MSc Degree Programs

in electrical engineering

Annex

Valid for studies started
in fall semester 2014 or earlier

Contents

I. Specialization study blocks

I.1 Infocommunication Systems (TMIT)

1. Name of the specialization:	**Infocommunication Systems**
2. MSc curriculum:	electrical engineering
3. Department:	Department of Telecommunications and Media Informatics (TMIT)
4. Responsible lecturer:	Dr. Rolland Vida associate professor

Wireline and wireless transmission technologies

(VITMM155, 1. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Characterization of transmission on wire. Distortions, possibility of duplex communication, echo cancellation. Attenuation of wireless links, two-path and multi-path fading. Moving transmitter/receiver, Doppler effect, Doppler spreading. Elements of optical networks. Transmission on fiber, attenuation, chromatic and polarization mode dispersion, nonlinear effects. Quality of signals, BER, Q-factor, SNR, OSNR. Modulation methods: real and complex PAM (CAP, QAM) systems. OFDM and DMT as robust and flexible modulation procedures. Bit allocation, signal processing. Compensation of dispersion, equalization methods. Pre-equalization. Error correcting algebraic coding. DFT over finite fields. Reed-Solomon codes. Correction of erasement and symbol errors. Extensions.

Convergent Networks and Services

(VITMM156, 1. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Network architectures. Infrastructural networks: fixed, wireless and mobile access networks; aggregation, metro, regional and provider backbone networks and their roles. Infrastructure-less networks; wireless mobile ad hoc networks (MANET), sensor networks, mesh networks, moving networks (NEMO), vehicular networks (VANET), opportunistic networking. End points and their characteristics; device, user, and service mobility; mobility models, nomadic networking. Convergence in the network; the concept of fixed-mobile convergence, horizontal and vertical handovers, next generation networks (NGN). Convergence at the end nodes. Multi-mode devices, Generic Access Network (GAN – UMA). Convergence in the services; the IP Multimedia Subsystem, SÍP signaling, Parlay/OSA. IPTV over wired and wireless access networks, VoIP connections in IMS systems, PSTN/VoIP gateway.

Network and Service Management

(VITMM157, 1. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Introduction to network management: motivations, players and complexities in network management: technical, organizational and business. Cases studies in network management: ISP, enterprise and a service provider; overview of different management tools. Basics of network management: devices, management systems, management networks and management support organizations. The different dimensions of network management. Network management functions and reference models. Management information and modeling of management information. Communication patterns in network management. SNMPv1, v2, v3, RMON-1, RMON-2. CLI, syslog, netconf and netflow as management protocols. Scaling the network management problem: complexities, hierarchies and management styles. Policy based management. Service management and service level agreements.

Human-Computer Interaction

(VITMM224, 2. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Introduction. Modalities between humans and the environment. Speech interfaces, speech communication. Visual interfaces; basic notions and methods of iterative design. User interface techniques; directives, golden rules. User interface principles and examples. Menu systems, text dialgue, graphical interface. Usability of websites; special user spaces (e.g., multimedia, groupware). Usability for everyone (W3C WAI). User interfaces on mobile devices; general principles, OS-related questions, modality-related problems. Evaluation of user interfaces; evaluation criteria and methods. Case studies. Presentation of practical tasks.

Network Planning

(VITMM215, 2. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Tasks, methods and algorithms for planning, design and configuration of core and access networks. Input and output of the planning, objectives of the design, cost function curves. Traffic descriptors, topologies and topology models, Optimization problems and algorithms, linear programming, heuristics (simulated annealing, tabu search, genetic algorithm, simulated allocation). Capacity planning, traffic separation, Quality of Service, Traffic Engineering, scalability. Network reliability, dedicated and shared protection, p-cycles, Shared Risk Link Group, restoration. Wireless access network design: RF spectrum management, fix and dynamic channel allocation, strategies for access point placement. Future Internet technologies.

Infocommunications Laboratory I.

(VITMM245, 2. semester, 0/0/3/p/4 credits, TMIT)

Topics covered: The goal of this course is to supplement the theoretical knowledge acquired during the other courses of this specialization with practical elements. It includes measurements on the following topics: baseband digital transmission on copper lines and optical fiber; line coding, eye diagram, error ratio, HDSL (High bitrate Digital Subscriber Loop). Data transmission over access networks (from the dial-up modem to the Digital Subscriber Line (DSL). Equalization of digital line segments (echo cancellation). IP data transmission over ATM networks. Analysis of Passive Optical Networks (PON). Analysis of local area computer networks (Ethernet - IEEE 802.3). Analysis of an ISDN-VOIP (SIP, H323) gateway (characteristics of the voice channel, signaling conversion, routing).

Infocommunications Laboratory II.

(VITMM311, 3. semester, 0/0/3/p/4 credits, TMIT)

Topics covered: The goal of this course is to supplement the theoretical knowledge acquired during the other courses of this specialization with practical elements. It includes measurements on the following topics: ADSL (Asymmetric Digital Subscriber Line) network management, automatic speech recognition, Voice over IP (VoIP) traffic measurements, analysis of voice coding solutions, network simulation, analysis of the operation and management of SDH networks, programming of web interfaces, analysis of image coding solutions.

Project Laboratory I.

(VITMM807, 1. semester, 0/0/5/p/5 credits, TMIT)

Project Laboratory II.

(VITMM857, 2. semester, 0/0/5/p/5 credits, TMIT)

Students work individually or in small teams with the help of a supervisor on a topic chosen from a set of topics related to the specialization study block. During the two semesters of this course the students solve a complex stand-alone engineering problem leading to a product such that the students get acquainted with all the important activities of an engineer. Students are supposed to solve the particular tasks autonomously.

Degree thesis I.

(VITMM907, 3. semester, 0/5/0/p/10 credits, TMIT)

Degree thesis II.

(VITMM957, 4. semester, 0/10/0/p/20 credits, TMIT)

In order to obtain the MSc degree, the student has to prepare an MSc degree thesis. The thesis has to prove that the student is capable of autonomous engineering work, knows about and knows how to apply the different engineering methods, is able to interpret the problem to be solved, and is capable of design decisions by evaluating and analyzing the available options. The program of the first semester starts with the study of the related literature and the creation of a system specification and workplan. Some progress in solving the problem is also expected, proportional to the available time period. In the second semester the work has to be finished, and the thesis has to be written.

II. Compulsory elective subjects

II.1 Compulsory elective subjects

II.1.1 Infocommunication Systems (TMIT)

Information and Network Security

(VITMM280, 2. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: The goal of the lecture is to give theoretical and practical knowledge on recent information and network security. Attacks and threats. Introduction to cryptography. Ciphering, block ciphers and stream ciphers (DES, 3DES, AES, RC4). Asymmetric key encryption (RSA). Cryptographic hash functions. Keyed hash functions. Key management protocols. Digital signature. Protection of the networked communication. Attacks to the communication. Encryption protocols (IPSec, TLS/SSL). Virtual private networks. Firewalls, Network Address Translation, Intrusion Detection Systems, Honeypots. Vulnerability assessment. Protection of WiFi wireless networks. WEP, WPA, 802.11i protocols.

Optical Networks

(VITMM347, 3. semester, 2/1/0/e/4 credits, TMIT)

Topics covered: Architecture and services of modern and next generation optical telecommunication systems. Application of optical networking in broadband IP core, metro and access networks. Optical network elements, physical impairments in optical transmission, modeling, simulation. WDM, (R)OADM, OXC, 1-10-100 GigabitEthernet systems, OBS, OPS. All optical networks. Passive Optical Networks. SONET/SDH, ATM, MPLS, T-MPLS, GMPLS, ASON. Resource management, traffic grooming, routing and wavelength assignment. Planning principles of optical networks. Characterization of services over optical networks, trends, applications (GRID, VoD, etc.), Economical aspects of operation and management, CAPEX, OPEX.

Performance Analysis of Infocommunication Systems

(VITMM325, 3. semester, 2/1/0/e/4 credits, TMIT – optional course)

Topics covered: Traffic modeling and basic notions of performance analysis. Fractal description of the traffic. Design and statistical analysis of performance measurements. Simulation methods in performance analysis. Over-provisioning and managed bandwidth, characteristics of streaming and elastic traffic, traffic shaping, packet and burst level congestion, call admission control (CAC) mechanisms and traffic engineering. Traffic measurements and modeling for applications on the Internet: web, P2P, gaming, VoIP, etc. Identifying the traffic of P2P applications, analyzing gaming and VoIP traffic. Performance analysis of the TCP/IP protocol stack; measurements, metrics, fairness study. Modeling and performance analysis of TCP. Adaptive queue management (AQM) methods, fast TCP variants. Basic design principles of the next generation Internet: the GENI approach, energy efficiency, identifier-locator split.

Sensor Networks and Applications

(VITMM348, 3. semester, 2/1/0/e/4 credits, TMIT – optional course)

Topics covered: Hardware and software architecture of intelligent sensors, communication portocols, single-hop and multi-hop communication, energy efficiency. Mobility and positioning, topology control. Event-driven, time-driven and query-driven networks, sleep scheduling solutions, MAC-layer issues, clustering and data aggregation algorithms. Typical application areas (habitat monitoring, industrial applications, healthcare, assisted living, intelligent home, etc.). The TinyOS operating system. Standardisation issues (IEEE 802.15.4, Zigbee).