Department of Electrical Engineering

Information and Communication Technology for Embedded Systems (International Program)

Program Master of Engineering Program in Information and Communication Technology for Embedded Systems (International Program)

Degree Master of Engineering (Information and Communication Technology for Embedded Systems), M.Eng. (Information and Communication Technology for Embedded Systems)

Plan A Option 2:

    Total credits required: minimum 36 credits

    (1) Major courses: minimum 24 credits

      - Seminar: 2 credits

01227597	Seminar	1,1

      - Major requirements: 16 credits

01227511	Computational Mathematics	3(3-0-6)
01227521	Software Concepts for Embedded Systems	3(3-0-6)
01227522	Software Designs for Embedded Systems	3(2-3-6)
01227523	Hardware Concepts for Embedded Systems	3(3-0-6)
01227524	Hardware Designs for Embedded Systems	3(2-3-6)
01227591	Research Methods in Information and Communication for Embedded Systems	1(1-0-2)

      - Major electives: minimum 6 credits

01227525	Communication Theory for Embedded Systems	3(3-0-6)
01227526	Digital Signal Processing for Embedded Systems	3(3-0-6)
01227527	Intelligence Processing	3(3-0-6)
01227528	Control Systems for Embedded Systems	3(3-0-6)
01227596	Selected Topics in Information and Communication for Embedded Systems	3(3-0-6)
01227598	Special Problems	1-3

    (2) Thesis: minimum 12 credits

01227599	Thesis	1-12

Course Description

01227511 Computational Mathematics   **3(3-0-6)**

Set theory, relations, formal proof methods, finite automata, regular expressions, context-free grammar, pushdown automata, first order logic, theories related to counting, graphs and networks, interplay between continuous models and their solution via discrete processes, vector spaces, basis, dimension, eigenvalue problems, diagonalization, inner products, unitary matrices, applied statistics to intelligent systems, supervised statistical learning.

01227521 Software Concepts for Embedded Systems   **3(3-0-6)**

Software programming, embedded operating systems and middlewares, verification and testing for embedded systems, software concepts on microcontroller architectures and peripherals, compilers and debuggers, timer and interrupt systems, interfacing of devices, software issues in design of embedded systems, communications and networking, real-time system design for embedded system, data structures, sequential and binary search, merging and sorting.

01227522 Software Designs for Embedded Systems   **3(2-3-6)**

Development process for embedded software, hardware and software development tools, software project management techniques and tools. Embedded system architecture, embedded processor, embedded operating systems. Project planning, system specification, software implementation and verification on prototype board. Internet connectivity and service access, concepts and implementation of Internet of Things. Example of application to railway signal or telecommunication.

01227523 Hardware Concepts for Embedded Systems   **3(3-0-6)**

Basic digital system design, processor architecture design, VLSI design methodologies, hardware concepts on microcontroller architectures and peripherals, device interface, hardware for communications and networking.

01227524 Hardware Designs for Embedded Systems   **3(2-3-6)**

Introduction to hardware design concept. Hardware development tools. Hardware description language. VHDL/Verilog programming. FPGA design flow. Input and output pin assignment. Synchronous and asynchronous logic design. Logic simulation and optimization. Verification of design constraints. Hardware development project. Coordinate Rotation Digital Computer (CORDIC) algorithm implementation. Hardware interfaces (I2C, SPI). High speed PCB design concept. Software and hardware implementation and verification. Practical issues on microcontroller and FPGA. Examples of application to railway electronics or electrification.

01227525 Communication Theory for Embedded Systems   3(3-0-6)

Information theory, signal processing, communication systems, data and digital communication concepts, theory and techniques in data communications: transmission, encoding, decoding, error detection, error correction, link control, networking and standards, communication software and hardware, synchronization subsystems, time division multiple access systems, code division multiple access systems, wireless communications, cryptography and security in Mobile communication.

01227526 Digital Signal Processing for Embedded Systems   3(3-0-6)

Digital signal processing theory, video and audio processing, discrete-time signals and systems, linear time-invariant systems, sampling of continuous-time signals and convolution, finite and infinite impulse response filter designs, discrete Fourier transform, fast Fourier transform algorithms, relations between Fourier transform: discrete-frequency Fourier transform, Fourier series, discrete-time Fourier transform, and discrete Fourier transform. Image and speech coding and decoding, transmultiplexers, filter banks, channel estimation and equalization, synchronization, array processing, power spectral estimation, adaptive filtering, analog digital converter and digital analog converter algorithms.

01227527 Intelligence Processing   3(3-0-6)

Human interface, computer graphics, artificial intelligence, concept and design of human-machine interface, trends of human interface design, graphics user interface, interactive software design, hardware technology for human interface, basic descriptive geometry, methods of creating, storing, manipulating, presenting and animating two and three dimensional objects, applications of artificial intelligence, artificial intelligence languages, search techniques, knowledge representation, reasoning and inference, machine learning, expert systems. Human sensory information processing.

01227528 Control Systems for Embedded Systems   3(3-0-6)

Control system theory, Laplace transform, control system description and block diagrams, dynamics of typical controlled systems, development and simplification of transfer functions, analytic tools for predicting system response and performance, root locus design techniques, applications for embedded systems: control systems and environment, environment control systems, power management systems and methods, control in power electronics. Examples of application to railway control systems.

01227591 Research Methods in Information and Communication Technology for Embedded Systems   1(1-0-2)

Research principles and methods in information and communication technology for embedded systems and problem analysis for research topic identification, data collecting for research planning, identification of samples and techniques, analysis, interpretation and discussion; of research result report writing for presentation and publication.

| 01227596 | Selected Topics in Information and Communication Technology for Embedded Systems | 3(3-0-6) |

**01227596 Selected Topics in Information and Communication Technology for Embedded   3(3-0-6)
Systems**

Selected topics in information and communication technology for embedded systems at the master's degree level, topics are subject to change each semester.

01227597 Seminar   1

Presentation and discussion on current interesting topics in information and communication technology for embedded systems at the master's degree level.

01227598 Special Problems   1-3

Study and research in information and communication technology for embedded systems at the master's degree level and compile into a written report.

01227599 Thesis   1-12

Research at the master's degree level and compile into a thesis.