School	School of Engineering
Major	Masters of Science in Computer and Communication Engineering

Major Requirements			
Code	**Title**	**Credits**	**Description**
ENGG510	Methods of Optimization	3	This course discusses optimization methods applied to engineering problems. Problem formulation and modeling is presented. Emphasis on linear systems of equations, non-linear systems of equations, unconstrained optimization, equality-constrained optimization, inequality-constrained optimization, and heuristics.
CENG505	Computer Architecture	3	The concepts of computer architecture from a quantitative approach. Instruction set design with examples from both RISC and CISC architectures. Processor implementation techniques and micro-programming, pipelining and methods to cope with pipeline hazards, and the memory hierarchy (cache and virtual memory). Parallel and vector architectures, future directions, and examples of highly parallel computers.
CENG557	Advanced Network Architectures	3	This advanced course will provide the student an outstanding knowledge of the most interesting advanced network architectures and technologies used nowadays for providing the different communication services. A good understanding of this course will also provide the student background knowledge on network design. Topics include: SONET/SDH and GFP, ATM Networks, QoS Metrics, IP QoS Generic , IP Intserv & Diffserv, Congestion Control in ATM Networks, Multi-Protocol Label Switching Architecture, Label Distribution Protocols, Optical , D35, Fibers and Components, Wavelength Routing Optical Networks, Optical Burst Switching, Broadband Access Network.
CENG645	Mobile Communication	3	This course aims to cover the breadth of topics relevant to state-of-the-art wireless communications engineering. The course deals with the fundamental cellular network concepts such as frequency reuse, duplexing, handoff, trunking and system design to maximize the number of users per unit bandwidth and unit area. Covered systems include: Global System for Mobile communications (GSM), Interim Standard 95 (IS-95), Universal Mobile Telecommunications System (UMTS) (also known as Wideband Code Division Multiple Access WCDMA), 3GPP Long-Term Evolution (LTE), and WiMAX. The course also addresses physical layer aspects, Medium Access Control (MAC) layer, networking considerations, radio resource allocation, sharing, control and management in cellular networks, Uplink and Downlink scheduling issues, as well as capacity evolution for the radio access network.
CENG644	Image Processing	3	This course teaches the signal processing theories and computing application of those theories to the problem of image processing. Images make up an important part of todays multimedia based communications. The use of images in this type of communication is made possible by processes that involve compression, segmentation, denoising and many others. This course focuses on the application of these methods to digital images from various sources and intended for use in multiple applications. A student who completes this course will have the knowledge required to understand existing and new image processing techniques and the suitability of these techniques for different application areas (such as medicine, mining, security, social networking, archaeology and archiving).
CENG695A	Master Thesis(Part I)	3	The Master□s Project course is six credits practical and research course. The master project is spread over two semesters. Students are requested to conduct a research relevant to the field of specialty; ending up with a thesis describing methodology; applications and results. The course also includes producing a prototype of the research subject (numerical model,__physical application). In addition students seek to spend a period of time in organizations specialized in the research field as a practical training.

EENG537	Digital Communications	3	The course is an introduction to modern digital communications at a graduate/senior undergraduate level. It emphasizes a conceptual understanding of principles, techniques, and fundamental limits in digital communication systems. This course covers modulation for digital communications over additive white Gaussian noise (AWGN) channels; bandpass and lowpass signal representation; signal space representation of waveforms; modulation; demodulation; optimum receivers for AWGN channels; probability of error analysis; channel coding; synchronization; an introduction to digital communication through band-limited channels.
EENG637L	Advanced Digital Communication Lab	1	This course introduces students to a wide range of topics in Communications such as Digital Communications systems, Wireless and RF communication techniques. It includes the digital modulation schemes: ASK, FSK, M-ary PSK, M-QAM and the eye diagram analysis and illustration. It also covers the Advanced Digital communication techniques related to the Equalization function, Channel Estimation, Frame Detection, Orthogonal Frequency Division Multiplex (OFDM), timing synchronization and Channel Encoding/Decoding. The students are guided through hands-on experiments in Digital communications. These experiments lay emphasis on design aspects, performance analysis of different systems, methods and techniques. This Lab is based on LabVIEW Communications System Design Suite that offers a design environment closely integrated with NI software designed radio (SDR) hardware, USRP2901, for rapidly prototyping communications systems.
EENG587	Wireless Communication	3	This course introduces the applications and challenges of current and envisioned wireless systems, as well as the fundamental principles underlying wireless communications. Topics include: overview of current wireless standards, wireless channels characteristics and models, path loss, shadowing, noise, interference, link budget, flat and frequency selective properties of multipath fading, capacity limits, diversity and combining techniques, multiple antenna techniques MIMO and space-time coding, multicarrier modulation and orthogonal frequency division multiplexing OFDM, spread-spectrum and frequency hopping techniques, multi-user systems.
EENG577	Advanced Digital Communications	3	This course is divided into two main parts and covers the two main functions in the digital communication system: Equalization and channel coding. The first part is focused on digital communication through band-limited channels. Topics covered include the characterization and signal design for band limited channels, the optimum receiver for channels with intersymbol interference and AWGN, and suboptimum equalization methods, namely, linear equalization and decision feedback equalization. The second part provides an introduction to lossless source coding, channel capacity for different channel models, and the channel reliability function. It treats linear block codes and their properties which includes a treatment of cyclic codes, BCH codes, Reed-Solomon codes, Convolutional codes, Turbo codes and concatenated codes. The course ends with a brief introduction to OFDM and MIMO systems.
EENG527	Digital Signal Processing	3	The objective of this course is to build a good understanding of the principles of Digital Signal Processing starting from the theoretical analysis of Discrete Time Systems up to the design and implementation of Digital Filters. Topics include: Analog to Digital Conversion, sampling, quantization, coding, Z-transform and its applications, structures for FIR and IIR systems, design and implementation of Filters using: window, frequency sampling and equiripple filter. In order to provide students with strong foundation of engineering practices and perform a practical application of the acquired knowledge, some design and simulation examples using Matlab are covered.

CENG695B	Master Thesis(Part II)	3	The Master□s Project course is six credits practical and research course. The master project is spread over two semesters. Students are requested to conduct a research relevant to the field of specialty; ending up with a thesis describing methodology; applications and results. The course also includes producing a prototype of the research subject (numerical model,__physical application). In addition students seek to spend a period of time in organizations specialized in the research field as a practical training.
CENG505L	Computer Architecture Lab	1	This lab is about implementing microprocessor architectures in Hardware descriptive language (VHDL/Verilog). Students will be able to design and simulate different elements that constitute a microprocessor. The lab covers advanced topics in Memory design, pipeline design, ALU architectures, forwarding units, hazard detection units, branch prediction methodologies, and parallel processing elements in HDL.
CENG557L	Advanced Network Architectures Lab	1	Introduction to network modeling tools (such as OpNet and ns3). Use of network modeling tools to analyze architectures learned in class.