Required Core Courses

ELE 600/ MTH 6XX  Probability Theory and Stochastic Processes in Engineering
3 hours; 3 credits
Probability space, elements of combinatorial analysis, conditional probability, independence, random variables, expectation, law of large numbers, random walks and Brownian motion, discrete and continuous parameter Markov chains, martingales and diffusion theory, linear estimation theory, Wiener and Kalman filters. Prerequisites: M.E.E.E. admission requirements

ELE 610  Advanced Signal Processing
3 hours; 3 credits

ELE 620  Networking Systems & Protocols (incl. laboratory)
3 hours; 3 credits
Introduction to computer networks; reference models; physical, transport and network layers; local area and wide-area networks; routing and congestion control, security, elementary performance evaluation; common protocols including Internet Protocol (IP) and Transmission Control Protocol (TCP); sensor networks. Prerequisites: M.E.E.E. admission requirements

ELE 630  Semiconductor Devices
3 hours; 3 credits
*Operating principles and practical use of the components that make up modern integrated circuits and optoelectronic systems.*
Semiconductor physics; carrier injection and recombination; p-n junction diodes, Schottky barriers and heterojunctions; Junction and MOS field-effect transistors; bipolar transistors; tunneling and charge-transfer devices; VLSI technology and scaling, light-emitting diodes and lasers; photodetectors and solar cells. Prerequisites: M.E.E.E. admission requirements
Elective Courses

**ELE 641  Advanced Digital Communications**  
3 hours; 3 credits  
*Engineering of digital communication systems at the physical layer.*  
Deterministic & stochastic signals; entropy & channel capacity; digital modulation techniques and error performance; inter-symbol interference, precoding and equalization; OFDM; fading, MIMO systems, multiple-access strategies.  
Prerequisites: M.E.E.E. admission requirements

**ELE 652  Information Theory**  
3 hours; 3 credits  
Information measures, Law of large numbers and the asymptotic equipartition property. Lossless data compression: Huffman codes, Krafts inequality, bounds on optimal code length. Channel capacity: joint typicality, channel coding theorem, Fano's inequality and the converse to the channel coding theorem. Differential entropy. Gaussian channels. Introduction to rate distortion theory.  
Prerequisites: M.E.E.E. admission requirements

**ELE 701  Photonic Devices (incl. laboratory)**  
2 laboratory hours, 2 lecture; 3 credits  
Prerequisite: ELE 630

**ELE 713  Principles and Practice of Secure Networking**  
3 hours; 3 credits  
Information-theoretic principles of security: confidentiality, authentication, integrity. Public key cryptography, discrete logarithm based systems, RSA system, systems based on coding theory, knapsack based systems, hash codes and authentication techniques, secret sharing schemes. Physical layer security including quantum entanglement. Elements of discrete mathematics and number theory required will be developed along the way.  
Prerequisites: ELE 600/MTH 6XX, ELE 620
ELE 722  Data Modeling and Compression
3 hours; 3 credits
Practical methods for modeling data, learning and data compression. Modeling of discrete and continuous alphabet data, quantitative methods for model comparison, learning algorithms for data modeling, data models in practice, lossless: (Huffman coding, arithmetic coding, Lempel-Ziv coding, run length coding, data transformations such as the Burrows-Wheeler transform) and lossy compression. (scalar and vector quantization, predictive coding, transform coding) of speech, audio, image, video and seismic signals. Speech, Audio, Image and Video coding standards.
Prerequisite: ELE 610

ELE 732  Estimation, Detection, Learning and Inference
3 hours; 3 credits
Algorithmic tools and theoretical framework for data driven analytics and system design. Fundamentals of probability, hypothesis testing, estimation; an introduction to optimization and iterative optimization methods, elements of learning theory, supervised methods, unsupervised methods, dimensionality reduction, regularization, learning in dynamic environments, large data sets, computing environments for large data sets.
Prerequisite: ELE 600/ MTH 6XX

ELE 741  Photonic Systems & Networks
3 hours; 3 credits
Optical fiber transmission, chromatic dispersion, passive components, switches and modulators, link budgets, optical amplifiers, noise figure in multi-span systems, wavelength routing, access networks, coherent transceivers, advanced modulation formats, free-space optics.
Prerequisite: ELE 701

ELE 755  Principles and Practice of Machine Vision (incl. laboratory)
2 laboratory hours, 2 lecture hours; 3 credits
Theoretical and practical aspects of machine vision. Topics covered: image formation, image representation, camera geometry and calibration, multi-view geometry, 3D reconstruction, image segmentation, object recognition, applications.
Pre- or Co-requisite: ELE 610
ENS 765  **Fundamentals of Wireless Communications**  
3 hours; 3 credits  
Pre- or Co-requisite: none

**ELE 79P  Master's Advanced Research Project**  
Participation in state-of-the-art research in a topic within Electrical Engineering. May be repeated twice for credit.  
Prerequisite: Admission to the program; completion of 12 graduate credits with a grade of B or better, permission of the instructor.

**ELE 79T  Master's Topical Study Project**  
Detailed study of the technical literature addressing a current topic within Electrical.  
May be taken only once for credit.  
Prerequisite: Admission to the program; completion of 12 graduate credits with a grade of B or better, permission of the instructor.
Course Numbers for Master of Engineering in Electrical Engineering

<table>
<thead>
<tr>
<th>Catalog number</th>
<th>Title</th>
<th>Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELE 600</td>
<td>Probability Theory and Stochastic Processes in Engineering</td>
<td>C</td>
</tr>
<tr>
<td>ELE 610</td>
<td>Advanced Signal Processing</td>
<td>C</td>
</tr>
<tr>
<td>ELE 620</td>
<td>Networking Systems &amp; Protocols (incl. laboratory)</td>
<td>C</td>
</tr>
<tr>
<td>ELE 630</td>
<td>Semiconductor Devices</td>
<td>C</td>
</tr>
<tr>
<td>ELE 641</td>
<td>Advanced Digital Communications</td>
<td>1</td>
</tr>
<tr>
<td>ELE 652</td>
<td>Information Theory</td>
<td>2</td>
</tr>
<tr>
<td>ELE 701</td>
<td>Photonic Devices (incl. laboratory)</td>
<td>1</td>
</tr>
<tr>
<td>ELE 713</td>
<td>Principles and Practice of Secure Networking</td>
<td>1,2</td>
</tr>
<tr>
<td>ELE 722</td>
<td>Data Modeling and Compression</td>
<td>2</td>
</tr>
<tr>
<td>ELE 732</td>
<td>Estimation, Detection, Learning and Inference</td>
<td>2</td>
</tr>
<tr>
<td>ELE 741</td>
<td>Photonic Systems &amp; Networks</td>
<td>1</td>
</tr>
<tr>
<td>ELE 755</td>
<td>Principles and Practice of Machine Vision (incl. laboratory)</td>
<td></td>
</tr>
<tr>
<td>ELE 765</td>
<td>Fundamentals of Wireless Communications</td>
<td></td>
</tr>
<tr>
<td>ELE 79P</td>
<td>Master’s Advanced Research Project (may be taken no more than twice for credit.)</td>
<td>1,2</td>
</tr>
<tr>
<td>ELE79T</td>
<td>Master’s Topical Study Project (may be taken no more than once for credit.)</td>
<td>1,2</td>
</tr>
</tbody>
</table>

1 Courses marked ‘C’ are required of all students; Courses marked ‘1’ are recommended for students focusing in Photonic Systems & Networks; Courses marked ‘2’ are recommended for students focusing in Information Processing & Transmission.

Note: 7XX level courses require at least one prerequisite from the 6XX level.