Course description

Robotics and Automation System Engineering Program Subjects

03607131   **Computer Programming for Robotic Applications**   **3(2-3-6)**

Function. Reusable modules and their use in multi-module software system. Fundamental of object oriented programming. Event-driven programming. Graphical user interface. Data representation. Basic database system.

03607151   **Robotics Exploration**   **3(3-0-6)**

Introduction to state of the art of robotic technologies. Basic robot component; mechanism, sensors, low level control system, and actuators. Basic programming. Learning by examples and hand-on experiments. Simple robot applications.

03607299   **Engineering Project for Robotics and Automation System I**   **1(0-3-2)**

Projects of practical interest in various fields of robotics and automation system engineering. Design and development of a basic robot or automation system.

03607311   **Robot Structure and Machinery Design**   **3(3-0-6)**

Prerequisite: 03604261

Fundamental of robot structure and machinery design. Properties of materials. Theories of failure. Design of simple mechanical elements of robot and machinery; rivets, welding, screw fasteners, keys and pins, shafts, springs, and power screws. Robot structure and machinery design project.

03607312   **Fundamentals of Robotics**   **3(3-0-6)**

Prerequisite: 03604201 or 03604222

Principles of robotics. Representing position and orientation.

Homogeneous transformation. Manipulator kinematics. Inverse kinematics. Jacobian. Trajectory generation. Manipulator dynamics. Robot design based on manipulator kinematics.

03607331   Machine Vision and Applications in Automation System   3(3-0-6)

Fundamental of digital image. Intensity transformation and spatial filtering. Color image processing. Edge and corner detection. Feature extraction. Image segmentation. Using of computer vision library. Image formation and camera model. Imaging with one camera. Camera calibration. Stereo imaging. Object recognition and tracking. Robot vision.

03607332   Artificial Intelligence for Robot and Machinery   3(3-0-6)

Introduction to artificial intelligence for robot and machinery. Mathematics for artificial intelligence. Knowledge representation and logic. Fuzzy logic. Agent. Search strategies. Planning. Genetic algorithm. Decision tree. Bayesian learning. Artificial neural networks. Reinforcement learning. Applications of artificial intelligence for robot and machinery.

03607341   Control Engineering for Robotics   3(3-0-6)

Prerequisite: 01417267

Mathematical models of basic robotic systems. Closed-loop and open-loop control systems. Transfer function. Time-domain and frequency-domain analysis and design of control systems. Bode plots. System stability. PID and modified PID controller. Pole placement. Quadratic optimal regulator. State observers. Applications of various controllers for robotic systems.

03607342   Industrial Control and SCADA   3(2-3-6)

Introduction to industrial control. Analog signal conditioning. Digital signal conditioning. Sensors and transducers. Analog controllers. Digital controllers. Sequence control. Programmable logic controllers (PLC). PLC programming. PLC interfaces. Human-machine interface. PLC applications

in automation systems. SCADA Systems.

03607351   **Industrial Robot and Applications in Manufacturing**   **3(2-3-6)**
Processes

        Overview of industrial robots. Mechanism of manipulators in industries. Actuators and sensors. Control system and components. Communication in industrial robot systems. Industrial robot operations and programming with teach pendant. Task modeling and simulation. Design and simulation of industrial robot systems for applications in manufacturing processes.

03607361   **Industrial Automation System Design**   **3(2-3-6)**

        Electrical machines. Pneumatic and electrical pneumatic systems. Hydraulic and electrical hydraulic systems. Programming of programmable logic control for electrical machines, electrical pneumatic and electrical hydraulic systems. Applications and design of automation system in industry.

03607395   **Overseas Studies**   **1-6**

        Learning and self development from courses taken in oversea universities. Credit equivalence according to Kasetsart University regulation.

03607396   **Body of Knowledge from Overseas Studies**   **1-15**

        Knowledge in Robotics and Automation System Engineering at the bachelor's degree level taken in oversea universities. Credit equivalence according to Kasetsart University regulation.

03607399   **Engineering Project for Robotics and Automation System II** **2(0-6-4)**

        Projects of practical interest in various fields of robotics and automation system engineering. Design and development of components of a robot or an automation system related to mechanical structures,

control systems, vision systems, or related fields.

03607421   Tools Design for Robotics   3(3-0-6)

Prehension technology. Prehension strategy and procedure. Active pair mating. Design of impactive gripper. Contigutive prehension. Astrictive prehension. Vacuum suction. Magnetoadhesion. Tool exchange and reconfigurability. Separation of materials. Instrumentation and control.

03607422   Smart Embedded System in Robotics   3(3-0-6)

Cyberphysical and embedded systems technologies for robots. Concepts and architectures of embedded systems. Software organization and architectures for embedded systems. Embedded systems design flow. Time and clocks. Real world Input/Output (IO) and subsystem integration. Wired/wireless network and smart sensor systems in robots. Analysis tools, debugging tools and techniques. Real-time operating systems. Fuzzy logic systems. Hardware/Software co-design. Design for robustness and fault recovery in robotics.

03607451   Introduction to Autonomous Mobile Robots   3(3-0-6)

Introduction to mobile robot. Locomotion. Mobile robot kinematics. Perception. Mobile robot localization. Planning and navigation.

03607461   การออกแบบระบบอินเทอร์เน็ตของสรรพสิ่ง   3(3-0-6)
Internet of Things System Design

Concepts of Internet of Things for robotics and automation systems. Basic elements of Internet of Things. Overview of TCP/IP networks. Wireless network protocols. Wireless sensor network design. Network routing. Cloud computing. Applications of Internet of Things in industry and robotics. Internet of Things project.

03607496   **Selected Topics in Robotics and Automation System**   **3(3-0-6)**
Engineering

     Selected topics in robotics and automation system engineering at the bachelor's degree level. Topics are subject to change each semester.

03607498   **Special Problems**   **1-3**

     Study and research in the robotics and automation system engineering at the bachelor's degree level and compiled into written reports.

03607499   **Engineering Project for Robotics and Automation System III**   **3(0-9-6)**

     Projects of practical interest in various fields of robotics and automation system engineering. Design and development of a robot or an automation system related to mechanical structures, control systems, vision systems, measurement systems, intelligent systems or related fields.

Robotics and Automation System Engineering Program Extracurricular Subjects

01417167   **Engineering Mathematics I**   **3(3-0-6)**

     Limits and continuity of functions. Derivatives and applications. Differentials. Integration and applications. Polar coordinates. Improper integrals. Sequences and series. Mathematical induction.

01417168   **Engineering Mathematics II**   **3(3-0-6)**
Prerequisite: 01417167

     Vector and solid analytic geometry. Calculus of multivariables functions. Calculus of vector. Valued functions.

01417267   **Engineering Mathematics III**   **3(3-0-6)**
Prerequisite: 01417168

     First order linear differential equations. Linear differential equations

with constant coefficients. Laplace transforms and inverse transforms. Power series solutions. System of linear differential equations.

| 01420111 | **General Physics I** | 3(3-0-6) |

Mechanics. Harmonic motion. Waves. Fluid mechanics. Thermodynamics.

| 01420113 | **Laboratory in Physics I** | 1(0-3-2) |

Prerequisite or in the same semester: 01420111 or 01420117

Laboratory for General Physics I or Basic Physics I.

| 03600490 | **Co-operative Education** | 6 |

On the job training as a temporary employee according to the assigned project including report and presentation.

| 03601211 | **Electric Circuit Analysis I** | 3(3-0-6) |

Definitions. Basic concept and units. Circuit elements. Node and mesh analysis. Circuit theorems. Resistance, inductance and capacitance. First and second order circuits. Phasor diagram. Sinusoidal signal. Alternating current power circuits. Three-phase systems.

| 03601213 | **Electric Circuit Laboratory** | 1(0-3-2) |

Prerequisite: 03601211

Laboratory experiments on topics covered in Electric Circuit Analysis I (03601211)

| 03601232 | **Digital Circuits and Logic Design** | 3(3-0-6) |

Number systems and codes. boolean algebra. combinational logic design principles and practices. logic design by using Karnaugh map. sequential logic design principles and practices. logic design by using state machine. synchronous and asynchronous sequential logic design. various

families of digital integrated circuits. programmable logic devices. interfacing with analogue circuits. introduction to computer aid design for digital logic design.

03601332   Microprocessors   3(3-0-6)

Prerequisite: 03601232

Introduction to microprocessors. Structure of microprocessors. Assembly programming. Interface techniques. Memories. Input-output interfaces. Applications of microprocessors in instrumentation systems. Applications of microprocessors in automation systems.

03602201   Introduction to Materials and Manufacturing Processes   3(3-0-6)

Relationship between structures, properties, manufacturing processes and applications of engineering materials. Metals. Polymers. Ceramics. Composites. Mechanical properties and material degradation. Fundamental of manufacturing processes foundry, forming, welding, powder metallurgy, hot and cold forming, cutting, turning, shaping, drilling, milling, and surface finishing.

03602212   Computer-Aided Design   3(2-3-6)

Prerequisite: 03604111

Application of computer-aided design software for 2D and 3D modeling. Principle of solid, wire frame and surface. Modeling creation. Assembly and simulation techniques. Parametric and feature-based design technology. Application for products design.

03602221   Applied Probability and Statistics for Engineers   3(3-0-6)

Prerequisite: 01417168

Probability. Random variables and probability distributions. Joint probability distributions. Sampling distributions. Descriptive statistics. Statistical inference for one-and-two sample problems. Simple linear

regression analysis and correlation. Analysis of variance.

03602251   **Engineering Economy**   **3(3-0-6)**

Prerequisite: 03602221

Economic analysis for engineering decisions under certainty, uncertainty and risk situations. Methods of measurement of equivalent value based on total investment analysis and incremental investment analysis. Applications of replacement analysis. Break-even analysis and government project analysis including effects of income taxes and inflation.

03602417   **Computer-aided Engineering and Manufacturing**   **3(3-0-6)**

Prerequisite: 03602212

Finite element analysis. Performance optimization. Simulation-based design. CNC programming. Computer-aided process planning. Virtual and augmented reality technologies in manufacturing processes. Case studies.

03603101   **Introduction to Computer Programming**   **3(2-3-6)**

Computer concepts, Computer component, Hardware and software interaction, EPD concepts, Program design and development methodology, High-level language programming.

03604111   **Engineering Drawing**   **3(2-3-6)**

Lettering. Orthographic projection. Orthographic drawing and pictorial drawing. Dimensioning and tolerancing. Sections. Auxiliary views and development. Freehand sketches. Detail and assembly drawing. Basic computer-aided drawing.

03604201   **Basic Principles of Engineering Mechanics**   **3(3-0-6)**

Prerequisite: 01417167

Force systems and resultant. Equilibrium. Dry friction. Application of

equilibrium equations to structures and machines. Fluid statics. Kinematics and kinetics of particles and rigid bodies. Newton's laws of motion. Principles of work and energy. Impulse and momentum.

03604261   Mechanics of Materials   3(3-0-6)

Prerequisite: 03604221 or 03604201

Forces and stresses. Stresses and strains relationship. Stresses in beams. Shear force and bending moment diagrams. Deflection of beams. Torsion. Buckling of columns. Mohr's circle and combined stresses. Failure criterion.

03604281   Workshop Practice   1(0-3-2)

Practice in work-piece measuring. Gas and arc welding. Metal sheet works. Lathe works. Safety in workshop.

03604323   Engineering Measurements   3(3-0-6)

Prerequisite: 01417267

Measurement of engineering quantity in electrical signal for control. Measurement of motion, pressure, temperature, strain, fluid flow, forces and torques. Dynamic response of measuring devices.