Department of Electrical Engineering
Doctor of Philosophy in Electrical Engineering
Program Guide

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1 Overview

The Ph.D. is the highest degree awarded by Wright State University. This pinnacle academic credential signifies a mastery of a body of skills and knowledge in preparation for a career as an independent and productive scholar. Doctoral training involves working closely with faculty on significant technological challenges of importance and mutual interest.

2 Program Objectives

The program of study leading to the Doctoral Degree in Electrical Engineering is designed to achieve the following objectives:

- To enable students to engage in continued advanced study and research

- To foster original and scholarly research contributions to the various fields composing Electrical Engineering

- To instill in each student a proficiency for innovation manifesting a fundamental advancement of knowledge

- To enable graduates to integrate their education and experience with the larger problems of the technological professions

A student's primary advisor, or Dissertation Director, is a key factor to success in graduate studies. Members of the dissertation committee also play critical mentoring roles in a student's academic progress. Each Ph.D. student is paired with a faculty advisor upon admission to the program. The faculty advisor will assist the student in developing the student's program of study, selecting a Dissertation Committee, and scheduling all program milestones.

3 How to Apply

3.1 Domestic Students

To apply to the Ph.D. in Electrical Engineering Program, submit an online graduate application to the Graduate School.

3.2 International Students

Visit the University Center of International Education (UCIE) website for information on international applications and deadlines.

3.3 Transfer Credit

3.3.1 Students with a relevant master's degree

Upon the recommendation of the student's dissertation advisor and approval of the Ph.D. Program Director and the Graduate School, graduate courses completed at another accredited academic institution as part of a relevant M.S. degree may be transferred to a student's graduate academic record and applied toward the requirements of the Ph.D. Degree in EE program at Wright State. No more than thirty (30) semester hours may be applied against the Ph.D. Degree requirements.

3.3.2 Students entering the program with graduate credit beyond the master's degree

Credit for courses taken beyond the master's degree may be applied against the Ph.D. Program requirements provided they have not been applied toward an awarded degree. The Ph.D. Program Director may consider such courses as satisfying certain requirements providing the student was admitted and enrolled as a graduate student in good standing at the institution where the graduate credit beyond the M.S. Degree was completed. Students who transfer to the Ph.D. in EE program and retain the same Dissertation Director must have their programs of study approved by the Ph.D. Program Director. Their programs of study, among other requirements, will specify any examinations which must be completed.

4 Admission Requirements

Program admissions will be based on a completed application of background information, submitted transcripts for undergraduate coursework and prior graduate coursework, GRE scores, 3 letters of recommendation, and a written statement of research interests and objectives. Students must first satisfy requirements for admission into the Wright State University Graduate School. Additionally, the student should be able to demonstrate a good understanding of electrical engineering fundamentals and have completed an M.S. degree to be considered for the program. Final admission decisions will be made by the Ph.D. Program Director based on the complete application package which must include documentation of:

- A B.S. in Electrical Engineering or a closely-related field, with a minimum GPA of 3.0

- An M.S. in Electrical Engineering or a closely-related field, with a minimum GPA 3.5 for all prior graduate coursework, although applicants with lower GPAs offset by high GRE scores will be considered

- Graduate Record Examination (GRE) test scores are not required.

- Transcripts of all prior course work

- A written statement of research interests and objectives

- Three Letters of Recommendation attesting to the student's potential for independent research

- International students who do not have a degree from a U.S. institution must meet UCIE's English proficiency criteria ([Graduate Admission Requirements | International Admissions | Wright State University](#))

4.1   Admission Criteria Variances

Students with M.S. degrees in (non-electrical) engineering fields will frequently begin graduate-level coursework without remediation. Students from other STEM fields (e.g., mathematics, physics, computer science) may be required to complete some remedial coursework before beginning graduate-level studies.

Prior work experience may improve an applicant's chances for admission but will not be considered as a substitute for required academic credentials.

4.2   Conditional and Provisional Admission

A student may be admitted conditionally into the Ph.D. program. For example, conditional status may be granted to a student whose record indicates curricular deficiencies or lack of demonstrated prerequisite proficiency. Upon satisfactory completion of the conditional requirements, within the time frame specified by the program, the student's admission status will be changed to "regular." Failure to satisfy all requirements in the specified time frame will result in dismissal from both the Ph.D. program and the Graduate School.

A student may be granted provisional admission in the Ph.D. doctoral program for a maximum of one semester for the purpose of granting a time variance for receipt of all application credentials. Granting provisional status does not imply or guarantee that the student will be granted admission into the program after all credentials have been received. Students admitted with provisional status must satisfy all admission requirements of the program within one semester.

5   Degree Requirements

5.1   Program Component Requirements

To fulfill the requirements for the Ph.D. in Electrical Engineering, a student must:

- Present for approval, by the end of the second semester, an approved Program of Study that contains at least 90 graduate semester credit hours beyond the bachelor's (B.S.) degree in electrical engineering or an equivalent degree in a related area, and 60 graduate semester credit hours beyond a Master's (M.S.) degree in electrical engineering or a related area.

- Complete the minimum of 90 graduate semester credit hours beyond the bachelor's degree, or 60 graduate semester credit hours beyond a Master's degree which must include, in aggregate, across the M.S. and Ph.D. programs:

→ No fewer than three EE *breadth courses* with a minimum grade of "B" in each course and any associated laboratory component. These courses must be numbered 7000-level or above entries from at least three distinct collections of focus area courses offered at

Wright State listed below. This requirement may not be satisfied with any similar course taken at the undergraduate level. Breadth courses must be at the 7000-level or above, although courses at the 6000-level may be permitted with approval from Director of Graduate Studies.

→ No fewer than 20 semester hours of courses in electrical engineering, numbered 7000- level and above. EE breadth courses may be used to partially satisfy this requirement, however thesis, dissertation, and independent study hours cannot be used to satisfy this requirement.

→ No fewer than 6 semester credit hours of graduate courses (numbered 6000-level and above) in mathematics (MTH) or statistics (STT).

→ No fewer than 30 and no more than 45 semester hours of Ph.D. dissertation research with a grade of "P".

→ No more than 3 semester hours of independent study

→ No more than 9 semester hours of M.S. thesis research.

- Pass the Program Qualification Exam. (see Section 6.3)

- Pass the Research Proposal Defense. (see Section 6.6)

- Present a seminar based on their dissertation research during an open meeting or a peer-reviewed, selective conference. (see Section 6.7)

- Submit at least one manuscript to a peer-reviewed (IEEE quality) journal. (see Section 6.8)

- Obtain approval from the Dissertation Committee, and successfully defend the dissertation before the Dissertation Committee, and satisfactorily complete the written Dissertation Document. A student is required to submit a comprehensive written report on the new research findings, which must be approved by the dissertation committee. Furthermore, the student is required to give a public oral presentation to defend the findings in the written report to a Ph.D. dissertation committee comprised of subject matter experts in the field. (see Section 6.9 –6.12)

5.2   Breadth Courses

The Ph.D. in Electrical Engineering courses that satisfy the "breadth" requirement include: Analog, Digital and Mixed-Mode VLSI

EE 7510/L ....Digital Wideband Receiver & Lab
EE 7520/L....................................Low Power VLSI System Design & Lab
EE 7530/L....................................VLSI Design Synthesis & Optimization & Lab
EE 7540/L....................................VLSI Testing & Design for Testability & Lab
EE 7550 ....Trust in Integrated Circuit Design
EE 7580/L ....CMOS Mixed Signal IC Design & Lab
EE 7590/L....................................CMOS Radio Frequency Integrated Circuit Design & Lab

Electronics, Power Electronics and Electronic Devices

EE 7410/L....................................Power Electronics I & Lab
EE 7420/L ....Power Electronics II & Lab
EE 7430/L....................................HF Magnetic Components & Lab
EE 7440/L ....RF Power Amplifiers & Lab

Intelligent Controls and Robotics

EE 7020..Modern Control I
EE 7200..Modern Control II
EE 7260..Autonomous Unmanned Systems
EE 7270 ....Adaptive Control
EE 7280..Intelligent Control
EE 7560/L....................................Advanced Robotics & Lab

Signal and Image Processing

EE 7150 ....Digital Image Processing
EE 7160 ....Multi Sensor and Information Fusion
EE 7170..Target Tracking and Data Association
EE 7330..Modern Radar Theory

Wireless Communication Systems

EE 7350 ....Wireless Communication Techniques
EE 7360..Advanced Wireless Communication Techniques
EE 7370 ....Advanced Electronic Warfare
EE 7400..Information Theory
EE 7610 ....Random Process
EE 7620..Detection Estimation & Optimal Filter Theory

RF & Microwave Materials, Devices and Systems

EE 7080 ....Advanced MEMS
EE 7460..Advanced Electromagnetics Engineering
EE 7470 ....Electromagnetic Simulation Methods
EE 7480..Advanced Microwave Engineering
EE 7490..Antenna Theory and Design

5.3   Program Variances and Constraints

Program Variances

A. With the approval of the Ph.D. Program Director, students may use graduate (6000-level and above) courses in mathematics (MTH) or statistics (STT) appearing on the M.S. transcript or transfer-credit transcript to satisfy, in part or in whole, the "6 semester hours of graduate math or statistics" requirement. In this case, additional semester credit hours of coursework are required in the apportion of credit hours so applied.

B. Students originally enrolled in the Ph.D. in Engineering at Wright State University who wish to transfer to the Ph.D. in Electrical Engineering Program may substitute "core courses" in the Engineering Program which were completed in Spring 2016 or earlier for "breadth courses" required for the Ph.D. in Electrical Engineering Program. Note that this is a "full

substitution" in that these courses may also be used to satisfy, in part, the requirement of 20 semester credit hours of EE 7000-level courses.

Program Constraints

Residence Students in the Ph.D. Program are considered to be in "residence" for any term for which they are registered for at least six semester hours of Wright State graduate courses. A minimum residence of two consecutive full-time academic semesters at Wright State University, devoted wholly to graduate work, is required by the University and hence by the program. (GS)

Independent Study No more than 3 semester credit hours of independent study (EE 7900) may be used to meet any program requirement. Further, independent study may not be used to satisfy either the "breadth courses" requirement or the "20 semester credit hours of EE 7000-level" requirement or the "6 semester hours of graduate math or statistics" requirement.

Prerequisite Material If deemed necessary by the Ph.D. Program Director and in order to fulfill program requirements, students will be required to successfully complete any prerequisite material at the undergraduate level. These courses may not be used to satisfy any of the Ph.D. degree requirements.

Time Limit Students must complete all degree requirements within 10 years from the date the student matriculated into the program. Courses older than ten years on a student's programs of study may not be used to satisfy program requirements. (GS)

Academic Standards

GPA All students are required to maintain a minimum cumulative grade point average of 3.0. A cumulative average of 3.0 is required for graduation. (GS)

C grades The grade of "C" is a minimum passing grade for graduate credit; although up to six semester hours of courses with a grade of "C" may be applied toward certain requirements of the program unless otherwise restricted. (GS)

First-year Review At the end of one year or 16 semester hours, each student will be evaluated as to academic progress by the Ph.D. Program Director. On the basis of this evaluation, and after review by the Graduate School, the student will be either: Recommended for continuation in the graduate program, Placed on probationary status, or Dismissed from the Program and the Graduate School. (GS)

Probation After completing sixteen (16) semester hours of course work in the Program, students will automatically be placed in probationary status if their cumulative GPA drops below 3.0. Students must achieve a cumulative GPA of at least 3.0 the semester they complete nine hours of course work subsequent to being placed on probation. Failure to meet this condition could result in their dismissal from the Graduate School. Students achieving a cumulative GPA of at least 3.0 prior to or during the semester that nine (9) hours have been completed will be cleared of probationary status. (GS)

Internships & CPT Candidates are eligible to engage in internship or co-op opportunities. One credit of internship-related Independent Study (EE 7900) may be counted toward the total credits for the degree. Additional semesters of internship may be registered, but not applied to satisfy degree requirements. Inter- national students must register the internship with the Brandeberry Career Development Center, register for 1 credit of independent study, and seek approval from the department for UCIE Departmental Certification. Domestic students are encouraged to register with Brandeberry Career Center and for Independent Study to receive 1 hour of credit toward the total credits. All students registered for credit bearing internships are required to submit a report upon completion of the internship detailing the learning objectives expected and the outcome of the experience.

Graduate students working on dissertation research may be approved for CPT without the requirement of academic credit hours. The dissertation advisor must provide a letter to UCIE explaining, in detail, how the research is absolutely necessary for the completion of the dissertation and cannot be completed otherwise.

6 Program Process and Milestones

6.1 Program of Study

By the end of the second semester, the student must complete an approved Program of Study meeting all program requirements.

6.2 Dissertation Committee Selection

A Dissertation Committee will be formed at the suggestion of the Dissertation Director with approval of the Ph.D. Program Director. The Ph.D. Program Director, in consultation with the Dissertation Director will submit the proposed Committee to the Dean of the Graduate School. The Dean of the Graduate School will formally approve the nominees to the committee.

The committee will consist of at least four (4) regular or associate members of the graduate faculty, including the Dissertation Director, with at least three of these having a primary tenure-track faculty appointment or Wright State University Faculty Emeritus status in the department of Electrical Engineering. The Dissertation Director, who chairs the committee, must be a regular member of the graduate faculty, a member of the Ph.D. in Electrical Engineering program faculty, and dissertation-qualified.

Co-Director Adjunct members of the graduate faculty who are dissertation-qualified may be eligible to co-direct a dissertation along with a Ph.D. in Electrical Engineering dissertation-qualified member and will be selected and nominated in accordance with the Ph.D. Program Policies. Stu- dents who transfer to the Ph.D. Program may retain the same Dissertation Director if they satisfy the above criteria. Committee members who continue from the student's previous institution are considered to possess adjunct status while the student continues in the Ph.D. in EE Program.

In consideration of the extensive agreements which established the Dayton Area Graduate Studies Institute in 1994, Wright State recognizes regular faculty members in engineering and computer

science at the other four original DAGSI institutions (Air Force Institute of Technology, University of Dayton, the Ohio State University, and University of Cincinnati) as possessing *á priori* the equivalent of adjunct graduate status.

6.3 Program Qualification Exam

Upon completion of the coursework students are required to pass a Qualifying Examination where problem-solving and independent research comprehension skills are thoroughly examined by a Dissertation Committee comprised of subject matter experts. All students in the program are expected to take and pass the qualifying examination before they will be admitted into "candidacy" status. The purpose of the qualifying examination is to determine if a student has acquired and is able to apply fundamental knowledge and acumen in the program area. The examination typically contains both written and oral components. The qualifying examination consists of:

- A written one-week-duration take-home exam composed by committee containing open-ended problems and paper reviews
- An oral, two-hour examination loosely centered around the written examination

Students will normally take the examination after they have completed the both the "breadth courses" and the Electrical Engineering courses satisfying program requirements in their Program of Study. Failure to pass the qualifying examination may result in dismissal from the program regardless of performance in other aspects of the program. Depending on the Dissertation Committee's recommendation, a student failing the examination may repeat it once. If necessary, students are expected to repeat the examination in a timely manner. Passing the examination is necessary for, but does not guarantee, a student's admission into candidacy. The program may establish additional criteria to determine a students eligibility for candidacy.

Students will be provided written notification of the results of the examination and of any actions to be taken within ten days of having taken the examination. The Ph.D. Program Director will notify, in writing, the Graduate School of the administration and results of the qualifying examination and the actions to be taken for those students who have failed to pass the examination. If dismissal action is to be taken, the Graduate School will formally notify the student by letter.

6.4 Achieve Candidacy

Acceptance into candidacy in the Ph.D. Program indicates that students have the potential to undertake work on the dissertation and to successfully complete all other requirements of the program. Students achieve *candidacy* by passing the qualifying examination and by obtaining approval of their dissertation topic from their Dissertation Committee. Candidacy is valid for five (5) years. The program can, however, terminate candidacy for unsatisfactory progress. Students may petition for an extension to the candidacy term.

6.5 Progress Reviews

Upon achieving candidacy, the student will provide formal progress reports to the Dissertation Committee at regular intervals not to exceed one year, until the dissertation is successfully defended.

It is the Dissertation Director's responsibility to convene the meetings and report a summary consensus of progress, along with a consensus projection of program completion to the Ph.D. Program Director. Students who fail to complete a progress review in a given academic year will be prevented from registering for classes the following fall semester, and thereafter, until their progress review status is made current.

6.6   Research Proposal Defense

Upon passing the qualifying examination and achieving candidacy, a student is required to survey the literature and demonstrate mastery of the current state of the art in the student's intended area of research. Based on this study, the student is required to independently develop a research plan that proposes an original and significant contribution expanding state of art knowledge in a specific research area. The innovation and importance in the research proposal is reviewed, examined and approved by subject matter experts in the Dissertation Committee.

6.7   Seminar Presentation

Present a seminar based on dissertation research during an open meeting or conference.

6.8   Journal Paper Submission

The Ph.D. candidate must submit at least one manuscript to a peer-reviewed (IEEE quality) journal before defending the dissertation. The Dissertation Director may require additional publication production beyond the one manuscript submission requirement.

6.9   Create the Dissertation

The dissertation is an original, significant contribution to scholarly, technical, or scientific knowledge in a specialized area. The dissertation must provide convincing evidence of the highest level of mastery in the techniques of research and a thorough understanding and application of the subject matter.

Students must complete the dissertation within the time frame established for candidacy. All course work associated with the dissertation must earn a grade of "P" in order to qualify the student for graduation. All grades for dissertation work will be given in each semester for which dissertation credit is awarded. The dissertation must be written in Standard American English.

6.10   Orally Defend the Dissertation

Each candidate is required to give an oral presentation to defend the findings in the written report to the Ph.D. Dissertation Committee. The final dissertation defense will normally be open to the public. The Dissertation Committee may also elect to privately question the candidate following the public presentation. The Ph.D. Program Committee will establish the procedures for the defense of the dissertation. The dissertation must be approved by at least three (3) members of the Dissertation Committee.

The dissertation defense must occur by the last day of classes of the semester in order for the student's successful completion of the degree to be awarded in that semester. This requirement also governs the student's ability to participate in the graduation ceremony in that term: in order to participate in the graduation ceremony, the student's dissertation defense must be held by the final day of classes in that semester.

6.11 Finalize the Dissertation Document

Candidates are required to submit an edited dissertation document incorporating all changes approved by the Dissertation Committee.

6.12 Disseminate the Dissertation

A computer file containing an approved dissertation, in PDF format, must be transmitted to OhioLINK and to the Ph.D. Program Director not later than 30 days after the end of the semester in which the degree will be granted (due dates are published by the Graduate School and distributed to the doctoral program offices). Instructions for submitting the student dissertation are on the OhioLINK Web site.

OhioLINK is the repository for Electronic Theses and Dissertations (ETDs) for the state universities system in Ohio. This final copy should follow the form prescribed in the Graduate Thesis/Dissertation Handbook, available at the Graduate School Web site and should be carefully produced, free of errors in style, mechanics, and format. The PDF file must include the typed dissertation approval page, *but without signatures*.

One (1) paper copy of the typed dissertation approval page, *with signatures*, must be submitted to the Graduate School and to the Ph.D. Program Director for filing. The ETD cannot be approved until the Graduate School receives the paper copy of the signed dissertation approval page. Please consult the Graduate Thesis/Dissertation Handbook for additional information and details about preparing the student ETD.

7 Graduate Curriculum Guide

The following listings of graduate courses representing area concentrations within Electrical Engineering are intended to guide students and their advisors in developing and completing a program of study:

7.1   Analog, Digital, and Mixed-Mode VLSI

Essential
EE 6540/L .... VLSI Design& Lab
EE 6620/L .... Digital Integrated Circuit Design& Lab
EE 7520/L .... Low Power VLSI System Design & Lab
EE 7530/L .... VLSI Design Synthesis & Optimization & Lab
EE 7550 .... Trust in Integrated Circuit Design
EE 7580/L .... CMOS Mixed Signal IC Design & Lab

Recommended
EE 7510/L .... Digital Wideband Receiver & Lab
EE 7540/L .... VLSI Testing & Design for Testability & Lab
EE 7590/L .... CMOS Radio Frequency Integrated Circuit Design & Lab
EE 7810 .... Embedded Systems
MTH 6070 (3) .... Optimization Techniques (CS 6270)
MTH 6570 (4) .... Combinatorics and Graph Theory (CS 6280)

7.2   Electronics, Power Electronics, and Electronic Devices

Essential
EE 6440/L .... Electronic and Linear Integrated Systems & Lab
EE 7410/L .... Power Electronics I & Lab
EE 7420/L .... Power Electronics II & Lab
EE 7430/L .... HF Magnetic Components & Lab
EE 7440/L .... RF Power Amplifiers & Lab

Recommended
EE 6130/L .... Continuous Control System & Lab
EE 6170/L .... Digital Control Systems & Lab
EE 7010 .... Applied Linear Techniques
EE 7580/L .... CMOS Mixed Signal IC Design & Lab
EE 7590/L .... CMOS Radio Frequency Integrated Circuit Design & Lab
MTH 6050 (3) .... Advanced Engineering Mathematics
MTH 6060 (3) .... Mathematical Modeling
MTH 6070 (3) .... Optimization Techniques (CS 6270)
MTH 6260 (3) .... Matrix Computations (CEG 6260)
STT 6460 (4) .... Statistical Methods for Engineers

7.3   Intelligent Controls and Robotics

Essential
EE 6120/L....................................Industrial Controls and Automation & Lab
EE 6130/L....................................Continuous Control System & Lab
EE 6170/L....................................Digital Control Systems & Lab
EE 6190/L....................................Intro Intelligent Control Systems & Lab
EE 6560/L ....Introduction to Robotics & Lab
EE 7020..Modern Control I
EE 7200..Modern Control II
EE 7270 ....Adaptive Control
EE 7280..Intelligent Control

Recommended
EE 6600/L....................................Autonomous UAV Flight Control & Lab
EE 7030..Computational Engineering Analysis
EE 7260..Autonomous Unmanned Systems
EE 7560/L....................................Advanced Robotics & Lab
MTH 6050 (3) ....Advanced Engineering Mathematics
MTH 6060 (3) ....Mathematical Modeling
MTH 6070 (3) ....Optimization Techniques (CS 6270)
MTH 6260 (3) ....Matrix Computations (CEG 6260)
MTH 6550 (3) ....Advanced Linear Algebra
MTH 7160 (4) ....Numerical Analysis I

7.4   Signal and Image Processing

Essential
EE 6360..Digital Signal Processing
EE 7150 ....Digital Image Processing
EE 7160 ....Multi sensor and Information Fusion
EE 7610 ....Random Process
EE 7620..Detection Estimation & Optimal Filter Theory

Recommended

EE 6840 ....Introduction to Machine Learning
EE 7010 ....Applied Linear Techniques
EE 7030......................................Computational Engineering Analysis
EE 7170......................................Target Tracking and Data Association
EE 7330......................................Modern Radar Theory
EE 7350......................................Wireless Communication Techniques
EE 7400......................................Information Theory
EE 7630......................................Stochastic Signal Processing
EE 7820......................................Pattern Recognition
EE 7830......................................Machine Learning
EE 7840......................................Computer Vision
MTH 6260 (3) ....Matrix Computations (CEG 6260)
MTH 6550 (3) ....Advanced Linear Algebra
MTH 7160 (4) ....Numerical Analysis I
STT 6110 (3)................................Applied Time Series
STT 7020 (3)................................Applied Stochastic Processes
STT 7440 (3)................................Applied Multivariate Analysis

7.5   Wireless Communication Systems

<u>Essential</u>
EE 6210/L...................................Digital Communication & Lab
EE 6730/L...................................Wireless Communication & Lab
EE 7350......................................Wireless Communication Techniques
EE 7360......................................Advanced Wireless Communication Techniques
EE 7400......................................Information Theory
EE 7610......................................Random Process
EE 7620......................................Detection Estimation & Optimal Filter Theory

<u>Recommended</u>
EE 6360......................................Digital Signal Processing
EE 6750......................................Introduction to Radar Systems
EE 6840 ....Introduction to Machine Learning
EE 7010 ....Applied Linear Techniques
EE 7030......................................Computational Engineering Analysis
EE 7330......................................Modern Radar Theory
EE 7370 ....Advanced Electronic Warfare
EE 7630......................................Stochastic Signal Processing
MTH 6240 (3) ....Coding Theory (CS 6240)
MTH 6260 (3) ....Matrix Computations (CEG 6260)
MTH 6290 (3) ....Cryptography and Data Security (CS 6290)
MTH 6550 (3) ....Advanced Linear Algebra
MTH 6570 (4) ....Combinatorics and Graph Theory (CS 6280)
STT 6110 (3)................................Applied Time Series
STT 7020 (3)................................Applied Stochastic Processes

7.6 RF & Microwave Materials, Devices, and Systems

Essential
EE 6100...Nano-fabrication of Integrated Solid State Devices
EE 6420/L...................................Microwave Engineering I - Passive Components & Lab
EE 6460/L . . . .   Microwave Engineering II - Active Components and Circuits &
Lab
EE 6470/L ....Antenna Theory and Design & Lab
EE 6480/L...................................Remote Sensing Detectors and Systems
EE 6700/L ....Introduction to MEMS
EE 7460..Advanced Electromagnetics Engineering

Recommended
EE 6400/L...................................Introduction to Nanoscience and Nanotechnology & Lab
EE 7080 ....Advanced MEMS
EE 7430/L...................................HF Magnetic Components & Lab
EE 7440/L ....RF Power Amplifiers & Lab
EE 7470 ....Electromagnetic Simulation Methods
EE 7480..Advanced Microwave Engineering
EE 7490/L ....Antenna Theory and Design
MTH 6050 (3) ....Advanced Engineering Mathematics
MTH 6060 (3) ....Mathematical Modeling