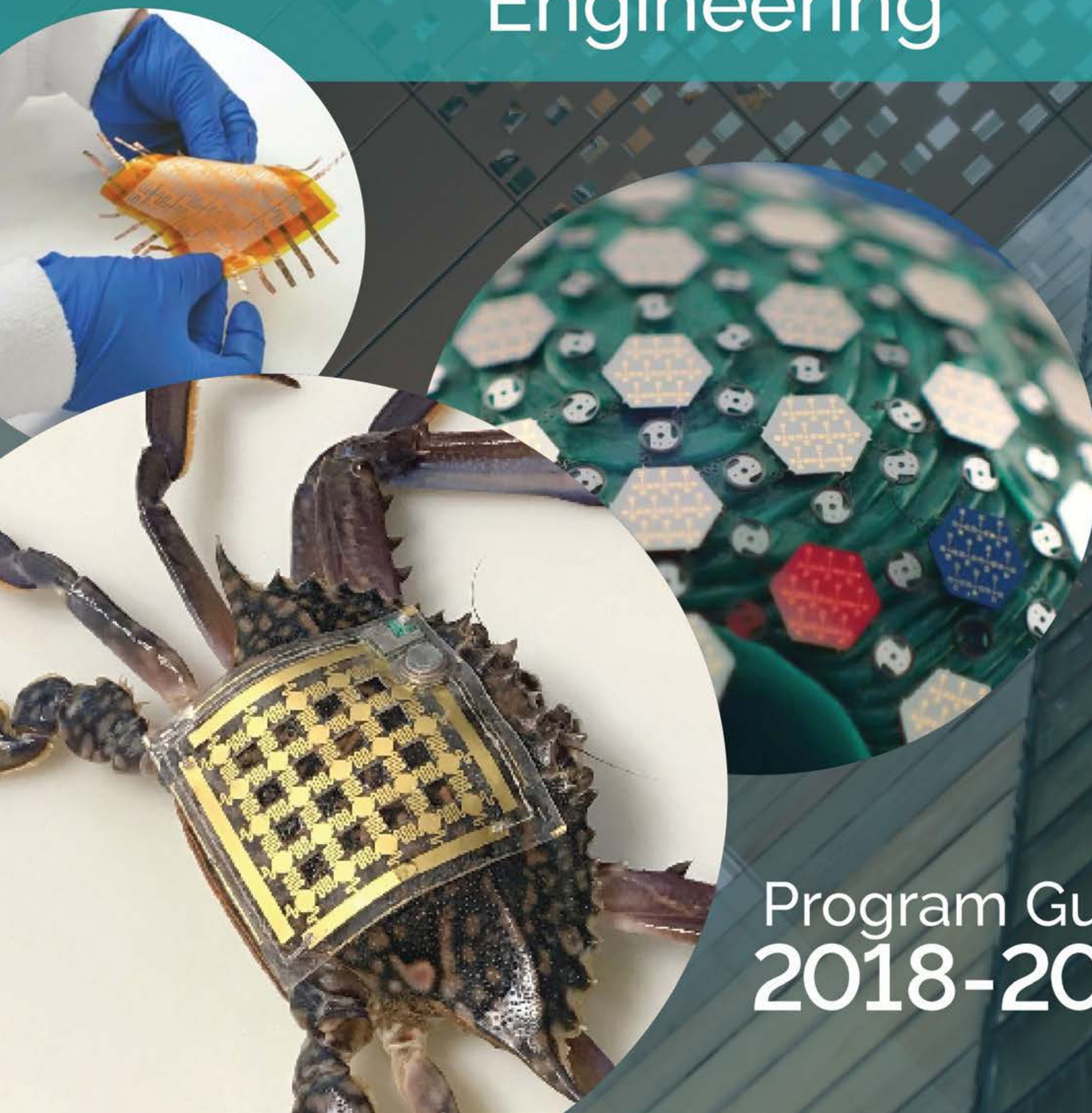
Electrical Engineering



Program Guide
2018-2019

Table of Contents

1. Aims and Scope

Electrical Engineering (EE) plays an important role in the fields of engineering, applied physics and computational sciences. A significant portion of advancement in technology originates from cutting-edge research performed in the field of EE. At KAUST the EE program is bound to this tradition: It aims for preparing students for a multitude of professional paths and advancing world-class research and research-based education through interdisciplinary partnering within engineering and science.

The EE degree program has two (2) major tracks:

- Electro-Physics
- Systems

The Electro-Physics track encompasses technical areas of solid-state electronics, microsystems, electromagnetics and photonics, while the Systems track encompasses communications, networking, signal processing, computer vision and control.

2. Assessment Test (If applicable)

Students are admitted to KAUST from a wide variety of programs and backgrounds. In order to facilitate the design of an appropriate study plan for each individual student, all admitted students without an MS are required to take a written assessment exam when they arrive on Campus. The purpose of the assessment is to determine whether students have mastered the prerequisites for undertaking graduate-level courses taught in the program. The Academic Advisor works with admitted students to develop a study plan if needed. Students are encouraged to prepare for the assessment by refreshing the general knowledge gained from their undergraduate education before arriving at KAUST. The remedial study plan requirements must be satisfactorily completed, in addition to the University degree requirements.

3. Master's Degree Requirements

It is the sole responsibility of the student to plan her/his graduate program in consultation with her/his advisor. Students are required to meet all deadlines. Students should be aware that most core courses are offered only once per year.

The Master's Degree (M.S.) is awarded upon successful completion of a minimum of 36 credit hours. A minimum GPA of 3.0 must be achieved to graduate. Individual courses require a minimum of a 'B-'for course credit. Students are expected to complete the M.S. degree in three semesters and one Summer Session. Satisfactory participation in every KAUST's Summer Session is mandatory. Summer Session courses are credit bearing and apply towards the degree.

The M.S. degree has the following components:

- Core Courses
- Elective Courses
- Research/Capstone Experience
- Graduate Seminar 298 (non-credit). All students are required to register and receive a Satisfactory grade for the first two semesters.

3.1 M.S. Course Requirements

3.1.1 Core Courses (twelve credits)

This portion of the degree is designed to provide a student with the background needed to establish a solid foundation in the program area:

- Electro-Physics Core Courses: EE 202, EE 203, EE 208, EE 221, and EE 231.
- Systems Core Courses: AMCS 211, AMCS 241, EE 242, EE 251, and EE 271A.

These core courses are designed to provide a student with the background needed to establish a solid foundation in the program area.

3.1.2 Elective Courses (twelve credits)

This portion of the degree is designed to allow each student to tailor his/her educational experience to meet individual research and educational objectives, with the permission of the student's academic advisor.

One (1) additional elective course (3 credits) in EE. Courses from any EE track can be used to fulfill this requirement. Two (2) additional courses (6 credits) from any 200- or 300-level course in any degree program at KAUST. If a core course is from AMCS or STAT, then this course can fulfill the Applied Mathematics/Statistics requirement. In this case, the Elective Curriculum requirement would need to increase to four (4) courses (12 credits). Course selection process, including core courses, Applied Mathematics/Statistics requirement, and elective EE courses, should be done with the consent of the Academic Advisor. The student must also register for EE 298 (non-credit seminar course) for the first two (2) semesters of the degree program.

The elective courses (which exclude research, internship credits, and IED courses) are designed to allow each student to tailor his/her educational experience to meet individual research and educational objectives, with the permission of the student's academic advisor.

3.1.3 Research/Capstone Experience (twelve credits)

See sections for thesis and non-thesis options below.

3.1.4 Winter Enrichment Program

Students are required to satisfactorily complete at least one full Winter Enrichment Program (WEP).

3.2 M.S. Thesis Option

Students wishing to pursue the thesis option must apply by the ninth week of their second semester for a thesis and must have at least a 3.2 cumulative GPA.

The selected thesis advisor must be a fulltime program-affiliated Assistant, Associate or Full Professor at KAUST. This advisor can only become project affiliated for the specific thesis project upon program level approval. Project affiliation approval must be completed prior to commencing research.

3.2.1 M.S. Thesis Defense Requirements

An oral defense of the M.S. Thesis is required, although it may be waived by the Dean's Office under exceptional circumstances. A requirement of a public presentation and all other details are left to the discretion of the thesis committee.

A written thesis is required. It is advisable that the student submits a final copy of the thesis to the Thesis Committee Members at least two weeks prior to the defense date.

- Students are required to comply with the university formatting guidelines provided by the library **CLICK HERE**
- Students are responsible for scheduling the thesis defense date with his/her thesis committee.
- A pass is achieved when the committee agrees with no more than one dissenting vote, otherwise the student fails. The final approval must be submitted at the latest two weeks before the end of the semester.

3.2.2 M.S. Thesis Defense Committee

The M.S. Thesis Defense Committee, which must be approved by the student's Dean, must consist of at least three members and typically includes no more than four members. At least two of the required members must be KAUST Faculty. The Chair, plus one additional Faculty Member must be affiliated with the student's program. This membership can be summarized as:

Member Role Program Status

Member	Role	Program Status
1	Chair	Within Program
2	Faculty	Within Program
3	Faculty or Approved Research Scientist	Outside Program
4	Additional Faculty	Inside or Outside KAUST

Notes:

- Members 1-3 are required. Member 4 is optional.
- Co-Chairs may serve as Members 2, 3, or 4, but may not be a Research Scientist.
- Adjunct Professors and Professors Emeriti may retain their roles on current Committees, but may not serve as Chair on any new Committees.
- Professors of Practice and Research Professors may serve as Members 2, 3 or 4 depending upon their affiliation with the student's program. They may also serve as Co-Chairs.
  - Visiting Professors may serve as Member 4.

View a list of faculty and their affiliations: **CLICK HERE**

3.3 M.S. Non-Thesis Option

Students wishing to pursue the non-thesis option must complete a minimum of six credits of Directed Research (299). Summer internship credits may be used to fulfill the research requirements provided that the Summer internship is research-based. Summer internships are subject to approval by the student's academic advisor.

Students must complete the remaining credits through one or a combination of the options listed below:

- Broadening Experience Courses: Courses that broaden a student's M.S. experience (maximum 6.0 credits can be applied to master degree requirements).
- Internship: Research-based Summer Internship (295). Students are only allowed to take one internship (maximum 6.0 credits can be applied to master degree requirements).
- PhD Courses: Courses numbered at the 300 level.
- Directed Research (299): Master's level supervised research (maximum 6.0 credits can be applied to master degree requirements).

4. Doctor of Philosophy

The Doctor of Philosophy (Ph.D.) Degree is designed to prepare students for research careers in academia and industry. It is offered exclusively as a fulltime program.

There is a minimum residency requirement at KAUST of three and a half years for students entering with a B.S. Degree and two and a half years for students entering with a M.S. Degree. A minimum GPA of 3.0 must be achieved on all doctoral coursework. Individual courses require a minimum of a 'B-' to earn course credit.

The Ph.D. Degree includes the following steps:

- Securing a Dissertation Advisor.
- Successful completion of Program Coursework.
- Passing the Qualifying Examination.
- Passing the Dissertation Proposal Defense to obtain candidacy status.
- Preparing, submitting and successfully defending a Doctoral Dissertation.

4.1 Ph.D. Course Requirements

The required coursework varies for students entering the Ph.D. Degree with a B.S. Degree or a relevant M.S. Degree. Students holding a B.S. Degree must complete all Program Core/Mandatory Courses and Elective Courses outlined in the M.S. Degree section and are also required to complete the Ph.D. courses below. Students entering with a B.S. Degree may also qualify to earn the M.S. Degree by satisfying the M.S. Degree requirements; however, it is the student's responsibility to declare their intentions to graduate with an M.S.

Students entering the Ph.D. Degree with a relevant M.S. Degree must complete the requirements below, though additional courses may be required by the Dissertation Advisor.

Ph.D. Courses

- At least two 300-level courses.
- Graduate Seminar 398 (non-credit): All students are required to register and receive a Satisfactory grade for the first two semesters.
- Winter Enrichment Program: Students are required to satisfactorily complete at least one full Winter Enrichment Program (WEP) as part of the degree requirements. Students who completed WEP requirements while earning the M.S. Degree are not required to enroll in a full WEP for a second time in the Ph.D. Degree.
- Satisfactory participation in every KAUST's Summer Session is mandatory. Summer Session courses are credit bearing and apply towards the degree.

4.2 Ph.D. Designation of Dissertation Advisor

The selected Dissertation Advisor must be a full time program-affiliated Professor at KAUST. The student may also select an advisor from another program at KAUST. This advisor can only become project affiliated for the specific thesis project with program level approval. Project affiliation approval must be completed prior to commencing research.

View a list of faculty and their affiliations: **CLICK HERE**

4.3 Ph.D. Candidacy

In addition to the coursework requirements, the student must successfully complete the required Ph.D. qualification milestones to progress towards Ph.D. candidacy status. These milestones consist of the subject-based qualifying examination and Ph.D. Proposal Defense.

4.3.1 Ph.D. Dissertation Proposal Defense Committee

The Ph.D. Dissertation Proposal Defense Committee, which must be approved by the student's Dean, must consist of at least three members and typically includes no more than six members. The Chair, plus one additional Faculty Member must be affiliated with the student's Program.

Member Role Program Status

Member	Role	Program Status
1	Chair	Within Program

2	Faculty	Within Program
3	Faculty	Outside Program
4	Approved Research Scientist	Inside KAUST

Notes:

- Members 1-3 are required. Member 4 is optional.
- Co-Chairs may serve as Members 2 or 3.
- Adjunct Professors and Professors Emeriti may retain their roles on current Committees, but may not serve as Chair on any new Committees.
- Professors of Practice and Research Professors may serve as Members 2 or 3 depending upon their affiliation with the student's program. They may also serve as Co-Chairs.

Once constituted, the composition of the Proposal Committee can only be changed with the approval of both the Dissertation Advisor and the Dean.

View a list of faculty and their affiliations: **CLICK HERE**

4.3.2 Ph.D. Dissertation Proposal Defense

The purpose of the Dissertation Proposal Defense is to demonstrate that the student has the ability and is adequately prepared to undertake Ph.D.-level research in the proposed area. This preparation includes necessary knowledge of the chosen subject, a review of the literature and preparatory theory or experiment as applicable.

The Dissertation Proposal Defense is the second part of the qualification milestones that must be completed to become a Ph.D. Candidate. Ph.D. students are required to complete the Dissertation Proposal Defense within the second year of doctoral studies. The Dissertation Proposal Defense includes two aspects: a written Research Proposal and an oral Research Proposal Defense. Ph.D. students must request to present the Dissertation Proposal Defense to the Proposal Dissertation Committee at the beginning of the Semester they will defend their proposal.

There are four possible outcomes from this Dissertation Proposal Defense:

- Pass
- Pass with conditions
- Fail with retake
- Fail without retake

A pass is achieved when the committee agrees with no more than one dissenting vote, otherwise the students fails.

In the instance of a Pass with Conditions, the entire committee must agree on the required conditions and if they cannot, the Dean decides. The deadline to complete the conditions is one month after the defense date, unless the committee unanimously agrees to change it.

In the instance of a Fail without Retake, the decision of the committee must be unanimous. The deadline to complete the retake is six months after the defense date, unless the committee unanimously agrees to reduce it. Students who fail the Dissertation Proposal Defense, or who fail the Retake will be dismissed from the University.

A student who successfully passes the Dissertation Proposal Defense is deemed a Ph.D. Candidate.

4.4 Ph.D. Defense

To graduate, a Ph.D. candidate has to form a Ph.D. Dissertation Defense Committee, finalize the Ph.D. dissertation and successfully defend his/her Ph.D. dissertation.

4.4.1 Ph.D. Dissertation Defense Committee

The Ph.D. Dissertation Defense Committee, which must be approved by the student's Dean, must consist of at least four members and typically includes no more than six members. At least three of the required members must be KAUST Faculty and one must be an Examiner who is external to KAUST. The Chair, plus one additional Faculty Member must be affiliated with the student's Program. The External Examiner is not required to attend the Defense, but must write a report on the dissertation and may attend the Dissertation Defense at the discretion of the Program.

Member Role Program Status

Member	Role	Program Status
1	Chair	Within Program
2	Faculty	Within Program
3	Faculty	Outside Program
4	External Examiner	Outside KAUST
5	Approved Research Scientist	Inside KAUST
6	Additional Faculty	Inside or outside KAUST

Notes:

- Members 1-4 are required. Members 5 and 6 are optional.
- Co-Chairs may serve as either members 2, 3 or 6.
- Adjunct Professors and Professors Emeriti may retain their roles on current Committees, but may not serve as Chair on any new Committees.
- Professors of Practice and Research Professors may serve as members 2, 3 or 6 depending upon their affiliation with the student's Program. They may also serve as Co-Chairs.
- Visiting Professors may serve as member 6, but not as the External Examiner.

The only requirement with commonality with the Proposal Committee is the Supervisor, although it is expected that other members will carry forward to this committee.

If the student has a co-supervisor, this person can be considered one of the above four members required, provided they come under the categories listed (i.e. meets the requirements of the position).

4.4.2 Ph.D. Dissertation Defense

The Ph.D. Degree requires the passing of the defense and acceptance of the dissertation. The final defense is a public presentation that consists of an oral defense followed by questions and may last a maximum of three hours.

The student must determine the defense date with agreement of all the members of the Dissertation Committee, meet deadlines for submitting graduation forms and inform the committee of his/her progress. It is the responsibility of the student to submit the required documents to the Graduate Program Coordinator no later than nine weeks before the scheduled defense. It is also expected that the student submits their written dissertation to the committee at least two months prior to the defense date in order to receive feedback.

The written dissertation is required to comply with the University Formatting Guidelines which are on the library website: **CLICK HERE**

There are four possible outcomes from this Dissertation Final Defense:
- Pass
- Pass with conditions
- Fail with retake
- Fail without retake

A pass is achieved when the committee agrees with no more than one dissenting vote, otherwise the student fails. If more than one member casts a negative vote, one retake of the oral defense is permitted if the entire committee agrees. In the instance of a 'Pass with Conditions', the entire committee must agree on the required conditions and if they cannot, the Dean decides. The deadline to complete the revisions is up to one month after the defense date, unless the committee unanimously agrees to reduce it. The deadline to complete the retake is as decided by the defense committee with a maximum of six months after the defense date, unless the committee unanimously agrees to reduce it. Students who fail without retake the Dissertation Defense or who fail the retake will be dismissed from the University.

Evaluation of the Ph.D. Dissertation Defense is recorded by submitting the Result of Ph.D. Dissertation Defense Examination form within three days after the Defense to the Registrar's Office.

5. Program Courses and Descriptions

Course Notation:

Each course is listed prefaced with its unique number and post fixed with (L-C-R) where:

L = the lecture hours to count towards fulfilling the student workload during the semester.
C = the recitation or laboratory hours
R = the credit hours towards fulfilling a degree course requirement.

E.g. CS 220 Data Analytics (3-0-3) has a total of three hours of lectures per week, has no labs and earns three credits for the semester.
100-level courses are preparatory in nature and do not count towards the MS or PhD degrees.

EE 101 – Circuits (3-0-3)
Prerequisites: familiarity with Resistance, Capacitance, Electric current, Kirchhoff's rules, DC circuits and AC circuits.
The course covers the fundamentals of the lumped circuit abstraction. The main contents are: independent and dependent sources; Resistive circuits RC, RL and RLC circuits in time domain and frequency domain; Impedance transformations; Two-port networks and parameters Operational amplifiers Filters, Diodes and Transistors. Small signal and large signal analysis.
Includes a weekly laboratory.

EE 102 – Analog Electronics (3-0-3)
Prerequisite: EE 101.
This course covers the design, construction and debugging of analog electronic circuits.
The main contents are: the basic principles of operation, terminal characteristics and equivalent circuit models for diodes, transistors and op-amps. Design and analysis of multistage analog amplifiers. Study of differential amplifiers, current mirrors and gain stages. Frequency response of cascaded amplifiers and gain-bandwidth considerations. Concepts of feedback, stability and frequency compensation. Includes a weekly laboratory.

EE 103 – Solid State (3-0-3)

Prerequisites: EE 101 Co-Requisite EE 102.

This course covers the physics of microelectronic semiconductor devices for Silicon integrated circuit applications. The main contents are: semiconductor fundamentals, p-n junction, metal-oxide semiconductor structure, metal semiconductor junction, MOS field-effect transistor and bipolar junction transistor. The course emphasizes physical understanding of device operation through energy band diagrams and MOSFET device design. Issues in modern device scaling are also outlined. Includes a weekly laboratory.

EE 122 – Electromagnetic (3-0-3)

Prerequisites: familiarity with Resistance, Capacitance, Electric current and basic vector calculus.

The course covers quasistatic and dynamic solutions to Maxwell's equations; waves, radiation, and diffraction.

The main contents are: vector analysis and vector calculus; The laws of Coulomb, Lorentz, Faraday, Gauss, Ampere, Biot-Savart and Lenz. Dielectric and magnetic materials; Poisson equation solutions; Forces, Power and Energy in electric and magnetic fields; Capacitance and Inductance; Maxwell's equations; Boundary conditions; Introduction to Wave equation; Poynting vector; Wave propagation and reflection. Includes weekly Simulations.

EE 151 – Signal and Systems I (3-0-3)

Introduction to analog and digital signal processing, a topic that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defense electronics, consumer electronics and consumer products. The course presents and integrates the basic concepts for both continuous-time and discrete-time signals and systems. It addresses the following topics: classifications of signals and systems, basic signal operations, linear time-invariant (LTI) systems, time-domain analysis of LTI systems, signal representation using Fourier series, continuous-time Fourier transform, discrete-time Fourier transform and Laplace transform.

EE 152 – Signal and Systems II (3-0-3)

Pre-requisite: EE 151.

This course builds upon the material investigated in EE 151 and addresses the following topics: z-transform, continuous-time filters, digital filters, finite impulse response (FIR) filter design, infinite impulse response (IIR) filter design, sampling and quantization and applications of digital signal processing including spectral estimation, digital audio, audio filtering and digital audio compression.

EE 199 – Directed Study in Electrical Engineering (3-0-0) (variable credit up to a maximum of 12 credits)

A course of self-study in a particular topic as directed by faculty and approved by the division.

EE 201 – Introduction to CMOS VLSI Circuits (3-0-3)

Design techniques for rapid implementations of very large-scale integrated (VLSI) circuits, MOS technology and combinational and sequential logic; Structured design; Design rules; layout design techniques; Computer Aided Design (CAD) layout; design rule checking; logic and circuit simulation; timing and power analysis.

EE 202 – Analog Integrated Circuits (3-0-3)

This course covers principles of designing and optimizing analog and mixed-signal circuits in CMOS technologies, including an overview of device physics of the MOS transistor; small and large signal models; Analysis and design of CMOS multi-transistor amplifiers; feedback theory and application to feedback amplifiers; Stability considerations; pole-zero cancellation; root locus techniques in feedback amplifiers and noise analysis.

EE 203 – Solid-State Device Laboratory (2-1-3)

Semiconductor material and device fabrication and evaluation: capacitors and field-effect transistors. Semiconductor processing techniques: oxidation, diffusion, deposition, etching, photolithography. Lecture and laboratory.

EE 204 – Integrated Microsystems Laboratory (1-2-3)

Device physics and technology of advanced transistors and the process and device interplay that is critical for sub-100 nm metal oxide semiconductor (MOS) capacitors and field-effect transistors (MOSFETs) based microsystems design. Design of MOS interface circuits: relationships between processing choices and device performance characteristics. Long-channel device I-V review, short-channel MOSFET I-V characteristics including velocity saturation, mobility degradation, hot carriers, gate depletion. MOS device scaling strategies, silicon-on-insulator, lightly doped drain structures, on-chip interconnect parasitics and performance. Major CMOS scaling challenges. Process and circuit simulation.

EE 205 – Introduction to MEMS (1-2-3)

(Same as ME 323) Micro electro mechanical systems (MEMS), devices and technologies. Micro-machining and microfabrication techniques, including planar thin-film processing, silicon etching, wafer bonding, photolithography, deposition and etching. Transduction mechanisms and modeling in different energy domains. Analysis of micro machined capacitive, piezo resistive and thermal sensors/actuators and applications. Computer-aided design for MEMS layout, fabrication and analysis.

EE 206 – Device Physics (3-0-3)

Structural properties of materials. Basic quantum mechanics of electrons in solids. Band theory and trap states. Charge transport, band conduction and hopping conduction. Optical properties of materials. Piezoelectric and ferro-electric phenomena. Magnetic effects in materials. Physical phenomena will be related transistors, light emitters, sensor and memory devices.

EE 208 – Semiconductor Optoelectronic Devices (3-0-3)

Materials for optoelectronics, optical processes in semiconductors, absorption and radiation, transition rates and carrier lifetime. Principles of LEDs, lasers, photo detectors and solar cells. Designs, demonstrations and projects related to optoelectronic device phenomena.

EE 221 – Electromagnetic Theory (3-0-3)

Prerequisites: EE 122 or equivalent undergraduate-level course on Electromagnetics Fundamental concepts of electromagnetics: Maxwell equations, Lorentz force relation, electric and magnetic polarizations, constitutive relations, boundary conditions, Poynting theorem in real and complex forms, energy relations. Solution of Helmholtz equation: plane, cylindrical and spherical waves, dispersion, phase and group velocities, attenuation, wave propagation in anisotropic media. Electromagnetic theorems: uniqueness, duality, reciprocity, equivalence and induction theorems, Huygen and Babinet principles. Guided wave propagation: mode expansions, metallic and dielectric waveguides, resonant cavities. Antennas: potentials, radiation, elementary antennas

EE 222 – Antenna Theory and Design (3-0-3)

Pre-requisites: EE 122 or equivalent undergraduate-level course on Electromagnetics. Desirable: Undergraduate-level course on Antenna Theory and Design Fundamental antenna system parameters: gain, directivity, efficiency, input impedance, radiation pattern. Theory of transmitting and receiving antennas: reciprocity, equivalence and induction theorems. Elementary antennas: dipole, monopole, loop, traveling-wave antennas. Antenna arrays: linear and phased arrays, mutual impedance. Antenna design: log-periodic, reflector, and (corrugated) horn antennas and micro strip, integrated and on-chip antennas. Computer aided design: student projects using antenna simulation tools.

EE 223 – Microwave Circuits (3-0-3)

Pre-requisite: Undergraduate electromagnetics course. Desirable: Undergraduate Microwave course
Fundamental microwave concepts: Transmission-line theory and practical transmission line design, Smith Chart, impedance matching (L and stub matching networks), guided wave propagation and rectangular

wave guide design, Z and Y parameters, S-parameters, ABCD matrix, Microwave Filters, Microwave system level concepts (Noise figure, Dynamic Range, Non-linearity), diode detectors, microwave transistors, microwave amplifier design concepts, Low Noise and Power Amplifier Design, Introduction to Microwave CAD tools, Microwave Design Simulation project

EE 231 – Principles of Optics (3-0-3)

Prerequisites: basic knowledge of electromagnetic, signals and systems, and linear algebra.
Basic principles of optics. Topics include classical theory of diffraction, interference of waves, study of simple dielectric elements such as gratings and lenses, analysis of Gaussian beams, elements of geometrical optics, Waveguides, interferometers and optical resonators. The course aims at equipping the student with a set of general tools to understand basic optical phenomena and model simple optical devices.

EE 232 – Applied Quantum Mechanics (3-0-3) (Same as MSE 232)

Introduction to nonrelativistic quantum mechanics. Summary of classical mechanics, postulates of quantum mechanics and operator formalism, stationary state problems (including quantum wells, harmonic oscillator, angular momentum theory and spin, atoms and molecules, band theory in solids), time evolution, approximation methods for time independent and time-dependent interactions including electromagnetic interactions, scattering.

EE 233 – Photonics (3-0-3)

Prerequisites: principle of optics EE 231.
Introduction to Photonics and integrated optics. Topics include the study of anisotropic media and anisotropic optical elements such as half/quarter-wave retarders, interaction of light and sound, elements of plasmonics, dielectric waveguides and optical fibers, bragg gratings, directional couplers and integrated optical filters. The course introduces the student to a variety of different integrated devices for the manipulation of optical signals, discussing also design and modeling principles.

EE 242 – Digital Communication and Coding (3-0-3)

Digital transmission of information across discrete and analog channels. Sampling; quantization; noiseless source codes for data compression: Huffman's algorithm and entropy; block and convolutional channel codes for error correction; channel capacity; digital modulation methods: PSK, MSK, FSK, QAM; matched filter receivers. Performance analysis: power, bandwidth, data rate and error probability.

EE 244 – Wireless Communications (3-0-3)

Prerequisite: preceded or accompanied by AMCS 241, EE 242.
This course introduces fundamental technologies for wireless communications. It addresses the following topics: review of modulation techniques, wireless channel modeling, multiple access schemes, cellular communications, diversity techniques, equalization, channel coding, selected advanced topics such as CDMA, OFDM, Multiuser detection, space time coding, smart antenna, software radio.

EE 251 – Digital Signal Processing and Analysis (3-0-3)

Prerequisite: adequate background in linear algebra, multivariate optimization, signals and systems, Fourier series and Fourier transform.
It addresses the following topics: sampling and quantization, multirate digital systems, discrete Fourier transform (DFT), windowed DFT, fast Fourier transform (FFT), digital filter design, decimation and interpolation filters, linear predictive coding, and an introduction to adaptive filtering.

EE 253 – Wavelets and Time-Frequency Distribution (3-0-3)

Prerequisite: EE 251.
Review of DTFT and digital filtering. Multirate filtering. Filter banks and subband decomposition of signals. Multiresolution subspaces. Wavelet scaling and basis functions and their design: Haar, Littlewood-Paley, Daubechies, Battle-Lemarie. Denoising and compression applications. Spectrogram, Wigner-Ville, Cohen's class of time-frequency distributions and their applications.

EE 262 – Communication Networks (3-0-3)

Prerequisite: preceded or accompanied by AMCS 241.

System architectures. Data link control: error correction, protocol analysis, and framing. Message delay: Markov processes, queuing, delays in statistical multiplexing, multiple users with reservations, limited service, priorities. Network delay: Kleinrock independence, reversibility, traffic flows, throughput analysis, Jackson networks, Multiple access networks: ALOHA and splitting protocols, carrier sensing, multi-access reservations. (Previously EE 243)

EE 271A and EE 271B – Control Theory (2-1-3).

First and Second Terms. (Same as ME 221A and ME 221B)

Prerequisites: Linear Algebra (AMCS 151), Differential Equations (AMCS 131), Signals and Systems (EE 151 & EE 152).

Content: Core material in linear systems and optimal control.

Topics in 271A: review of vector spaces, systems of linear equations, internal stability, controllability, observability, Lyapunov equations, input-output stability, linear matrix inequalities, stabilization, and state observers.

Topics in 271B: The aim of this course is to introduce the student to the area of nonlinear control systems with a focus on systems' analysis and control design. Nonlinear phenomena including multiple equilibria, limit cycles and bifurcations will be presented. Lyaponuv and input/output stability will be discussed. Examples of control design will be studied such as feedback linearization and sliding mode control.

EE 272A and EE 272B – Mechatronics and Intelligent Systems (2-1-3)

First and Second Terms. (Same as ME 222A and ME 222B)

Principles, modeling, interfacing and signal conditioning of motion sensors and actuators; acquire and analyze data and interact with operators. Basic electronic devices, embedded microprocessor systems and control, power transfer components and mechanism design. Hardware-in-the-loop simulation and rapid prototyping of real-time closed-loop computer control of electromechanical systems; modeling, analysis and identification of discrete-time or samples-data dynamic systems; commonly used digital controller design methods; introduction to nonlinear effects and their compensation in mechatronic systems; robotic manipulation and sensing; obstacle avoidance and motion planning algorithms; mobile robots, use of vision in navigation systems. The lectures will be divided between a review of the appropriate analytical techniques and a survey of the current research literature. Course work will focus on an independent research project chosen by the student.

EE 273A and EE 273B – Advanced Dynamics (3-0-3).

First and Second Terms (Same as ME 232A and ME 232B). Prerequisites: AMCS 201 and AMCS 202 or equivalents (may be taken concurrently)

Content Analysis of models described by nonlinear differential equations. Topics: equilibria, stability, Lyapunov functions, periodic solutions, Poincaré Bendixon theory, Poincaré maps, attractors and structural stability, the Euler-Lagrange equations, mechanical systems, small oscillations, dissipation, energy as a Lyapunov function, conservation laws, introduction to simple bifurcations and eigenvalue crossing conditions, Discussion of bifurcations in applications, invariant manifolds, the method of averaging, Melnikov's method and the Smale horseshoe.

EE 274 – System Identification and Estimation (3-0-3)

(Same as ME 224) Prerequisite: EE 271A and EE 271B (EE 271B can be taken concurrently).

Content: Building mathematical models and estimates of unknown quantities in dynamic settings based on measured data.

Topics: Deterministic state estimation, recursive observers, estimation for uncertain process dynamics; SISO and MIMO least-squares parameter estimation, linear system subspace identification, random variables and random processes, linear systems forced by random processes, power-spectral density, Bayesian filtering including Kalman filter, jump-Markov estimation and fault diagnosis, nonlinear estimation, particle filters, unscented Kalman filter, introduction to estimation for hybrid systems.

EE 294 – Contemporary Topics in Electrical Engineering (3-0-0)
A course of current interest. Topics are not permanent and the content of the course will change to reflect recurring themes and topical interest. The content will be approved by the division.

EE 295 – Internship
Master-level supervised research.

EE 297 – Thesis Research (variable credit)
Master-level supervised thesis research.

EE 298 – Graduate Seminar (non-credit)
Master-level seminar focusing on special topics within the field.

EE 299 – Directed Research (variable credit)
Master-level supervised research.

EE 301 – Advanced VLSI Systems (3-0-3)
Prerequisite: EE 201.
This course offers a system level approach toward VLSI design and covers a wide range of topics, including digital IC flow, synthesis and placement and routing, FPGA design and Verilog implementation, complex arithmetic units, clock distribution, timing considerations and skew tolerant design, VLSI functional testing and verification.

EE 302 – Integrated Analog/Digital Interface Circuits (3-0-3)
Prerequisite: EE 202.
This course covers most of the well-known digital-to-analog and analog-to-digital conversion schemes. These include the flash, folding, multi-step and pipeline Nyquist rate, architectures. Oversampling converters are also discussed. Practical design work is a significant part of this course. Students design and model complete converters.

EE 303 – Integrated Circuits (3-0-3)
Alternate device architectures, materials and physics for integrated circuits based on alternate channel materials like SiGe, Ge, III-V, two (2) dimensional materials such as graphene, dichalcogenides, one (1) dimensional nanowire and nanotube architecture devices, tunneling FET, spin logic, ferroelectric devices, nanoelectromechanical (NEM) switches and such for logic computation and ultra-mobile communication devices.

EE 304 – Integrated Microsystems (3-0-3)
Prerequisites: EE 203 and EE 205.
Integrated systems including MOS circuits, energy harvesting, MEMS sensors and actuators to understand the design rule, process integration, physical and electrical characterization of fabricated systems.

EE 305 – Advanced MEMS Devices and Technologies (3-0-3)
Prerequisite: EE 205.
Advanced micro electro mechanical systems (MEMS) devices and technologies. Transduction techniques, including piezoelectric, electro thermal and resonant techniques. Chemical, gas and biological sensors; microfluidic and biomedical devices. Micromachining technologies such as laser machining and micro drilling, EDM, materials such as SiC and diamond. Sensor and actuator analysis and design through CAD.

EE 306 – Electronic and Optical Properties of Semiconductors (3-0-3)
The course discusses in detail the theory behind important semiconductor based experiments such as Hall effect and Hall mobility measurement, velocity-field measurement, photoluminescence, gain, pump-probe

studies, pressure and strain dependent studies. Theory will cover: Band structure in quantum wells; effect of strain on band structure; transport theory; excitons, optical absorption, luminescence and gain.

EE 307 – High-Speed Transistors (3-0-3)

Prerequisite: EE 204.
Detailed theory of high-speed digital and high-frequency analog transistors. Carrier injection and control mechanisms. Limits to miniaturization of conventional transistor concepts. Novel submicron transistors including MESFET, heterojunction and quasi-ballistic transistor concepts.

EE 308 – Semiconductor Lasers and LEDs (3-0-3)

Prerequisite: EE 208.
Optical processes in semiconductors, spontaneous emission, absorption gain, stimulated emission. Principles of light-emitting diodes, including transient effects, spectral and spatial radiation fields. Principles of semiconducting lasers, gain-current relationships, radiation fields, optical confinement and transient effects.

EE 309 – Flexible and Stretchable Electronics (3-0-3)

Prerequisite: College level knowledge on Physics, Chemistry, Mathematics and Biology.
In this course we will study physics and mechanics, materials and chemistry, devices and circuits and finally system level integration aspects of flexible, stretchable and reconfigurable electronics.

EE 310 – Integrated Sensors

The design and implementation of monolithic and hybrid sensors using integrated circuits, particularly in CMOS is presented. Performance metrics of sensors will be defined. The advantages and shortcomings of sensors built in silicon-based fabrication processes will be analyzed. A comprehensive study of the design and analysis of CMOS integrated image sensors, integrated biosensors and electronic backbone of MEMS hybrid sensors including silicon photodetectors; CCD and CMOS sensor architectures and circuits; affinity-based detection and biochemical transduction, integrated microarrays, biochips and sensor SoCs will be studied.

EE 321 – Numerical Methods in Electromagnetics (3-0-3)

Prerequisites: EE 221 or equivalent Master-level course on Electromagnetics
Introduction to computational electromagnetics. Finite difference time domain method: fundamentals, absorbing boundary conditions, perfectly matched layers. Integral equations: fundamentals, method of moments, Galerkin schemes, fast solvers. Finite element method: fundamentals, vector and higher-order basis functions, hybridization of finite and boundary element methods. Applications of these methods in problems of electromagnetics, optics and photonics.

EE 323 – Microwave Measurements Laboratory (1-2-3)

Prerequisites: EE 221 or EE 222, EE 223.
Advanced topics in microwave measurements: introduction to state-of-the-art microwave test equipment (Vector Network analyzer, spectrum analyzer), power spectrum and noise measurements, calibration, S-parameter and impedance measurements, methods for measuring the dielectric constant of materials, Low Noise and Power amplifier measurements, Non-linearity measurements, near-field and far-field antenna pattern measurements, Printed Circuit Board (PCB) design and fabrication, Introduction to Microwave and Antenna CAD tools. Followed by a project that includes design, analysis, fabrication and testing of a microwave subsystem.

EE 331 – Classical Optics (3-0-3)

Prerequisite: EE 231.
Theory of electromagnetic, physical and geometrical optics. Classical theory of dispersion. Linear response, Kramers-Kronig relations and pulse propagation. Light scattering. Geometrical optics and propagation in inhomogeneous media. Dielectric waveguides. Interferometry and theory of coherence. Diffraction, Fresnel and Fraunhofer. Gaussian beams and the ABCD law.

EE 332 – Lasers (3-0-3)
Prerequisites: EE 331, EE 333.
Complete study of laser operation: the atom-field interaction; homogeneous and inhomogeneous broadening mechanisms; atomic rate equations; gain and saturation; laser oscillation; laser resonators, modes and cavity equations; cavity modes; laser dynamics, Q-switching and mode-locking. Special topics such as femto-seconds lasers and ultra-high-power lasers.

EE 333 – Optical Waves in Crystals (3-0-3)
Prerequisite: EE 233.
Propagation of laser beams: Gaussian wave optics and the ABCD law. Manipulation of light by electrical, acoustical waves; crystal properties and the dielectric tensor; electro-optic, acousto-optic effects and devices. Introduction to nonlinear optics; harmonic generation, optical rectification, four-wave mixing, self-focusing and self-phase modulation.

EE 334 – Nonlinear Optics (3-0-3)
Prerequisites: EE 331, EE 333.
Formalism of wave propagation in nonlinear media, susceptibility tensor, second harmonic generation and three (3)-wave mixing, phase matching, third-order nonlinearities and fourwave mixing processes, stimulated Raman and Brillouin scattering. Special topics: nonlinear optics in fibers, including solitons and self-phase modulation.

EE 341 – Information Theory (3-0-3)
Prerequisite: AMCS 241.
The concepts of source, channel, rate of transmission of information. Entropy and mutual information. The noiseless coding theorem. Noisy channels, the coding theorem for finite state zero memory channels. Channel capacity. Error bounds. Parity check codes. Source encoding.

EE 343 – Digital Communication Theory (3-0-3)
Prerequisite: AMCS 241, EE 242, a strong background in linear algebra, detection and estimation and a working knowledge of optimization and discrete Fourier transform (DFT).
It addresses the following topics: review of digital modulation techniques and maximum likelihood detectors, fading channels, diversity techniques, multiple-input/ multiple-output (MIMO) systems, space-time coding and orthogonal frequency-division multiplexing (OFDM).

EE 351 – Advanced Signal Processing (3-0-3)
Prerequisites: AMCS 241, EE 251.
Estimators of second-order properties of random processes: nonparametric and model-based techniques of spectral estimation, characterization of output statistics for nonlinear systems, time-frequency representations. Performance evaluation using asymptotic techniques and Monte Carlo simulation. Applications include speech processing, signal extrapolation, multidimensional spectral estimation and beam forming.

EE 352 – Image Processing (3-0-3)
Prerequisites: EE 251, multi-variable calculus and linear algebra.
This course gives an overview of the theoretical and practical foundations of digital image processing, including random field models of images, sampling, quantization, image compression, enhancement, restoration, segmentation, shape description, reconstruction of pictures from their projections, pattern recognition. Applications include biomedical images, time-varying imagery, robotics and optics.

EE 353 – Adaptive Signal Processing (3-0-3)
Prerequisites: AMCS 241, EE 251.
Theory and applications of adaptive filtering in systems and signal processing. Iterative methods of optimization and their convergence properties: transversal filters; LMS (gradient) algorithms. Adaptive

Kalman filtering and least-squares algorithms. Specialized structures for implementation (e.g., least-squares lattice filters, systolic arrays). Applications to detection, noise canceling, speech processing and beam forming.

EE 354 – Introduction to Computer Vision (3-0-3)

Prerequisites: Multi-variable calculus and linear algebra.
This course gives an introductory overview of concepts (e.g. photometric and multi-view stereoscopy, epipolar geometry, interest point detection and description), problems (e.g. image-to-image matching and alignment, image classification, clustering/ segmentation, face recognition) and methodology (e.g. linear/nonlinear image filtering, RANSAC for robust fitting, discriminative and generative models) in the field of computer vision. It is intended to provide a solid background for students, who are planning to do research in visual computing.

EE 355 – Estimation, Filtering and Detection (3-0-3)

Prerequisite: AMCS 241.
Principles of estimation, linear filtering and detection. Estimation: linear and nonlinear minimum mean squared error estimation and other strategies. Linear filtering: Wiener and Kalman filtering. Detection: simple, composite, binary and multiple hypotheses. Neyman-Pearson and Bayesian approaches.

EE 372 – Dynamic programming and Optimal Control (3-0-3)

Prerequisites: Familiarity with basic probability, optimization and differential equations.
Dynamic programming is a framework for deriving optimal decision strategies in evolving and uncertain environments. Topics include the principle of optimality in deterministic and stochastic settings, value and policy iteration, connections to Pontryagin maximum principle, imperfect state measurement problems and simulation-based methods such as online reinforcement learning.

EE 374 – Advanced Control Systems (3-0-3)

(Same as ME 324) Prerequisites: AMCS 201 and AMCS 202 or equivalent; EE 271A and EE 271B or equivalent.
Introduction to modern control systems with emphasis on the role of control in overall system analysis and design. Input-output directions in multivariable systems: eigenvalues and singular value decomposition. System norms and introduction to MIMO robustness. Controller design for multivariable plants: linear quadratic regulator, linear quadratic Gaussian optimal control, H-infinity and H-2 control, sampled-data, model predictive control. Convex design methods: Youla parameterization, linear matrix inequalities; adaptive control, neural networks, fuzzy logic systems; introduction to neurofuzzy systems and soft computing. Multivariable control design examples drawn from throughout engineering and science in the field of aerospace, automotive, chemical- and energy-efficient buildings.

EE 376 – Robust Control (3-0-3) (Same as ME 326)

Prerequisites: AMCS 201 and AMCS 202 or equivalents; EE 271A and EE 271B or equivalent.
Contents: Advanced methods for control design of multivariable linear systems subject to modeling errors. Topics: Signal and system norms and performance measures, robust stability and performance, linear fractional transformations, uncertainty modeling, optimal disturbance rejection, structured uncertainty analysis and synthesis, model reduction.

EE 390AA – Special Topics in Circuits (3-0-3)

Doctoral-level lectures focusing on state of the art within the field

EE 390B – Special Topics in Semiconductors Epitaxy and Devices (3-0-3)

This course discusses key technologies in semiconductor devices. The innovative ideas and technologies in semiconductor epitaxy have made possible the realization of new devices. The course explains the influence of new technologies on device development. Topics include semiconductor epitaxy technologies including their underneath physics and chemistry to device applications such as liquid-phase epitaxy, molecular-beam epitaxy, metalorganic vapor-phase epitaxy, Si-based large scaled integrated circuit, and LED and laser diodes.

EE 390C – Special Topics in Electromagnetics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390D – Special Topics in Photonics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390E – Special Topics in Electro physics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390F – Special Topics in Communications (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390G – Special Topics in Signal Processing (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390H – Special Topics in Computer and Communication Networks (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390I – Special Topics in Control (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 390J – Contemporary Topics in Systems (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394 – Contemporary Topics in Electrical Engineering (3-0-0)
A course of current interest. Topics are not permanent and the content of the course will change to reflect recurring themes and topical interest. The content will be approved by the division.

EE 394A – Contemporary Topics in Circuits (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394B – Contemporary Topics in Solid State Devices (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394C – Contemporary Topics in Electromagnetics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394D – Contemporary Topics in Photonics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394E – Contemporary Topics in Electro physics (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394F – Contemporary Topics in Communications (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394G – Contemporary Topics in Signal Processing (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394H – Contemporary Topics in Computer and Communication Networks (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 394I – Contemporary Topics in Control (3-0-3)

Doctoral-level lectures focusing on state of the art within the field.

EE 394J – Contemporary Topics in Systems (3-0-3)
Doctoral-level lectures focusing on state of the art within the field.

EE 395 – Internship (variable credit) (Summer semester)
Doctoral-level supervised research.

EE 397 – Dissertation Research (variable credit)
Doctoral-level supervised dissertation research.

EE 398 – Graduate Seminar (non-credit)
Doctoral-level seminar focusing on special topics within the field.

EE 399 – Directed Research (variable credit)
Doctoral-level supervised research.

AMCS 211 – Numerical Optimization (3-0-3)
Prerequisites: Advanced and multivariate calculus and elementary real analysis.
Solution of nonlinear equations. Optimality conditions for smooth optimization problems. Theory and algorithms to solve unconstrained optimization; linear programming; quadratic programming; global optimization; general linearly and nonlinearly constrained optimization problems.

AMCS 241 – Stochastic Processes (3-0-3) (Equivalent to STAT250)
Introduction to probability and random processes. Topics include probability axioms, sigma algebras, random vectors, expectation, probability distributions and densities, Poisson and Wiener processes, stationary processes, autocorrelation, spectral density, effects of filtering, linear least-squares estimation and convergence of random sequences.

AMCS 308 – Stochastic Methods in Engineering (3-0-3)
Prerequisites: Basic probability, numerical analysis, and programming.
Review of basic probability; Monte Carlo simulation; state space models and time series; parameter estimation, prediction and filtering; Markov chains and processes; stochastic control; Markov chain Monte Carlo. Examples from various engineering disciplines.

AMCS 396 – Mathematical Modeling in Computer Vision (3-0-3)
Prerequisites: multivariable calculus, and basic probability theory.
This course covers topics of interest in computer vision, including image denoising/deblurring, image segmentation/object detection, and image registration/matching. The emphasis will be on creating mathematical models via the framework of Bayesian estimation theory, analyzing these models and constructing computational algorithms to realize these models. Techniques from calculus of variations, differential geometry, and partial differential equations will be built up as the need arises.

CS 244 – Computer Networks (3-0-3)
Prerequisite: knowledge of the basic concepts of operating systems and systems programming.
Packet switching, Internet architecture, routing, router architecture, control algorithms, retransmission algorithms, congestion control, TCP/IP, detecting and recovering from errors, switching, Ethernet (wired and wireless) and local area networks, physical layers, clocking and synchronization. Assignments introduce network programming using NS-3, sockets, designing a router and implementing a transport layer. Also, advanced research papers on cloud computing, software define networking and wireless sensor networks. The course consists of a final implementation project on a novel idea.

CS 337 – Information Networks (3-0-3)

Prerequisite: probability, stochastic systems, network architecture of the Internet and the systems performance.
Modeling, experimental design, performance measurement, model development, analytic modeling, single queue facility, networks of queues, stochastic systems, deterministic systems, birth-death model analysis, closed network model, bottleneck, interactive networks, M/M/m queues, M/G/1 priority queues, Markovian queuing model, random numbers, discrete event simulation, verification and validation of simulation models, workload characterization and benchmarks. Also, advanced research papers on using queuing theory for networking systems. The course consists of a final modeling and simulation project on a novel idea that leads to publication.

CS 344 – Advanced Computer Networks (3-0-3)

Prerequisites: solid computer networking background or CS 244 computer networks, excellent skills in programming using C/C++, using network simulators such as NS-3, working with Linux systems.
Topics in Computer Networks will be analyzed and discussed. Topics will vary by a semester.

6. University Wide Courses

University wide courses are courses in areas not tied to any specific degree program. They are designed to meet institutional requirements, provide broadening experience or to provide supplemental preparation to support students in their degree.

These are listed below:

6.1 English as a Second Language

These courses are designed to provide English language training for students who do not fully meet the University's English language entrance requirements. Students will be assigned courses based on their level of English or proficiency.

ESL 101 English as a Second Language I (6-0-0)

ESL 101 is a foundational English skills course for reading, listening, speaking and writing.
The course has a strong focus on teaching students the basics of academic writing and grammar structures in preparation for thesis work. Course materials are typically A2 level to help students acquire basic academic English skills required for graduate coursework.

ESL 102 English as a Second Language II (3-0-0)

ESL 102 is a pre- English skills course for reading, listening, speaking and writing. The course continues to focus on building academic writing and grammar skills and also have more emphasis on reading for academic purposes. Course materials are typically B1 level to help students further develop pre-intermediate English skills required for graduate coursework.

ESL 103 English as a Second Language III (3-0-0)

ESL 103 is an upper-intermediate English skills course for reading, listening, speaking and writing. The course helps to further develop academic English skills necessary to successfully complete research and thesis work. Course materials are typically B2 level to help students refine upper-intermediate English skills required for graduate coursework.

6.2 Enrichment Program – WEP Courses

The Winter Enrichment Program (WEP) takes place in January each year and is designed to broaden students' horizon.WEP is an essential and core requirement of the degree programs at KAUST. Satisfactory completion of at least one WEP is required of all M.S. students as part of the completion of the degree requirements. Ph.D. students who did not receive their M.S. Degree at KAUST are also required to satisfactorily complete at least one WEP. To satisfy this mandatory requirement, full participation must occur within a single WEP period.

6.3 Innovation and Economic Development

Innovation and Economic Development (IED) courses are meant as a broadening experience and are not technical electives. Students should consult with their program to ensure credits can be applied toward their degree.

6.3.1 IED 210 – Technology Innovation and Entrepreneurship (3-0-3)

This course introduces students to using an entrepreneurial and design thinking view to solving real-world challenges including the pathway to commercializing research. It is about changing methods of thinking and equipping graduate students to be able to understand and manage innovation in the corporate world. This course is open to all M.S. students as an elective and to Ph.D. students with permission of their academic advisors.

6.3.2 IED 220 – New Venture and Product Innovation Challenge (6-0-6)

This intensive 8 week module will give a small select group of students, the opportunity and time to develop a detailed value proposition for a product based on an existing piece of intellectual property. This technology may be from the KAUST IP portfolio or potentially from a corporate partner. As part of the program, students will be provided with an overview of key creative subjects related to new product development including; key aspects of intra/entrepreneurship, innovation management including new product development, Go-to-Market strategies as part of commercialization roadmaps, as well as general knowledge on relevant creativity and design thinking. It will also enable students to develop these skills in a full time, heavily mentor-led and experiential learning environment that includes regular pitches and feedback from a wide range of pre-selected mentors from both inside and outside KAUST including international experts.

7. Grading

The KAUST grading system is a 4.0 scale utilizing letter grades and these are the only grades that will be assigned:

A	=	4.00	C	=	2.00
A-	=	3.67	C-	=	1.67
B+	=	3.33	D+	=	1.33
B	=	3.00	D	=	1.00
B-	=	2.67	D-	=	0.67
C+	=	2.33	F	=	0.00
I	=	Incomplete			
IP	=	In-Progress			
W	=	Withdrew			
S	=	Satisfactory			
U	=	Unsatisfactory			
WF	=	Withdrew-Failed			

7.1 Incomplete Grades

Students who complete the majority of the requirements for a course but are unable to finish the course may receive an Incomplete (I) grade. A grade of Incomplete will be assigned only with the consent of the instructor of the course after the instructor and the student have agreed on the academic work that needs to be completed and the date it is due (but no later than the end of the second week of the following semester or session). When the requirements for the course are completed, the instructor will submit a grade that will replace the Incomplete grade on the student's academic record. 'Incompletes' not completed by the end of the second week of the following semester or session will be changed to Failing (F) grades.

Grades for students that are due to Graduate

Note that any Incomplete grades (as well as Fail grades) will mean a student will not graduate or receive a diploma during the Commencement Ceremony.

Incomplete grades are granted to individual students on a case-by-case basis. Incomplete grades should not be used as a mechanism to extend the course past the end of the Semester. Students are allowed only one Incomplete grade while in a degree program at KAUST.

7.2 In-Progress Grades

Thesis Research (297) or Dissertation Research (397) should be graded as In-Progress (IP) or Unsatisfactory (U) for each semester. These 'IP' Grades will be converted by the Registrar's Office to 'S' Grades for all semesters once the office has been notified that the thesis or dissertation has been submitted to the library.

7.3 Research and Seminar Courses

297 =	Thesis Research	-Either 'IP' or 'U'
397 =	Dissertation Research	-Either 'IP' or 'U'
295/395 =	Summer Internship	-Either 'S' or 'U'
298/398 =	Seminar	-Either 'S' or 'U'
299/399 =	Directed Research	-Either 'S' or 'U'

8. Academic Standing

A student's academic standing is based on his/her cumulative performance assessment and a semester performance based on the number of credits earned and GPA during the most recently completed semester.

Academic Standing classifications are divided into four categories of decreasing levels of Academic Performance:

- Good Standing
- Academic Notice
- Academic Probation
- Academic Dismissal

Cumulative Grade Point Average

- A minimum GPA of 3.0 must be achieved in all coursework.
- Individual courses require a minimum of a B- for Course credit.

Cumulative Assessment

GPA	Academic Standing
3.00-4.00	Good Standing
2.67-2.99	Academic Notice
2.33-2.66	Academic Probation
Below 2.33	Academic Dismissal

S/U Performance	Academic Standing
0-2 Credits	GPA Standing
3-5 Credits	GPA Standing less one category
6-8 Credits	GPA Standing less two categories
9+ Credits	Academic Dismissal

Semester Assessment (Registered in 12 Credits)

Credits Earned	Academic Standing
12+ Credits	GPA Standing
9-11 Credits	GPA Standing less one category

6-8 Credits	GPA Standing less two categories
0-5 Credits	Academic Dismissal

Semester Assessment (Registered in 9 Credits)

Credits Earned	**Academic Standing**
9+ Credits	GPA Standing
6-8 Credits	GPA Standing less one category
3-5 Credits	GPA Standing less two categories
0-2 Credits	Academic Dismissal

Summer Session Assessment

Credits Earned	**Academic Standing**
6 Credits	GPA Standing
3-5 Credits	GPA Standing less one category
0-2 Credits	GPA Standing less two categories

Definitions:

Good Standing

Student is making satisfactory academic progress towards the degree.

Academic Notice

Student is not making satisfactory progress towards the degree. A student placed on Academic Notice will be monitored in subsequent semesters to ensure satisfactory progress towards the degree (see Good Standing). If the student's performance does not improve in the following semester, the student will be placed on Academic Probation.

Academic Probation

Student is not making satisfactory progress towards the degree. A student placed on Academic Probation will be monitored in subsequent semesters to ensure satisfactory progress towards the degree (see Good Standing). If the student's performance does not improve in the following semester, the student will be academically dismissed.

Academic Dismissal

Student is not making satisfactory progress towards the degree and is unlikely to meet degree requirements. Dismissed students will be required to leave the University. If deemed eligible, dismissed students will have one week from receiving Notice of Dismissal to file an Appeal.

Appeal Process for Students Academically Dismissed

If the student is eligible to appeal, he/she must submit a written explanation why the dismissal should be rescinded along with any supporting documentation. The Committee on Academic Performance will hear the appeal and make a decision to grant or deny the appeal based on the appeal and documentation, the student's past performance and the likelihood that the student is capable of successfully completing his/her academic program. If the appeal is denied, the student will be required to leave the University. The decision of the committee is final – no additional appeals are permitted.

S/U Protection

Due to the significant impact of Unsatisfactory (U) Grades, a Faculty Member giving a 'U' Grade for a course involving six or more credits must obtain concurrency of the Dean prior to submitting the grade. If the grade is given for only a single class (including Research Credit), the number of credits will be capped at six when using the Academic Standing Table displayed above.

Returning to Good Standing

A student not in Good Standing due to a GPA deficiency may return to Good Standing by improving his/her cumulative GPA such that it meets or exceeds 3.0. A student not in Good Standing due to 'U' Grades may return to Good Standing by completing at least twelve credits during the subsequent semester with no 'U' grades and a semester GPA of at least 3.0 in traditionally graded courses.

9. Transferring Credits

A student may petition to transfer graduate credits from KAUST or another University upon approval of the Program Director and the Registrar.

Each student's application will be reviewed on a case-by-case basis.

The following rules apply:

- Students entering the program with an M.S. Degree from KAUST may transfer unused coursework toward the Ph.D. program requirements subject to program level approval.
- Up to three graduate-level courses not to exceed nine credits may be transferred for credit. Courses already used for another degree cannot be used as transferred credits.
- The course grade for any course to be transferred must be a 'B' or above.
- Courses transferred for degree credit must have been taken within three years prior to admission to KAUST.
- The student must submit a completed KAUST Transfer of Credit Form and include the Course Syllabus and Course Description.
- The student is responsible for supplying an official transcript:
- The transcript may be no more than three months old.
- The transcript must be in English or accompanied by a certified English translation.
- The Grading Key must be included with the transcript.
- The Transcript must include the course name, level, grade and credit value.
- The credit value of the course must be equivalent to a minimum of three KAUST credit hours.

Course Transfer and Equivalency

Graduate credit hours taken from any KAUST program may be applied to other KAUST graduate programs under the guidelines of the degree program to which the student is admitted. Graduate courses taken from another University or KAUST program that are equivalent in level and content to the designated courses in a major track may be counted towards meeting the major track requirement if their equivalence is confirmed by the Program Director.

Students transferring from other Ph.D. programs may receive some Dissertation Research and Coursework credit units on a case-by-case basis for related work performed at their original Institution. However, such students must satisfy the written and oral requirements for a research proposal (if the proposal had been submitted and approved at the original Institution, the proposal may be the same, if approved by the research advisor). The minimum residency requirement for enrolment of such students at KAUST is two years.

10. Policy for Adding and Dropping Courses

A course may be added during the first week of the semester. Students may add courses after the first week with the permission of the instructor. Instructors have the right to refuse admission to a student if the instructor feels that the student will not have the time to sufficiently master the material due to adding the course late. A course may be dropped without penalty at any time during the first two weeks of the semester. Between the second and ninth week, students can drop a course but the course will appear on the student's transcript with the grade of Withdraw (W). After the ninth week of a full semester, courses may be dropped only under exceptional circumstances and with the approval of the Course Instructor, the Program Director and the Registrar.

11. Program Planning

It is the sole responsibility of the student to plan her/his graduate program in consultation with her/his advisor. Students are required to meet all deadlines. Students should be aware that most core courses are offered only once per year.