Graduate Student Handbook

Master of Science in
Electrical and Computer Engineering

Department of Electrical and Computer Engineering

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1 MSECE Program Objectives

The Master of Science in Electrical and Computer Engineering (MSECE) program is designed to provide the student with advanced problem solving and professional communication skills needed to pursue a senior engineering position or gain entrance to a Ph.D. program. The department offers a single graduate degree designed to provide suitable depth and breadth in electrical and computer engineering. Each MSECE course is aimed at the following global program objectives. The student will

(a) apply and develop knowledge of advanced topics in electrical and computer engineering;

(b) analyze and interpret state-of-the-art engineering information via the latest techniques and technologies;

(c) implement modern techniques as an electrical and computer engineering project;

(d) read and review relevant technical and scientific literature;

(e) communicate effectively in written, oral, graphical, and digital forms; and

(f) develop an awareness of professional issues, such as ethics and lifelong learning, through participation in local and national chapters of the Institute of Electrical and Electronics Engineers (IEEE) and the Association for Computing Machinery (ACM).

2 Admission to the Program

Admission to the MSECE program commences at the start of the semester designated in the student's letter of admission. Admission to the program does not imply admission to any other MS program at LTU; each program has its own application process. An admission to the MSECE program occurs on either a *regular* basis or a *conditional* basis. In addition, a *provisional restriction may* accompany either type of admission.

2.1 Regular Admission

An applicant who has met all program admission criteria and received approval from the Program Director and the College Dean to pursue a graduate degree is designated as a *regular student*.

2.2 Conditional Admission

An applicant whose academic record indicates potential difficulty with maintaining satisfactory performance in a graduate degree program is designated a *conditional student* by the Program Director or by the College of Engineering. Conditional classification is intended to give the student an opportunity to establish, through academic performance, a suitability for regular admission to the program.
No conditional student will be encouraged to enroll for more than eight credit hours per semester or hold a position such as Teaching Assistant (T.A) or Grader in his or her area

of subject matter deficiency.
Conditional admission may be granted if an applicant has (a) a baccalaureate or a professional degree from an unaccredited college or university, (b) less than the 2.9 Graduate School minimum undergraduate or graduate point-hour ratio, or (c) an indicated subject matter deficiency.

2.3 Provisional Restrictions

Students admitted under regular or conditional status may also be held in provisional status for transcripts or degree statement(s) that were pending at the time of admission. Provisional documents are listed in the Admission Notice and are to be submitted by the student by the first day of the first semester or session of enrollment. If the provision has not been satisfied by the second Friday of the first semester or session of enrollment, a provisional warning email is sent to the student. A hold will be placed on the student's record.

2.4 Specific Conditions of Admission

The Graduate Program Director is responsible for specifying the conditions of admission. The Program Director will state the requirements for conditional admission, provide advising, and communicate requirements and time limits for completion. If a conditional student is assigned another advisor, the student and new advisor are responsible for meeting the admission conditions within the allowed time frame.

2.5 Change in Admission Classification

A student's classification (regular or conditional) may be changed by the student's advisor, in conjunction with the Graduate Program Director and the ECE Department Chair, through notification of the Admissions Office. The Admissions Office will change the student's classification upon receipt of any outstanding material.
Any student admitted conditionally is required to achieve regular student status before completing the third semester. Failure to meet the conditional admission requirements within the time limit specified by the Program Director will result in denial of further registration in the graduate program.

3 Matriculation and Degree requirements

The MSECE degree requirements are three-fold: (1) completion of required core courses, (2) attendance at program assessment events, and (3) completion of electives.

3.1 Required CoreCourses

To meet program objectives (a), (b), and (f), every MSECE student must complete the following required core courses (worth 16 credit hours):

- EEE 5534 Digital Control Systems (offered Fall semesters)
- EEE 5654 Digital Signal Processing (Fall)
- EEE 5114 Engineering Analysis (Spring)

- EEE 5444 Digital Communications (Spring)

Two of the core courses will be offered in each of the Fall and Spring semesters, and students should complete all core courses before taking any elective course (for non-thesis program). Full-time graduate students are expected to complete the required core courses within two semesters of joining the program. Part-time students are expected to complete all core courses before enrolling for electives.
All graduate students must file a plan of study at the end of the first semester as graduate student. The plan of study form can be found as part of the graduate handbook. During advising period graduate students are required to update their plan of study and have it approved by the graduate program advisor or thesis advisor.

3.2 Electives and Thesis Option

The third requirement is to complete the electives listed under either Option I or Option II below.

Option I: Course Work Only
Complete Tech Electives (16 credit hours) for a total of 32 credit hours. At least one of the four-credit courses must be at the 6000 level.

Option II: Thesis
Complete two Tech Electives (8 credit hours) plus a six-credit-hour Thesis for a total of 30 credit hours.

4 Transfer Credits

A maximum of eight graduate semester credit hours may be transferred, and these must be from an accredited Master of Science program in electrical, electrical and computer, or computer engineering. Credit for courses taken in a graduate program other than those listed above will be reviewed by the program director and the Graduate Admissions Committee for acceptability as a substitute within Lawrence Tech's program. Courses transferred must have been taken in the last five (5) years and a grade of B (3.0) or higher must have been achieved. All petitions for course transfer consideration must be made in writing at the time of application. Credit may be earned at another university after matriculation by guest credit. Guest credit forms must be completed at both Lawrence Tech and the university where the courses are to be taken. No guest credit will be granted for courses that are being offered at Lawrence Tech during the same semester during which the student is applying for guest credit. Since fewer MSECE graduate courses are offered during the summer semester, some students apply for guest credit during the summer. All requests for transfer or guest credit must be accompanied by an official transcript.

5 Academic Standing

Students are expected to maintain a 3.0 Grade Point Average (GPA). A student whose GPA drops below 3.0 will be placed on academic probation. Failure to raise the GPA to 3.0 by the end of one semester of academic probation will necessitate an appearance before the ECE Graduate Committee. During this appearance, the student must explain

why he or she should not be terminated from the program. A student whose GPA has been below 3.0 for one semester, who fails to appear before the committee, or who has not attained a GPA of 3.0 after two semesters of academic probation will be terminated from the program. A student terminated from the program may reapply after one calendar year. A maximum of two grades below B (B-, C+, or C) can be counted towards a Master's degree, provided the student's GPA remains at or above 3.0, and the grades in question were earned at LTU. In no case will a grade of C- (or lower) be counted toward a graduate degree.

6 Thesis Option

A student may begin work on the Master's thesis after all required ECE graduate courses are completed. The student, in consultation with his or her thesis advisor, proposes a thesis topic. This involves both completing the Petition for a Master's Thesis Form, and writing a thesis proposal that lays out a detailed description of the research topic along with a research plan. The thesis proposal must be successfully presented to the student's Thesis Committee before Master's Thesis credits are elected. After the thesis proposal is accepted, the student elects any combination of EEE6911, EEE6912, and EEE6913 that totals six credits. The completed thesis must be successfully defended before the student's Thesis Committee.

7 Plan of Study

Every student must file a plan-of-study (form enclosed in the graduate handbook) by the end of the first semester and keep the file updated as he or she progresses through the program. Failure to file

8 MSECE Courses

Graduate Standing (GS) means completion of a Bachelor of Science in Electrical Engineering or Computer Engineering degree, or a related Bachelor of Engineering degree and completion of math through Differential Equations, Circuits, Electronics, Digital Circuits, and Control Systems or their equivalent.

8.1 Electrical Engineering

EEE 5114 Engineering Analysis

Prerequisite: Graduate Standing or Department Approval.
This is a beginning graduate level course in applied numerical analysis. It offers background preparation for subsequent courses in signal processing, control theory, filter design, and many other areas of study.
Topics Covered: Applied Programming: review of elementary structures, basic syntax in Octave/Matlab. Root Finding: bisection method, Newton-Raphson method, secant method, multidimensional Newton method, fixed point iteration, applications to equation solving and optimization problems. Numerical Integration: rectangular, trapezoidal, and Simpson rules; numerical solution of ordinary differential equations. Numerical Linear Algebra: review of matrix operations, Jordan canonical form, solution of systems of linear

algebraic equations, matrix norms, condition number and ill-conditioned systems, matrix eigenvalue problem, applications to linear system stability and the solution of linear integral equations.

EEE 5534 Digital Control Systems

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Discrete time mathematics, Z transforms, sampling rates, zero and first order hold, time delays, system stability, continuous and discrete time system interfacing, computer control implementation concepts, state space realization.

EEE 5524 Modern Control Systems

Prerequisite: Graduate Standing or Department Approval.
Topics covered: State space realization of transfer functions, canonical forma, fundamental and state transition matrices, introduction to optimal control, quadratic performance indices, observers, Liapunov stability theory.

EEE 5554 Applications of Artificial Intelligence

Prerequisite: Graduate Standing or Department Approval.
Topics covered: System design using AI methods; AI programming languages, intelligent vision and imaging systems, data base search methods, logic and deduction using predicate calculus. Expert system design with applications to robots.

EEE 5564 Interfacing and Control of Robots

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Shaft encoders, actuators, robot coordinate systems, kinematics, path control, sensors, robot vision, design of robot interfaces.

EEE 5204 Advanced Computer Architecture

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Studies of contemporary computer organizations covering early systems, CPU design, instruction sets, control, processors, busses, ALUs, memory, I/O interfaces, connection networks, virtual memory, pipelined computers, multiprocessors, and case studies.

EEE 5264 Advanced Microprocessors

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Design and applications microcomputers, 16 bit vs. 32-bit processor organization, controller design, I/O port interfacing, memory structure, addressing methods, keyboard and display interface, and hardware arithmetic functions. Design and interface considerations for peripheral and interrupt devices.

EEE 5284 Parallel Architectures

Prerequisite: Graduate Standing or Department Approval.
Topics covered: In-depth study of the design, engineering, and evaluation of modern

parallel computers. Fundamental design, naming, synchronization, latency, and bandwidth. Architectural evolution and technological driving forces. Parallel programming models and communication primitives.

EEE 5624 VLSI Design

Topics covered: Specification of MOSFETS and CMOS, IC fabrication, mask design, semi-custom and full-custom designs, application-specific integrated circuit design, and system design. Specific integrated circuit design, design rules, and case studies.

EEE 5144 Power Distribution Systems

Prerequisite: Graduate Standing or Department Approval.
Topics covered: A.C. power, three-phase systems, per-unit analysis, one-line diagrams. Transformers, synchronous machines, salient pole machines, transient effects. Transmission line inductance, transmission line capacitance, transmission line models. The admittance model, the impedance model, the load-flow problem.

EEE 5134 Electrical Machines and Transformers

Note: This course is intended for graduate students who wish to pursue the study of electric energy and power systems, but who did not have sufficient undergraduate preparation.
Topics covered: steady state and dynamic modeling of transformers, dc machines, induction machines, and synchronous machines. Also included are studies of power, torque, loss mechanisms, efficiency, and power electronic control of electric machinery.

EEE 5314 Power Electronics

Topics covered: Zener diode and other linear voltage regulators. Standard power converter topologies using cycle-by-cycle averaging to model the power electronics. Ac to dc power supplies such as are used in personal computers and other electronic devices, dc to dc converters such as are used in automotive and other battery-powered applications, and dc to ac converters such as are used in the speed control of electric motors and in power inverters used to produce 110V ac from the battery of an automobile. The component building blocks of power electronic circuits, design strategies and design considerations. A brief introduction to the design of magnetic components. Soft-switching, Motor Drives, UPS, Thyristors, Utility Applications. This graduate version of the course requires an end-of-term project.

EEE 5324 Network Synthesis

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Network functions, filters, normalization, magnitude approximation, phase approximation, time domain considerations, sensitivity. Properties and synthesis of LC driving point functions, properties of transfer functions, synthesis of transfer functions. Single amplifier filters, op-amp parasitics, state variable filters, universal active filter, bi quadratic filters, active networks for direct realization, switched capacitor filters.

EEE 5364 Computer Networking

Prerequisite: Graduate Standing or Department Approval.

Topics covered: Advanced treatment of the following: OSI model, TCP/IP encoding and modulation, transmission and signals of digital data; interfaces and modems, transmission media, multiplexing, error detection and correction, data link control and protocols, LANS/MANS,/VLANS/VPNS, switching. Point-to-point Protocol (PPP), network security, hardware including: ISDN; X.25; frame relay; ATM; SONET/SDH.

EEE 5444 Digital Communications

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Design of baseband and passband digital communication systems. Modulation techniques including PAM, QAM, PSK, FSK, and spread spectrum. Optimal demodulation techniques and their performance. Analysis evaluation and design of integrated circuits for communication applications.

EEE 5654 Digital Signal Processing

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Sampling theory and sampling hardware, Z transform, Discrete Time Fourier Transform, architecture of VLSI digital signal processors. Design and implementation of real time polynomial, FIR, IIR, and adaptive filters, spectral analysis with DTFT will be dealt. Filter realization techniques, Direct I, Direct II, Canonical, Parallel form. Design of DSP application in communication and digital control.

EEE 5274 Digital Image Processing

Prerequisite: Graduate Standing or Department Approval.
Topics covered: This course introduces concepts and methodologies for digital image processing and help develop a foundation that can be used to learn more advanced topics such as computer vision, machine learning and machine intelligence. The content of the course starts with comprehensive introduction to mathematical tools used in image processing. Spatial correlation, convolution and their application to image filtering/enhancement will be discussed and compared to other histogram based image enhancement methods such as histogram equalization, contrast corrections. Frequency domain analysis of 2D images and its application to image compression will be discussed. Finally, the course will be concluded with discussions involving color image processing, color image formats, and color format conversion

EEE5634 Optical Systems Engineering

Prerequisite: Graduate Standing or Department Approval.
Topics covered: Maxwell's equations, geometrical and physical optics, optical components. Gaussian beams. Fourier transforming properties of lenses. Properties of Lasers, LEDs, and detectors. Design of emitter and detector circuits. Design of free space and optical fiber systems.

EEE 5784 Communication Circuits

Prerequisite: EEE4423, and Graduate Standing or Department Approval.
Topics covered: Transmitters and receivers. Small-signal, high-frequency, and power amplifiers. Network noise and distortion. Hybrid and transmission-line transformers.

Oscillators. Phase- locked loops. Modulators and demodulators.

EEE 5911-4 Directed Study

Prerequisite: Graduate Standing In-depth study of an Electrical or Computer Engineering topic with written report to the course faculty advisor.

EEE 5993-4 Special Topics in Electrical and Computer Engineering

Prerequisite: Graduate Standing or Department Approval.
Material of a specialized nature not covered in other courses that is of interest to both faculty and students.

EEE 6444 Software Defined Radio

This course is designed to give graduate students an overview of SDR systems, and the technologies necessary for successful SDR implementation.
Topics covered: The course includes an introduction to Software Radio Concepts, Radio Frequency Implementation Issues, Digital Generation of Signals, Digital Signal Processing Techniques, Analog to Digital (ADC) and Digital to Analog Conversion (DAC), Smart Antennas, Digital Hardware Choices Case Studies in Software Radio Design.

EEE 6524 Nonlinear and Optimal Control

Prerequisite: EEE5524 or EEE5534 and Graduate Standing.
Topics covered: Nonlinearity analysis with second order systems by phase plane, Lyapunov stability criteria, Describing functions, Feedback linearization, Performance measures in optimal control, dynamic programming, Hamilton Jacobi Bellman equation, Calculus of variations, Minimization principles, Numerical techniques

EEE 6144 Smart Grid Communications

Prerequisite: Graduate Standing.
Communication Networks in Smart Grid: An Architectural View, Demand-Side Management for Smart Grid, Communications and access technologies for smart grid, Wide-Area Networks for Smart Grid, Wireless Networks for Smart Grid Applications, Wireless Sensor Networks for Smart Grid: Research Challenges and Potential Applications, Sensor Techniques and Network Protocols for Smart Grid, Potential Methods for Sensor and Actuator Networks for Smart Grid, Implementation and Performance Evaluation of Wireless Sensor Networks for Smart Grid, Cyber-attack impact analysis of smart grid, Jamming for manipulating the power market in smart grid, Power-system state-estimation security: attacks and protection schemes, A hierarchical security architecture for smart grid, Application-driven design for a secured smart grid, Case Studies and Lessons Learned from Recent Smart Grid Field Trials.

EEE 6534 Adaptive Control

Prerequisite: EEE5524 or EEE5534 and Graduate Standing.
Topics covered: Theory and design of adaptive identification and control methods for automatically identifying and compensating for unknown plant parameters in dynamical systems. Deterministic finite-dimensional continuous-time linear and non-linear dynamical

systems, identification and control of mechanical systems possessing unknown parameters (e.g. mass, inertia, friction). Stability of linear and nonlinear dynamical systems, Lyapunov stability, input-output stability, adaptive identification, and direct adaptive control techniques for linear and nonlinear plants and systems.

EEE 6704 Engineering Optimization

Prerequisite: EEE5114 and Graduate Standing.
Topics covered: Linear optimization, constraints, slack variables, feasibility, basic solutions, the Simplex method, duality. Nonlinear optimization, existence, feasible directions, unconstrained problems, convex and concave functions, basic descent methods, conjugate direction methods, quasi Newton methods. Constrained minimization, Lagrange multipliers, Kuhn Tucker conditions.

EEE 6784 Advanced Communication Theory

Prerequisite: EEE4423 and Graduate Standing.
Modern communication systems. Probability and random variables. Computer communications. Random process and spectral analysis. Performance of communication systems. Optimum digital receivers.

EEE 6901-4 Master's Project

Prerequisite: Graduate Standing
The student designs or analyzes an electronic, electrical or computer system, and reports the results to his/her Committee via a written report and an oral defense.

EEE 6911-3 Master's Thesis Research

Prerequisite: Graduate standing and completion of the required graduate courses. The student works in collaboration with a faculty advisor (or advisors) and, optionally an industrial advisor, and is expected to meet regularly with his or her advisors. Upon completion of the six credit hours of thesis research, the student makes an oral defense of the thesis, and submits the thesis to the university for publication.

EEE 6993-4 Special Topics in Electrical and Computer Engineering

Prerequisite: Graduate Standing and completion of core courses. Material of a specialized nature not covered in other courses that is of interest to both faculty and students.

8.2 Computer Engineering

MCS 5023 Java Programming

This is an advanced course in Java programming, students may need permission of department chair and program director before registration.
Topics covered: Advanced multi-trending, multimedia and graphics. Networking and RMI. Database access with Java. Java Beans and EJB. Servlets and JSP. Multi-tier application development using COBRA. Java and embedded systems. JINI. Current topics in Java technology.

MCS 5103 Software Engineering

Student must have the permission of department chair and program director before registration. Topics covered: Selection of programming language, debugging techniques and tools, program maintenance, software economics, team programming and its application to projects, software life cycle.

MCS 5303 Database Systems

Student must have the permission of department chair and program director before registration.
Topics covered: Design and implementation of relational, hierarchical and network database system. Query/update data language, conceptual data model, physical storage methods, database system architecture and normal forms. Database security and integrity. Relational Database system are emphasized. A project involving an on-line database system is normally assigned. No credit given after MIS6113.

MCS 5503 Intelligent Systems

Topics covered: Introduction to artificial intelligence and computational intelligence, Problem solving by searching, Optimization methods, Knowledge representation and reasoning, Machine learning, Multi-agent systems, Pattern recognition. Introduction to evolutionary computation, neural networks and Fuzzy logic.

MCS 5703 Intro to Distributed Computing

Student must have the permission of department chair and program director before registration.
Topics covered: Introduction to data communications, network models, topologies and structures. Includes the OSI model, transport mediums (routers, bridges, gateways), and an overview of communication protocols, particularly TCP/IP.

MCS 6123 Adv. Topics Software Engineering Techniques

Topics covered: Architecture of software environments, Syntax directed editors, Tools for programming-in-the-large, Tools to support the assessment of partial design, and Expert systems for software development.

MCS 6323 Distributive Database Systems

Topics covered: Relational operators, dependency theory, project-join mapping, representation theory, query optimization, null values, distributed databases, concurrence control, Distributed databases, networking, office information systems, distributed vision applications.

MCS 6513 Adv. Topics in Intelligent Systems

Topics covered: Advanced topics in artificial intelligence and computational intelligence. Advanced evolutionary computation. Advanced neural networks. Advance fuzzy logic systems. Introduction to neuro-fuzzy systems and soft computing. Practical applications to wireless devices, web programming, robotics and data mining.

MCS 6723 Adv. Topics in Distributed Computing

Topics covered: A continuation of MCS 5703. Advanced topics in the area of distributed and network computing. Topics include routing, addressing, implementations of LANs and WANs.

MSECE Plan of Study

Student Name: _____ **Date:** _____

Student ID: _____

s.no	Semester	Year	Course Name	Course Number	Grade
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Application for Transfer Credit

All transfer credits will be subject to verification of official transcripts.

Semester	Year	Institution	Course Name	Grade

Student Signature: _____

Advisor Signature: _____

MSECE Directed Study Petition

Student Name: _____ **Date:** _____

Student ID: _____

Description of Directed study

Describe how this D.S. assist you with your MS Thesis

Number of Credit Hours: _____

Semester: _____ **Year:** _____

Student Signature: _____ **Advisor Signature:** _____

MSECE Thesis Petition

Student Name: _____ **Date:** _____

Student ID: _____

Thesis Description

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Thesis Committee

Principal Advisor's Signature: _____

Associate Advisor's Signature: _____

Associate Advisor's Signature: _____

Program Director's Signature: _____

Student Signature: _____