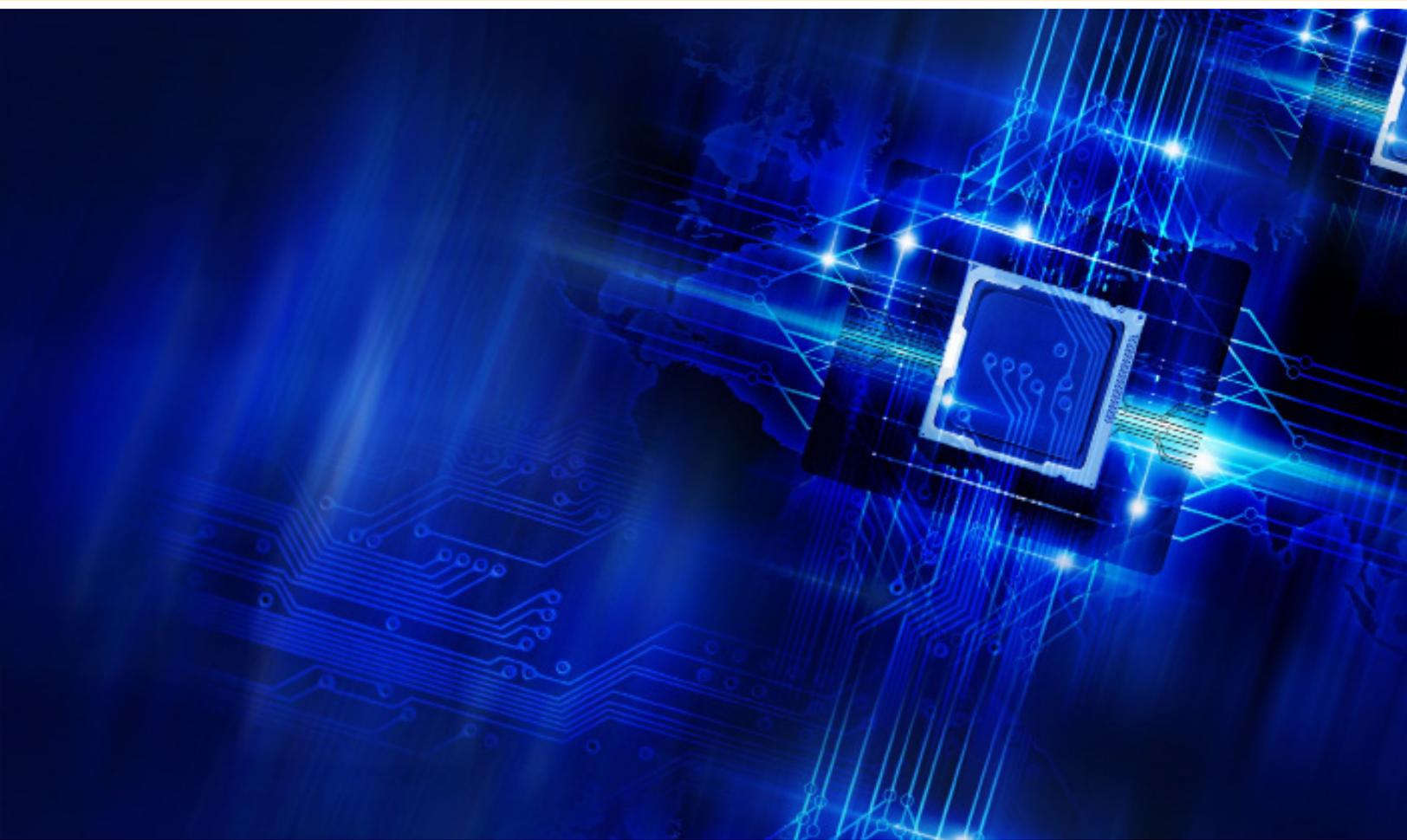


# ELECTRICAL ENGINEERING

## Program Guide

2016/2017





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## 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

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 incoming students will be required to take an assessment during orientation week. There is no grade for the assessment.

The purpose of the assessment is to determine whether students have mastered the prerequisites for undertaking graduate-level courses taught in the program. The Advisor uses the results of the assessments to design, if necessary, a remedial study plan with a list of courses aimed at addressing content areas that may impede a student from successful completion of the degree requirements. 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

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.

### 3.1 Masters Course Requirements

- Core Curriculum;
- Elective Curriculum
- Research/Capstone Experience.

#### 3.1.1 Core Courses (12 credit hours):

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.

#### 3.1.2 Elective Courses (9 credit hours):

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, then this course can fulfill the Applied Mathematics 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 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.

### 3.1.3 Research/Capstone Experience (12 credit hours):

The details comprising this portion of the degree are uniquely determined by the student, with the permission of the student's academic advisor, and will involve a combination of research and other capstone experiences. A student is expected to work a minimum of 3 hours per each research credit he/she is registered.

- Graduate Seminar 298 (non-credit): All students are required to register and receive a Satisfactory (S) grades for every semester the program Graduate Seminar is offered to meet degree requirements.

### 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 to be a thesis student and must have at least a 3.2 cumulative GPA.

A minimum of 12 credits of Thesis research (297) is required. Students are permitted to register for more than 12 credits of M.S. thesis research as necessary and with the permission of the Thesis Advisor.

The selected Thesis Advisor must be a full time program-affiliated assistant, associate or full 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 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 submit 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 <http://libguides.kaust.edu.sa/theses>
- 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 Member 2, 3 or 4, but may not be a Research Scientist. Adjunct Professors and Professor 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: [HERE](#)

### 3.3 M.S. Non Thesis Option

- Research Experience
- Directed Research (EE 299): Master's-level supervised research.
- Internship (EE 295): Research-based summer internship. Summer internships are subject to approval by the student's Academic Advisor and the EE program chair. A student may not enroll in more than one (1) internship.
- Broadening Experience Courses: Courses that broaden a student's M.S. experience.
- Ph.D.-Level Courses: EE courses numbered 300 or greater. Any course in the Ph.D. core requirement that is passed with a minimum grade of B- may be used towards meeting the core Ph.D. requirements of the EE program if the student chooses to continue for a Ph.D. degree in EE at KAUST.

## 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 full-time program.

There is a minimum residency requirement at KAUST of 3.5 years for students entering with a B.S. degree and 2.5 years for students entering with an 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

- Two 300-level courses
- Graduate Seminar 398 (non-credit): All students are required to register and receive a satisfactory grade for every semester the program requires they attend.
- 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 enrol in a full WEP for a second time in the Ph.D. degree.

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. Students transferring from another university's Ph.D. program may receive some dissertation research and coursework credit on a case by case basis for related work performed at the original institution upon approval by the Dean. However, such students must still satisfy the Qualifying Exam and Dissertation Proposal Defense requirements at KAUST. If these milestones were passed at the original institution, the proposal may be the same if approved by the Dissertation Advisor.

#### 4.2 Ph.D. Designation of Dissertation Advisor

The selected Dissertation Advisor must be a full time program-affiliated assistant, associate or full 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 at <http://www.kaust.edu.sa/faculty-advisors.html>

#### 4.3 Ph.D. Candidacy

In addition to the coursework requirements, the student must successfully complete the required PhD Qualification Milestones to progress towards Ph.D. candidacy status. These milestones consist of the Subject based Qualifying Examination and a Ph.D. proposal defense.

##### 4.3.1 Subject-based Qualifying Exam

The purpose of the Subject-based Qualifying Exam is to test the student's knowledge of the subject matter within the field of study. All students entering the Ph.D. program with a B.S. degree must take this examination within two years of their admission. Students admitted to the program with an M.S. degree must take this exam within one year. Students who fail the Subject-based Qualifying Exam with no retake or fail the retake will be dismissed from the university.

##### 4.3.2 Ph.D. Dissertation Proposal Defense Committee

Formation of Dissertation Proposal Defense Committee must include the following members:

- First member: Dissertation Advisor who acts as committee chair.
- Second member: Program or Program-affiliated faculty member.
- Third member: KAUST faculty member from another program.

The Proposal Dissertation Committee must be approved by the Dean. 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 at <http://www.kaust.edu.sa/faculty-advisors.html>

### 4.3.3 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 experimentation 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 2 years of starting the Ph.D. 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 student 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. This membership can be summarized as:



### 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 Member 2, 3 or 6.
- Adjunct Professors and Professor 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. The supervisor is a non-voting member on the 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 position).

It is the responsibility of the student to inform the Dissertation Defense Committee of his/her progress, deadlines for submitting graduation forms, the defense date, etc. It is expected that the student submits her/his dissertation nine weeks prior to the defense date in order to receive feedback from the committee members in a timely manner.

#### 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. It is the responsibility of the student to notify and submit the required documents to the Graduate Program Coordinator at the beginning of the semester they intend to defend. It is also expected that the student submits their written dissertation to the committee nine weeks prior to the defense date in order to receive feedback. The written dissertation is required to comply with the university formatting guidelines provided by the library [http://libguides.kaust.edu.sa/ld.php?content\\_id=9914831](http://libguides.kaust.edu.sa/ld.php?content_id=9914831)

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 one month after the defense date, unless the committee unanimously agrees to reduce it. The deadline to complete the retake is four months after the defense date, unless the committee unanimously agrees to reduce it. Students who fail 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.



## 5. Program Courses and Descriptions

### 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 weekly laboratory.

### EE102. 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 weekly laboratory.

### EE103. 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 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.

### EE151. 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.

### EE152. Signal and Systems II (3-0-3)

Pre-requisites: EE151.

This course builds upon the material investigated in EE151 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.

### EE189 Directed Study (variable credit up to a maximum of 12 credits)

Provides an individualized course of study that meets specific needs in a particular topic as outlined and directed by the instructor. A student may take this course based on the approval of the instructor and the student's home Division.



### EE 199. Directed Study in EE(3-0-0)

This course is a self-study in a particular topic directed by a faculty. Students do not register for this course. They may be required to enroll in it based on the recommendation of a faculty and approval of the program.

### 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. Projects to design and simulate device fabrication sequence.

### 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 micromachined capacitive, piezoresistive 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 microstrip, 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 EE231.  
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.

### 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. Probability and Random Processes (3-0-3)

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.

### 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 EE 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 252. Estimation, Filtering and Detection (3-0-3)

Prerequisite: EE 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 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.

### 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.

### EE 262. Communication Networks (3-0-3)

Prerequisite: preceded or accompanied by EE 241.

System architectures. Data link control: error correction, protocol analysis, 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 EE271B. 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 (EE151 & EE152).

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: review of finite-dimensional optimization, calculus of variations, maximum principle, Hamilton-Jacobi-Bellman equation, linear quadratic regulator and optimal deterministic filtering.

### 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 EE273B. 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 EE271B (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

## EE295 Internship

### 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: EE203 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, electrothermal and resonant techniques. Chemical, gas and biological sensors; microfluidic and biomedical devices.

Micromachining technologies such as laser machining and microdrilling, 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. RF Circuits (3-0-3)

Prerequisite: EE 202.

Introduction to RF Basic concepts and terminology, impedance transformation, noise analysis, low noise amplifiers, power amplifiers, mixers, phase-locked loops, oscillators and synthesizers. In addition, this course covers the architecture and design of radio receivers and transmitters.

### 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.

### 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.

### 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: EE241, EE242, 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: EE 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: EE 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.

### 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 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 CS244 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.

### 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 391A. Advanced Topics in Circuits and Microsystems (3-0-3)

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

### EE 391B. Advanced Topics in Solid State Devices (3-0-3)

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

### EE 391C. Advanced Topics in Electromagnetics (3-0-3)

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

### EE 391D. Advanced Topics in Photonics (3-0-3)

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

### EE 391E. Advanced Topics in Electrophysics (3-0-3)

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

### EE 392A. Advanced Topics in Communications (3-0-3)

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

### EE 392B. Advanced Topics in Signal Processing (3-0-3)

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

### EE 392C. Advanced Topics in Computer and Communication Networks (3-0-3)

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

### EE 392D. Advanced Topics in Control Theory (3-0-3)

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

### EE 392E. Advanced Topics in Systems (3-0-3)

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

EE 395 Internship

### 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.



## 6. KAUST University Requirements; Office of the Registrar

King Abdullah University of Science and Technology (KAUST) advances science and technology through bold and collaborative research. It educates scientific and technological leaders, catalyzes the diversification of the Saudi economy and addresses challenges of regional and global significance, thereby serving the Kingdom, the region and the world.

Research and education, as well as their transformative potential, are central to KAUST's mission. KAUST has a three-part mission:

Research at KAUST – both basic and goal-oriented – is dedicated to advancing science and technology of regional and global impact. Research excellence inspires teaching and the training of future leaders in science and technology.

Research and education at KAUST energize innovation and enterprise to support knowledge-based economic diversification.

Through the synergy of science and technology, with a focus on innovation and enterprise, KAUST is a catalyst for transforming people's lives.

In support of this mission, King Abdullah University of Science and Technology offers eleven graduate programs leading to M.S. and Ph.D. degrees.

KAUST Offers the Following two Degrees:

The M.S. degree typically takes three semesters and a summer to complete (18 months). The degree allows flexibility for internships, research, and academics. [Learn more about M.S. degree requirements.](#)

The Ph.D. degree is typically a three- to four-year post-master's degree. The Ph.D., involves original research, culminating in a research dissertation. [Learn more about Ph.D. degree requirements.](#)

Three are academic divisions:

### Biological and Environmental Science and Engineering (BESE)

Bioscience (B)

Environmental Science and Engineering (EnSE)

Marine Science (MarS)

Plant Science (PS)

### Computer, Electrical and Mathematical Science and Engineering (CEMSE)

Applied Mathematics and Computational Science (AMCS)

Computer Science (CS)

Electrical Engineering (EE)

### Physical Science and Engineering Division (PSE)

Chemical and Biological Engineering (CBE)

Chemical Science (ChemS)

Earth Science and Engineering (ErSE)

Materials Science and Engineering (MSE)

Mechanical Engineering (ME)

Each program is administered by a Graduate Committee and a Graduate Chair. Courses for each program will be listed at the 100 (non-credit), 200, 300 or 400 level.



## 7. Master's Program

### 7.1 Admissions

Admission to the M.S. program requires the satisfactory completion of an undergraduate B.S. degree in a relevant or related area, such as Engineering, Mathematics or the Physical, Chemical and Biological Sciences.

### 7.2 Master's Degree requirements

The M.S. degree requires successful completion of 36 credits. Students are expected to complete the M.S. degree in three semesters plus one) summer session. Degree requirements are divided into three sections: Core Curriculum; Elective Curriculum; and Research/Capstone Experience.

#### Core Curriculum (9-15 credits)

This portion of the degree program is designed to provide a student with the background needed to establish a solid foundation in the program area over and above that obtained through undergraduate studies.

#### Elective Curriculum (9-15 credits)

This portion of the degree program is designed to allow each student to tailor his/her educational experience to meet individual research and educational objectives. Depending upon the program and the objectives, this may be met by added coursework or by additional research experience.

#### Research/Capstone Experience (12 credits)

The details of this portion of the degree program are uniquely determined by the student and his/her advisor and will involve a combination of research and other capstone experiences that build on the knowledge gained in coursework.

- Satisfactory participation in KAUST's Summer Sessions and Winter Enrichment Program (WEP) is mandatory.
- Summer Session courses are credit bearing and apply toward the degree.
- WEP courses do not earn credit towards the degree.

At least thirty-six (36) degree credits must be completed in graduate-level courses and research projects. These courses should be 200-level or above and must be approved by the student's advisor. Additional non-credit bearing activities, such as graduate seminars may be required by the Program. Details on the specific program expectations, as well as the difference between the thesis and non-thesis degree options can be found through the link in the Program Guide: View a list of faculty and their : [HERE](#)

#### 7.2.1 Thesis Requirements

Students wishing to pursue a thesis as part of their M.S. degree, must identify a research advisor and must file for thesis status. The application for the thesis option is due to the Registrar's Office by the ninth week of the student's second semester at KAUST. Criteria for Acceptance into the Master's Degree with Thesis program. Students should have a well-constructed thesis proposal that includes a time-line for completion. The thesis proposal must be approved by the research advisor and the Dean of the Division.

In the case of an optional thesis program, the student should have a minimum GPA of 3.2 and at least 12 credit hours completed at the conclusion of the first semester and be registered in at least 12 credit hours during the second semester. The research advisor must indicate that he/she endorses the thesis topic and scope of work and that it could reasonably be completed by the end of the third semester. Alternatively, the faculty member agrees to a longer time frame, not to exceed the end the fourth semester and to cover the student and experimental costs that accrue during this period.

The student's program of study should be structured such that the student may change to the M.S. without Thesis option and finish the degree by the end of the student's third semester.

Thesis format requirements are described in the KAUST Thesis and Dissertation Guidelines (<http://libguides.kaust.edu.sa/theses>).



## Thesis Defense

Evaluation of satisfactory completion of M.S. thesis work is performed by the M.S. Thesis Defense Committee. The evaluation of M.S. thesis credits comprises of a satisfactory or unsatisfactory grade. The requirement of a public seminar based on the student's work is left to the discretion of the M.S. thesis advisor.

The student is responsible for scheduling the thesis defense date with his/her supervisor and committee members. It is advisable that the student submits a written copy of the thesis to the thesis committee members at least two weeks prior the defense date.

## 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 Member 2, 3 or 4, but may not be a Research Scientist. Adjunct Professors and Professor 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

### 7.2.2 Non-Thesis Option

Students wishing to pursue the Non-Thesis options must complete a minimum of 6 credits of directed research (299). Summer internship credits may be used to fulfil 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.
- Ph.D.-Level Courses : Courses numbered 300 or greater. Any course in the Ph.D. core requirements that is passed with a minimum grade of B- may be used towards meeting the core Ph.D. requirements of the program if the student chooses to continue for a Ph.D. degree in KAUST.
- Internship: Research-based summer internship (295). Students are only allowed to take one internship.
- It should be noted that a student may also combine courses to satisfy the six (6) credit requirement. For example, a student could take one Ph.D.-level course and one graduate-level course in another program. A student may not enroll in two summer internships.

Students may select a KAUST faculty member from another program to act as a research advisor (for either thesis or directed research), but must provide a one -page description of the research and an explanation of how such research would be relevant to the degree program. Upon approval by the program and the Dean, the faculty member would be allowed to act as an affiliated faculty member and advisor for the student.



Please Note: Degree Programs may have additional requirements to those listed above.  
View a list of faculty and their : [HERE](#)

## 8 Ph.D. Program

### 8.1 Admissions

Ph.D. students apply for and enter a specific degree program. A faculty advisor is either immediately designated (in the case of a student being recruited by a specific faculty member) or temporarily assigned; in the latter case, the student is expected to identify a research advisor by (at the latest) the end of the first year.

There are three phases and associated milestones for Ph.D. students:

- Passing a qualifying exam
- Passing an oral defence of the dissertation proposal
- Dissertation phase with a final defense milestone.

### 8.2 PhD Degree Requirements

There is a minimum residency requirement (enrolment period at KAUST) of 2.5 years for students entering with an M.S. degree, 3.5 years for students entering with a B.S. degree. Qualification and advancement to candidacy are contingent upon: (i) successfully passing Ph.D. coursework, (ii) designating a research advisor, (iii) successfully passing a qualifying exam, and (iii) writing and orally defending a research proposal. Possible outcomes include pass, failure with complete retake, failures with partial retake, and failure with no retake. Students not permitted to retake the exam, or who fail the retake, will be dismissed from the University. The maximum allotted time for advancement to candidacy for a student entering with a M.S. degree is one (1) year after passing the qualifying exam; two years for students entering with a B.S.

Satisfactory participation in KAUST's Summer Session and Winter Enrichment Period (WEP) is mandatory. Summer Session courses are credit bearing and apply towards the degree. WEP courses do not earn credit towards the degree.

The required coursework is outlined below and see program for specific program course requirements:

#### M.S. Degree

- Core courses
- Elective courses

#### Ph.D. Degree

- Two or more courses (6 credits of coursework) at the 300 level
- Graduate seminar if required by the program.

Students entering the program with a relevant M.S. from another institution may transfer coursework toward the requirements of the M.S. degree listed above upon approval of the program.

Students entering the program with a M.S. from KAUST may transfer coursework toward both the M.S. and Ph.D. requirements listed above upon approval of the program and based on their program of study at KAUST.

Students entering with a B.S. from another institution may transfer in up to 9 credits of graduate level coursework towards the above requirements upon approval of the program. In addition, students entering with a B.S. may also qualify to earn a M.S. degree by satisfying the M.S. degree requirements as part of the Ph.D. program.



Some degree programs may require a diagnostic entrance exam as a basis for admission, and students may be required to complete additional coursework depending on their degree-granting institution. If the M.S. degree is from a subject other than the Ph.D. degree program, there may be additional courses required and specified by the advisor.

### 8.3 Candidacy

Achieving Ph.D. candidacy is contingent upon successfully passing a qualifying examination, acceptance by the research advisor of a written research proposal and successfully passing an oral examination. Details should be confirmed in the individual degree program material. For a list of eligible faculty advisors for any degree program. View a list of faculty and their : [HERE](#)

Passing the qualification phase is achieved by acceptance of all committee members of the written proposal and a positive vote of all but, at most, one member of the oral exam committee. If more than one member casts a negative vote, one retake of the oral defense is permitted if the entire committee agrees. A conditional pass involves conditions (e.g. another course in a perceived area of weakness) imposed by the committee, with the conditional status removed when those conditions have been met. Once constituted, the composition of the qualification phase committee can only be changed upon approval by both the faculty research advisor and the division dean.

### 8.4 Dissertation Research Credits

Besides coursework (6 or more credit hours), dissertation research (course number 397) must be earned during the first (proposal preparation and defense) and second phases of the Ph.D. program. A full-time workload for Ph.D. students is considered to be 12 credit hours per semester (courses and 397) and 6 credit hours in summer (397 only). There is a minimum residency requirement (enrolment period at KAUST) of 2.5 years for students entering with an M.S. degree, 3.5 years for students entering with a B.S. degree. Ph.D. students typically complete the degree in 5 years.

### 8.5 Dissertation and Dissertation Defense

The Dissertation Defense is the final exam of the Ph.D. degree. It involves a public presentation of the results of the dissertation research followed by a question and answer session by the Ph.D. Dissertation Defense Committee. It is the responsibility of the student to inform the dissertation committee of his/her progress and meet deadlines for submitting defense date and graduation forms. It is expected that students will submit their dissertations to their committee six (6) weeks prior to the defense date in order to receive feedback from the committee members in a timely manner. However, the advisor may approve exceptions to this expected timeline. The dissertation format requirements are described in the KAUST Thesis and Dissertation Guidelines. <http://libguides.kaust.edu.sa/theses>

The result of the defense will be made based on the recommendation of the committee. There are four possible results: Pass: the student passes the exam and the dissertation is accepted as submitted; Pass with revisions: the student passes the exam and the student is advised of the revisions that must be made to the text of the dissertation; Failure with retake: normally this means the student must do more research to complete the dissertation. The student must revise the dissertation and give another oral examination within six months from the date of the first defense; and Failure: the student does not pass the exam, the dissertation is not accepted, the degree is not awarded, and the student is dismissed from the University.

### 8.6 Ph.D. Dissertation Defense Committee

The Dissertation Defense is the final exam of the Ph.D. degree. It involves a public presentation of the results of the dissertation research followed by a question and answer session by the PhD Dissertation Defense Committee. It is the responsibility of the student to inform the dissertation committee of his/her progress and meet deadlines for submitting defense date and graduation forms. It is expected that students will submit their dissertations to their committee six (6) weeks prior to the defense date in order to receive feedback from the committee members in a timely manner. However, the advisor may approve exceptions to this expected timeline. The dissertation format requirements are described in the KAUST Thesis and Dissertation Guidelines. <http://libguides.kaust.edu.sa/theses>

The result of the defense will be made based on the recommendation of the committee. There are four possible results: Pass: the student passes the exam and the dissertation is accepted as submitted; Pass with revisions: the student passes the exam and the student is advised of the revisions that must be made to the text of the dissertation; Failure with retake: normally this means the student must do more research to complete the dissertation. The student must revise the dissertation and give another oral examination within six (6) months from the date of the first defense; and Failure: the student does not pass the exam, the



dissertation is not accepted, the degree is not awarded, and the student is dismissed from the University.

### PhD Dissertation Defense Committee

The PhD 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. This membership can be summarized as:

### 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 Member 2, 3 or 6.

Adjunct Professors and Professor 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.

It is the responsibility of the student to inform the dissertation committee of his/her progress and meet deadlines for submitting defense date and graduation forms. It is expected that students will submit their dissertations to their committee six (6) weeks prior to the defense date in order to receive feedback from the committee members in a timely manner. However, the advisor may approve exceptions to this expected timeline. The dissertation format requirements are described in the KAUST Thesis and Dissertation Guidelines. <http://libguides.kaust.edu.sa/theses>

## 9. Program Descriptions

The Master's and Doctoral degree program requirements listed above represent general university-level expectations. The specific details of each degree requirements are outlined in the descriptions of the individual degree programs.

### Course Notation

Each course is listed prefaced with its unique number and post fixed with (l-c-r) where:

- l is the lecture hours, to count toward fulfilling the student workload during a semester.
- c is the recitation or laboratory hours.
- r is the credit hours toward fulfilling a degree course requirement.



Eg CS 220 Data Analytics (3-0-3) has a total of three hours of lectures per week, has no labs and earns 3 credits for the semester

## 9.1 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 experiences or to provide supplemental preparation to support students in support of their degree. These are listed below.

### 9.1.1 English as a Second Language

These courses are designed to provide English language training for student who do not fully meet the university's English language entrance requirements and students will be assigned based on the student's 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 course work.

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

ESL 102 is a pre-intermediate English skills course for reading, listening, speaking and writing. The course continues to focus on building academic writing and grammar skills and also 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 course work.

#### 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 course work.

### 9.1.2 Enrichment Program WEP Courses

The Winter Enrichment Program (WEP) takes place in January each year and is designed to broaden student's horizons. WEP is an essential and core requirement of the degree programs at KAUST. Satisfactory completion of at least one WEP is required of all MS students as part of completion of the degree requirements. PhD students who did not receive their MS 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.

### 9.1.3 Innovation and Economic Development

#### 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 MS students as an elective and to PhD students with permission of their academic advisors.

#### 9.1.4 IED 220 New Venture and Product Innovation Challenge (6-0-6)

This is an experiential, industry mentor-led program: this course will enable students to 'learn-by-doing' through the development a fully formed business proposition for real intellectual property that has been developed in the Kingdom. The objective is to create a plan for commercialization and launch of a new product and/or new venture. The process will include students learning how to Creatively View Technology Opportunities; the Identification and Assessment of Opportunity; the Structuring and Packaging of a Validated Commercial Idea. In addition students will learn key skills including the development of real-world Strategy, Planning & Team Building; Integrating Continuous Feedback and Communicating Key Concepts to Different Audiences.



## 10 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

### 10.1 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 F (failing) 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.

### 10.2 In Progress grade

(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).

### 10.3 Research or Seminar courses

Use the following grades for these research or seminar courses:

297	Thesis Research	Either IP or U
397	Dissertation Research	Either IP or U
295/395	Internship (summer)	Either S or U
298/398	Seminar	Either S or U
299/399	Directed Research	Either S or U

### Summer Session and Winter Enrichment Program:

Satisfactory participation in KAUST's Summer Session and Winter Enrichment Period (WEP) is mandatory. Summer Session courses are credit bearing and apply toward the degree. WEP courses do not earn credit towards the degree.



## 10.4 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.

## 11. 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 (4) categories of decreasing levels of academic performance: Good Standing; Academic Notice; Academic Probation; and Academic Dismissal.

### 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	Credits Earned	Academic Standing
12 credits	12+credits	GPA Standing
	9-11credits	GPA Standing less one category
	6- 8 credits	GPA Standing less two category
	0- 5 credits	Academic Dismissal

### Semester Assessment

Registered in	Credits Earned	Academic Standing
9 credits	9 + credits	GPA Standing
	6 – 8 credits	GPA Standing less one category
	3 – 5 credits	GPA Standing less two category
	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 toward the degree.



### Academic Notice

Student is not making satisfactory progress toward the degree. A student placed on Academic Notice will be monitored in subsequent semesters to ensure satisfactory progress toward 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 toward the degree. A student placed on Academic Probation will be monitored in subsequent semesters to ensure satisfactory progress toward 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 toward 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 U grades, a faculty member giving a U grade for a course involving 6 or more credits must obtain concurrence 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 6 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 3.00. A student not in good standing due to U grades may return to Good Standing by completing at least 12 credits during the subsequent semester with no U grades and a semester GPA of at least 3.00 in traditionally graded courses.

## 12. Transferring Credits

A student may petition to transfer graduate credits from another university, upon approval of the Program Chair and the Registrar. Each student's application will be reviewed on a case-by-case basis. The following rules apply:

Up to three graduate-level courses not to exceed nine credits may be transferred for credit. Courses transferred for credit cannot have been counted as credits for another granted degree.

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 toward meeting the major track requirement if their equivalence is confirmed by the program chair.

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.

## 13 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 "W" (withdraw). 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 Chair and the Registrar.

## 14 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.