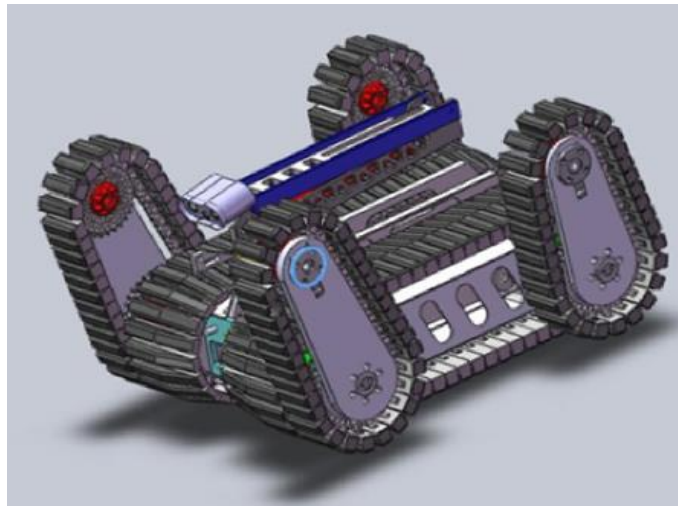


Bachelor of Engineering Program
in
Robotics Engineering and Automation System



Production Engineering Department, Faculty of Engineering
King Mongkut's University of Technology North Bangkok
1518 Pracharad 1 Rd., Wongsawang, Bangsue, Bangkok 10800 Thailand
Tel. 02-555-2000 ext 8208 Fax 02-587-0029



Brief History

Since founded in 1984, Production Engineering Department has offered only one undergraduate curriculum. With ample available resources, the department identifies the next step as a new curriculum responding to industrial needs.



PE Students become so skillful that they have won many prizes in various robot competitions.

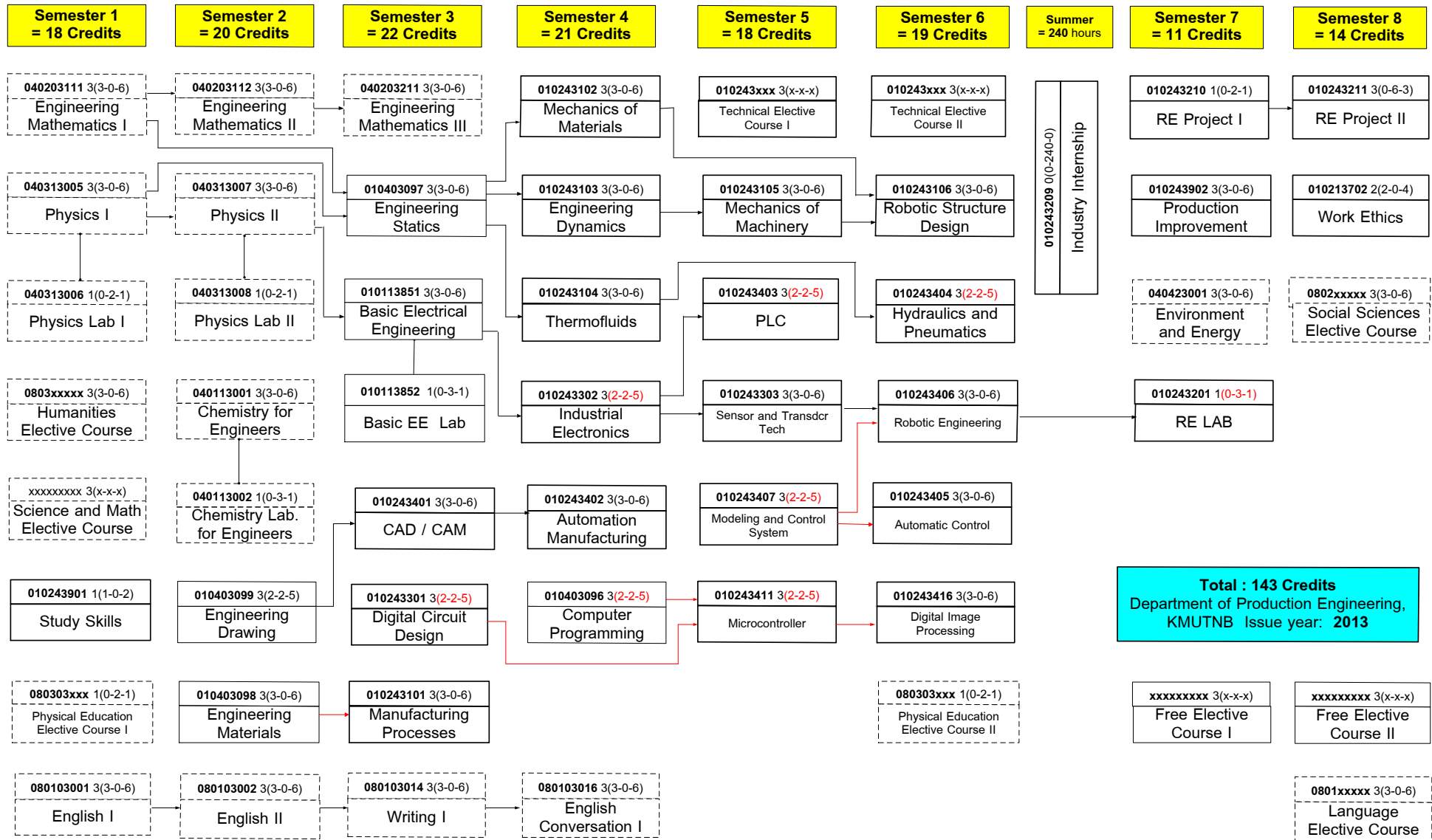
Curriculum Objectives

- Produce graduates in Robotics Engineering and Automation System for industry and ASEAN.
- Produce students with skills and knowledge to proudly represent KMUTNB uniqueness.
- Support innovative creation according to KMUTNB philosophy



Program of Study for Robotics Engineering & Automation System (หลักสูตรปรับปรุง พ.ศ. 2556)

Total = 143 Credits



Total : 143 Credits
 Department of Production Engineering,
 KMUTNB Issue year: 2013

 รายวิชา PE
 ภาควิชาานอกภาควิชาฯ
 รายวิชาเอกคณะ
 รายวิชาต่อเนื่อง
 เช่น ต้องผ่าน 080103001 ก่อน ถึงจะเรียน 080103002 ได้

Curriculum Structure

Course and Course Credit

Group 1. General Education Courses	31 credits
a. Social Sciences	5 credits
b. Humanities	3 credits
c. Languages	15 credits
- Elective courses	12 credits
- Required courses	3 credits
d. Physical Education	2 credits
e. Sciences and Mathematics	6 credits
Group 2. Major Courses	106 credits
a. Core Sciences and Mathematics Courses	21 credits
b. Core Engineering Courses	34 credits
c. Required Major Courses	45 credits
d. Elective Major Courses	6 credits
e. Industrial Training	240 hours
Group 3. Free Elective Courses	6 credits

Course title and Course Credit

Group1. General Education Courses 31 credits

a. Social Sciences 5 credits

Required courses 2 credits

Course Number	Course Title	Credits (lecture-lab-self study)
010213702	Work Ethics	2(2-0-4)

Elective courses 3 credits

Select 1 course from the following list:

Course Number	Course Title	Credits (lecture-lab-self study)
080203903	Social Economics and Politics Dimension	3(3-0-6)
080203904	Law for Everyday Life	3(3-0-6)
080203905	Economy and Everyday Life	3(3-0-6)
080203907	Business and Everyday Life	3(3-0-6)

Or other Social Sciences in General Education Courses offered by Faculty of Applied Arts

b. Humanities 6 credits

Elective courses 3 credits

Select 1 course from the following list:

Course Number	Course Title	Credits (lecture-lab-self study)
080303101	General Psychology	3(3-0-6)
080303104	Psychology for Work	3(3-0-6)
080303601	Human Relations	3(3-0-6)

080303602 Development of Life Quality 3(3-0-6)

Or other Humanities in General Education Courses offered by Faculty of Applied Arts

c. Languages 15 credits

Required courses 12 credits

Course Number	Course Title	Credits (lecture-lab-self study)
80103001	English I	3(3-0-6)
080103002	English II	3(3-0-6)
080103014	Writing I	3(3-0-6)
080103016	English Conversation I	3(3-0-6)

Elective courses 3 credits

Select 1 course from the following list:

Course Number	Course Title	Credits (lecture-lab-self study)
080103011	English Study Skills	3(3-0-6)
080103015	Writing II	3(3-0-6)
080103017	English Conversation II	3(3-0-6)
080103018	English for Work	3(3-0-6)
080103020	English for Industrial Management	3(3-0-6)

Or other Languages in General Education Courses offered by Faculty of Applied Arts

d. Physical Education 2 credits

Elective courses 2 credits

Select 2 courses from the following list:

Course Number	Course Title	Credits (lecture-lab-self study)
080303501	Basketball	1(0-2-1)
080303502	Volleyball	1(0-2-1)

080303503	Badminton	1(0-2-1)
080303504	Dancing	1(0-2-1)
080303505	Table Tennis	1(0-2-1)

Or other Physical Education in General Education Courses offered by Faculty of Applied Arts

e. Sciences and Mathematics 6 credits

Required courses 3 credits

Course Number	Course Title	Credits (lecture-lab-self study)
040423001	Environment and Energy	3(3-0-6)

Elective courses 3 credits

Course Number	Course Title	Credits (lecture-lab-self study)
010123801	Computer in Everyday Life	3(2-2-5)
040503001	Statistics in Everyday Life	3(3-0-6)

Or other Science and Mathematics in General Education Courses offered by Faculty of Applied Science or other Faculty.

Group 2. Major Courses 106 credits

a. Core Science and Mathematics Courses 21 credits

Course Number	Course Title	Credits (lecture-lab-self study)
040113001	Chemistry for Engineers	3(3-0-6)
040113002	Chemistry Laboratory for Engineers	1(0-3-1)
040203111	Engineering Mathematics I	3(3-0-6)
040203112	Engineering Mathematics II	3(3-0-6)
040203211	Engineering Mathematics III	3(3-0-6)
040313005	Physics I	3(3-0-6)

040313006	Physics Laboratory I	1(0-2-1)
040313007	Physics II	3(3-0-6)
040313008	Physics Laboratory II	1(0-2-1)

b. Core Engineering Courses

34 credits

Course Number	Course Title	Credits (lecture-lab-self study)
010113851	Basic Electrical Engineering	3(3-0-6)
010113852	Basic Electrical Laboratory	1(0-3-1)
010243101	Manufacturing Process	3(3-0-6)
010243102	Mechanics of Materials	3(3-0-6)
010243103	Engineering Dynamics	3(3-0-6)
010243104	Thermofluids	3(3-0-6)
010243105	Mechanics of Machinery	3(3-0-6)
010243106	Robotics Structure Design	3(3-0-6)
010403001	Engineering Drawing	3(2-2-5)
010403002	Engineering Materials	3(3-0-6)
010403003	Engineering Statics	3(3-0-6)
010403004	Computer Programming	3(2-2-5)

c. Required Major Courses

45 credits

Course Number	Course Title	Credits (lecture-lab-self study)
010243201	Robotics Engineering and Automation System Laboratory	1(0-3-1)
010243210	Project I	1(0-2-1)
010243211	Project II	3(0-6-3)
010243301	Digital Circuit Design	3(2-2-5)

010243302	Industrial Electronics	3(2-2-5)
010243303	Sensor and Transducer Technology	3(3-0-6)
010243407	Modeling and Control System	3(2-2-5)
010243411	Microcontroller	3(2-2-5)
010243416	Digital Image Processing and Machine Vision	3(3-0-6)
010243401	Computer-aided Design and Manufacturing	3(3-0-6)
010243402	Automation Manufacturing	3(3-0-6)
010243403	Programmable Logic Controller	3(3-0-6)
010243404	Hydraulics and Pneumatics	3(2-2-5)
010243405	Automatic Control	3(3-0-6)
010243406	Robotics Engineering	3(3-0-6)
010243901	Study Skills	1(1-0-2)
010243902	Production Improvement	3(3-0-6)

d. Elective Major Courses

6 credits

Select 2 courses from the following list:

Course Number	Course Title	Credits (lecture-lab-self study)
010243304	Electrical Machine and Driving System	3(3-0-6)
010243305	Microprocessor	3(3-0-6)
010243306	Computer Interfacing	3(3-0-6)
010243410	CNC Programming	3(3-0-6)
010243412	Control System Design	3(3-0-6)

010243413	Feedback Control	3(3-0-6)
010243414	Fuzzy Logic and Neural Network	3(3-0-6)
010243415	Mechanical Vibration	3(3-0-6)
010243417	Machine Condition Monitoring	3(3-0-6)
010243418	Artificial Intelligence	3(3-0-6)
010243419	Data Structure and Algorithm	3(3-0-6)
010243420	Robotics Computer Simulation	3(3-0-6)
010243421	Automatic Material Handling System	3(3-0-6)
010243422	Computer Integrated Manufacturing	3(3-0-6)
010243498	Special Topics in Robotics Engineering	3(3-0-6)
010243499	Special Topics in Automation System	3(3-0-6)
010243910	Maintenance Engineering	3(3-0-6)
010243911	Safety Engineering and Management	3(3-0-6)
010243999	Special Topics in Management	3(3-0-6)

e. Industrial Training

240 hours

Course Number	Course Title	Credits (lecture-lab-self study)
010243209	Industry Internship	0(0-240-0)

Group 3. Free Elective Courses

6 credits

Select course offered by Bachelor Program in King Mongkut's University of Technology

Course Description

010113851 Basic Electrical Engineering 3(3-0-6)

Prerequisite : 040313007 (Physics II)

Electrical quantities and units, resistor, inductor, capacitor, steady-state analysis in electrical circuit, AC 1 and 3 phase electrical circuit analysis, power factor improving and calculation, basic magnetic circuit, transformer and applications, AC/DC machine and applications, electrical power transfer, fundamental of electrical instrumentation.

010113852 Basic Electrical Laboratory 1(0-3-1)

Pre/Corequisite : 010113851 (Basic Electrical Engineering)

Usage and experiment of electrical instruments and electrical experiments supporting basic electrical engineering subject.

010123801 Computer in Everyday Life 3(2-2-5)

The usage of package programs, word processing, spreadsheets. Familiarization with computer. The usage of operating systems, Windows, Unix, Internet and basic programming.

010213702 Work Ethics 2(2-0-4)

Virtue, morality, ethics, four principles of service and social integration, four noble sentiments, four paths of accomplishment, considerations in different work characteristics, emotion management, ethical behaviors suitable for occupational contexts.

010243101 Manufacturing Process 3(3-0-6)

Method and theory of casting, forming, turning, shaping, cutting, drilling, welding and coating focused on relationship of material selection and product design, basic of production costing, industrial factory visit, demonstration of machine tool operation in basic manufacturing process.

010243102 Mechanics of Materials 3(3-0-6)

Prerequisite : 010403003 (Engineering Statics)

Forces, stress and strain, mechanical properties of solids, stress-strain relationship, bending moment and shearing force diagram, stress and deformation of beams, deflections of beams, torsion, buckling of columns, plane stress and plane strain, principal stress and principle strain, Mohr's circle.

010243103 Engineering Dynamics 3(3-0-6)

Prerequisite : 010403003 (Engineering Statics)

Kinematics and kinetics of particles and rigid bodies, mechanics of motion, Newton's Laws of motion; rectilinear motion, curvilinear motion, simple harmonics motion, principle of work and energy, conservation of energy, impact of particles and rigid bodies, principles of impulse and momentum, conservation of momentum, fundamental of mechanical vibration, relative motion using translating and rotating axes.

010243104 Thermofluids 3(3-0-6)

Prerequisite : 010403003(Engineering Statics)

Basic of thermodynamics, principle and definition, properties of pure substances, work and heat, first law of thermodynamics, closed system and control volume, basic of fluid mechanics, fluid properties, conservative of mass, momentum and energy, fluid statics, Bernoulli's equation, flow field, steady incompressible flow, basic heat transfer, conduction, convection and radiation heat transfer.

010243105 Mechanics of Machinery 3(3-0-6)

Prerequisite : 010243103 (Engineering Dynamics)

Application of vector, matrix and graphical techniques for kinematics, dynamics analysis and for determination of positions, velocities, accelerations and forces in linkages, mechanisms and machine elements which normally used in robotics.

010243106 Robotics Structure Design 3(3-0-6)

Prerequisite : 010243102 (Mechanics of Materials)

010243105 (Mechanics of Machinery)

010243301 Digital Circuit Design 3(2-2-5)

Base number conversion and calculation, boolean algebra, truth table, Karnaugh's map, gate circuits, combination circuits, multiplex circuits, flip-flop circuits, encoding and decoding circuits, counter circuits, shift-register circuits, sequential circuits: synchronous and asynchronous, analog-to-digital converter, digital-to-analog converter.

010243302 Industrial Electronics 3(2-2-5)

Prerequisite: 010113851 (Basic Electrical Engineering)

Semi-conductors for basic electronic circuits, voltage and current characteristics of electronic components, amplifier circuits, oscillator circuits, power supply circuits, design of driver and buffer circuits, operational amplifier circuits, characteristic of power electronic components, power diode, thyristors, power transistors, MOSFET, IGBT, application of electronic circuits in fields of robotics engineering and automation system.

010243303 Sensor and Transducer Technology 3(3-0-6)

Prerequisite : 010243302 (Industrial Electronics)

Direct and indirect measurement, principle of sensors and transducers in mechanical and electrical measurement, characteristic of sensors, resistive type, capacitive type, inductive type, electromagnetic type, reactance type, error in sensors, signal amplifier and signal conditioner circuits, noise protection, grounding, communication between sensor and controller, application of sensor in fields of robotics engineering and automation system.

010243304 Electrical Machine and Driving System 3(3-0-6)

Prerequisite : 010243302 (Industrial Electronics)

Magnetic and transformer circuits, AC voltage control circuits, switching power supply, concept of rotating machine: DC and AC, torque and induced voltage, motor start and control, physical structure and fundamental of 3 phase induction motor, DC driving control, AC driving control, driving control by power electronics, open loop and closed loop control, servo motor and control, linear motor and control.

010243305 Microprocessor 3(3-0-6)

Prerequisite : 010243301 (Digital Circuit Design)

010403004 (Computer Programming)

Architecture of microprocessor, Memory addressing, Input/Output units, Bus timing, Microprocessor programming, Memory interfacing, Input/Output interfacing, Application of microprocessor in Robotics Engineering and Automation System.

010243306 Computer Interfacing 3(3-0-6)

Prerequisite : 010243305 (Microprocessor)

Basic of data communication and standard of network system, signal theory and encoding, serial port interfacing, parallel port interfacing, USB port, wireless communication, switching and multiplexing systems, communication network architecture models, connection control, channel allocation and multi-access communication, data control and data flow in computer network system, IEEE 802 LAN standards, internet protocols.

010243401 Computer-aided Design and Manufacturing 3(3-0-6)

Prerequisite : 010403001(Engineering Drawing)

Basic of CAD/CAM, hardware system and operating system for CAD/CAM, 3 dimensional part design, data transfer between CAD and CAM, basic working of CAM system, data preparation for CAM system, production simulation on CAM system, transformation from CAM data to CNC code, transfer CNC code to CNC machine, selection of CAD/CAM system which is suitable for industrial work.

010243402 Automation Manufacturing 3(3-0-6)

Prerequisite : 010243401 (Computer-aided Design and Manufacturing)

Basic of automation system in production, Components of automatic manufacturing system, such as pneumatics and hydraulics, PLC, CNC, motion system, motion direction, analog sensors, digital sensors, components of machine in measuring system, flexible manufacturing system, cellular production, computer integrated manufacturing system.

010243403 Programmable Logic Controller 3(2-2-5)

Prerequisite: 010243302 (Industrial Electronics)

Control system, architecture and concept of microprocessor, sensors and actuators, instruction set of PLC, languages for PLC programming, programming technique error

Introduction to control systems, mathematical model of systems, transfer function, block diagram, system response, characteristic of control systems, stability analysis of control systems in time and frequency domain, design of feedback control systems based on PID controllers compensation, control system analysis based on state variables, system simulation using computer software.

010243410 CNC Programming 3(3-0-6)

Prerequisite : 010243401 (Computer-aided Design and Manufacturing)

Computer Numerical Controller, motion system and direction, equipment and component of machine in measuring system, CNC program structure, computer aided programming, CNC machine tool in real industry, maintenance of CNC machine.

010243411 Microcontroller 3(2-2-5)

Prerequisite: 010243301(Digital Circuit Design)

010403004 (Computer Programming)

Basic of embedded system development, architecture of microcontroller, Instruction sets of micro-controller, high-level language programming, input/output interfacing, programming to control electronic equipment, sensor and transducer interfacing, motor control, hydraulic and pneumatic valve control, timer and interrupt, analog to digital conversion and digital to analog conversion, serial port communication, UARTS, application of micro-controller to industry.

010243412 Control System Design 3(3-0-6)

Prerequisite : 040203211 (Engineering Mathematics III)

Basic and principles of control system, mathematical models of control system, components of control system, stability and performance of control system, feedback control, control system design and analysis in time and frequency domains.

010243413 Feedback Control 3(3-0-6)

Prerequisite : 040203211 (Engineering Mathematics III)

Analysis and design of linear feedback control system, modeling of physical system, system performance, system sensitivity and error, Routh Hurwitz and Nyquist stability

tests, use of root locus and frequency-response techniques to analyze system performance, design compensation to meet performance specification.

010243414 Fuzzy Logic and Neural Network 3(3-0-6)

Prerequisite : 010243405 (Automatic Control)

Basic of fuzzy control, fuzzy sets, fuzzy relation, fuzzy controller design, classification of fuzzy models, fuzzy control systems simulation, design concept, analysis and application of artificial neural networks, neural fuzzy systems, applications in control system.

010243415 Mechanical Vibration 3(3-0-6)

Prerequisite : 010243103 (Engineering Dynamics)

Systems with a single degree of freedom, free and forced vibration, natural frequency and damped effect, response to harmonic excitation, energy dissipation in mechanical system, forced vibration, unbalanced rotation, systems with two degree of freedom, principle of dynamic absorber, systems with more than one degree of freedom, vibration measuring instruments, design for vibration suppression.

010243416 Digital Image Processing and Machine Vision 3(3-0-6)

Prerequisite : 010243301 (Digital Circuit Design)

010403004 (Computer Programming)

Basic of digital image processing, Image acquisition, light condition setting, Image signal filtering and conditioning, dot pixel processing, image compression, image segmentation, edge detection and interested point tracking, motion capture, character recognition, picture comparing, object recognition, signal transformation, distance measurement by image signal, Image analysis by software program, DIP in control applications, interfacing between camera and robot, DIP and machine vision in real industry.

010243417 Machine Condition Monitoring 3(3-0-6)

Prerequisite : 010243303(Sensor and Transducer Technology)

Interfacing between sensor and computer, signal aliasing and signal conditioning, signal analysis: signal based and parameter based analysis, vibration signal

analysis, temperature, pressure, and torque, decibel in machine, acoustic emission monitoring, life time estimation and system maintenance.

010243418 Artificial Intelligence 3(3-0-6)

Prerequisite : 010403004 (Computer Programming)

History and definition of Artificial Intelligence, search algorithm, knowledge representation, propositional logic, predicate logic, rule base, expert system, Automated planning, artificial neural network, genetic Algorithm, fuzzy logic, natural language processing, symbolic processing, machine translation, machine vision, image processing, application of artificial intelligence.

010243419 Data Structure and Algorithm 3(3-0-6)

Prerequisite : 010403004 (Computer Programming)

Linear data structure, order, stack, queue, priority queue, data structure, link list, one-way communication, two-way communication, string manipulation, comparison, tree, tree representation, B-tree, AVL tree, graph, data searching and sorting, managing heap memory, hash coding, recursion, backtracking.

010243420 Robotics Computer Simulation 3(3-0-6)

Prerequisite : 010243106(Robotics Structure Design)

Design of modern robotics and machine tools, analysis and design of robotics and machine tools structures, translation and angular motion systems, dynamics of machine tools and thermal effects, drives and control of robotics and machine tools, adaptive control systems, CAD/CAE in design and analysis, models and model testing in robotics machine tools design.

010243421 Automatic Material Handling System 3(3-0-6)

Type of material handling equipment, selection criteria of material handling equipment, components and function of material handling system, conveyer belt control, roller, screw feeder, chains, blower, vertical conveyer, vibration conveyer, industrial robot conveyer, crane, automated guided vehicle and transportable vehicle.

010243422 Computer Integrated Manufacturing 3(3-0-6)

Basic of computer integrated manufacturing system, computer aided design and manufacturing, computer numerical control, CNC programming, Industrial robotics, robotic programming, automatic material handling system, automated guided vehicle, programmable logic controller, automatic storage and automatic receive system, flexible manufacturing system, design of CIM system by using computer software.

010243436 Process Control and Improvement 3(3-0-6)

Prerequisite : 040503011 Statistics for Engineers and Scientists

Philosophy of quality, quality control management, manufacturing quality control using statistical techniques, process capability analysis, measurement system analysis, batch quality assurance, basic design of experiment, reliability engineering and reliability for manufacturing, industrial visit or case study.

010243490 Manufacturing Plant Design 3(3-0-6)

Product development and design, planning of manufacturing process selection, development of production system and plant layout, design the plant by group technology, design the material handling and storage system, considering the number of personnel and analysis of plant location.

010243498 Special Topics in Robotics Engineering 3(3-0-6)

Specific problem focused on structure and control system in robotics. Problem can be studied and concluded within a semester.

010243499 Special Topics in Automation System 3(3-0-6)

Specific problem focused on automation system. Problem can be studied and concluded within a semester.

010243901 Study Skills 1(1-0-2)

Application of learning methods to suitable learning skills of each student, lecture-note taking, communication in work and group activities, time management and organization of hardcopy and digital document, study and career planning, literature

010243999 Special Topics in Management 3(3-0-6)

Specific problem focused on management. Problem can be studied and concluded within a semester.

010403001 Engineering Drawing 3(2-2-5)

Freehand Sketching for visualization and communication. Orthographic projections, Basic descriptive geometry Dimension, Notes, Limits and geometric Shapes and Reference plane; Pictorial drawing Sectional view, Developments

010403002 Engineering Materials 3(3-0-6)

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

010403003 Engineering Statics 3(3-0-6)

Prerequisite : 040203111 (Engineering Mathematics I)
040313005 (Physics I)

Classification of engineering mechanic; state and behavior of body in engineering statics; system and resultant of forces acting to body; resultant and resolution of forces: equilibrium; analysis of simple structures; centroid and center of gravity of body; friction force; truss structure; moment of inertial of an area; virtual work and stability

010403004 Computer Programming 3(2-2-5)

Introduction to computer science with emphasis on problem solving, use of a high-level programming language for solving engineering problems with emphasis on procedural program design and development, topics include basic programming constructs, primitive data types and derived types, expressions, conditional selections, iterations, functions, arrays, and strings, Software reuse via libraries and application programming Interface (API), elementary algorithms for sorting and searching, Introduction to object-oriented programming paradigm

040113001 Chemistry for Engineers 3(3-0-6)

Matters and scientific measurement, atoms molecules and ions, stoichiometry, electronic structure of the atoms, periodic properties, chemical bond, shape of molecules, gas liquid and solid, solutions thermochemistry, chemical kinetics, chemical equilibrium, acid-base equilibrium, electrochemistry.

040113002 Chemistry Laboratory for Engineers 1(0-3-1)

Pre/Corequisite : 040113001 (Chemistry for Engineers)

Laboratories related to theoretical background in 040113001 Chemistry for Engineers

040203111 Engineering Mathematics I 3(3-0-6)

Analytic geometry, polar coordinates, parametric equations; vector algebra, lines and planes in three dimensional space; limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications, indeterminate forms, techniques of integration, numerical integration; improper integrals.

040203112 Engineering Mathematics II 3(3-0-6)

Prerequisite : 040203111 (Engineering Mathematics I)

Mathematical induction; sequence and series of real numbers, Taylor series expansions of elementary functions; Fourier series; matrices and determinants, systems of linear equations, eigenvalues and eigenvectors; surfaces in three-dimensional space; limit, continuity, differentiation and integration of real-valued functions of several variables and their applications.

040203211 Engineering Mathematics III 3(3-0-6)

Prerequisite : 040203112 (Engineering Mathematics II)

Vector-valued functions, space curves, derivatives and integrals of vector-valued functions, gradient, curl and divergence, line integrals, surface integrals; introduction to differential equations and their applications, linear differential equations, Laplace transforms, system of linear differential equations, solution in series.

040313005 **Physics I** **3(3-0-6)**

Vector, motion, Newton’s law of motion in one dimension, circular motion, simple harmonic motion, superposition of simple harmonic waves, damped oscillations, forced oscillation, types of wave, standing wave equation, supersonic wave, beat, intensity and level of intensity, doppler effect, moment of inertia, rotational equation, torque, angular momentum, rolling, gyroscope motion, properties of matter, heat transfer, idea gas equation, laws of thermodynamics, heat engines, reverse heat engine, physical property of fluids, Buoyant force, Pascal’s law, equation of continuity of fluids, Bernoulli’s equation, pressure measurement, flow rate measurement.

040313006 **Physics Laboratory I** **1(0-2-1)**

Pre/Corequisite : 040313005 Physics I
Experiments in the topics of 040313005 Physics I

040313007 **Physics II** **3(3-0-6)**

Prerequisite : 040313005 (Physics I)
Wave properties, reflection, refraction, interference, diffraction, geometrical optics, optical instruments, Coulomb’s law, electric field, Gauss’s law, Ampere’s law, induced emf, inductor, magnetic material, AC circuit and electronics, blackbody radiation, photoelectric effect, Compton scattering, X-ray, hydrogen atom, wave-particle duality, many electron-atom, hydrogen spectrum, structure of nucleus, radioactivity, nuclear reaction.

040313008 **Physics Laboratory II** **1(0-2-1)**

Pre/Corequisite : 040313007 Physics II
Experiments in the topics of 040313007 Physics II

040423001 **Environment and Energy** **3(3-0-6)**

Relationships between organism and their environment; Major pollution problems and effect to the environment; Introduction to environmental management; Energy; Type of energy; Renewable energy and energy conservation.

040503001 Statistics in Everyday Life 3(3-0-6)

Overview statistics in everyday life. Problem solving systems using statistically logical skill. The uses of statistics in social science, humanity, government, sport, education, environment, advertisement, finance, epidemiology, or others.

080103001 English I 3(3-0-6)

Integrated skills of listening, speaking, reading, and writing at basic level in order to apply in daily life with the cultural awareness of diverse users. Learning vocabulary and grammatical structures through conversations, academic and general journals. Writing non-complex sentences and paragraphs. Extensive practice at Self-Access Learning Center (SALC).

080103002 English Conversation I 3(3-0-6)

Prerequisite: 080103001 (English I)

Integrated skills of listening, speaking, reading, and writing at basic level in order to apply in daily life with the cultural awareness of diverse users. Learning vocabulary and grammatical structures through conversations, academic and general journals. Writing complex sentences and paragraphs. Extensive practice at Self-Access Learning Center (SALC) to promote life-long learning.

080103011 English Study Skills 3(3-0-6)

Prerequisite : 080103002 (English II)

Practice of self-management study through various techniques in learning English, for examples, using English dictionary in facilitating verbal and written communications, note-taking and summarizing. Self-regulation in learning, such as planning, monitoring and evaluating as a study tool for higher level of English study

080103014 Writing I 3(3-0-6)

Prerequisite : 080103002 (English II)

Writing sentences of various structures such as simple, compound and complex sentences. outlining, paragraph writing and chronological order writing by selections of appropriate words and vocabulary.

- 080103015 Writing II 3(3-0-6)**
Prerequisite : 080103014 (Writing I)
Writing sentences in complex structures such as compound complex sentence. Various expository writing , for example, narrative writing, argumentative writing, descriptive and report writing.
- 080103016 English Conversation I 3(3-0-6)**
Prerequisite : 080103002 (Writing II)
Fundamental skill in pronunciation and speaking skill for communication in daily life. Self introduction, describing things, giving direction, and expressing opinions.
- 080103017 English Conversation II 3(3-0-6)**
Prerequisite : 080103016 (English Conversation I)
Pronunciation and speaking skill with complex sentences in both prepared and impromptu situations: job interview, working, and for academic purposes.
- 080103018 English for Work 3(3-0-6)**
Prerequisite : 080103002 (English II)
Language skills for work, writing job applications, simple business letters, memos and minutes. Job interviews, making appointments, welcoming visitors, negotiations, describing job positions and products. Writing, presenting, and assessing projects.
- 080103020 English for Industrial Management 3(3-0-6)**
Prerequisite : 080103002 (English II)
Learning processes, techniques and language associated with Industrial Management; Technical language of real-world Industrial Management environments. Practice of both speaking and writing.
- 080203903 Social, Economics and Politics Dimension 3(3-0-6)**

Important nature of society, economy and society, development and change in society, economy, and politics, ethics for living in dynamics society that lead to sustainable development.

080203904 Law for Everyday Life 3(3-0-6)

Characteristics and evolution of law, types of laws, basic knowledge of laws for living in society and being good citizen of the country.

080203905 Economy and Everyday Life 3(3-0-6)

Economics related in everyday life, consumption, investment, inflation, deflation, financial institution, tax, learning different situations in economics, understanding economics problems and ways to solve the problems by government, learning appropriate self-adapting to live with the various economics situations.

080203907 Business and Everyday Life 3(3-0-6)

Basic ideas in business management, nature of business, environment, model, business ownership and problems in business

080303101 General Psychology 3(3-0-6)

Basic theories and concepts of psychology, human behavior, human development, Individual differences, Learning and perception, intelligence, personality and personality development, emotional and social adjustment.

080303104 Psychology for Work 3(3-0-6)

Concepts of psychology, psychology applied to work, individual differences, motivation, decision-making, conflict problem-solving at work, team building, group behaviors, job delegation, job coaching and communication at workplace.

080303501 Basketball 1(0-2-1)

History of basketball, rules, regulations, proper use of equipment, individual skills, playing as a team member, good sportsmanship and development of a positive attitude, learning how to enjoy basketball as a spectator.

080303502 Volleyball 1(0-2-1)

History of volleyball, rules, regulations proper use of equipment, individual skills, playing as a team member, good sportsmanship and development of a positive attitude, learning how to enjoy volleyball as a spectator.

080303503 Badminton 1(0-2-1)

Individual skills and tactics, rules, regulations, preparation and use of equipment of badminton, good sportsmanship and enjoyment of game as a spectator.

080303504 Dancing 1(0-2-1)

History of dancing and learn about different types of dancing, such as latin dancing and ballroom dancing, basic dancing skills and dancing etiquette will help to develop positive attitudes.

080303505 Table Tennis 1(0-2-1)

Individual skills and tactics, preparation and use of equipment of table tennis, good sportsmanship and enjoyment of game as a spectator.

080303601 Human Relations 3(3-0-6)

Principles and theories of human behavior, understanding human nature, self-development, social and cultural norms and etiquette, communication and team working, conflict management, application of religious principles to enhancing human relations.

080303602 Development of Life Quality 3(3-0-6)

Definition and significance of quality of life, application of religious principles to developing quality of life, ethical judgment and criteria, positive thinking, rational analysis, solving problem creatively, time management, role learning, morality and civic sense, ethics, social obligations, process of working effectively and happily.