

2009-10

**Graduate Student
Handbook**

Electrical & Computer Engineering



Tennessee Technological University

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The Campus

Tennessee Tech University is Tennessee's technological university. It is located in Cookeville, a small city of 30,000, a little more than an hour's drive east of Nashville, west of Knoxville, and north of Chattanooga. There are many exciting outdoor sports available in the nearby Smoky Mountains. Founded in 1915, Tennessee Technological University is a comprehensive university with an enrollment of about 11,000 students. About one fifth of TTU students are enrolled in the College of Engineering. Tennessee Tech was named one of the Top Public Schools in the South by *US News & World Report* (for the sixth consecutive year) and as a Best Southeastern College by *The Princeton Review* (for the fourth consecutive year). The vision for TTU is shaped around the "T.E.C.H." acronym — Technological leadership, Enrollment growth, a Caring campus, and High quality. Tennessee Tech University's mission as the state's technological university is to provide leadership and outstanding programs in engineering, the sciences, and related areas that benefit the people of Tennessee and the nation.

ECE Program History

The Electrical Engineering program at Tennessee Tech began in the 1940s, and the BSEE program has been continuously ABET accredited since 1966. More than 2500 BSEE degrees have been granted to date. In 1998, the BSCmpE computer engineering program was started and the department name was changed to Electrical and Computer Engineering (ECE). This BSCmpE program was ABET accredited in 2000 and there have been over 100 BSCmpE graduates to date. There are now about 350 ECE undergraduate students. The first TTU ECE Master's degree was awarded in 1967, and there have been about 500 MS graduates in ECE to date. The first TTU Ph.D. degree in Engineering was awarded in 1974, and there have been about 70 Ph.D. graduates in ECE to date. There are now about 40 Masters and 25 PhD ECE graduate students.

ECE Graduate Program Goals

The ECE Graduate Program has been a part of the Strategic Plan of Tennessee Tech since the late 1960s. TTU's ECE Graduate Program is important in realizing the University's Mission. It helps the University attract and retain quality faculty and students. It brings substantial value to the research infrastructure of the University, State, Region, and Nation. The graduates and research results produced by this program raise the quality of life by stimulating economic development and adding high-paying jobs. Our graduate program goals are:

1. To provide industry, academia, and society with highly-qualified graduate Electrical and Computer engineers who possess state-of-the-art knowledge in the field of ECE, as well as the research, critical-thinking, and leadership skills necessary to be globally competitive.
2. To inspire students to pursue a high level of education and research experience, and to make a lifelong commitment to continuous learning and personal contribution in their chosen field of research, teaching, and/or industry.
3. To establish and foster a culture of curiosity, excitement, collaboration, and engagement in the global research community, with a commitment to quality and academic integrity, thereby gaining national and international recognition for TTU's ECE program.
4. To train students in the techniques, methods, and disciplines of collaborative research, including problem identification, literature search, design of experiments, hands-on experimentation, data collection

and analysis, simulation, both independent work and teamwork, authoring journal papers, and presenting conference papers.

5. To improve the written and oral communication skills of students to the level required for effective international research, industry, and educational documentation and presentation.

6. To instill in students strong principles and skills of professionalism, integrity, and ethics.

ECE Graduate Program Strengths

The ECE Graduate Program is a strong and dynamic program. Its strengths are attributable to its high-quality, active faculty and students. Its international reputation attracts a high number of applications from well-qualified students. Student morale is good. The faculty members have expertise in a number of areas in electrical engineering which provides opportunities for students to pursue research in a variety of areas. The presence of the three Research Centers of Excellence in the College is an added strength to the Department's graduate program. The centers provide assistantship support to graduate students enhancing the chances of attracting high quality students. Also, they provide some release time support to faculty to develop research proposals. The research funding and publications by faculty and students are showing great positive momentum over the past few years pointing to the strengthening of the research environment in the department. The success of the placement of ECE graduates in high profile companies such as Intel, Qualcomm, and DELL, as well as in faculty positions at Georgia Tech, Carnegie Mellon, City University of NY, NC A&T University, and Western Kentucky University has enhanced the reputation of the program. A particular strength of the program is the quality of faculty and their concern for students.

TTU ECE Research Productivity

Year	Books/ Chaps	Journal Pubs	Conference Pubs	Proposals Submitted	Activated Projects	Activated Research Funding
2001-02	0	5	34		7	\$332,021
2002-03	1	3	23		7	\$357,375
2003-04	1	3	26		11	\$721,028
2004-05	3	18	33		14	\$1,067,864
2005-06	3	22	41		15	\$1,582,649
2006-07	1	21	45	24	14	\$1,000,105
2007-08	3	18	47	29	16	\$1,574,294
2008-09	6	40	53	23	13	\$1,547,553

ECE Graduate Degrees and Tracks

The MS Program has three tracks: 1) Non-thesis, 2) Thesis, and 3) Fast-Track.

The PhD Program has two tracks: 1) PhD from MS, and 2) PhD direct admit from BS.

TTU ECE Graduate Degrees, Tracks, and Combinations

	Non- thesis MS	Thesis MS	Fast-Track BS + MS	PhD from MS	PhD direct from BS
Course credits	34	25	19 + 6*	19	43
Research credits	0	6	6	30	30
Total credits	34	31	25 + 6*	49	73

* 6 graduate credit hours are earned while the student is a senior in the BS program

Non-thesis Track MS

The non-thesis track MS is available to students who desire an industry-oriented degree, and who may be attending school part-time while working. ECE 6910 (1 credit), eleven graduate courses (33 credits), and a written final Comprehensive Exam are required for graduation.

Thesis Track MS

The thesis track MS is recommended for students who are planning a career in corporate or academic research, design, and development and who may pursue a PhD in the future. ECE 6910 (1 credit), eight graduate courses (24 credits), 6 credits of Research, a Thesis, and an oral Thesis Defense (Comprehensive Exam) are required for graduation.

Fast-Track BS+MS

The new Fast-Track BS-MS 5-year Program is designed to attract exceptional TTU ECE seniors to stay at Tech for one additional year to obtain the MS degree. Application is made during the last semester of the junior year. In order to be admitted to the Fast-Track program, the student must have a cumulative GPA of at least 3.25. During their senior year, Fast-Track students are permitted to take two 5000 or 6000 level MS courses, which count **both** as their BS senior electives and as their first two MS courses. They are also able to begin working with an MS faculty research advisor during their senior year, thus getting an early start on their Masters research project. Fast-Track students are required to apply for admission to the MS program during their senior year in the normal fashion. The summer between the senior and graduate years is devoted to research, and the student takes three classes and three research credits in each semester of the graduate year.

The Fast-Track program is designed to enable TTU ECE seniors to accumulate up to six credit hours of graduate coursework and to transition to the TTU ECE graduate program smoothly, with accelerated completion. Up to six hours of graduate coursework, exclusive of directed study, taken during the student's senior year can be used to satisfy both undergraduate and graduate degree requirements. These courses must be taken at Tennessee Tech University and must be approved as appropriate substitutions in the undergraduate curriculum for senior ECE electives. Fast-Track students receive normal undergraduate financial aid and tuition during their senior year and a normal graduate teaching or research assistantship and graduate tuition waiver during their graduate (fifth) year. Fast-Track students who do not succeed in their first two graduate courses during their senior year (B grade or better) will be advised to complete their BS degree, and withdraw from the Fast-Track program.

Ph.D from MS

The Doctor of Philosophy (Ph.D.) degree in Engineering is offered by the College of Engineering. This type of Ph.D. degree allows students a high degree of flexibility in designing an interdisciplinary program of study and research. ECE 6910 (1 credit), six graduate courses (18 credits), 30 credits of Research, a Preliminary Assessment, a Comprehensive Exam & oral Research Proposal, a Dissertation, and an oral Dissertation Defense are required for graduation. At least two of the graduate courses must be taken at the 7000-level.

Ph.D Direct admit from BS

Highly qualified applicants with a bachelor's degree may be directly admitted to the Ph.D. program, provided the applicant has a record of excellent academic performance in an appropriate engineering undergraduate program. The applicant's test scores, personal recommendations, and relevant experience must indicate a high potential for success in doctoral study and research. Undergraduate research experience is desired. ECE 6910 (1 credit), 14 graduate courses (42 credits), 30 credits of Research, a Preliminary Exam, a Comprehensive Exam & oral Research Proposal, a Dissertation, and an oral Dissertation Defense are required for graduation. The MS degree may be obtained midway through the PhD Direct admit program.

The ECE Faculty

The ECE Department is fortunate to have a highly competent faculty with excellent academic training and a diversity of backgrounds. They have expertise and interest in a broad spectrum of fundamental areas of electrical and computer engineering. ECE faculty members have substantial professional service on the local, state, national, and international levels. Many faculty members serve IEEE and other professional organizations in various capacities.

ECE Faculty & Staff

Faculty Names	Title
Abdelrahman, Mohamed	Professor
Alouani, Ali	Professor
Austen, Jeffrey	Associate Professor
Carnal, Charles	Professor
Elkeelany, Omar	Assistant Professor
Gao, Wenzhong	Assistant Professor (CESR)
Haggard, Roger	Associate Professor
He, Xubin	Associate Professor
Mahajan, Satish	Professor
Ojo, Joseph	Professor
Parke, Stephen	Professor and Chair
Qiu, Robert	Professor (CMR)
Radman, Ghadir	Professor
Rajan, P.K.	Professor
Sekar, Arun	Professor
Ventrice, Carl	Professor
Staff Names	
Dalvi, Swati	Receptionist, Secretary
Joshi, Valerie	Secretary, Outreach Coordinator
Murray, Conard	R&D Engineer
Peterson, Robert	IT Support Technician
Venters, Claudette	Secretary, Financial Accounting, Graduate Coordinator

Research Focus Areas of Faculty

Control Systems

Mohamed Abdelrahman
Ali Alouani
Joseph Ojo
Ghadir Radman

Communication Systems & Signal Processing

Ali Alouani
Jeff Austen
Charles Carnal
Robert Qiu
P.K.Rajan
Carl Ventrice

Computer Systems & Networks

Jeff Austen
Omar Elkeelany
Roger Haggard
Xubin He
Faculty from the Computer Science department

Opto/Nanoelectronic Devices, Fields, & Sensors

Mohamed Abdelrahman
Satish Mahajan
Stephen Parke
Carl Ventrice

Power & Renewable Energy Systems

Wenzhong David Gao
Satish Mahajan
Joseph Ojo
Ghadir Radman
Arun Sekar

ECE Graduate Program Admission Criteria

The criteria to be met by an applicant for Full admission to the ECE Graduate program are:

- **Bachelor's degree in engineering or a related field from an accredited institution**
- **GPA \geq 3.0 for MS,**
- **GPA \geq 3.25 for MS Fast Track**
- **GPA \geq 3.5 for Ph.D.**
- **GRE General Test Scores Verbal + Quantitative \geq 1100**
- **Evidence of Prior Research Experience**
- **Three Letters of Recommendation**
- **TOEFL Score \geq 550 or CBT equivalent for international applicants**

These admission standards are appropriate to the degree level and comparable to our peer institutions. These admission standards are stated clearly on the ECE and TTU Graduate Studies Web pages and in the on-line Graduate Catalog, for all applicants to read. An applicant who does not meet all of these criteria may be admitted on a Provisional (conditional) basis as determined by the ECE Graduate Program Committee. The Graduate Committee examines the overall undergraduate record of the applicant (GPA), performance in Math and Science courses, performance in the major area, GRE scores, TOEFL scores, letters of recommendation, undergraduate research experience, and any other evidence the applicant may have provided. Based on this examination, the committee determines the applicant's capabilities, motivation, and potential for success in the graduate program, and arrives at an admission recommendation. If an applicant shows weakness in any of the above areas, but shows high motivation and reasonable chance for success, Provisional admission is recommended. In the case of Provisional admission, conditions for reclassification to Full standing are specified in the letter of admission. These conditions are typically one or more of the following: i) attainment of 3.5 GPA in the first semester of graduate study at TTU, ii) satisfactory GRE scores, and iii) successful completion of specific undergraduate ECE "bridging" courses for a non-ECE entering student. If the student meets the specified conditions during the first two semesters, the VP of Graduate Studies reclassifies the student to Full standing. Otherwise, the student is dismissed from the graduate program. Applicants not having BS degrees in electrical, computer, or similarly named engineering programs, but otherwise qualifying for admission, are admitted on a Provisional basis. They are reclassified to Full standing after they complete a set of ECE undergraduate "bridging" courses specified by their committee. All international students must take an English language test, usually just prior to enrollment. If the student scores below a certain criterion, he/she is required to take ESL 1010 and 1020.

Fees and Assistantships

Current TTU Graduate fees may be found at <http://www.tntech.edu/bursar/pdfs/feesgrad08.pdf> The ECE Department offers graduate teaching assistantships (GTA) and the Research Centers offer graduate research assistantships (GRA) each semester. Some of these positions are full (including a \$1000-\$1500 monthly stipend plus full fee waiver for 20 hours/week of work) and some are half (including a \$500-750 monthly stipend plus half fee waiver for 10 hours/week of work). If a student receives either a half or full assistantship, the entire out-of-state fee is waived. The TTU Office of Graduate Studies also offers a limited number of Minority Student Fellowships each year.

- Students who are on academic probation (GPA<3.0) are not eligible for assistantships.
- Non-thesis MS students and students with a full external fellowship or corporate support are not eligible for assistantships.
- MS students may only receive an assistantship during the first two years after their initial enrollment.
- It is strongly recommended that PhD students have at least one semester of teaching assistant experience before graduating.
- Students may receive half GTA and half GRA support at the same time.
- Students interested in receiving a research or teaching assistantship for a certain semester must submit an ECE assistantship application at <http://www.tntech.edu/ece/GRAD/assistapp.html> by March 15th for Fall semester or by October 15th for Spring semester. The ECE Graduate Program Committee reviews assistantship applications and recommends which applicants are qualified for teaching and research assistantships. This review is done in close collaboration with the Research Center faculty and directors. Successful applicants are sent an assistantship offer letter, and must accept or decline this offer in writing by May 1st for Fall semester or by December 1st for Spring semester. Applicants must also show proof of having preregistered for classes at that time.
- MS graduate assistants are required to register for a minimum of 9 hours and PhD graduate assistants are required to register for a minimum of 6 hours. To meet this requirement, students may take thesis/dissertation hours as needed beyond their regular course hours.
- There is no guarantee that a student will receive an assistantship. Whether or not a student receives an assistantship depends on the availability of funds, the student's academic record, and the suitability of the student to carry out the responsibilities.

Orientation of New ECE Graduate Students

Admitted students are advised to report to the university a few days before the start of classes. The Department holds a graduate student orientation and welcome meeting every semester, on the Thursday afternoon before classes begin. In this meeting, the Department chairperson introduces faculty and staff, and gives both continuing and new graduate students an opportunity to introduce themselves and their research interests. Current graduate students share their experiences with the new students and give them some pointers for success in the graduate program. Services offered and procedures required by the Department office, library, information technology services, counseling center, fitness center, Graduate Studies office, research centers, and International Student Affairs office are explained. Finding an advisor, formation of the graduate committee, preparation of the Program of Study, advice on courses to be taken during the first semester, registration for classes, and assistantship expectations and procedures are explained. A copy of the ECE Faculty Research Profile and a Graduate Student Handbook are given to every graduate student. The Department chairperson serves as interim advisor until the student chooses a faculty advisor and obtains their signature on his/her Program of Study. The Advisor selection, Committee Formation, and Program of Study are required to be completed by each student by the beginning of their second semester.

The Department offers a one-credit course, ECE 6910 Introduction to Graduate Research, which is required for every entering graduate student. In this course, students are given an opportunity to learn about the graduation requirements and procedures, the choice of advisor, selection of a research topic, thesis requirements, research methods, literature searching, and ethical standards in research. To meet the special needs of international students, Tennessee Tech has an International Student Affairs Office. This office provides special orientation and other activities for new international students to help them become familiar with the university, its services, and the surrounding community.

From the time of joining the ECE Graduate Program, a student receives significant advisement in forming and executing his/her program of study. The Office of Graduate Studies has published the “TTU Pathway to a Graduate Degree” (<http://www.tntech.edu/graduatestudies/pdf/Pathway%20to%20Graduate%20Degree.pdf>) and the ECE Department maintains flowcharts for all the graduate degree options (Appendix C).

ECE Weekly Research Seminar sponsored by GECESA

In addition to classroom studies, graduate students are provided a number of opportunities to enrich their experience at Tennessee Tech. A weekly ECE Research Seminar is sponsored by the Graduate ECE Student Association, which is a great organization for every new ECE graduate student to join. **Graduate students are expected to attend the weekly seminars as well as the thesis/dissertation presentations of their fellow students.** Graduate students, faculty, and occasionally external guests give formal presentations of their research. It is expected that each research project underway in the Department will be presented at least once per year in this seminar series. The ECE alumni have also established a Seminar Endowment to support travel expenses for one national or international speaker to present a seminar each year. Once each semester, the campus-wide Stonecipher Distinguished Lecture is held. Additionally, throughout the academic year, Sigma Xi and ASEE hold seminars for scientists and engineers.

Annual TTU Research Day

The annual TTU Research Day is held during the first week of April every year, in which poster presentations of all undergrad and graduate research projects across the campus are presented in the University Student Center. ECE has had great participation in this event. Top student presentations receive small cash awards, and all participants receive certificates. **Every ECE graduate student is expected to participate annually in this event.**

Journal Publications & Conference Presentations

ECE graduate students are expected to write papers for conference presentation and journal publication. **Each thesis MS student is expected to present at least one conference paper and to submit at least one journal paper before their thesis submission and oral defense at TTU. Each PhD student is expected to present at least two conference papers and to submit at least two journal papers before their dissertation submission and oral defense at TTU.** The ECE Department and the Research Centers support student travel to conferences. The annual Southeastern Symposium on System Theory (SSST) and the IEEE SoutheastCon are good opportunities for TTU graduate students. **It is essential that the department Chair and research advisor must pre-approve**

the costs of travel to a conference BEFORE a student or faculty member submits their paper to the conference for review. Acceptance of a paper at a conference does not automatically guarantee that the student or faculty will receive travel or registration funding from the department. Our ECE students have been co-authors of 75 journal and 125 conference papers over the past five years!

Research Labs & Offices

The ECE Department is housed in three buildings on the TTU Engineering Quad. The department offices, conference room, student study room, 24/7 Computer Lab, most classrooms, half of faculty offices, and most of the teaching and research labs are located on the second, third, and fourth floors of Brown Hall. The remaining half of faculty offices, classrooms, and labs are located in Clement and Prescott Halls. The Department maintains laboratory facilities for the graduate students to conduct their thesis research. Some of the laboratories are dedicated to undergraduate education, some for graduate students, and others for both undergraduate and graduate students. Table 6 shows a list of the ECE laboratories. Significant renovation and re-equipping of labs began in Fall 2006 and continues as part of the ECE 20/20 Vision Plan. This plan engages both industry and alumni in sponsoring individual labs for renovation and upgrading. The Department has one R&D Engineer and one IT Technician. They serve the faculty, undergraduate students and graduate students.

Students who serve as teaching assistants or research assistants are provided with designated office spaces in Brown Hall (BN), Clement Hall (CH) or Prescott Hall (PH). Normally, students who carry out research in a laboratory are assigned office space in that laboratory.

ECE LABORATORIES

Building and Room Number	Laboratory Name	Faculty responsible
BN 408A	DENSO Capstone Design	Parke / Alouani
BN 408B	Advanced Robotic Systems	Alouani
BN 407 / 403	McDearman Basic Circuits	Austen
BN 409	Sensors & Instrumentation	Abdelrahman
BN 410	Control Systems	Alouani
BN 411	Embedded Systems	Elkeelany
BN 412	Power Electronics & Drives	Ojo
PH 441	TVA Power Relays	Gao / Sekar
BN 415, 413	STAR Networks	He
BN 320 / 324	CAD & Computer Systems	Haggard
PH 441	EDGE Energy Lab	Gao
PH 120	Bio/Opto/Nano Devices (BOND)	Mahajan / Parke
PH 441	Telecommunications	Austen
CH 103	High Voltage Lab	Mahajan
CH 400	Wireless Networking	Qiu

MS Advisory Committee

Each MS student must have an advisory committee of at least three faculty members, which assists the student in developing and executing his/her Program of Study and monitors and evaluates the student's progress towards completion of the degree. The student is responsible for identifying a faculty member who is willing to chair his/her advisory committee. The chairperson of this committee is the student's faculty advisor and has the responsibility to guide the student's research toward completion of the MS degree within a reasonable period of time (usually two years for fulltime students). The ECE Department Chairperson will act as the advisor for new students until the student chooses an advisor from the ECE faculty during their first semester. The ECE Chairperson is also responsible for ensuring that a student's Program of Study satisfies the Department and university policies. In consultation with his/her advisor, the student is responsible for identifying at least two other faculty members who are willing to serve on his/her committee. The other members are selected such that they have either taught the student in a course or have some expertise relevant to the student's research. At least two members of the MS advisory committee, including the chairperson/advisor, must be from the ECE faculty. The MS advisory committee may include more than three members. Students with a Computer Engineering focus should include at least one Computer Science faculty on their committee. If desired or required, two members of the committee may serve as co-chairs of the committee rather than the committee having one chair. If a student is not able to identify a sufficient number of faculty who are suitable and willing to serve on his/her advisory committee, the student will be advised by the Department Chairperson that he/she should either change his/her area of research interests to more closely match those of the available faculty or consider selecting another major. A graduate student's advisory committee is selected during his/her first semester of study and each member must approve and sign the student's Program of Study form by the beginning of the student's second semester. Failure to form a committee by the end of the second semester, as evidenced by a signed Program of Study form, is cause for dismissal.

MS Program of Study

Each MS student is required to develop and submit a Program of Study before the beginning of the second semester of study. The student prepares this Program of Study in consultation with his/her Advisory Committee. The student's advisory committee, the ECE Chair, the Assoc. Dean for Graduate Studies, and the VP of Graduate Studies must approve and sign the Program of Study. Any subsequent changes to courses on the approved Program of Study must be made on a Substitution Approval form. Example Program of Study forms are given in Appendix D. In no case will a student be allowed to take a random collection of courses. All approved Programs of Study are stored and updated with approved substitutions on the ECE shared drive server database. Each MS Program of Study must include the following:

Thesis Track MS Program of Study

ECE 6910 Intro to Graduate Research	1 credit
Four ECE graduate core courses	12 credits
Four Elective course (some may be outside ECE)	12 credits
Two ECE 6990 Research & Thesis	<u>6 credits</u>
	31 credits

Non-Thesis Track MS Program of Study

ECE 6910 Intro to Graduate Research	1 credit
Seven ECE graduate core courses	21 credits
Four Elective courses (some may be outside ECE)	<u>12 credits</u>
	34 credits

- Each MS student must take at least two ECE graduate core courses in their focus area.
- Each MS student must take at least two ECE graduate core courses from outside their focus area.
- The elective courses may be from ECE or from outside ECE. Usually they include some mathematics and computer science courses, as appropriate to the student's interest and focus area. No more than six credits (2 courses) of 4000/5000-level dual-listed courses may be used to satisfy the MS requirements.
- MS students may take PhD 7000-level courses if they have the appropriate prerequisite course preparation.
- No more than six credits (2 courses) of directed/independent study ECE 6980 may be used to satisfy the MS requirements.
- No more than nine credits (3 courses) of approved graduate coursework may be transferred from another university to satisfy the MS requirements.

Admission to Candidacy is achieved following the term in which a student complete 9 hours, usually the second semester, at the same time as the Program of Study is submitted. The basic requirements for candidacy are full standing, completion of nine credit hours of graduate work, and a TTU GPA of at least 3.0.

PhD Advisory Committee

Each Ph.D. advisory committee will have a minimum of five voting members, including the chair and at least one more member from the ECE faculty. At least one member must be from outside the ECE department. The Associate Dean for Graduate Studies and Research will serve as an ex officio, nonvoting member. The student is responsible for identifying, in consultation with the department chairperson and Associate Dean, a faculty member who is willing to chair his/her advisory committee. In consultation with the chairperson of the committee, the student is responsible for identifying the other faculty members required/desired and determining if they are willing to serve. Advisory committee is permitted to have more than the minimum number required. Normally one faculty member will serve as the chair. If the proposed research work is interdisciplinary, or if the initial chair retires, experiences health problems, or for some other cannot continue to perform all of the duties of the chair, the student may request that a co-chair be appointed. The request should be made in writing to the Associate Vice President for Research and Graduate Studies, via the Department Chair and the Associate Dean of Engineering for Graduate Studies and Research. If a student is not able to identify a sufficient number and type of faculty who are suitable and

willing to serve on his/her advisory committee, the student will be advised by the Associate Dean that he/she should either change his/her area of research interest to more closely match those of the available faculty or consider selecting another major. Failure to form a committee by the end of the second semester, as evidenced by a signed Program of Study form, is cause for dismissal.

PhD Preliminary Assessment

It is recommended that new Ph.D. students in ECE take the Preliminary Assessment of readiness for doctoral studies in their chosen field of research during their **first** semester of graduate study at TTU. A Ph.D. student must successfully complete this assessment by the midterm of their second semester in the PhD program.

The purpose of the PhD preliminary assessment is to:

- 1) Insure that the student possesses the knowledge and skills necessary for successful Ph.D. study and research.
- 2) Tailor a Program of Study for their future Ph.D. coursework to address any observed weaknesses, as well as to prepare the student to undertake independent research in their specific area.

1) Selection of a Ph.D. Advisor and Advisory Committee, 2) Proposal of a research topic, 3) Completion of the Preliminary Assessment, and 4) Completion of the Program of Study must occur by the end of the **second** semester of Ph.D. study. The student, in consultation with their Advisor, will form a Ph.D. Advisory Committee prior to taking the Preliminary Assessment. The Ph.D. Advisory Committee must include the student's Advisor, three other faculty in areas closely related to the proposed research topic, and the ECE Dept. Chairperson (five members in total). Following successful completion of this assessment, the ECE Chairperson will be replaced by a faculty from outside the ECE Dept. for the remainder of the Advisory Committee's existence.

The Preliminary Assessment will consist of an oral presentation by the student to the Committee, followed by a period of oral and/or written questioning. The Committee will evaluate the strengths and weaknesses of the candidate in their chosen field of research and make an overall recommendation of pass or fail. A student will have two chances to pass, with only one attempt per semester. The Ph.D. student and the Advisory Committee shall meet for the scheduled Preliminary Assessment and complete the following tasks:

1. The Ph.D. student must give a short presentation to show his/her readiness for advanced Ph.D. study. The presentation should include:
 - (a) A listing of and brief description of all background courses taken at the graduate level. This includes any 5000, 6000 and 7000 level courses taken at TTU, and any advanced courses taken at other institutions.
 - (b) Prior research projects and activities in which the student has participated, including any publications or manuscripts that the student has developed and published.
 - (c) A brief statement of the proposed topic of research.
2. The Ph.D. student should answer all questions from the evaluators clearly and accurately.
3. The Ph.D. student should present a tentative Program of Study for the Committee to tailor as needed.
4. The committee should prepare and ask questions pertaining to the student's strengths, weaknesses, and ability to perform independent research.

5. The committee should complete an evaluation form summarizing the student's strengths and weaknesses and make an overall recommendation of pass or fail. They should also provide suggestions to improve the student's proposed Program of Study.

At the end of questioning, the Committee will meet in a private session to assess the proposed Program of Study, and the student's suitability to continue in the Ph.D. program. The results of this Preliminary Assessment will be conveyed to the student and to the Associate Dean of Engineering for Graduate Studies in a memorandum from the student's Advisor, stating whether the student may continue in his or her Ph.D. studies at TTU.

PhD Preliminary Exam (for Direct Admission from BS)

If admitted with a Bachelors degree (Direct Admit), a Ph.D. student must successfully complete a 4-hour written Preliminary Exam, by the end of their **third** semester of graduate study at TTU. This Preliminary Exam is similar in format to the non-thesis track MS comprehensive exam, covering the ECE graduate core courses taken by the student, and requiring an overall score of 70 percent to pass.

PhD Program of Study

Each PhD student is required to develop and submit a Program of Study before the beginning of the second semester of study. The student prepares this program of study in consultation with his/her Advisory Committee. The student's advisory committee, the ECE Chair, the Assoc. Dean for Graduate Studies, and the VP of Graduate Studies must approve the program of study. The PhD Program of Study shall include ECE 6910 and a minimum of 18 credits of coursework beyond the Master's degree or 43 credits of coursework beyond the Bachelor's degree. The Program of Study shall also include a minimum of 30 credits of Research & Dissertation, as well as any background, graduate-level courses taken prior to enrollment in the Ph.D. program. If the student has not taken at least 24 credits of appropriate MS courses (as determined by the advisory committee), the student will be required to take additional MS courses. No more than 9 credits of Independent/Directed Study courses are permitted. Twelve credits must be at the 7000-level. The Program of Study must be approved by the student's advisory committee, the department chairperson, the Associate Dean of Engineering for Graduate Studies and Research, and the Associate Vice President for Research and Graduate Studies.

PhD Comprehensive Exam and Admission to Candidacy

The PhD comprehensive examination will consist of an exam and a written and oral presentation of the Research Proposal. The examination will be formulated by the advisory committee, as appropriate to the student's area of research. This examination will test the student's breadth of knowledge across the discipline, depth of knowledge in the research area, and the ability to integrate the knowledge acquired from several courses. This examination is given after the student has completed most of the coursework prescribed in the program of study. It must be completed within one semester following completion of all coursework in the program of study. All parts of the comprehensive examination should be completed within a period of two weeks. The details of this examination, including format, content, method of evaluation and timing, will be left to the discretion of the committee. All voting members of the committee should participate in evaluating the student's performance in the examination. The research proposal should consist of the development of the research problem from the extant

knowledge in the area, the approach and methodology to be followed, the expected original contribution to the extant knowledge and the expected time-line for the completion of the research. The student should submit copies of written proposal to the committee at least two weeks before the oral proposal presentation. The student will be informed of the results of the entire comprehensive examination at the end of the defense of the research proposal. On passing the comprehensive exam, the student is admitted to candidacy for the doctoral degree. A student not passing any part of the comprehensive examination will be given a second chance to pass the part of the examination that he/she did not pass. The committee may prescribe additional academic work to be undertaken by the student prior to making the second attempt. No student will be permitted to continue in the PhD program if he/she does not successfully complete all parts of the comprehensive examination after the second attempt.

Thesis/Dissertation Writing

Each thesis-track MS and PhD student is expected to demonstrate mastery of research. This research typically requires literature search, consultation with researchers at other universities and labs, formulation of a problem statement, design, execution, and analysis of experiments, model development, simulation, and oral and written presentation of the results. In carrying out the thesis research, the student selects a thesis topic with guidance from the advisor. The thesis topic typically involves an engineering problem within the student's chosen focus area. Solution of the problem usually requires some analysis, simulation, and experimental verification. The student's foundation for solving the chosen problem is established by his/her coursework and by extensive reading of current engineering publications. While the advisor typically provides guidance on the methods and approaches, the burden of effort for the research rests with the student. She/he must independently apply the knowledge gained from courses and literature research to successfully solve the problem. During the research, the student and his or her advisor are strongly urged to submit both conference and journal publications of their work. At the end of his or her research, the student is required to write a MS thesis or PhD dissertation following the guidelines outlined in the TTU Graduate Manual (<http://www.tntech.edu/graduatestudies/thesis/asp/forward.asp>). The student must submit a draft thesis/dissertation copy to the student's advisory committee and Graduate Studies using the electronic submission process at least two weeks before the student's defense.

Thesis/Dissertation Oral Defense

A fundamental milestone in the graduation requirements is completion of the Oral Defense, which consists of an oral presentation by the student of her/his thesis/dissertation research results, followed by questioning. The overall intention is to test the breadth of knowledge in the discipline, depth in the specific area of research and ability to integrate concepts and techniques learned in the various courses. Students should schedule the thesis defense date well in advance to insure that all members of their committee are in attendance. Students must submit a draft copy of their thesis/dissertation to their committee and to Graduate Studies at least two weeks before the defense date. The defense begins with an open session in which the candidates make a presentation to their committee and other faculty and students. The audience then asks the candidate questions regarding their research work. Afterward, in a closed session, the committee examines the candidate on the details of their thesis, as well as any other relevant material. Then the candidate is asked to leave the room, and the committee discusses the candidate's performance and then votes to pass or fail the candidate. The student must pass this examination by

three (3) positive votes or three-fourths of the committee members eligible to vote. A signature form is then forwarded to Graduate Studies with the results of the examination. If the candidate passes the exam, the committee instructs the candidate on any required changes or new work needed to complete their thesis. If the candidate fails the exam, the committee informs the candidate in writing regarding the additional work that the candidate must undertake before taking the examination a second time. The second attempt may be scheduled as soon as these deficiencies are rectified. However, failure on the second attempt results in dismissal from the graduate program. The requested revisions to the thesis/dissertation must be made, final signatures of all committee members obtained, and the Final Thesis/Dissertation must be electronically uploaded to the office of Graduate Studies at least one week before graduation. **Bound paper copies of thesis/dissertation are no longer required.**

Comprehensive Written Exam for MS Non-Thesis Track

The non-thesis track MS comprehensive examination is a four-hour written examination taken during the semester of graduation, consisting of two questions from each of four ECE graduate core courses that were taken by the student. The four core courses for examination may be selected by the student. These questions are prepared and graded by the professor from whom the student took that core course. The Department Chair is responsible for assembling, proctoring, and compiling the overall score on the exam. An overall score of 70 percent is required to pass. A committee signature form is then forwarded to the office of Graduate Studies that keeps the result of the examination. If the student fails this exam, they will be given a written list of specific deficiencies which must be addressed prior to a second exam attempt. That second attempt may be scheduled as soon as the deficiencies are rectified. However, failure on the second attempt results in dismissal from the MS program.

Time Limits for Completing Degrees and Residency

The time limit for completing the MS degree requirements is six years. The time limit for completing the PhD degree requirements is eight years. These time limits have been established so that the knowledge and experience gained by the student does not become obsolete by the time the student graduates. Residence of four semesters, with at least two semesters in continuous residence, is required for PhD students. All requirements, including the thesis/dissertation, must be completed within these time limits.

Academic Performance

The Office of Graduate Studies has instituted a number of policies to ensure high quality student work. These policies are enforced by the VP of Graduate Studies, with assistance from the ECE Department chairperson. These retention standards are stated clearly on the ECE and Graduate Catalog Web pages and are circulated to all enrolled students via this ECE Graduate Student Handbook.

A graduate student is required to maintain a cumulative grade point average (GPA) of at least 3.0 (B).

Credit toward the degree will be granted for any graduate course in the Program of Study in which a grade of A, B, C, S, or SP (for Research & Thesis) is received. However, not more than six hours of C credit will be accepted in the courses constituting the Program of Study. If a grade of D, U, F, WF, or NF is received, the course must be repeated, and both the original grade and the grade for the repetition will be counted in the cumulative GPA.

A graduate student must achieve a grade of at least C on each course taken for non-degree purposes, that is, “bridging” courses taken for background preparation. A student will be required to repeat each non-degree course in which a grade of D, U, F, WF, or NF is assigned except that, with the approval of the student's advisory committee, repetition of the course will not be required if the student's cumulative GPA is at least 3.0 (B).

Academic Probation and Dismissal for Unsatisfactory Performance

When a student's cumulative GPA falls below 3.0, the student will be placed on academic probation. The student will be permitted two semesters of probationary standing in which to raise the GPA back to 3.0 or higher (this includes the semester in which the student is placed on probation). A graduate student will be dismissed if any one of the following conditions occurs:

- Two consecutive semesters of probation (GPA < 3.0)
- Two “F” grades in courses required for graduation
- Two consecutive semesters of “No Progress” grades assigned in a Research & Thesis course.

A student who has been dismissed for unsatisfactory performance may request reinstatement, provided he/she produces evidence of extenuating circumstances. The request must be approved by the ECE Chair, the student’s advisor, the Dean of Engineering, and the Graduate School Executive Committee. The decision of the Graduate School Executive Committee is final.

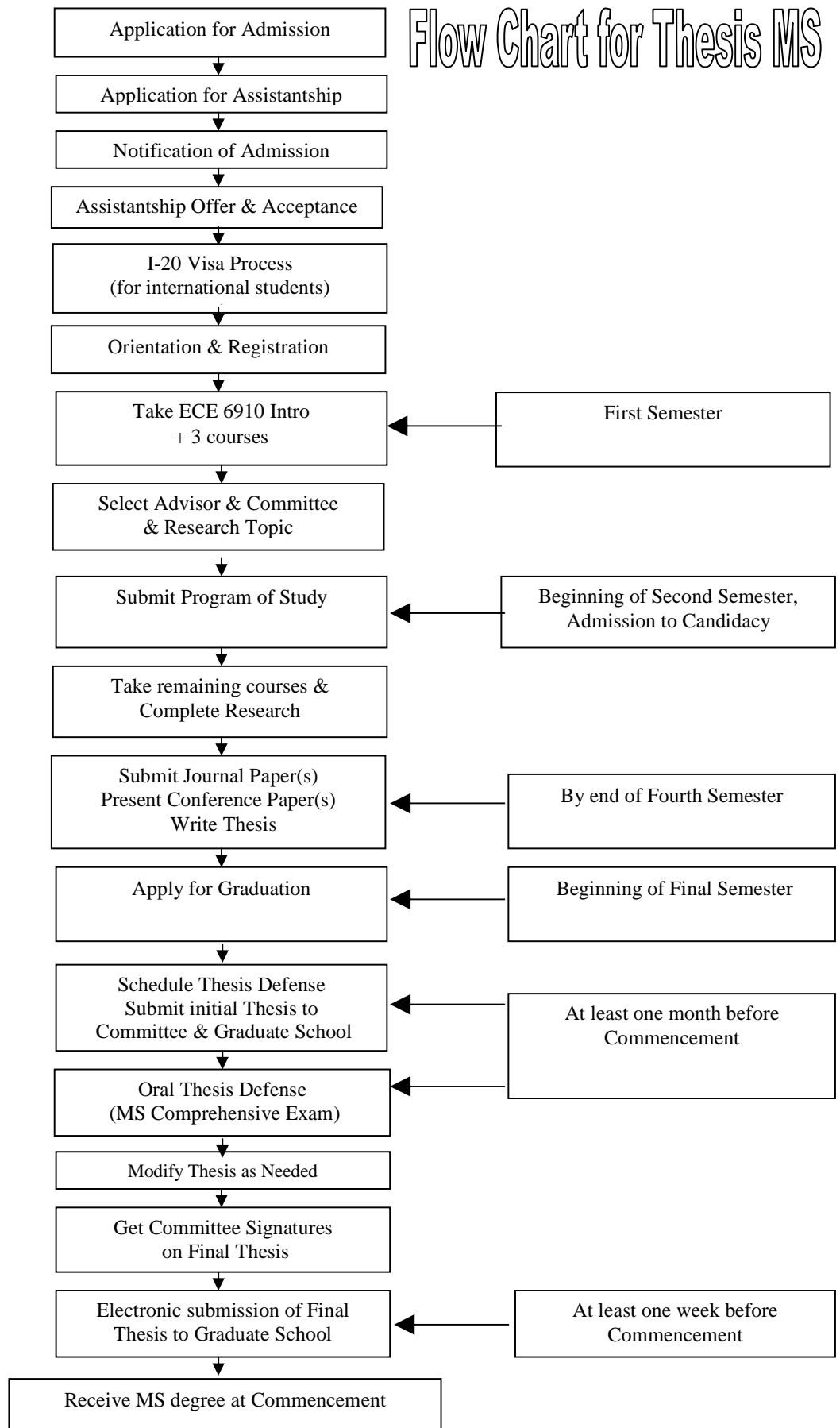
Co-op/CPT/Internship Policy

It is not in the best interest of students to try to finish the final revisions of their thesis/dissertation and their defense while away from campus on a co-op assignment. Therefore, ECE will no longer approve applications for CPT Co-ops after a student has signaled the end of their graduate degree studies by dropping below full-time enrollment (9 hours for MS, 6 hours for PhD) during a regular semester (summers do not count). International students are allowed to register for less than full-time (as little as 1 credit) for ONLY ONE semester prior to graduation. In the past this could be either 1 credit of Research or 1 credit of Co-op. However, ECE will no longer approve 1 credit of Co-op in the last semester before graduation.

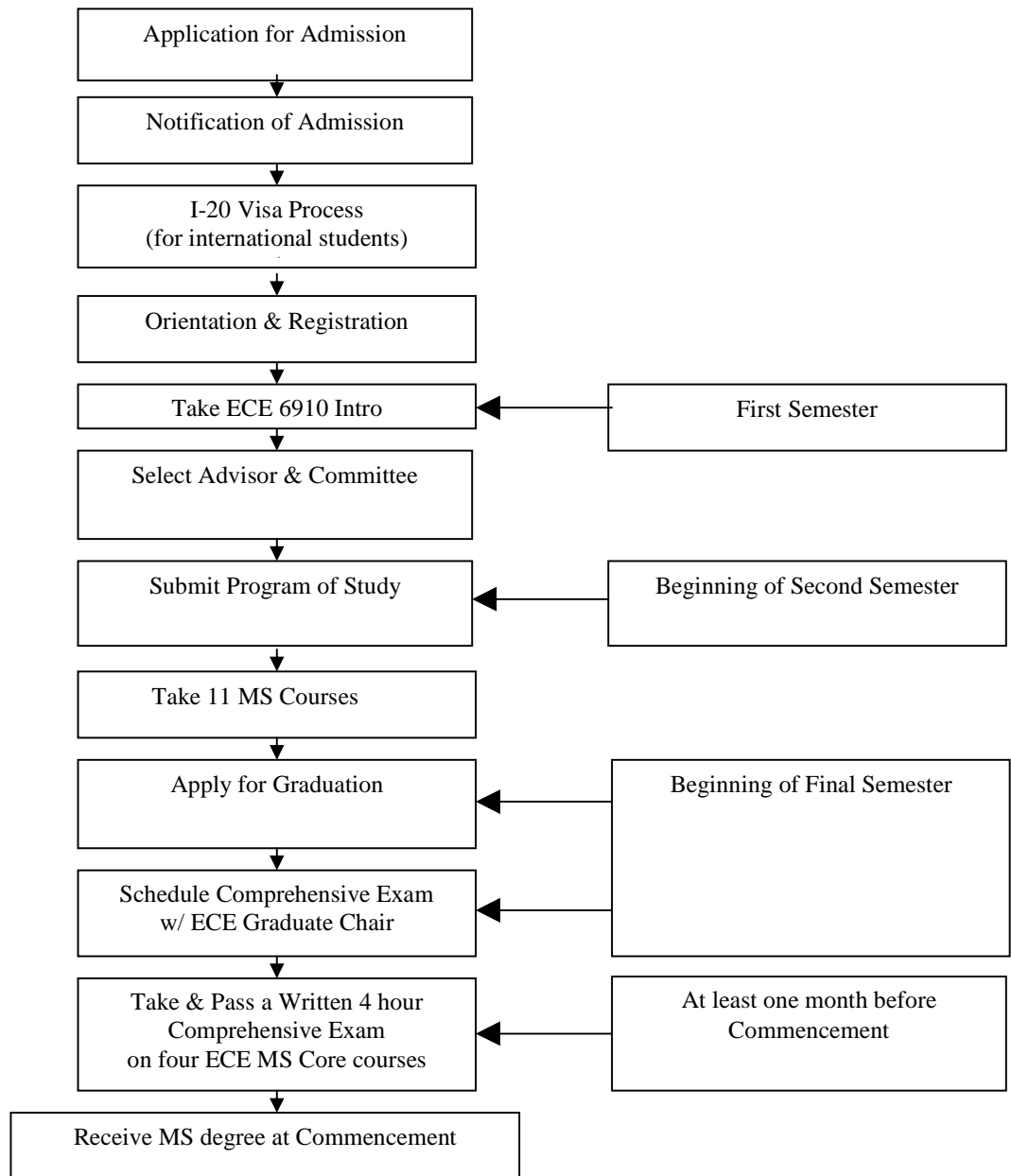
International students who have already dropped below full-time in a given semester will need to register as full-time students again the following semester if they do not submit their final thesis/dissertation to Graduate Studies.

ECE faculty advisors should discuss carefully the decision and implications for your student to drop below full-time registration. They should be in agreement with their student that they can indeed finish their work during that final part-time semester.

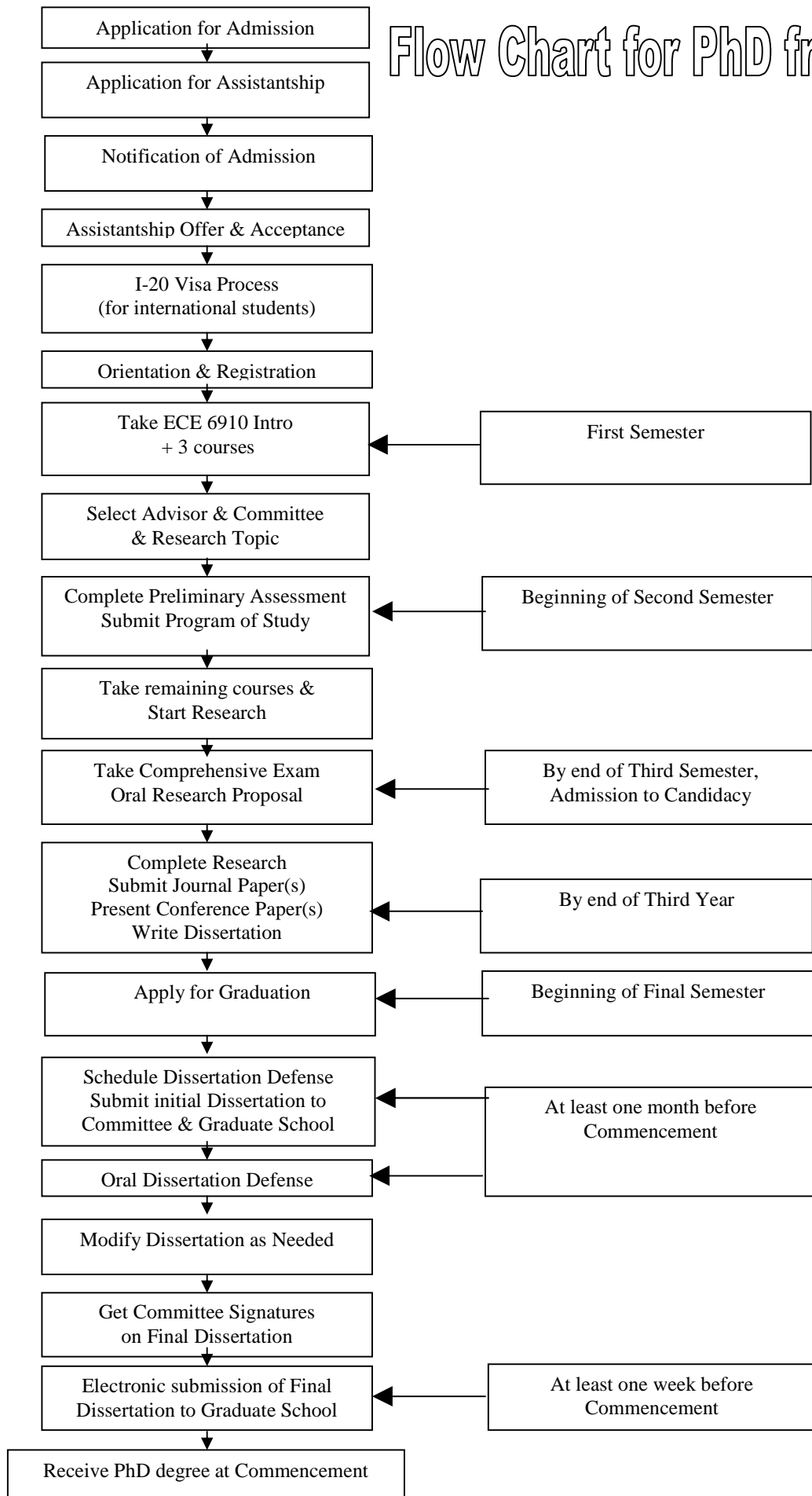
Flow Chart for Thesis MS



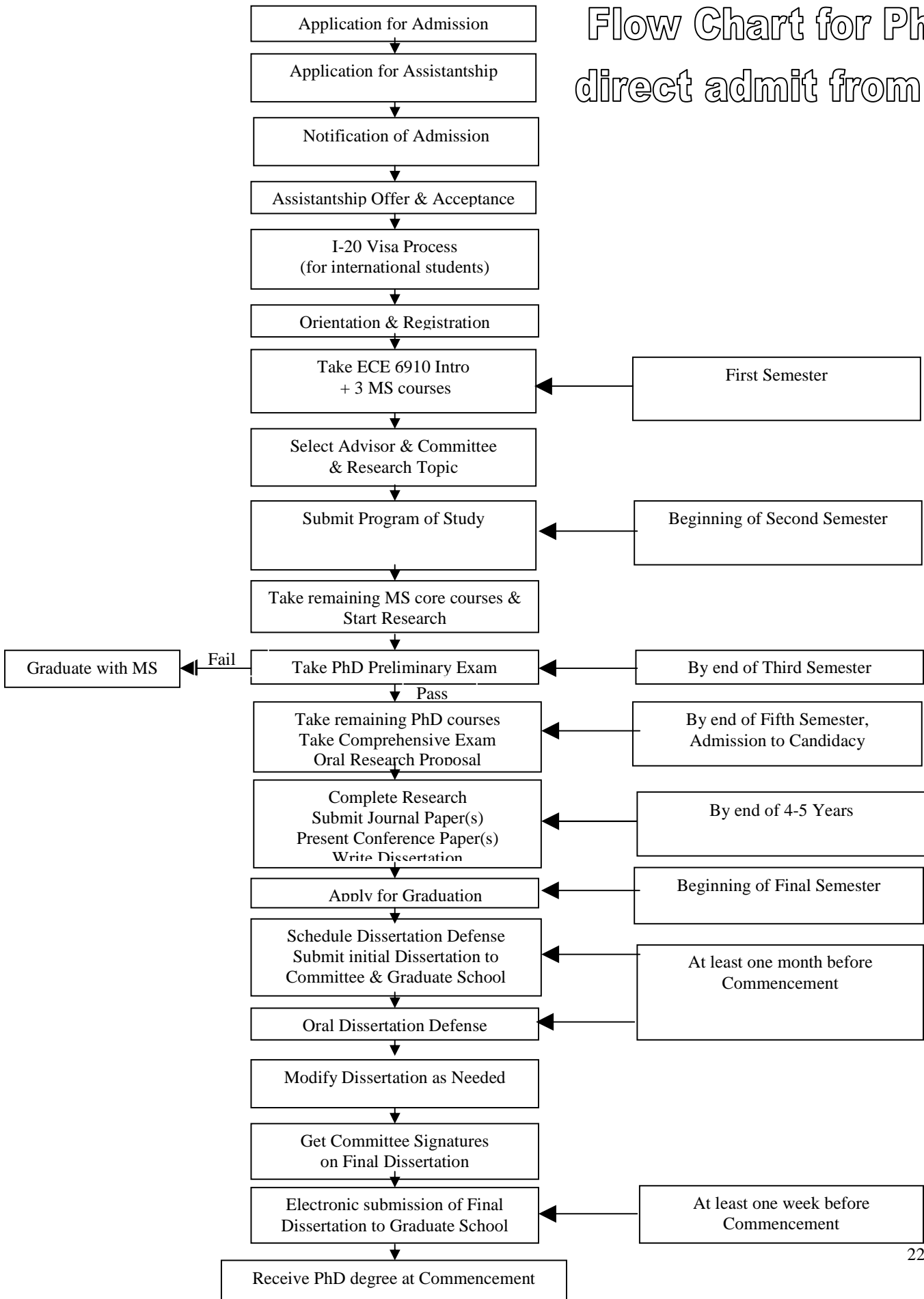
Flow Chart for Non-Thesis MS



Flow Chart for PhD from MS



Flow Chart for PhD direct admit from BS



**Master of Science MS in Electrical Engineering
PROPOSED PROGRAM OF STUDY**

Student T Number _____

Name _____

Track _____

	Course Number	Course Description	Where Taken	Semester Completed	Credit Hours	Grade	
TRANSFER COURSES IF ANY maximum of 3							
	ECE 6910	Intro to Graduate Research			1		
		Core courses (4 for Thesis, 7 for Non-thesis)					
			Elective courses (4 or more)				
			Research courses (2 or more)				
		ECE 6990	Research and Thesis			3	
	ECE 6990	Research and Thesis			3		
TOTAL Semester Hours Credit to be Counted Toward Degree Must be at least 31 for Thesis or 34 for Non-Thesis							

Total semester hours including research:
7000 level ____ 6000 level ____ 5000 level ____

Do you anticipate using human subjects in your research? ____ Yes ____ No.
If yes, contact the Research Office.

ADVISORY COMMITTEE:

_____ Chairperson

_____ ECE Department Chairperson _____ date

_____ Member

_____ COE Assoc. Dean of Graduate Studies _____ date

_____ Member

_____ TTU Graduate Studies _____ date

SIGNATURES VERIFY APPROVAL OF TOTAL FORM

Doctor of Philosophy Ph.D. in Engineering
PROPOSED PROGRAM OF STUDY

Student T Number _____

Name _____ **Admitted from MS or from BS?** _____

	Course Number	Course Description	Where Taken	Semester Completed	Credit Hours	Grade
TRANSFER COURSES IF ANY maximum of 3						
Ph.D. COURSES	ECE 6910	Intro to Graduate Research			1	
		Primary Area Courses				
		Related Area Courses				
		Research Courses (must be 30 cr or more)				
TOTAL Semester Hours Credit to be Counted Toward Degree (must be ≥49 from MS or ≥73 from BS)						

Total semester hours including research:
 7000 level _____ 6000 level _____ 5000 level _____ Do you anticipate using human subjects in your research? ___Yes ___ No.
 If yes, contact the Research Office.

TITLE OF PROPOSED RESEARCH: _____

ADVISORY COMMITTEE:

_____ Chairperson	_____ ECE Department Chairperson	_____ date
_____ Member		
_____ Member	_____ COE Assoc. Dean of Graduate Studies	_____ date
_____ Member		
_____ Member	_____ TTU Graduate Studies	_____ date

SIGNATURES VERIFY APPROVAL OF TOTAL FORM