

PROGRAMME DESCRIPTION
MASTER'S PROGRAM DESCRIPTION
«Microelectronics of Telecommunications Systems»

Program Objective: Master's students training for research and development in the field of integrated circuits design as well as in micro- and nanoelectronics for perspective wireless telecommunications systems. It includes RF, analog, and digital circuits design for receivers and transmitters and digital signal processing based on FPGA and microcontrollers.

Program Duration: two years

Start of the program: October, 1

Participants: Russian and international students

Admission requirements: participants of the program are required to have a Bachelor's degree in Telecommunications, Electrical Engineering, Microelectronics or an equivalent degree according to the educational system of the country they represent. They should possess fluent command of English as a foreign language.

Teaching staff: Professors and Associate Professors of St. Petersburg State Polytechnical University, Hamburg University of Technology; Joseph Fourier University, Grenoble; Tampere University of Technology.

Training methods: Curriculum is of module type. It includes lecturing, seminars, labs and computer simulation of microelectronics devices, circuits, and systems combining practical skills and fundamental knowledge. Research work in international scientific teams and participation of international research projects are also possible. E-learning support of the educational process is provided.

ECTS: 120 ECTS at the minimum

Program structure: compulsory courses, elective courses, a Master's thesis. Compulsory lecture courses and a Master's theses are included into the syllabus of a student. The students have to choose one of the elective courses presented in the each group A, B, C, D from the list below to get 120 ECTS to complete the program.

Program content:

Compulsory Courses:

✓ **Simulation and Optimization Methods in Integrated Circuits Design, 5 ECTS**

Description: Model of passive components; Models of active components; MOSFET SPICE model of MOSFET; MOSFET BSIM model; MOSFET small-signal model; MOSFET high-frequency model. MOSFET noise model; Temperature effects in MOSFET; Component simulations based on MOSFET.

✓ **Functional and Organic Microelectronics, 5 ECTS**

Description: Principal physics of functional acoustoelectronics, organic electronics, molecular electronics, semiconductor electronics and optoelectronics; Instruments and devices of functional microelectronics.

✓ **Basics of Nanotechnology, 5 ECTS**

Description: Electronic, optical and electrical properties of two-dimensional structures; Devices based on two-dimensional semiconductor structures; Properties and applications of one-dimensional and zero-dimensional structures; Principles of creation of nanoelectronic devices based on one-dimensional and zero-dimensional structures.

✓ **Theory of Telecommunication Systems and Networks, 5 ECTS**

Description: Basis of Telecommunication technologies; General theory of signal transmission in different environments; Theory of digital signal processing; Methods of network analysis and

synthesis; Static and dynamic models of networks of different topologies; Systems and networks hardware and software.

✓ **Theory of electromagnetic compatibility, 3 ECTS**

Description: Electromagnetic Interference, Conducted and Radiated Emission, Electromagnetic field propagation, skin effects, electric and magnetic dipole, near field and far field radiation, capacitive and inductive coupling, Rayleigh range of antennas, Common-mode and Differential-mode emission, Electrostatic Discharge coupling.

✓ **Design of Microelectronics Digital Circuits, 4 ECTS**

Description: Main logic blocks, parameters, and descriptions; Combinational logic; Sequential logic; SRAM, DRAM, nonvolatile memory cells, FLASH; Digital circuits design in CMOS-technology; Short channel effects in digital design; Low-power digital circuits, pass transistor logic, adiabatic logic; High-speed digital circuits design; Digital circuits simulations based on **Cadence** platform.

✓ **Programmable Digital Devices, 4 ECTS**

Description: Basics of Verilog; Practical aspects of the digital devices programming; SPARTAN FPGA; ST-Microelectronics ST5/ST7 microcontrollers.

✓ **Physics of Integrated Circuit Technology, 5 ECTS**

Description: Basic operations of planar technology; Thermal oxidation; Methods for doping; Epitaxial technology; Lithography; Technology of bipolar and CMOS integrated circuit structures; Three-dimensional integrated circuits; Perspective materials of microelectronics.

✓ **Microelectronics Filter Design, 4 ECTS**

Description: Approximation problem; Reactance transformation; Sensitivity problem; Cascade design; Element simulation method based on Bruton transform; Operational simulation method; Switched capacitor technique; Analysis of SC-circuits in time and Z-domain, Lacker models; Transconductance amplifier based filters, tuning systems.

✓ **UNIX based operational Platform, 2 ECTS**

Description: Theoretical basics and practicum in LINUX operational system.

✓ **Humanitarian Module, 4 ECTS**

Description: Philosophy of natural science, History and methodology of Physics.

Scientific and Research work:

- ✓ Scientific and Research Work, **57 ECTS**
- ✓ Master's Theses Completion, **3 ECTS**

Research Laboratories:

- ✓ Telecommunication Systems Laboratory
- ✓ Integrated Circuits Design Laboratory
- ✓ Optical Systems and Organic Electronics Laboratory

Elective Courses. One discipline should be chosen from each group:

Group A (4 ECTS)

✓ **Design of Microelectronics Analog and RF Circuits**

Description: Main analog and RF building blocks: cascode stages, OpAs, transconduction amplifiers, current amplifiers, low-noise amplifiers, wide band amplifiers, mixers, VCO; Analog and RF circuits design in CMOS-technology; Short channel effects in analog circuits design; Analog and RF circuits simulations based on **Cadence** platform, RF circuits simulations based on **ADS**.

✓ **Basics of Optical Communication Systems**

Description: Parameters of optic communication lines. Elements and components of fiber-optic communication lines. Manufacturing technology elements and components of fiber-optic communication lines.

Group B (4 ECTS)

✓ **Methods of Optimal Synthesis of Microelectronics Devices**

Description: Basics of Optimization Theory; Cost function; Gradient methods; Davidon-Fletcher-Powell algorithm; Hooke-Jeeves algorithm; Rosenbrock function and Rosenbrock algorithm; Constrained optimization; Multidimensional optimization.

✓ **Optoelectronic Devices**

Description: Properties and characteristics of the optical radiation. Physics of quantum interaction of radiation with matter. Main types of optical radiation sources. Lasers. Optoelectronics. Photoelectric radiation receiver. Fiber Optic System.

Group C (2 ECTS)

- ✓ **Seminar on Design of Microelectronics Digital Circuits**
- ✓ **Seminar on Design of Microelectronics Analog and RF Circuits**

Group D (2 ECTS)

- ✓ **Seminar on Methods of Optimal Synthesis of Microelectronics Devices**
- ✓ **Seminar on Basics of Optical Communication Systems**

The Final Certifying Examination (3 ECTS)

STUDY ENVIRONMENT

Admission procedure: The information about the admission procedure and the application form is available on the web-page <http://www.imop-spbpspu.ru>

Deadline for the application: September, 24

Financial terms: Tuition fees is 150 000 RUR per 1 year. Individual financial support and a limited number of free of charge positions have been provided

Tuition fees: are available on the web-page <http://www.imop-spbpspu.ru>
The tuition fees cover study expenses, library services and the costs of supplementary material.

Registration fees: are available on the web-page <http://www.imop-spbpspu.ru>

Accommodation: rooms for two persons in a two-roomed apartment with shared facilities and a kitchen in a comfortable students' hostel.

For further information please contact:

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