ROBOTICS AND ARTIFICIAL INTELLIGENCE ENGINEERING
(INTERNATIONAL PROGRAM)
(B.ENG)

Robotics and artificial intelligence engineering is an interdisciplinary engineering field that combines principles of mechanical, electrical, computer, system, and mechatronics engineering. It covers the advanced machine design with a computer-based controller, which is the mechatronics system concept. The advanced machine design with the advanced automatic control design would increase the system mechanism performance. Moreover, electrical engineering, computer-based automatic control, and artificial intelligence algorithm would enhance the system to be more intelligent and be able to complete complicated tasks.

Robotics and artificial intelligence engineering focuses on the advanced machine design, manufacturing process, and maintenance process consisting of mechanisms and electronic system. Thus, the system can be automatically operated and work with high precision. This system consists of system or plant, actuators, sensors, controllers, and intelligence. Therefore, robotics and artificial intelligence engineer would learn the knowledge on these components as well as industrial standard, industrial safety standard, and management process to effectively use the advanced machines.

Each student is required to accumulate a minimum of 146 credits to graduate for Bachelor of Engineering Program in Automotive Design and Manufacturing Engineering (International Program) which also includes 2 credits of industrial training and 3 credits of senior project.

Curriculum board

Viboon Sangveraphunsiri	Ph.D. (Georgia Tech)
Ratchatin Chancharoen	Ph.D. (Chula)
Phongsaen Pitakwatchara	Ph.D. (M.S.M.E.)
Manop Wongsaisuwan	D.Eng. (Tokyo Inst. Tech)
Attawith Sudsang	Ph.D. (Illinois)
Surat Kwanmuang	Ph.D. (Minnesota)
Nattee Niparnan	D.Eng. (Chula)
Gridsada Phanomchoeng	Ph.D. (Minnesota)

Professors

Mechanical Engineering

Pramote Dechaumphai	Ph.D. (Old Dominion)
Viboon Sangveraphunsiri	Ph.D. (Georgia Tech)

Associate Professors

Mechanical Engineering

Asi Bunyajitradulya	Ph.D. (UC Irvine)
Kuntinee Maneeratana	Ph.D. (London)
Ratchatin Chanchareon	D.Eng. (Chula)

Industrial Engineering

Somkiat Tangjitsitchareon	D.Eng. (Kobe Japan)

Metallurgical and materials Engineering

Seksak Asavavisithchai	Ph.D. (Nottingham)

Assistant Professors

Electrial Engineering

Wanchalerm Pora	Ph.D. (London)
Suree Pumrin	Ph.D.(Washington)

Mechanical Engineering

Boonchai Lertnuwat	Ph.D. (Tokyo)
Sunhapos Chantranuwathana	Ph.D. (Michigan)
Witaya Wannasuphoprasit	Ph.D. (Northwestern)
Nopdanai Ajavakom	Ph.D. (UC.Berkeley)
Niphon Wansophark	D.Eng. (Chula)
Alongkorn Pimpin	D.Eng. (Tokyo)
Chanat Ratanasumawong	D.Eng. (Tokyo Tech)
Thanyarat Singhanart	Ph.D. (Tokyo)

Industrial Engineering

Somchai Puajindanetr	Ph.D. (London)

Lecturer

Electrial Engineering

Boonchuay Supmonchai	M.Eng. (Chula)

Mechanical Engineering

Nuksit Noomwongs	D.Eng. (TUAT)
Chirdpun Vitooraporn	(MIT)
Tawan Paphapote	Ph.D.C.(USA)

Industrial Engineering

Oran Kittithreerapronchai	Ph.D. Georgia

ISE Staffs

Yan Zhao	Ph.D. (London)
Prabhath De Silva	Ph.D. (USA)

Guest lecturer

Somchai Peungperksuk	Ph.D.
Kaukeart Boonchukosol	Poitiers (Frence)

Visiting Professor (USA)

Stanley Peter Lynch	Ph.D. (UK)

Curriculum

Total number of credits requirement	135	credits
General Education	30	credits
Core Courses	99	credits
Basic Sciences	21	creditis
Basic Engineering	31	credits
Compulsory	50	credits
Approved Electives	24	credits
Free Electives	6	credits

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1. General Education **30 credits**

Social Science	3	credits
Humanity	3	credits
Science and Mathematics	3	credits
Interdisciplinary	3	credits
Foreign Language	12	credits
5501112 Communicative English I		3(3-0-6)
5501123 Communicative English II		3(3-0-6)
5501214 Communication and Presentation Skills		3(3-0-6)
5501225 Technical Writing		3(3-0-6)
General Education (Special)	6	credits
2147111* Exploring Robotics Engineering		3(3-0-6)
2147102* Introduction to Robotics Eng		3(3-0-6)

2. Core Course **99 credits**

Compulsory	73	credits
2301107 Calculus I		3(3-0-6)
2301108 Calculus II		3(3-0-6)
2147103* Discrete Mathematics		3(3-0-6)
2182203 Probability and Statistics for Eng		3(3-0-6)
2147204* Linear Algebra and Multivariable Calculus		3(3-0-6)
2190101 Computer Programming		3(3-0-6)
2147105* Data Structure and Algorithm		3(3-0-6)
2147206* Fundamentals of Digital Circuits		3(3-0-9)
2147307* Logic Design		3(3-0-6)
2304153 Physics for Engineers		3(3-0-6)
2304154 Physics and Electronics for Eng		3(3-0-6)
2304193 Physics Laboratory for Engineers		1(0-3-0)
2304194 Physics and Electronics Laboratory for Engineers		1(0-3-0)
2183212 Statics		3(3-0-6)
2183231 Dynamics		3(3-0-6)
2147308* Industrial Robot		3(3-0-6)
2147309* Mechatronics		3(3-0-6)
2183213 Mechanics of Materials		3(3-0-6)
2147310* Mechanical Engineering Design		3(3-0-6)
2147211* Engineering Design Process using CAD		3(3-0-6)
2147212* Robotic Project I		1(0-3-0)
2147213* Robotic Project II		3(0-6-3)
2147314* Robotic Project III		1(0-3-0)
2147315* Robotic Project IV		3(0-6-3)
2147416* Final Project I		3(0-6-3)
2147417* Final Project II		6(0-12-4)

Approved Electives 24 credits

Robots and Automation Design and Control

2147318*	Differential Equations for Dynamic Modelling and Simulation	3(3-0-6)
2147319*	Mechanics of Machinery	3(3-0-6)
2147320*	Feedback Control Systems	3(3-0-6)
2147321*	Modern Control and Digital Control Systems	3(3-0-6)
2147322*	Sensors and Actuators for Robotic and Automation	3(3-0-6)
2147323*	Machine Design and Automation Systems	3(3-0-6)
2183431	Mechanical Vibrations	3(3-0-6)
2147324*	Thermo-Fluid Mechanics	4(4-0-8)
2147325*	Introduction to Finite Element Analysis	3(3-0-6)
2147326*	Mobile Robots	3(3-0-6)

Robots, Digital Electronics and System

2182307*	Signals and Systems	3(3-0-6)
2147327*	Design of Microprocessor-Based Mechanical Systems	3(3-0-6)
2147328*	System Identification	3(3-0-6)
2147329*	Digital Image Processing and Vision Systems	3(3-0-6)

Robot, Computer and Artificial Intelligence

2147330*	Programming Methodology	3(3-0-6)
2147331*	Perception of Cognitive Robots	3(2-2-6)
2147332*	Artificial Intelligence	3(3-0-6)
2147333*	Cyber Physical Robotics	3(3-0-6)
2147334*	Machine Learning or Deep Learning	3(3-0-6)
2147335*	Virtual Reality and Augmented Reality	3(3-0-9)
2147336*	Internet of Things	3(3-0-6)

Manufacturing

2147237*	Manufacturing Workshop	1(0-3-0)
2147238*	Manufacturing Processes	3(3-0-6)
2189101	Engineering Materials	3(3-0-6)
2147239*	Materials in Daily Life	3(3-0-6)

Special Approved Electives

2147240*	Topics in Robotics Engineering I	3(3-0-6)
2147241*	Topics in Robotics Engineering II	3(3-0-6)
2147342*	Topics in Robotics Engineering III	3(3-0-6)
2147443*	Topics in Robotics Engineering IV	3(3-0-6)
2140301	Industrial Training	2(0-6-0)

3. Free Electives **6 credits**

Select 6 credits from any courses offered in English by any International Programs in Chulalongkorn University.

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COURSE NO.	SUBJECT	CREDITS
	FIRST SEMESTER	
2147103*	Discrete Mathematics	3
2190101	Computer Programming	3
2301107	Calculus I	3
2304153	Physics for Engineers	3
2304193	Physics Laboratory for Engineers	1
5501112	Communicative English	3
xxxxxxxx	General Education	3
		19
	SECOND SEMESTER	
2301108	Calculus II	3
2304154	Physics and Electronics for Engineers	3
2304194	Physics and Electronics Laboratory for Engineers	1
2182203	Probability and Statistics for Engineers	3
5501123	Communicative English II	3
2147105*	Data Structure and Algorithm	3
xxxxxxxx	General Education	3
		19
	THIRD SEMESTER	
2147204*	Linear Algebra and Multivariable Calculus	3
5501214	Communication and Presentation Skills	3
2147206*	Fundamentals of Digital Circuits	3
2183212	Statics	3
2147211*	Engineering Design Process using CAD	3
2147212*	Robotic Project I	1
xxxxxxxx	General Education	3
		19
	FOURTH SEMESTER	
5501225	Technical Writing	3
2183231	Dynamics	3
2147213*	Robotic Project II	3
xxxxxxxx	General Education	3
xxxxxxxx	Approved Elective	3
		15

COURSE NO.	SUBJECT	CREDITS
	FIFTH SEMESTER	
2183213	Mechanics of Materials	3
2147310*	Mechanical Engineering Design	3
2147314*	Robotic Project III	1
xxxxxxxx	General Education	3
xxxxxxxx	Approved Elective	3
xxxxxxxx	Approved Elective	3
		16
	SIXTH SEMESTER	
2147307*	Logic Design	3
2147308*	Industrial Robot	3
2147309*	Mechatronics	3
xxxxxxxx	General Education	3
2147315*	Robotic Project IV	3
		15
	SUMMER SEMESTER	
2140301	Industrial Training	2
	SEVENTH SEMESTER	
2147416*	Final Project I	3
xxxxxxxx	Approved Elective	3
xxxxxxxx	Approved Elective	3
xxxxxxxx	Approved Elective	3
xxxxxxxx	Free Elective	3
		15
	EIGHTH SEMESTER	
2147417*	Final Project II	6
xxxxxxx	Approve Electives	3
xxxxxxx	Approve Electives	3
xxxxxxx	Free Elective	3
		15
	TOTAL CREDITS FOR GRADUATION	**135**

ROBOTICS AND ARTIFICIAL INTELLIGENCE ENGINEERING (B.ENG)

General Education

2147111* Exploring Robotics Engineering 3(3-0-6)
Engineering topics related to daily life: energy, resources, environment manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering

2147102* Introduction to Robotics Engineering 3(3-0-6)
Introduction to varity types of robotics and their applications, build a basic robot and write a basic programing for a robot.

5501112 Communicative English I 3(3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123 Communicative English II 3(3-0-6) Condition: PRER 5501112*
Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned, and presenting opinions from group discussion.

5501214 Communication and Presentation Skills 3(3-0-6) Condition: PRER 5501123*
Practice using English for social communication and giving oral presentation on engineering related topics.

5501225 Technical Writing 3(3-0-6) Condition: PRER 5501123*
Practice in writing summaries composing different types and styles of writing in the field of engineering and writing reports of studies and experiments.

Core Course

2301107 Calculus 1 3(3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals.

2301108 Calculus 2 3(3-0-6) Condition: PRER 2301107
Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three-dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2147103* Discrete Mathematics 3(3-0-6)
This course covers elementary discrete mathematics for computer science and engineering. It emphasizes mathematical definitions and proofs as well as applicable methods. Topics include formal logic notation, proof methods; induction, well-ordering; sets, relations; elementary graph theory; integer congruence; asymptotic notation and growth of functions; permutations and combinations, counting principles; discrete probability. Further selected topics may also be covered, such as recursive definition and structural induction; state machines and invariants; recurrences; generating functions.

2182203 Probability and Statistics for Engineers 3(3-0-6)
Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: estimator, bias, consistency; point estimation; interval estimation; engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in engineering applications; case studies.

2147204* Linear Algebra and Multivariable Calculus 3(3-0-6) CONDITION: PRER 2301108
System of linear algebraic equations; linear spaces; inner products; eigenvalues and eigenvectors; principal axis theorem; higher-order linear differential equations; method of variation of parameters; system of first-order linear differential equations; qualitative analysis and dynamical system; Vector; curves, planes and surfaces; derivatives of vector-valued functions; partial, total and directional derivatives; implicit differentiation; maxima-minima; gradient, divergence, curl; scalar and vector fields; line integral; surface integral and volume integral; integral theorems of vector analysis.

2190101 Computer Programming 3 (3-0-6)
Computer concepts, computer system components, hardware and software interaction, electronic information and data processing concepts; programming: data types, operators, statements, control structures; programming tools; programming styles and conventions; debugging; program design and development with applications to engineering problems using a high-level language.

2147105* Data Structure and Algorithm 3(3-0-6) Condition: Prerequisite 2190101
Linear allocation: array, stack, queue, dequeues; linked allocation: singly linked lists, and doubly linked lists; trees: binary tree, traversal, representation, AVL-tree; heap storage, hash coding

2147206* Fundamentals of Digital Circuits 3(3-0-9)
Introduction to digital circuit design; synthesis of logic circuit; CAD tools and VHDL; standard chips, programmable logic devices and gate arrays; optimized implementation of logic functions; combinational circuit design; synchronous sequential circuit design; controller; digital system design; microcontroller; digital system design; microcontroller-based design.

2147307* Logic Design 3(3-0-6)
Number systems; logic gates and logic expressions; Boolean algebra: Karnaugh map and tabulation method; combination logic circuit and applications: adder, subtractor, multiple outputs circuit, decoder, encoder, multiplexer and demultiplexer; gate implementation: tristate; speed and delay in logic circuits; sequential circuits and design; flip-flop, and counter; register.

2304153 Physics for Engineers 3(3-0-6)
Mechanics of particles and rigid bodies, properties of matter, fluid mechanics, heat, vibrations and waves, elements of electromagnetism, optics, modern physics.

2304193 Physics Laboratory for Engineers 1(0-3-0) CONDITION: Co-requisite 2304153
Measurement and precision; experiments on simple harmonic motion, radius of gyration, dynamics of rotation, velocity of sound, viscosity of fluids.

2304154 Physics and Electronics for Engineers 3(3-0-6) CONDITION: PRER 2304153
Electricity; DC circuit; AC circuit; basic electronics; solid state devices; electrical actuators

2304194 Physics and Electronics Laboratory for Engineers 1(0-3-0) CONDITION: Co-requisite 2304154
Resistance and electromotive force measurements; experiments on amp meter, voltmeter, oscilloscope, AC

circuit, transistor, lenses and mirrors, polarization, interference, diffraction.

2183212 Statics 3(3-0-6)

Force-couple system; resultants; equilibrium; factor of safety; frames and machines; truss; Pappus theory; distributed forces; fluid statics; flexible cable; friction, friction in machines; principle of virtual work; stability.

2183231 Dynamics 3(3-0-6)
Condition: Corequisite 2183212

Kinematics and kinetics of particles and planar rigid body; Newton's second law; equations of motion; work and energy; impulse and momentum of particles and planar rigid body.

2147308* Industrial Robots 3(3-0-6)
Condition: Prerequisite 2183231

Introduction Industrial Robots; robot reference frames; manipulator kinematics; inverse manipulator kinematics; Jacobian; manipulator dynamics; introduction to robot controls; trajectory generation; mechanism design; introduction to hybrid force/position control; summary.

2147309* Mechatronics 3(3-0-6)

Introduction to mechanical system interfacing; combinational digital logic; industrial electronic components; industrial sensors; simple computer structure; low level programming techniques; embedded control computers; microcontroller; stepping motors; DC motors; analog/digital conversion; position and velocity measurement; amplifiers; projects related to mechatronics.

2183213 Mechanics of Materials I 3(3-0-6)
Condition: PRER 2183212

Concept of stress and strain; stress and strain components; plane stress and plane strain; Mohr's circle of plane stress; Hooke's law and modulus of elasticity; engineering stress-strain diagrams; working stress; factor of safety; problems in axial loading including statically indeterminate problems and temperature changes; thin-walled pressure vessel; torsion of circular shaft; statically indeterminate shaft; beam; stress in beam; deflection of beam; statically indeterminate beam; Euler's formula; combined stress.

2147310* Mechanical Engineering Design 3(3-0-6)

Design machine concept; design of robotics components; joints and transmission system design of robots; link and joint connection design, design standard; materials used in robots, design for manufacturing.

2147211* Engineering Design Process Using CAD 3(3-0-6)

Engineering Design Process; Conceptual Design; Detail Design; Introduction to CAD/CAM/CAE, 3D solid modeling, design concepts and implementation; link to manufacturing interface.

2147212* Robotic Project I 1(0-3-0)

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147213* Robotic Project II 3(0-6-3)
Condition: PRER 2147012

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147314* Robotic Project III 1(0-3-0)

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147315* Robotic Project IV 3(0-6-3)
Condition: PRER 2147314*

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147416* Final Project I 3(0-6-3)

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147417* Final Project II 6(0-12-4)
Condition: PRER 2147416*

Conduct and complete a engineering project in a team such that the processes comply with prescribed design processes as well as documenting and presenting the project in a professional manner.

2147318* Differential Equations for Dynamic Modelling and Simulation 3(3-0-6)
Condition: Corequisite 2183231

Differential Equations; Mechanical background; mathematical modeling and numerical solution of engineering problems; modeling of mechanical systems; model representation and response; modeling of electrical, hydraulic and thermal system; modeling of mixed systems; time response analysis of linear dynamic systems; introduction to optimization and numerical solution; solution techniques for non-linear systems; signal processing.

2147319* Mechanics of Machinery 3(3-0-6)
Condition: Prerequisite 2183231

Basic Mechanisms; Position, velocity and acceleration of Linkages, Graphical linkage synthesis; Linkage synthesis; Static and dynamic force analysis; Static and dynamic balancing of a simple rotating and reciprocating machine.

2147320* Feedback Control Systems 3(3-0-6)
Condition: Prerequisite Differential Equations for Dynamic Modelling and Simulation

Introduction to control system; mathematical models of systems; state-space description; dynamics simulation; feedback control system characteristics; the performance of feedback control systems; the stability of linear feedback systems; essential principles of feedback, the root-locus method; frequency response methods; stability of the frequency domain, time-domain analysis of control systems; the design and compensation of feedback control systems.

2147321* Modern Control and Digital Control Systems 3(3-0-6)
Condition: Prerequisite 2147320*

Describing-function analysis of non-linear control systems, phase-plane analysis, state-space analysis of control system; linear dynamical equations and impulse-response matrices; controllability and observability of linear dynamical equations, irreducible realizations: strict system, equivalence and identification; digital control design

2147322* Sensors and Actuators for Robotic and Automation 3(3-0-6)

Sensors and actuators used in process industries; signal conditioning and transmission analog and digital controllers; interfacing and communication; programmable logic controllers; distributed process control systems; safety in process automation.

2147323* Machine Design of Automation Systems 3(3-0-6)

Properties of materials, theory of failure; fatigue analysis for mechanical design, design of various interesting mechanical elements

2183431 Mechanical Vibrations 3(3-0-6)
Condition : Prerequisite 2183212

One degree of freedom systems; applications of vibration principles to various types of practical problems; multi-degrees of freedom systems, formulation of equation, numerical solving methods, continuous system, non-linear vibration.

2147324* Thermo-Fluid Mechanics 4(4-0-8)

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; steady incompressible flow. Modes of heat transfer: conduction, convection, radiation and applications of heat transfer, heat exchangers and heat transfer enhancement, boiling and condensation.

2147325* Introduction to Finite Element Analysis 3(3-0-6)

Mathematical preliminaries and matrices, general procedure of the finite element method, derivation of finite equations using; direct approach, variational approach and method of weighted residuals, finite element types in one, two and three dimensions, and their interpolation functions, applications to structural, heart transfer, and fluid flow problems; using MATLAB-based finite element

2147326* Mobile Robots 3(3-0-6)

Types and application of mobile robots, control of mobile robots

2182307* Signals and Systems 3(3-0-6)

Classification of signals and systems; linear time-invariant (LTI) systems; time domain and frequency domain models of the continuous linear time-invariant (LTI) systems; convolution integral and impulse response; Fourier series and Fourier transforms; Bode plot of signals and LTI systems; Laplace transforms; analysis of LTI systems using Laplace transforms; applications to circuit analysis, feedback control, and communications.

2147327* Design of Microprocessor-Based Mechanical Systems 3(3-0-6)

Fundamentals of embedded system hardware and firmware, real-time processing, feedback loop control, communication protocols, transistor logic, memory circuits, interfacing logic families, standard bus interfaces, interrupt, boot-loading stages and direct-memory access (DMA); microprocessors related to problems in mechanical systems.

2147328* System Identification 3(3-0-6)
Condition : Prerequisite Modern control and Digital Control systems or Consent of Faculty

Models for linear time-invariant and time-varying systems; nonparametric time- and frequency-domain methods; parameter estimation methods; convergence and consistency; asymptotic distribution of parameter estimates; computing the estimate; recursive identification methods; experiment design; choice of identification criterion; model structure selection and model validation.

2147329* Digital Image Processing and Vision Systems 3(3-0-6)

Visual perception, digitization and coding of images, converting pictures to discrete(digital) forms; image enhancement; image restoration including improving degraded low-contrast, blurred, or noisy pictures; image compression: data compression used in image processing; image segmentation referred to as first step in image analysis.

2147330* Programming Methodology 3(3-0-6)
Condition : Prerequisite 2190101

Programming methodology: object-oriented programming, event-driven programming, concurrent programming; error and exception handling; application programming interface (API); programming tools; programming styles and practice.

2147331* Perception of Cognitive Robots 3(2-2-6)

Programming of robots to enable the achievement of goals in environments, cognitive capabilities such as perception, attention, anticipation, planning, memory, learning, and reasoning. social capabilities, such as communication, collaborative task execution, and reasoning about the mental states of other agents. artificial intelligence techniques, as well as insights from cognitive science.

2147332* Artificial Intelligence 3(3-0-6)
Condition : Prerequisite

Definitions and application of artificial intelligence; knowledge representation; Prolog programming; natural language processing; machine learning techniques.

2147333* Cyber Physical Robotics 3(3-0-6)

The mathematics of complex networks/systems in natural and man-made environments; bacteria swarms; smart grid; social media; models for network design; control and optimization, identifying their limitations in relation to the actual characteristics of physical processes; developing advanced mathematical models of CPR based on actual measurements; overview of network theory and research in applied mathematics, physics, and engineering.

2147334* Machine Learning or Deep Learning 3(3-0-6)

Computing with logic; using logic set theory, number theory, algebras graph theory, automata; language of first order logic, model theory and logic programming; problems of inductive inference in the framework of first-order predicate calculus and the probability calculus; introduction of computational learning theory.

2147335* Virtual Reality and Augmented Reality 3(3-0-6)
Condition : Prerequisite

Theory, development, and applications of virtual reality (VR) technology for the generation of the virtual environments (VE); human-computer interaction based on the 5 basic senses of human perception; use of 3D software and some scripting language to generate models in the CAVE system; application of VR technology in product and production design and others.

2147336* Internet of Things 3(3-0-6)

This course covers the topics of smart things network and communication: architectures, services and protocols; privacy and security; enabling technologies of IoT; IoT and smart system applications: smart cities, smart energy, smart transportation and mobility, smart home and building, smart factory and manufacturing, smart health and up-to-date applications related to RAI; smart things networks for data management; IoT related standardization. The course also includes a substantial group design project.

2147237* Manufacturing Workshop 1(0-3-0)

Manufacturing process: casting, turning, milling, welding, heat treatment; manufacturing process selection for materials and shapes; manufacturing process selection for linear tolerance and geometric tolerance; surface roughness; metrology and examination techniques.

2147238* Manufacturing Processes 3(3-0-6)

Manufacturing process; casting, plastic processing, metal forming, sheet metalworking, turning, milling, welding and assembly process; Manufacturing process selection for materials and shapes; dimensions, tolerances, surfaces and their measurement.

2189101 Engineering Materials 3(3-0-6)

Crystal structure of solids. Crystal defects. Mechanical properties of materials. Dislocation and strengthening mechanism of metals. Mechanical failure of materials. Phase diagram and solid state reaction. Fabrication and applications of metals. Structure, properties, and applications of ceramic. Structure, properties, and applications of polymers. Structure, properties, and application of composite materials. Corrosion and degradation of materials. Properties and applications of

2147239* Materials in Daily Life 3(3-0-6)

Learn different aspects of materials as found in daily life, in various occupations and in suitable applications. Environmentally friendly materials. Full utilization of materials in both efficient sense and aesthetic sense. Topics include materials for design and 126 architecture, fashion, arts and craft materials, biomedical materials and biomaterials, automotive materials and household materials.

2147240* Topics in Robotics Engineering I 3(3-0-6)

Selected technical topics in robotics engineering

2147241* Topics in Robotics Engineering II 3(3-0-6)

Selected technical topics in robotics engineering

2147342* Topics in Robotics Engineering III 3(3-0-6)

Selected technical topics in robotics engineering

2147443* Topics in Robotics Engineering IV 3(3-0-6)

Selected technical topics in robotics engineering

2140301 Industrial Training 2(0-6-0)

Industrial Training in related areas under supervision of experience experienced engineers in private sectors or government agencies.