

## วิทยาลัยการคอมพิวเตอร์

### หลักสูตรวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ

#### ชื่อปริญญาและสาขาวิชา

ภาษาไทย	ชื่อเต็ม	วิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ
	ชื่อย่อ	วศ.บ. (วิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ)
ภาษาอังกฤษ	ชื่อเต็ม	Bachelor of Engineering in Artificial Intelligence and System Engineering
	ชื่อย่อ	B.Eng. in Artificial Intelligence and System Engineering

#### ปรัชญาของหลักสูตร

To be a creative driving force in engineering and innovation of highest quality in the university and worldwide.

#### ผลลัพธ์การเรียนรู้ของหลักสูตร

เนื่องจากเป็นหลักสูตร Sandbox ที่ไม่ได้มีรูปแบบของเนื้อหาตาม Format ของทางมหาวิทยาลัย ดังนั้นจึงไม่มีส่วนของ PLO (Program Learning Outcome) ทั้งนี้สิ่งที่เป็เป้าหมายของหลักสูตรนี้ ต้องการให้เกิดผลลัพธ์ดังนี้

วิศวกรผู้มีความรู้ เชี่ยวชาญ เฉพาะทางด้านวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ สามารถวิเคราะห์ ออกแบบ และพัฒนาระบบดิจิทัลปัญญาประดิษฐ์เพื่อนำไปประยุกต์ใช้งานให้อุตสาหกรรมด้านต่างๆ ได้อย่างเหมาะสม

โครงสร้างหลักสูตร

จำนวนหน่วยรวมตลอดหลักสูตร	360 หน่วย
<b>1. หมวดกลุ่ม Core technical fundamental</b>	<b>150 หน่วย</b>
<b>2.1 Artificial Intelligence Core</b>	<b>130 หน่วย</b>
<b>Programming Fundamentals</b>	<b>30</b>
AIC-101 Algorithmic Thinking	2
AIC-102 Intro to Programming	4
AIC-103 Advanced Imperative Programming	4
AIC-104 Object Oriented Programming*	4
AIC-105 Functional Programming*	4
AIC-106 Dataflow Programming*	4
AIC-107 Algorithms and Data Structures	8
*optional (ในกลุ่มนี้ required 18 หน่วย)	
<b>Mathematics for AI</b>	<b>40</b>
AIC-201 Probability and Statistics	12
AIC-202 Discrete Mathematics	12
AIC-203 Matrices and Linear Transformations	12
AIC-204 Data Domains   Time/Frequency Domain*	4
*optional, competency ชุดนี้สามารถนับชั่วโมงการเรียนรู้อื่นในกลุ่ม math/science (ในกลุ่มนี้ required 36 หน่วย)	
<b>Artificial Intelligence</b>	<b>18</b>
AIC-301 Logic-based Models	6
AIC-302 Probability-based Models*	4
AIC-303 Planning and Search Strategies	4
AIC-304 Neural Networks and Deep Learning and CNN	4
*optional (ในกลุ่มนี้ required 14 หน่วย)	
<b>Data Mining</b>	<b>12</b>
AIC-401 Information Extraction and Retrieval, Search and Indexing*	4
AIC-402 Proximity Measurement and Cluster Analysis*	4
AIC-403 Classification and Regression*	4
*optional	
<b>Machine Learning</b>	<b>14</b>
AIC-501 Supervised and Unsupervised Learning	6
AIC-502 Reinforcement Learning	4
AIC-503 Transformer Network	4
ต้องเรียนทุก competency	
<b>AI Applications</b>	<b>4**</b>

AIC-601	Recommendation Systems**	4
AIC-602	Natural Language Processing (NLP) **	4
AIC-603	Autonomous Agents**	4
AIC-604	Computer Vision**	4
	** เลือกเรียนเพียง 1 competency ซึ่งแนะนำให้สอดคล้องกับหัวข้อของงาน undergraduate R&D	
<b>2.2</b>	<b>Human - Centered Design</b>	<b>42 หน่วย</b>
	<b>Analysis and Presentation</b>	
HCD-101	Visualization	4
HCD-102	User Experience and Interface Design	4
HCD-103	User Interface Design and Evaluation*	6
HCD-104	Immersive Environments (AR/VR)*	6
	<b>Understanding Context of Use</b>	
HCD-201	Accessibility and Universal Design	4
HCD-202	User Research Methodologies & Data*	4
	<b>Design for Human-Machine Teaming</b>	
HCD-301	Ethics in Computer Engineering	2
HCD-302	Creating Explainable AI	4
HCD-303	Human Psychology for User Interface Design**	4
	<b>Engaging in Critical Oversight</b>	
HCD-401	Ethical Principles for AI (Fairness, Accountability, Transparency, Ethics) **	4
	* optional	
	** เป็น optional และสามารถนับเป็นชั่วโมงการเรียนรู้อื่นในหมวดกลุ่ม Arts, humanities, social science and communication	
<b>2.3</b>	<b>Scalable Systems</b>	<b>72 หน่วย</b>
	<b>Computing and Computer Fundamentals</b>	
SYS-101	Operating Systems Basics	8
SYS-102	Basic Computer Architecture	6
SYS-103	Web Architecture*	4
SYS-104	Storage and File Systems Fundamentals*	2
SYS-105	Networks*	4
	<b>Software Development and Maintenance</b>	
SYS-201	Software Engineering Processes	6
SYS-202	Software Testing*	4
SYS-203	Software System Design*	4
SYS-204	Designing and Implementing Data Base*	6
	<b>Computer System Fundamentals</b>	
SYS-301	Cyber-Physical Systems	4
SYS-302	Cloud Computing	4
SYS-303	Scalable Management of Data and Models*	4

SYS-304	Scalable Algorithms and Infrastructure*	4	
	<b>Big Data Systems</b>		
SYS-401	Parallel Computing	4	
SYS-402	Distributed Data Storage*	4	
SYS-403	Big Data Computing*	4	
	*optional		
<b>2.4</b>	<b>Modern Computer System</b>	<b>18</b>	<b>หน่วย</b>
	<b>Modern Computing</b>		
MCS-101	Modern Computing	3	
	<b>High Performance Computing</b>		
MCS-201	Hardware acceleration	6	
	<b>Internet of Things (IoT)</b>		
MCS-301	Data gathering	9	
<b>2.5</b>	<b>Entrepreneurship and Innovation</b>	<b>57</b>	<b>หน่วย</b>
	<b>Entrepreneurship</b>		
ENI-101	Intellectual Property	3	
ENI-102	Communication and Marketing	3	
ENI-103	Business Models and Funding	3	
	<b>Entrepreneurship with AI Applications*</b>		
ENI-201	Healthcare & medical management	12	
ENI-202	Tourism, hospitality and event management	12	
ENI-203	Food technology	12	
ENI-204	Smart cities	12	
	* ให้ผู้เรียนเลือกเพียง 1 competency ใน subdomain Entrepreneurship with AI Applications		
<b>2. หมวดกลุ่ม Arts, humanities, social science and communication66</b>			<b>หน่วย</b>
<b>2.1</b>	<b>Pillar Communication and Presentation</b>	<b>28</b>	<b>หน่วย</b>
COM-101	Research and Technical Writing	8	
COM-102	Creative Writing	8	
COM-103	Improviseational Acting	4	
COM-104	Graphics and Visual Storytelling	8	
<b>2.2</b>	<b>Pillar Arts, humanities and social science</b>	<b>72</b>	<b>หน่วย</b>
HAS-101	Sociology and Cultural Anthropology	9	
HAS-102	Social Psychology	9	
HAS-103	Political Studies	9	
HAS-104	Human Geography	9	
HAS-105	Global Histories	9	
HAS-106	History of Visual Arts	9	
HAS-107	History of Music	9	

HAS-108	Economics	9
<b>2.2 Pillar Soft Skills</b>		- หน่วย
SOF-101	Creative flexibility	Yes
SOF-102	Working flexibility	Yes
SOF-201	Human-centered focus	Yes
SOF-202	Respect for diversity	Yes
SOF-301	Social consciousness	Yes
SOF-302	Honesty	Yes
SOF-303	Fairness	Yes
SOF-304	Respect for privacy and confidentiality	Yes
SOF-401	Service orientation	Yes
SOF-402	Continuous improvement focus	Yes
SOF-501	Responsibility	Yes
SOF-502	Compliance with organizational norms	Yes
SOF-503	Time management	Yes
SOF-504	Quality focus	Yes
SOF-505	Professional awareness	Yes
SOF-506	Interpersonal relations	Yes
SOF-601	Motivation to learn	Yes
SOF-602	Active learning.	Yes
SOF-701	Attention	Yes
SOF-702	Respect and courtesy	Yes
SOF-703	Openness	Yes
SOF-704	Team spirit	Yes
<b>3. หมวดกลุ่ม Math and Science</b>		<b>90 หน่วย</b>
<b>3.1 Pillar Science</b>		<b>60 หน่วย</b>
SCI-101	Fundamentals of Biology*	12
SCI-102	Fundamentals of Chemistry	12
SCI-103	Physics I	12
SCI-104	Physics 2	12
SCI-105	Quantum Physics	12
* แนะนำ competency นี้สำหรับผู้เรียนที่เลือกหัวข้อ undergraduate research and development ที่เกี่ยวข้องกับ Biology		
<b>3.2 Pillar Mathematic</b>		<b>36 หน่วย</b>
MAT-101	Differential Equations and Approximation	12
MAT-102	Differential and Integral Calculus	12
MAT-103	Calculus in Three Dimensions	12
<b>4. หมวดกลุ่ม Undergraduate Research and Development</b>		<b>54 หน่วย</b>

URD-101 Undergraduate Research and development 1	18
URD-102 Undergraduate Research and development 2	18
URD-103 Undergraduate Research and development 3	18

## แผนการศึกษาตลอดหลักสูตร

### ปีที่ 1

#### ภาคการศึกษาที่ 1

MAT-101	Differential Equations and Approximation	12
MAT-102	Differential and Integral Calculus	12
SCI-103	Physics I	12
AIC-101	Algorithmic Thinking	2
AIC-102	Intro to Programming	4
SYS-102	Basic Computer Architecture	6
HCD-101	Visualization	4
ENI-101	Intellectual Property	3
ENI-102	Communication and Marketing	3
HAS-102	Social Psychology	9
SOF-101	Creative flexibility	
SOF-102	Working flexibility	

#### ภาคการศึกษาที่ 2

MAT-103	Calculus in Three Dimensions	12
SCI-104	Physics II	12
AIC-103	Advanced Imperative Programming	4
AIC-107	Algorithms and Data Structures	8
HCD-102	User Experience and Interface Design	4
SYS-101	Operating Systems Basics	8
MCS-101	Modern Computing	3
ENI-103	Business Models and Funding	3
HAS-108	Economics	9
SOF-201	Creative flexibility	
SOF-202	Working flexibility	

### ปีที่ 2

#### ภาคการศึกษาที่ 1

AIC-201	Probability and Statistics	12
AIC-202	Discrete Mathematics	12
MCS-201	Hardware acceleration	6
SYS-201	Software Engineering Processes	6
HCD-201	Accessibility and Universal Design	4
COM-101	Research and Technical Writing	8
HAS-105	Global Histories	9
HAS-106	History of Visual Arts	9
SOF-301	Social consciousness	
SOF-302	Honesty	

SOF-303 Fairness  
 SOF-304 Respect for privacy and confidentiality  
 SOF-401 Service orientation  
 SOF-402 Continuous improvement focus

### ภาคการศึกษาที่ 2

AIC-203	Matrices and Linear Transformations	12
MCS-301	Data gathering	9
SYS-301	Cyber-Physical Systems	4
SYS-302	Cloud Computing	4
ENI-204	Smart cities	12
HAS-107	History of Music	9
HAS-104	Human Geography	9
SOF-501	Responsibility	
SOF-502	Compliance with organizational norms	
SOF-503	Time management	
SOF-504	Quality focus	
SOF-505	Professional awareness	
SOF-506	Interpersonal relations	

### ปีที่ 3

#### ภาคการศึกษาที่ 1

AIC-301	Logic-based Models	6
AIC-303	Planning and Search Strategies	4
AIC-304	Neural Networks and Deep Learning and CNN	4
AIC-501	Supervised and Unsupervised Learning	6
AIC-502	Reinforcement Learning	4
AIC-503	Transformer Network	4
AIC-602	Natural Language Processing (NLP) **	4
HCD-301	Ethics in Computer Engineering	2
HCD-302	Creating Explainable AI	4
SYS-401	Parallel Computing	4
COM-103	Improvisational Acting	4
COM-104	Graphics and Visual Storytelling	8
SOF-601	Motivation to learn	
SOF-602	Active learning.	

#### ภาคการศึกษาที่ 2

URD-101	Undergraduate Research and development 1	18
URD-102	Undergraduate Research and development 2	18
URD-103	Undergraduate Research and development 3	18



## คำอธิบายรายวิชา

หลักสูตรวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ

<b>AIC-101</b>	<b>Algorithmic Thinking</b>	<b>2</b>
	Techniques for analyzing a program specification in order to design a solution	
<b>AIC-102</b>	<b>Intro to Programming</b>	<b>4</b>
	Programming constructions for conditional logic, iteration and other modifications of control flow	
	Programming constructions for dividing processing into reusable units	
	Reading and writing files containing text	
	Reading and writing non-text information	
	Fundamental data structuring techniques provided by most high level languages	
	Apply programming concepts learned in one language to another language	
<b>AIC-103</b>	<b>Advanced Imperative Programming</b>	<b>4</b>
	Principles for dividing functionality into components; overview of strategies used in different languages and environments to integrate multiple software components into a single applications	
	Combining multiple source modules into a single executable; approaches in different languages	
	Systems composed of multiple communicating component processes.	
	System architecture as a description of components and their methods of communication	
<b>AIC-104</b>	<b>Object Oriented Programming</b>	<b>4</b>
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<b>AIC-105</b>	<b>Functional Programming</b>	<b>4</b>
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<b>AIC-106</b>	<b>Dataflow Programming</b>	<b>4</b>
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<b>AIC-107</b>	<b>Algorithms and Data Structures</b>	<b>8</b>
	Lists and other sequential data structures	
	Tree-based structures and their applications	
	Many-to-many data structures and their applications, including important graph/network algorithms	
	Concepts and examples of recursion in programming solutions	
	Hash tables and related data structures	
<b>AIC-201</b>	<b>Probability and Statistics</b>	<b>12</b>

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**AIC-202 Discrete Mathematics**

**12**

Graphs as abstract models for architectures and processes in computing (e.g., networks, software dependencies)

Discretization as a means to transform differential equations (that model physical processes) into discrete equations that can be computed, analyzed, and used as a control system

**AIC-203 Matrices and Linear Transformations**

**12**

Vector and matrix manipulation and operations

Matrix decomposition methods such as matrix diagonalization and Singular Value Decomposition

The general concept of linear transformation

Understand eigenvectors and eigenvalues and their applications

Understand the definition of rank and nullity of matrices and linear transformation

How to formulate a set of linear equation into a matrix form and solve it

Least square minimisation method to find a solution to minimisation problem

**AIC-204 Data Domains | Time/Frequency Domain**

**4**

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**AIC-301 Logic-based Models**

**6**

Understand the concept of support vector machine (SVM)

Understand the concept of decision tree

Understanding the concept of K-Nearest Neighbours

**AIC-302 Probability-based Models**

**4**

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**AIC-303 Planning and Search Strategies**

**4**

Abstraction of problem solving as searching within a |space| of possible solutions

Rule-based and symbol-based approaches to solving problems, including backward chaining

Heuristic search techniques inspired by systems and organisms in nature

Problems modeling as a state space and a set of states that a problem can be in. Applying both uninformed and heuristics (informed) search algorithms to identify solution.

Case studies in Real-world settings consideration and how to apply planning & search strategies to the problem

**AIC-304 Neural Networks and Deep Learning and CNN**

**4**

Terminology for basic neural networks plus a review of their history in the AI literature

Concepts and mathematics of learning in NN using back-propagation  
Highlights of modern deep neural networks including CNN, RNN, GAN, transformers, reinforcement learning.

Understanding the concept of convolutional layers

The concept and benefit of pooling layers

Understand the structure of Convolutional Neural Networks

**AIC-401 Information Extraction and Retrieval, Search and Indexing 4**

**AIC-402 Proximity Measurement and Cluster Analysis 4**

**AIC-403 Classification and Regression 4**

Understand the concept of Risk/Loss function

Understand the definition of estimator and how to train these estimators

Understand how MLE works and how to find parameters of the model using MLE

Understand a definition of metrics and how they are different from loss

Understand the core concept of logistic regression

Basic reviews of probability and the definition of likelihood

**AIC-501 Supervised and Unsupervised Learning 6**

Definition of ML, concepts of training and testing data, distinction between supervised and unsupervised methods, etc.

Statistically-based supervised learning techniques including regression, SVM, and decision trees

Clustering, factor analysis and other unsupervised learning techniques

**AIC-502 Reinforcement Learning 4**

Definition of agents, actions, states, environments, observations, policy

**AIC-503 Transformer Network 4**

Understanding the concept of attention mechanism

Understanding the concept of encoder-decoder

**AIC-601 Recommendation Systems 4**

Understanding of taxonomy and basic concepts used to classify and analyze recommender algorithms; including Item-Content Matrix, User-Rating Matrix and Preferences

Defining measurement for the quality of a recommender system and relevant metrics including evaluation techniques, dataset partitioning, overfitting, error metrics, classification metrics and ranking metrics

Applying algorithms used to define similarity of user's preference based on content and its representation including Cosine Similarity, Matrix Notation, KNN, Item-Content Matrix and TF-IDF

Applying collaborative filtering (CF) techniques which uses user rating matrix (URM) as the primary input including user-based CF and item-based CF, and model-based vs memory-based consideration C

**AIC-602 Natural Language Processing (NLP) 4**

Deep learning for text classification and neural network architectures for NLPs (transformers, recurrent-neural network)

Basic lexical semantics and computation of co-occurrence matrices

Speech tagging and named entity recognition

**AIC-603 Autonomous Agents 4**

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**AIC-604 Computer Vision 4**

Understand fundamental concepts and representation of 'vision' in computing; bitmap, filter and related transformation

Object classification methods and algorithms used in computer vision; applying deep learning model such as resnet, vgg, and others.

Object detection and tracking using CNN, R-CNN and other relevant methods

Solving generative application with computer vision method such as GAN, scene compositions and other relevant methods

**HCD-101 Visualization 4**

Fundamental characteristics of human vision that affect visualization effectiveness

Dimensions of visual displays that can be manipulated to create effective visualizations

Rules of thumb for designing effective visualizations

An introduction to issues involved in visualizing relationships in data sets of various types

**HCD-102 User Experience and Interface Design 4**

Techniques for understanding and documenting the goals of a user in using a proposed system, and the interactions that might be used to achieve those goals

Techniques for designing and analyzing survey tools to acquire information about potential users

Dimensions of difference between users that may influence UI design including language, culture, gender, age, education, disabilities, etc. Techniques for designing inclusive user experiences that take this diversity into account.

What do we mean by user experience, what are its dimensions, and how can a UI be designed to create a positive user experience?

Principles of cognitive and social psychology that influence ease of use, attractiveness and satisfaction in user experience

General rules of thumb for designing UIs that provide a positive user experience.

**HCD-103 User Interface Design and Evaluation 6**

Overview of the process for designing and developing a user interface

Techniques for creating and testing mockups of a user interface with different levels of fidelity

Survey of the many techniques for creating user interfaces and discussion of development strategies that apply across all techniques

Techniques for evaluating the quality of a user interface, focusing on usability testing but also considering other dimensions.

**HCD-104 Immersive Environments (AR/VR) 6**

Introduction, Background, Usage, Hardware, Software

Fundamental Experiential and Visual Concepts

VR Development and Scripting/Coding

AR Development and Scripting/Coding

MR Development and Scripting/Coding

Modelling and Animation

Implementing physics and special effects

Everything that follows context and immersion

Intelligent Virtual Agent (IVA) technologies

**HCD-201 Accessibility and Universal Design 4**

Exploration of what it means to make a user interface accessible, including a survey of the wide range of limitations an accessible interface must consider

Best practices for creating accessible web sites

Discussion of accessibility issues outside the domain of web applications

**HCD-202 User Research Methodologies & Data 4**

Learn how to validate your million-dollar startup ideas using renown methodologies like Lean Startup and Design Thinking. In this class, students will go through a series of hands-on exercises and learn to use different tools for testing their ideas. Get into groups (or go solo if you dare), identify market segments, validate customer needs, and test key assumptions to make sure that you build the right product for the right group of people. This class will also provide some basic training for tools that are essential to early startup entrepreneurs, i.e., tools like for UI/UX design, analytics, user testing, rapid prototyping, and landing page building which will be essential for your experiments.

**HCD-301 Ethics in Computer Engineering 2**

Understanding and applying the ACM code of Professional Ethics

**HCD-302 Creating Explainable AI 4**

Model explanation, visual explanation, global and local explanation

Explainability in model development process; transparent development and data collection

**HCD-303 Human Psychology for User Interface Design 4**

Industry-standard methods for how to approach the design of a user interface and key theories and frameworks that underlie the design of most interfaces you use today.

**HCD-401 Ethical Principles for AI (Fairness, Accountability, Transparency, Ethics) 4**

Definition of bias, identification of its negative aspects, discussion of its sources

Definition of transparency, consideration of factors that make AI systems non-transparent, identification of negative consequences

Who is responsible for AI system behavior and its outcomes, and how should that responsibility be enforced?

**SYS-101 Operating Systems Basics**

**8**

how single-address space kernels are used for real-time control, task management and inter-task communication

role of Linux in all forms of computing: file system layout and common utilities

**SYS-102 Basic Computer Architecture**

**6**

understand Instruction Set Architecture (ISA), basics of assembly code

External interface, polling versus interrupts, analog interfaces (debouncing), PWM

use of hardware timers and their place in software

**SYS-103 Web Architecture**

**4**

Web application development; including JS/TypeScript and frontend development (HTML/CSS)

Component-based application development (e.g. React/Svelte)

Building block for web services and protocols; including REST API / GraphQL / JSON; and scalable design using caching, load-balancing, CDN

**SYS-104 Storage and File Systems Fundamentals**

**2**

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**SYS-105 Networks**

**4**

Routing algorithms over LAN/WAN (e.g. OSPF, BGP)

Relevant network protocols including TCP/IP, HTTP; OSI design

Wireless networking, wifi, mobility & cellular, datalink

**SYS-201 Software Engineering Processes**

**6**

What is software engineering and why is it necessary and important?

Requirements analysis, use case analysis, feature tracing and other techniques for defining and documenting the problem a software system must solve

What is design and why is it important? levels of design; design tools and notations.

SCM concepts and tools and why they are important

Overview of software testing including types of testing, goals, tools, recommendations

Introduction to issues that arise in deployment and maintenance; introduction to DevOps and continuous integration

Why documentation is critical and suggestions for best practices

Introduction to different approaches for unifying and organizing software engineering processes including waterfall, Rational Unified Process, Extreme Programming, and Scrum

**SYS-202 Software Testing**

**4**

Principles and importance of software testing

Design and implementation of a software test plan

Common techniques and tools that are available for software testing

	How to test web and mobile applications	
<b>SYS-203</b>	<b>Software System Design</b>	<b>4</b>
	What is design and why is it important?	
	Designing the functionality to be provided by the system: use cases, logical flow, etc.	
	Designing the overall organization of system components	
	Designing how information in the system should be organized, stored, accessed and related to other information	
	Designing the computations to be done by the system	
	Understanding design documents created by others and using them to guide development.	
<b>SYS-204</b>	<b>Designing and Implementing Data Base</b>	<b>6</b>
	Entities, attributes, and relationships - how these can be expressed in tables with linked information	
	Concepts and guidelines for simple schema design, including SQL DDL	
	Retrieving information from a relational database using SQL, including joins and embedded queries	
	Inserting, updating and deleting information using SQL	
	Writing software modules that retrieve or store data in an RDBMS	
	Introduction to the NoSQL database paradigm	
	Survey of popular RDBMS and NoSQL databases, considering how to choose appropriate data storage for a project	
	Introduction to more advanced features of RDBMS: constraints, triggers, stored procedures, distributed data bases	
<b>SYS-301</b>	<b>Cyber-Physical Systems</b>	<b>4</b>
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<b>SYS-302</b>	<b>Cloud Computing</b>	<b>4</b>
	Cloud and virtualized infrastructure; Lifecycle-management for VM, containers and server-less computing;	
	Service orchestration using container-based (Kubernetes) or server-less (Function as a service) and using other cloud services	
	Consideration for cloud service model; SLAs, metering, SDN/SDS, and distributed data (center) management	
<b>SYS-303</b>	<b>Scalable Management of Data and Models</b>	<b>4</b>
	Big data modeling using various approaches including columnar table, graph data and vector space model	
	Working with data models and formats; data streams and data lakes; streaming feed data	
	Exploring various data management systems including key-value stores, semi-structured data, text and relational data management	
<b>SYS-304</b>	<b>Scalable Algorithms and Infrastructure</b>	<b>4</b>
	Parallel algorithm model and parallel programming paradigm	
	Asynchronous programming model; thread, channels, message passing and other relevant constructs	
<b>SYS-401</b>	<b>Parallel Computing</b>	<b>4</b>

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<b>SYS-402 Distributed Data Storage</b>	<b>4</b>
Physical storage systems and operations, including SSD, hard drives, NVMe and network interfaces	
File system, caching and integrity of storage system	
Management and organization of disk arrays; data redundancy	
Distributed File system and NAS. Scalable data stores. Evolution of large scale distributed storage system	
<b>SYS-403 Big Data Computing</b>	<b>4</b>
Big data architecture and distributed computing paradigm (Hadoop, Spark)	
Scalability challenge and distributed machine learning algorithm; Survey of distributed ML & querying system	
including SparkQL, GraphX, MLLib	
Distributed data pipeline implementation (e.g. Spark)	
<b>MCS-101 Modern Computing</b>	<b>3</b>
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<b>MCS-201 Hardware acceleration</b>	<b>6</b>
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<b>MCS-301 Data gathering</b>	<b>9</b>
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<b>ENI-101 Intellectual Property</b>	<b>3</b>
Great products in the blue ocean can lead to the first mover advantage, one of the critical strategies for innovative firms. How about a copycat? If the time to make the same product by other firms is too short, the competitive first mover advantage will not last long. We will learn the critical role of Intellectual Property in slowing down the competitors from doing me-too products and creating unhealthy competition.	
<b>ENI-102 Communication and Marketing</b>	<b>3</b>
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<b>ENI-103 Business Models and Funding</b>	<b>3</b>
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**ENI-201 Healthcare & medical management 12**

**ENI-202 Tourism, hospitality and event management 12**

**ENI-203 Food technology 12**

**ENI-204 Smart cities 12**

**COM-101 Research and Technical Writing 8**

- Sentences as expression of a single idea, compound sentences indicating logical relationships
- Logical structure of a paragraph; exposition patterns
- Determining the audience for and the purpose of your document; how this influences the document
- Strategies for generating and organizing the content of a document
- The parts and purposes of a research paper (journal article or thesis)
- Importance of a problem statement and strategies for writing an effective problem statement
- Contents and purpose of the literature review section and how to create it.
- Contents and purpose of methodology section and how to create it
- Contents and purpose of results/discussion/conclusion sections and how to create them.
- How to create a references section and how to cite references in the body of a paper

**COM-102 Creative Writing 8**

This will explore at least two of the meanings of the word matters as in is of importance, and as in things, concerns. Through reading and writing, and meeting with the authors of all the books they will be reading, students will discover and discuss how creative writing engages with the world around us while also learning some of the important techniques of writing creatively in various genres, including scriptwriting, fiction, nonfiction, and poetry. The class will read a wide variety of books, and students will have the opportunity to interact with the authors through public readings and classroom visits.

**COM-103 Improvisational Acting 4**

**COM-104 Graphics and Visual Storytelling****8**

Students will get to work as a team to write, produce, shoot, as well as edit several visual story assignments. This class also teaches useful skills for becoming a creative technological storytelling and how to think visually and aurally along with the aspects of mine-en-scene, classical continuity-style coverage, trans media, as well as temporal and spatial montage theory.

**HAS-101 Sociology and Cultural Anthropology****9**

Studying Sociology and Anthropology allows you to take different perspectives on how humans behave, interact and give meaning to their environment. You will examine societies past and present, how they are constructed and how they influence each other.

The course explores anthropological approaches to society, culture, history, and current events. Themes include social organization, ideology, religion, exchange, subsistence, gender, land use, ethnicity, ethnic conflict, and local/global interrelations. Students grapple with the intellectual and ethical challenges, both past and present, of anthropologists.

**HAS-102 Social Psychology****9**

Provide the student with a survey of the field of social psychology. Students will become familiar with the major theories of social psychology as well as the concepts and research methods used in this area. It is expected that students will gain a broader understanding of the complex social environment and how it impacts individual behavior.

**HAS-103 Political Studies****9**

Introduces the use and abuse of power in societal struggles for justice, equality, freedom, and the common good. It deals with issues, at the local, national and international levels, relating to government and governance, authority and legitimacy, equity and resource distribution, rights and responsibilities, and peace and conflict.

Then, we navigate the analysis of issues at the intersection of science, technology, public policy, and business. Cases drawn from antitrust and intellectual property rights; health and environmental policy; defense procurement and strategy; strategic trade and industrial policy; and R&D funding. Structured around theories of political economy, modified to take into account integration of uncertain technical information into public and private decision-making.

**HAS-104 Human Geography****9**

Human Geography examines the relationships among people, culture, and space. It is the study of spatial variations among cultural groups and the spatial functioning of societies at local, regional and global scales both within the United States and throughout the world. This course focuses on describing, analyzing and comparing the ways in which human attributes, cultural characteristics and structures, including population, demographics, migration, language, religion, popular and folk cultures, race, ethnicity, gender roles, political and economic systems, levels of development, resource management, and land use and urbanization, remain constant or vary around the world. Students examine the relationships among cultural and human patterns, economic activities, and the physical environment, analyze and interpret information from primary sources, and develop skills in writing appropriate for geography and the social sciences.

**HAS-105 Global Histories****9**

Human activity transcends political, geographical, and cultural boundaries. From wars to social movements, technological innovations to environmental changes, our world has long been an interconnected one. Acquiring the ability to understand such transnational and even worldwide processes is an indispensable part of any college education. This

course provides students with an opportunity to develop the skills and perspectives needed to understand the contemporary world through investigating its global history. All sections are comparable in their composition of lectures and recitations, required amounts of reading, and emphasis on written assignments as the central medium of assessment.

**HAS-106 History of Visual Arts** **9**

Have you ever felt that you liked an artwork but couldn't explain why? Do you have questions about art that you were always afraid to ask? This competency is conceived to give students the tools to feel at home when visiting a museum and talk about art in social, business and academic settings. It is organized over two semesters, but students can take only one of the two courses. Cultural History of the Visual Arts I (in the fall) covers the period from the 1500s to the 1800s and features masterpieces and lesser known works in Western and Non-Western art, organized chronologically and by theme

**HAS-107 History of Music** **9**

This competency will be an in-depth analytical study of music of the Medieval, Renaissance, and Baroque Periods. It will emphasize selected genres and forms by representative composers in order to trace the evolution of musical style and to clarify the main characteristics of these periods, to set the musical developments in broader cultural contexts, and to apply this knowledge to practical decisions made by today's musician.

**HAS-108 Economics** **9**

This is an introductory class to economics. The goal of this course is threefold: think like an economist, talk like an economist and use economic tools to analyze current and past issues in the business, financial and economic news. To accomplish these objectives, the emphasis of the course will be put on understanding basic economic models and applying them to real-life examples.

The first half of the class will focus on individual markets. We will study how resources are allocated through the driving forces of supply and demand, why markets can be a good way to organize economic activity, why markets can fail and what the government can do in those situations. The second half of the class will study the economy as a whole. We will learn how to measure the performance of the overall economy, investigate the forces that drive the economic activity both in the short- and long-run and discuss the potential and limitations of fiscal and monetary policies.

**SOF-101 Creative flexibility** **Y**

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**SOF-102 Working flexibility** **Y**

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**SOF-201 Human-centered focus** **Y**

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**SOF-202** **Respect for diversity** **Y**

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**SOF-301** **Social consciousness** **Y**

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**SOF-302** **Honesty** **Y**

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**SOF-303** **Fairness** **Y**

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**SOF-304** **Respect for privacy and confidentiality** **Y**

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**SOF-401** **Service orientation** **Y**

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**SOF-402** **Continuous improvement focus** **Y**

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**SOF-501** **Responsibility** **Y**

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**SOF-502** **Compliance with organizational norms** **Y**

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**SOF-503** **Time management** **Y**

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**SOF-504 Quality focus** **Y**

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**SOF-505 Professional awareness** **Y**

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**SOF-506 Interpersonal relations** **Y**

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**SOF-601 Motivation to learn** **Y**

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**SOF-602 Active learning** **Y**

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**SOF-701 Attention** **Y**

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**SOF-702 Respect and courtesy** **Y**

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**SOF-703 Openness** **Y**

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**SOF-704 Team spirit** **Y**

**SCI-101 Fundamentals of Biology 12**

This is an introductory course that provides the basis for further studies in biochemistry, cell biology, genetics and molecular biology. This course emphasizes the chemical principles underlying biological processes and cell structures as well as the analysis of genetics and heredity from a molecular perspective. This is the introductory biology course for all science and non-science majors.

**SCI-102 Fundamentals of Chemistry 12**

This course begins with a very brief survey of some fundamental principles of chemistry and a presentation of chemically interesting applications and sophisticated problems. These will form the basis for introducing the relationships between the structure of molecules and their chemical properties and behavior. The subject matter will include principles of atomic structure, chemical bonding, intermolecular interactions and molecular structures of organic and inorganic compounds including some transition metal complexes. Relevant examples will be drawn from such areas as environmental, materials, and biological chemistry.

**SCI-103 Physics I 12**

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**SCI-104 Physics II 12**

This is the second half of a two-semester calculus-based introductory physics sequence for engineering students. One fifth of the course covers waves, including standing and traveling waves, superposition, beats, reflection, and interference. Two fifths of the course cover electricity, including electrostatics and electric fields, Gauss' law, electric potential, and simple circuits. The remaining two fifths cover magnetism, including magnetic forces, magnetic fields, induction and electromagnetic radiation.

**SCI-105 Quantum Physics 12**

- Quantum computation representation
- Algorithms that can be applied on quantum circuits
- Potential applications used in quantum computing

**MAT-101 Differential Equations and Approximation 12**

Begins with a strengthening of our integration skills. We introduce three new techniques for use in different situations which, when combined with the Method of Substitution and Integration by Parts, allow us to integrate a wide variety of functions. We also extend the range of integration problems we are willing to consider, allowing discontinuities in the integrand, and integration over an interval of infinite extent.

Our second main theme is the study of differential equations, i.e. equations that involve the derivative of a function. To solve such an equation, i.e. to determine the unknown function, usually requires the computation of an integral. Differential equations are ubiquitous in the natural sciences and social sciences, because they are useful in modeling the behavior of systems over time. We will discuss how to write a mathematical model for a physical system, and also how to compute solutions for two fundamental types of equations.

Our third theme is that of Approximation. The idea of approximation shows up in numerical integration, and in Newton's method for finding an approximate root of a function. We shall also devote a substantial portion of the course to finding polynomial approximations to functions. To do so, we will develop the notions of an infinite sequence, and infinite series (a summation with infinitely many terms). We will discuss convergence of these series in terms of limits and derive tests for convergence. We will also see how many functions may be described in terms of a power series.

**MAT-102 Differential and Integral Calculus** **12**

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**MAT-103 Calculus in Three Dimensions** **12**

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**URD-101 Undergraduate Research and Development1** **18**

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**URD-102 Undergraduate Research and Development2** **18**

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**URD-103 Undergraduate Research and Development3** **18**

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## รายชื่ออาจารย์ประจำหลักสูตร

หลักสูตรวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ

- ภาคปกติ       ภาคสมทบ  
 หลักสูตรปกติ       หลักสูตรนานาชาติ       หลักสูตรภาษาอังกฤษ  
 หลักสูตรใหม่ พ.ศ. ....2566.....       หลักสูตรปรับปรุง พ.ศ.....

### 1. อาจารย์ผู้รับผิดชอบหลักสูตร (ส่วนงานมหาวิทยาลัยสงขลานครินทร์)

- 1.1 ผู้ช่วยศาสตราจารย์ ดร. วรรณรัช สันติอมรทัต, Ph.D. Computer Science, U of Manchester, UK, 2006.
- 1.2 ผู้ช่วยศาสตราจารย์ ดร. สกฤณา เจริญปัญญาศักดิ์, Ph.D. Institut National Polytechnique de Toulouse (INPT), France, 2008.
- 1.3 ดร. กุลจรี ดันตยกุล , Ph.D. in Computer Engineering, National Polytechnic Institute of Toulouse (ENSEEIH), France

### 2. อาจารย์ผู้รับผิดชอบหลักสูตร (ส่วนกลาง Sandbox สอวช. ภายใต้ AIEI)

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ผลลัพธ์การเรียนรู้ระดับหลักสูตร (PLOs) กลยุทธ์/วิธีการสอน และกลยุทธ์/วิธีการวัดและการประเมินผล

วิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ

ผลลัพธ์การเรียนรู้ระดับหลักสูตร (PLOs)	กลยุทธ์/วิธีการสอน	กลยุทธ์/วิธีการวัดและการประเมินผล
<p>วิศวกรผู้มีความรู้ เชี่ยวชาญ เฉพาะทางด้านวิศวกรรมปัญญาประดิษฐ์และระบบอัจฉริยะ สามารถวิเคราะห์ ออกแบบ และพัฒนาระบบดิจิทัลปัญญาประดิษฐ์เพื่อนำไปประยุกต์ใช้งานให้อุตสาหกรรมด้านต่างๆ ได้อย่างเหมาะสม</p>	<ol style="list-style-type: none"> <li>1. เรียนรู้ภาคทฤษฎีจากชั้นเรียนปกติ หรือ สามารถเลือกการเรียนรู้ได้ด้วยตัวเองผ่านช่องทางที่หลากหลายเช่น Coursera หรือ Mooc หรือในสถาบันการศึกษาชั้นนำทั่วโลก</li> <li>2. เรียนรู้จากโจทย์และการทำงานจริงร่วมกับภาคเอกชน มากกว่า 50% ของหลักสูตร</li> <li>3. รูปแบบการจัดการเรียนการสอนที่มีความยืดหยุ่น ทำให้ผู้เรียนสามารถเลือกได้อย่างเหมาะสมตามสมรรถนะของตนเอง</li> </ol>	<p>จัดทำ Level ของการประเมินในแต่ละ Topic / Skills ไว้อย่างชัดเจน โดยมีรายละเอียดของ 6 Level ดังนี้</p> <p>“1” – Describe</p> <p>“2” – Understand</p> <p>“3” – Apply</p> <p>“4” – Analyze</p> <p>“5” – Evaluate</p> <p>“6” – Create</p>