publications**
    (1) **Mitrpanont J**, Roungsuriyaviboon J, Sathapornwatanakul T, Sawangphol W, Kobayashi D, Haga J. Extending MedThaiVis-Thai medical research visualization to SAGE2 display walls. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017. [Best Paper Award].
    (2) **Mitrpanont J**, Sawangphol W, Vithantirawat T, Paengkaew S, Suwannasing P, Daramas A, Chen Y. A study on using python vs weka on dialysis data analysis. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017.
    (3) Tuarob S, **Mitrpanont JL**. Automatic discovery of abusive Thai language usages in social networks. In: the 19th International Conference on Asia-Pacific Digital Libraries (ICADL); 2017 Nov 13-15; Bangkok, Thailand; 2017.

(4) ดวงหทัย แพงจิกรี, ภูวเดช อินทร์ตะโคตร, **เจริญศรี มิตรภานนท์**, ฐิตินันท์ ตันติธรรม, ศุจิกา ศรีนันทกุล. การพัฒนาระบบเซ็นเซอร์ต้นแบบ ด้วย IR Proximity Sensor เพื่อตรวจจับระยะห่างที่ ปลอดภัยในการมองจอคอมพิวเตอร์. ใน: เอกสารการประชุมวิชาการระดับประเทศด้านเทคโนโลยี สารสนเทศ (National Conference on Information Technology: NCIT) ครั้งที่ 9; 1-2 พฤศจิกายน 2560. นครปฐม; 2560.

(5) Haga J, **Mitrpanont J**, Roungsuriyaviboon J, Sathapornwatanakul T, Sawangphol W, Kobayashi D, MedThaiSAGE: visualization of Thai medical research data on large tiled display walls. In: The Pacific Rim Application and Grid Middleware Assembly (PRAGMA33); 2017 Oct 16; Brisbane, Australia; 2017.

(6) **Mitrpanont J**, Atchaphan A, Rattanajung S, Chaiphadung S. Herbe-Herb database management system. In: the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.

(7) **Mitrpanont J**, Janekitiworapong N, Ongsritrakul S, Varasai S. MedThaiVis: an approach for Thai biomedical data visualization. In: the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.

(8) **Mitrpanont J**, Phandhu-Fung J, Klubdee N, Ratanalaor S, Pratiphakorn P, Damrongvanakul K, Chuanvaree P, Mitrpanont T. iCare-Stress: an integrated mental health software. In: the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.

(9) **Mitrpanont J**, Chongcharoen P. TH-WSD: Thai word sense disambiguation using cross language knowledge sources approach. International Journal of Computer Theory and Engineering Dec 2015;7(6):428.

- <u>Academic Articles</u>
  -

- <u>Books</u>
  -

- Other types of academic publications
  (1) Project leader for Mednacea: R2R Knowledge Map for Medical and Public Health CoP

Current Teaching Courses

ITCS	241	Database Management Systems	3 (3 – 0 – 6)
ITCS	367	IT Infrastructure Management	3 (3 – 0 – 6)
ITCS	411	Database Management Systems	3 (3 – 0 – 6)
ITCS	452	Knowledge-Based Systems	3 (3 – 0 – 6)
ITCS	457	Decision Support and Business Intelligent Systems	3 (3 – 0 – 6)

Teaching Courses in Revised Program

ITCS	241	Database Management Systems	3 (3 – 0 – 6)
ITCS	367	IT Infrastructure Management	3 (3 – 0 – 6)
ITCS	411	Database Management Systems	3 (3 – 0 – 6)
ITCS	452	Knowledge-Based Systems	3 (3 – 0 – 6)
ITCS	457	Decision Support and Business Intelligent Systems	3 (3 – 0 – 6)

2. **Name:**　　Lecturer Dr. Pattanasak Mongkolwat

Degree	Field of Study	University/Institution	Year of Graduation
B.Sc.	Computer Science	University of the Thai Chamber of Commerce	1988
M.Sc.	Computer Science	McNeese State University, USA	1991
Ph.D.	Computer Science	Illinois Institute of Technology, USA	1996

Department　　　　Faculty of Information and Communication Technology, Mahidol University

Research Interests

　　Medical and imaging Informatics, Software Engineering, Object-Oriented Programming

Academic Publications

(1) Owolabi M, Ogbole G, Akinyemi R, Salaam K, Akpa O, **Mongkolwat P**, and et al. Development and reliability of a user-friendly multicenter phenotyping application for hemorrhagic and ischemic stroke. Journal of Stroke and Cerebrovascular Diseases 2017 Jul;11:2662-70.

(2) Roongsangjan S, Sunetnanta T, **Mongkolwat P**. Using FCA implication to determine the compliance of model practice implementation for software process. In: the 2017 International Conference on Management Engineering, Software Engineering and Service Sciences (ICMSS); 2017 Jan 14-16; Wuhan, China; 2017.

(3) Dandamudi S, Collins JD, Carr JC, **Mongkolwat P**, Rahsepar AA, Tomson TT, Verma N, Arora R, Chicos AB, Kim SS, Lin AC, Passman RS, Knight BP. The Safety of cardiac and thoracic magnetic resonance imaging in patients with cardiac implantable electronic devices. Academic Radiology 2016 Dec;23(12):1489-1505.

(4) **Mongkolwat P**, Kleper V, Talbot S, Rubin D. The National Cancer Informatics Program (NCIP) Annotation and Image Markup (AIM) foundation model. J Digit Imaging 2014 Dec;27(6):692–701.

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(6) Magrath E, Pham DL, Chou YY, Afzal M, Rao A, **Mongkolwat P**, Latour L, Butman JA. Characterizing TBI radiology reads using the annotation and image markup platform. In: National Capital Area TBI Research Symposium; 2014 Mar; Bethesda, Maryland, USA; 2014.

- Academic Articles

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- Books

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- Other types of academic publications

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Current Teaching Courses

ITCS	403	Introduction to Healthcare Systems	3 (3 – 0 – 6)
ITCS	405	Information Models and Healthcare Information Standards	3 (3 – 0 – 6)
ITCS	476	Digital Image Processing	3 (3 – 0 – 6)

Teaching Courses in Revised Program

ITCS	403	Introduction to Healthcare Systems	3 (3 – 0 – 6)
ITCS	405	Information Models and Healthcare Information Standards	3 (3 – 0 – 6)
ITCS	476	Digital Image Processing	3 (3 – 0 – 6)

3. **Name:**   Lecturer Pagaporn Pengsart

Degree	Field of Study	University/Institution	Year of Graduation
B.Sc. (honors: 2)	Medical Technology	Mahidol University	1989
B.Sc.	Computer Science	Mahidol University	1992
M.Sc.	Computer Science	Mahidol University	1996

Department   Faculty of Information and Communication Technology, Mahidol University

Research Interests

Network Management, Health Information Technology

Academic Publications

- **Research Publications**
  (1) **Pengsart P**, Belo ARX, Vaz JX, Marques JBS, Junior E. ADFS Authentication for Healthcare System. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017.

- Academic Articles
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- Other types of academic publications
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Current Teaching Courses

ITCS	323	Computer Data Communication	3 (3 – 0 – 6)
ITCS	343	Principle of Operating Systems	3 (3 – 0 – 6)
ITCS	391	Computer Network Lab	1 (0 – 2 – 1)
ITCS	403	Introduction to Healthcare Systems	3 (3 – 0 – 6)
ITCS	404	Information Technology for Healthcare Services	3 (3 – 0 – 6)
ITCS	405	Information Models and Healthcare Information Standards	3 (3 – 0 – 6)
ITCS	422	Local Area Networks	3 (3 – 0 – 6)
ITCS	465	Network Management	3 (3 – 0 – 6)

Teaching Courses in Revised Program

ITCS	323	Computer Data Communication	3 (3 – 0 – 6)
ITCS	343	Principle of Operating Systems	3 (3 – 0 – 6)
ITCS	391	Computer Network Lab	1 (0 – 2 – 1)
ITCS	403	Introduction to Healthcare Systems	3 (3 – 0 – 6)
ITCS	404	Information Technology for Healthcare Services	3 (3 – 0 – 6)
ITCS	405	Information Models and Healthcare Information Standards	3 (3 – 0 – 6)
ITCS	422	Local Area Networks	3 (3 – 0 – 6)
ITCS	465	Network Management	3 (3 – 0 – 6)

4. **Name:**　　Lecturer Dr. Pawitra Chiravirakul

Degree	Field of Study	University/Institution	Year of Graduation
B.Sc. (honors. 1)	Information and Communication Technology	Mahidol University	2551
M.Sc.	Software Systems Engineering	University College London, United Kingdom	2553
Ph.D.	Computer Science	University of Bath, United Kingdom	2558

Department　　Faculty of Information and Communication Technology, Mahidol University

Research Interests

　　Cognitive Science, Human-computer Interaction and User Behavioural Model

Academic Publications

- **Research Publications**
  (1) Rakfukfon K, Siraphaibool S, Rattanadechaphitak S, **Chiravirakul P**. MySRT management system for senior project document repository and tracking. In: Proceedings of the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.

  (2) Pisalayon N, Sae-Lim J, Rojanasit N, **Chiravirakul P**. FINDEREST: identifying personal skills and possible fields of study based on personal interests on social media content. In: Proceedings of the 2017 Sixth International Student Projects Conference (ICT-ISPC); 2017 May 23-24; Skudai, Malaysia; 2017.

(3) Suwattananon N, Thongliam N, Wongwachirawanich N, **Chiravirakul P**. BeEvaluator: an online evaluation system with KPIs matching. In: Proceedings of the 2016 Fifth ICT International Student Project Conference (ICT-ISPC); 2016 May 27-28; Nakhon Pathom, Thailand; 2016.

(4) Wangskarn N, Siritantitam J, Meesri N, **Chiravirakul P**. Flowty-Flow: a web application for preparation and distribution of standard operating procedures. In: Proceedings of the 2016 Fifth ICT International Student Project Conference (ICT-ISPC); 2016 May 27-28; Nakhon Pathom, Thailand; 2016.

- Academic Articles
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- Books
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- Other types of academic publications
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Current Teaching Courses

ITCS	200	Fundamentals of Programming	3 (3 – 0 – 6)
ITCS	210	Web Programming	3 (3 – 0 – 6)
ITCS	241	Database Management Systems	3 (3 – 0 – 6)
ITCS	336	Human Computer Interface	3 (3 – 0 – 6)

Teaching Courses in Revised Program

ITCS	201	Fundamentals of Programming	3 (2 – 2 – 5)
ITCS	212	Web Programming	3 (2 – 2 – 5)
ITCS	241	Database Management Systems	3 (3 – 0 – 6)
ITCS	337	Human Computer Interface	3 (3 – 0 – 6)

5. **Name:**   Lecturer Dr.Wudhichart Sawangphol

Degree	Field of Study	University/Institution	Year of Graduation
B.Sc. (Honors. 1)	Information and Communication Technology	Mahidol University	2008
MIT (MIT Honors)	Software Engineering and Data Management	Monash University, Australia	2012
Ph.D.	Information Technology	Monash University, Australia	2017

Department   Faculty of Information and Communication Technology, Mahidol University

Research Interests

Artificial Intelligence, Description Logic, Ontology, Automated Reasoning, Optimisation, Data analysis

Academic Publications

- **Research Publications**

  (1) Mitrpanont J, Roungsuriyaviboon J, Sathapornwatanakul T, **Sawangphol W**, Kobayashi D, Haga J. Extending MedThaiVis-Thai Medical Research Visualization to SAGE2 Display Walls. In: the 2nd International Conference on Information Technology (InCIT), 2017 Nov 2-3; Nakhon Pathom, Thailand; 2017. [Best Paper Award].

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- <u>Academic Articles</u>
  - -

- <u>Books</u>
  - -

- <u>Other types of academic publications</u>
  - -

Current Teaching Courses

ITCS	101	Problem Solving Techniques	2 (1 – 2 – 3)
ITCS	210	Web Programming	3 (3 – 0 – 6)

Teaching Courses in Revised Program

ITCS	101	Problem Solving Techniques	2 (1 – 2 – 3)
ITCS	212	Web Programming	3 (2 – 2 – 5)