HANDBOOK

Electrical Engineering Department

Hashemite University

2017

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The Electrical Engineering (EE) department was one of the first departments established in the Faculty of Engineering in the Hashemite University (HU) in 1999. The Department was originally named "Electrical and Computer Engineering (ECE) Department". The ECE Department was split into two Departments, namely EE and Computer Engineering (CE) with the first courses in the new EE program offered in fall 2006.

The EE department offers a five years' general program that leads to Bachelor of Science in Electrical Engineering. During his/her study, the student takes several courses in science, engineering, power systems, communication systems and electronics in addition to courses in other fields that help them in his professional life. Although there are no tracks or specializations within the EE department, the curriculum allows students in their fifth year to take fifteen elective credit hours (five courses) from one of the following two fields:

- Power Engineering.
- Communications and Electronics Engineering.

EE Program Mission

The Electrical Engineering Department is committed to providing the students with up-to-date knowledge and practices towards advancing Jordan and the region in the fields of electrical engineering technologies. The department is also committed to research that leads to better solutions for industrial and governmental sectors in engineering-related problems.

EE Program Vision

The Electrical Engineering department is dedicated to provide electrical engineers who are able to compete within and beyond the national labor market.

EE Program Educational Objectives

The program educational objectives (PEOs) of the Electrical Engineering program at HU are to produce graduates who:

1. Apply breadth and depth of knowledge, critical thinking, and problem solving skills to excel in professional careers, and address contemporary issues related to electrical engineering.
2. Pursue postgraduate studies and excel in academic research.
3. Communicate and work effectively in a multidisciplinary team environment with diversity and challenges, and demonstrate commitment to the professional and ethical standards of engineering.
4. Demonstrate commitment and progress in a continuous learning, professional development, and leadership.

EE Student outcomes

Student outcomes (SOs) are the knowledge, skills, and capabilities students should possess by the time of graduation. The definition of SOs was done based on the SOs defined by ABET for engineering programs, which are the (a) to (k) student outcomes. Consequently, the EE program student outcomes at HU lead to the achievement of the program educational objectives, and consist of eleven (11) student outcomes (a) to (k), which are the general engineering outcomes. Table 1 summarizes student outcomes adopted for the EE program.

Table 1: EE Student Outcomes.

(a)	an ability to apply knowledge of mathematics, science, and engineering
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d)	an ability to function on multidisciplinary teams
(e)	an ability to identify, formulate, and solve engineering problems
(f)	an understanding of professional and ethical responsibility
(g)	an ability to communicate effectively
(h)	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i)	a recognition of the need for, and an ability to engage in life-long learning
(j)	a knowledge of contemporary issues
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Student Admissions

Students can apply for College of Engineering at the Hashemite University by choosing one of the following programs:

1) Regular Program

Students who are admitted within the regular program are of Jordanian Nationality and are accepted on the basis of competition for the year they have finished their final high school year. Students are accepted according to their GPA in the general secondary school certificate (Unified admission). In which any GPA less than 80% in the scientific stream is not taken into account for the admission in any engineering program.

2) Parallel Program

Students accepted on basis of the Parallel Program opens the door to Jordanian students who have been excluded from admission through competition. The same academic programs, staff, lectures, exams, training opportunities, assessments, rules and regulations, which are applied in the Regular Program, are also applicable in the Parallel Program except the tuition fees.

3) International Program

The international students are admitted to HU on basis of the International Program aiming to provide non-Jordanian students with top quality degree from a highly reputed university. The same academic programs, staff, lectures, exams, training opportunities, assessments, rules and regulations, which are applied in the Regular Program, are also applicable in the International Program except the tuition fees.

Evaluating Student Performance

The evaluation of student performance is a continuous process; it begins by the time a student is admitted to the university, where he/she has to take the English and Computer Placement Tests to display mastery in the basic university educational skills. Based on his/her score in these tests, English as well as Computer Skills courses requirements are determined.

Student evaluations in regular courses follow the University by-laws that stipulate a grade distribution of 20-25% for the first and second exams and 40% for the final exam, with the remainder for other course activities throughout the semester including team projects, quizzes, and home works. These by-laws also allow departments to set the grading policies for courses of special nature, such as graduation projects, or special topics courses.

The class activities that are assessed in the EE program courses may include homework assignments, projects, quizzes, lab reports, computer-programming projects, etc. As for lab courses, 25- 30% is usually given to the Midterm exam of which 10- 15% is devoted to the relevant theories and 10-15% for conducting the practical/experimental procedures. Lab reports are usually given 20% and 5-10% is given for a particular design of experiment work plus 5% for quizzes. The remaining 40% is for the final exam and it is divided as 20% and 20% for the practical and theoretical aspects, respectively. Results of the first, second and midterm exams are usually revealed to the students after one week of the exam to give them a feedback about their performance. A letter grade system is adopted in the university. The minimum passing grade is D. Table 2 illustrates the equivalent point grade for each letter grade in the system.

Table 2: Grading system used in the Hashemite University.

Letter Grade	A+	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Grade-Point (out of 4.0)	4.00	3.75	3.50	3.25	3.00	2.75	2.50	2.25	2.00	1.75	1.50	0.0

The passing grade, which is in accordance with the university policy, is 1.5 points. However, students must maintain an accumulate scores of 2 points in order to graduate. Students must take at least 9 credit hours of classes per semester. Students, who have cumulative scores of less than 2.0 points, are put on probation for three semesters. If they fail, they are given a fourth

semester but the number of hours they are allowed to take is limited and the cost per hour is doubled.

Prior to the final exam period, the course instructors usually posted the student names barred from taking the final exam for certain courses due to their absence over 15% of the classes without authentic medical excuses. This assures proper follow-up of University regulations on absenteeism. The grading policy of the department does not allow any curving in any examination.

All courses have stated goals (general objectives) and specific learning objectives (course learning outcomes). All instructors are expected to assign grades based on the effort by students to achieve the stated course outcomes. The EE program provides its students with the learning skills and abilities (student outcomes) needed to satisfy the program objectives as well as the BSc EE degree requirements.

Two important evaluation steps before the final evaluation in preparation for graduation occur at the time students register for Graduation Project I and the Engineering Training (Practical Training). Students must finish 120 credits before he/she register for Graduation Project I: EE 581 and 112 credit hours at the time he/she registers for practical training: EE 400. The final detailed evaluation of the student's academic record occurs at the final semester. All the grades are checked to ensure that the final GPA and courses are fulfilled to satisfy the department requirement for graduation. The registrar compiles the grades and sends the department a final report for all students for verification of completion and GPA. The final report is endorsed by the Department and the Faculty Council.

Grades are entered electronically with upper and lower limits for each particular evaluation component in a well-organized university grading system, so there is minimal chance for human errors. Also, a hard copy is sent to the Registrar's office within 72 hours after each final exam. The course instructor, relevant Department Chair, and the Dean sign these grade sheets (the hard-copies), thus acquainting themselves with prevailing trends in grades. If there are any irregular trends of grades, they are openly discussed in Departmental and Faculty Board meetings and recommendations are formulated for the following semesters.

Prerequisite courses are programmed in the registration system electronically, and hence, no student is allowed to register for a course unless the course prerequisites have already been completed. However, and by university regulations, the program chair may give an exceptional approval to a student for taking a prerequisite course as a co-requisite in the case the student failed the prerequisite three times. Hence, the pre-requisite course must show up as being successfully passed in the student's record, otherwise the system will not allow the student to proceed.

It is worthy to mention that University bylaws allow for grade appeals. A student may challenge his /her grade within two weeks of posting the grades. He /she may formally appeal to the Dean. The Dean would then form a 3-member committee comprised by the Chair of the relevant department, the course instructor, and the assistant dean for students' affairs. They go over the exam booklets and check that all answers have been graded and all sub-grade additions are correct. The committee would not "re-grade", however, any part, as grading is the sole responsibility of the course instructor. The findings are relayed to the Dean in a formal report and the student is then advised of the finding, which becomes final. All records of exams are stored for a minimum of two semesters, making them available for reference by other faculty and in case of appeals.

Transfer Students and Transfer Courses

Transfer applications are submitted to the admission and registration unit at the HU. These applications are in turn forwarded to the Dean of the faculty to which the student is applying for transfer, to assess the number of the credit hours transfer based on the study plan of the transfer program.

- For a student to transfer to a bachelor's program at HU, the following conditions should be satisfied:
    1. There must be an availability within the program of study to which the student wants to transfer.
    2. The transferring student must have passed 30 credit hours (counting towards their GPA) prior to transfer to HU.
    3. The grand total of the general secondary Jordanian certificate must be acceptable with respect to the transfer program.
    4. If a student is successfully admitted to a bachelor's program at HU, the minimum grade that is considered for a course to be transferred is C- (or 60%) without counting towards the student GPA.
    5. International students coming from outside Jordan, or Jordanian students studying at a private university may be admitted to the international program at HU to transfer.
    6. Student must not have been expelled from the transfer university for disciplinary or educational reasons.
- Students allowed into the bridging program should provide the previous documents in addition to the following:
    1. Copies of their College Degree and the transcripts certified by Ministry of Higher Education and Scientific Research.
    2. An equivalence certificate of non-Jordanian College degrees issued by Ministry of Higher Education and Scientific Research in Jordan.
    3. A certified Course Description for the courses enlisted in the transcript that can be considered to obtain advanced standing.
- Students who want to study courses in other universities must do the following:
    1. Fill in a course transfer form and submit it to the program chairman.
    2. The chairman consults the faculty who teaches the course.
    3. The faculty reviews the syllabus of the transfer course in light of the program course syllabus and checks the equivalency of the syllabus and credits.
    4. The chairman approves the equivalency and signs the transfer form.
    5. The student should then get the approval of the vice dean.
    6. The student submits the form to university registrar office and gets an official acceptance letter to study the course at the specified university.
    7. After studying the course, the student should get an official completion letter and the transcript from the registrar office of the university where the transfer course was completed.
    8. Finally, the student should submit the official completion letter to the HU registrar office.

Advising and Career Guidance

1) Enrollment Advising

The Electrical Engineering department has a permanent Academic Advising Committee (AAC) which is primarily responsible for overseeing the academic advising process in the department at the beginning of each academic year. The AAC is composed of all department faculty members. The AAC allocates a group of students to each faculty member. Each student sees their advisor before registration and whenever he needs any advice on matters related to his student life.

2) Functions of the Academic Advisor

Academic advisors provide educational counseling for students. The academic advisor's primary responsibility is to evaluate the student's plan of study to ensure it will satisfy the college and university requirements while it meets each student's specific needs. To be effective, the advisor must recognize that each student has different abilities, interests, aspirations, needs, experiences, and problems so that his approach in dealing with students can be different from one to another.

To fulfill this requirement, the general advising duties can be stated as follows:

- Advise and help students in early registration and registration formalities,
- Provide guidance in dropping and adding courses and in improving academic performance.
- Follow-up the students' academic progress, especially those who are not in good academic standing (on academic probation students). The advisor will seek to meet these academically weak students (who's GPA <2 out of 4) and recommend the proper course of action they should take to improve their GPA.
- Develop and provide a trusting and respectful environment that allows students to define, develop, and achieve their realistic goals.
- Assist students in gaining learning, communication, decision making, and leadership skills.
- Make students aware of how one's own academic experiences connect to one's life.
- Motivate students' sense of responsibility towards their educational plans and achievements.
- Understand and effectively communicate to students the department policies and procedures, graduation requirements, and educational requirements.

3) Guidelines for Advisees

The student is highly encouraged to meet with his academic advisor every semester prior to or during the registration week. The goal of this meeting is to review the student academic requirements. In addition, the student can take an appointment to meet individually with his academic advisor to discuss the program of study, career plans, or any problems he may encounter in the study program.

4) Counseling services

HU believes in the importance of student counseling and guidance to achieve the utmost adaptation and integration of students into campus life. Proper guidance and counseling leads to a healthy, mature, emotionally balanced personality leading to the best academic achievement. Many issues and concerns are addressed at HU. Those issues include

communication/Assertiveness skills, eating disorders or eating concerns, Physical/Emotional abuse, coping with stress, Depression thoughts, coping with loss-grief, Conflict resolution, Post-trauma Debriefing, Anxiety/Panic/Phobias, and Homesickness/Loneliness.

The following counseling services are provided to all HU students through the unit of student care and services at the deanship of student affairs.

- Help new students to engage in the HU community, adjust to university student life and overcome any obstacles that might arise.
- Provide guidance and support for students socially, psychologically, and academically.
- Addressing various student problems and issues by solving them and reducing their impact.
- Provide specialized assistance for students with learning and/or physical disability to engage in HU community and overcome any obstacle that might arise throughout their time at HU.
- Provide personal and group therapy for students.
- Perform training and personal development seminars for students to ensure positive attitudes and strength of character.
- Provide counseling brochures and booklets for students.
- Organize preventative workshops, lectures, seminars, and training for students to raise their awareness, resilience and mitigate any possible hardship.

5) Career Guidance

The Hashemite University has established a career guidance office allocated at deanship for student affairs. The career's office aims to provide students with guidelines, hints and tips for their future career lives. The office organizes events and lectures that help students write their CV's or prepare for a Job interview.

The Electrical Engineering Department understands the importance to bridge the academic sector with the industrial sector. The department of Electrical Engineering organizes events regularly to introduce current students to the job market by inviting speakers from highly reputed companies and organizations.

EE Curriculum Components

The course work (curriculum) that students will have to finish in EE was developed and improved to meet the Jordanian market requirements, ABET standards, and the IEEE guidelines for undergraduate degree programs. Table 3 provides summary of the main curriculum components.

Table 3: Electrical Engineering Program Graduation Requirements.

CURRICULUM COMPONENT			CREDIT HOURS
General Education			27
Mathematics and Basic Sciences			32
Electrical Engineering and Core	Core Engineering Courses		25
	Core	Core Electrical Engineering Courses	55

Engineering Topics	Electrical Engineering Topics	Engineering Training	0
		Graduation Projects	3
		Total	58
	Total		83
Electives (Electrical Engineering)			15
Free Elective			3
Grand Total			160

1) University requirements (27 CH)

Students are required to finish (27) credit hours (CH) which cover 16.875% of the curriculum. They are divided into two categories, the first one is covered by (12) CH which are compulsory as shown in Table 4. And the second one is covered by (15) elective CH, where students choose five courses from the following three different fields: Human Sciences; Social and Economic Sciences; Science and Technology and Agriculture and Health. These courses are shown in Table 5.

Table 4: Summary of University Requirements-Compulsory Courses.

Course No.	Course Title	Detailed Distribution of Credit Hours		Credit Hours	Prerequisite or Co-requisite
		Lecture	Practical		
Compulsory Requirements (all R)					
111404117	Military Sciences	3	-	3	-
111404118	National Education	3	-	3	-
111405101	Arabic Language	3	-	3	Level test in Arabic language or 111405098
111405110	English Language	3	-	3	Level test in English language or 111405099

Table 5: Summary of University Requirements-Elective Courses.

Elective Requirements- *five courses from the following three different fields*					
Human Sciences					
111404110	Islam and contemporary Issues	3	-	3	-
111404111	Islamic Thought	3	-	3	-
111404112	Jerusalem's History and Civilization	3	-	3	-
111404113	Fundamentals of Art and Literature	3	-	3	-
111404114	Jordan's History and Civilization	3	-	3	-
111405102	Applied Arabic Language	3	-	3	-
111405111	Applied English Language	3	-	3	-
111405112	Technical Translation	3	-	3	-

141603101	Italian Language	3	-	3	-
141404193	Palestinian Cause	3	-	3	-
Social and Economic Sciences					
111404101	University life of student	3	-	3	-
111404102	Psychology	3	-	3	-
111404103	Life Skills	3	-	3	-
111404104	Family and child education	3	-	3	-
111404115	Science of Sociology	3	-	3	-
111404116	Archeology and tourism science	3	-	3	-
111404120	Economic Science and Management	3	-	3	-
111404121	Law And The Ordering of Our Life	3	-	3	-
Science, Technology, Agriculture and Health					
110108104	Energy Resources	3	-	3	-
110108113	Biotechnology and society	3	-	3	-
110108114	Automobile Essentials	3	-	3	-
110108115	Computer Ethics	3	-	3	-
110108130	Health promotion and nutrition	3	-	3	
110108131	Health Education and First Aids	3	-	3	-
110108132	Sport and Health	3	-	3	-
110108133	Environmental awareness	3	-	3	-

2) College Requirements (33 CH)

Electrical Engineering students are required to finish (33) CH of college requirements, which include (23) CH of Basic sciences such as four math courses, two basic physics classes and their lab, a chemistry course and its lab, and computer programming. These requirements are all offered by the faculty of science. The remaining (10) CH are general Engineering courses and include manual and computer aided engineering drawing (AutoCAD), engineering workshop where students learn some handicraft skills, and ethics. These general engineering courses aim to equip EE graduates with both scientific and practical knowledge and skills needed to pursue a successful profession in general. College requirements, their weight of credit hours and their prerequisites are all summarized in Table 6 below.

Table 6: (33) CH of College Requirements.

Course No.	Course Title	Detailed Distribution of Credit Hours		Credit Hours	Prerequisite or Co-requisite
		Lecture	Practical		
110108101	Calculus 1	3	3	–	–
110101102	Calculus 2	3	-	3	110108101
110101201	Calculus (3)	3	-	3	110101102
110101203	Ordinary Differential Equations (1)	3	-	3	110101102
110102101	General Physics (1)	3			–
110102102	General Physics (2)	3	-	3	110102101
110102103	General Physics Lab 1	1	–	3	110102101 – Co-requisite

110103107	Basics of General Chemistry	3	3	-	–
110103108	Basics of General Chemistry Lab.	1	–	3	110103107 -Co-requisite
110108112	Computer Programming	3	3	–	Level Test in Computer Skills or 110108099
110400201	Manual Engineering Drawing	2	1	3	–
110400202	Computer Aided Engineering Drawing	1	–	3	110400201
110400101	Engineering Workshop	1	0.5	2	–
110400203	Ethics and Communication Skills	3	3	–	111405110

3) Department Requirements (97 CH)

Department requirements are divided into two categories: a) 82 CH of Compulsory Requirements as shown in Table 7 and b) 15 CH of Department Electives where students choose 15 hours from one of two fields; Power Engineering as shown in Table 8 and Electronic and Communication Engineering as described in Table 9.

The 82 CH of compulsory requirements mainly cover basic and advanced topics in engineering courses and electrical engineering courses that are necessary for any electrical students. The courses are basically divided into two categories; the first one includes engineering courses that electrical engineers need to have enough knowledge of, such as numerical analysis, control systems, digital logic, assembly language and microprocessor systems, and their labs. These courses weigh (18) CH. The other (64) CH are core electrical engineering courses such as electrical circuits 1 & 2, electronics 1 & 2, random processes, signal systems, electromagnetic 1 & 2, analog and digital communication, digital signal processing, digital electronics, communication electronics, wireless communications, electrical machines, power electronics, electrical power systems and renewable power generations. The curriculum also includes several labs, such as circuits lab, electronics lab, communication lab, and the machine lab. In addition to in-class courses, students are required to finish two graduation project courses, and a two months course of practical training.

Table 7: (82) CH of Department Requirements-Compulsory Courses.

Course No.	Course Title	Detailed Distribution of Credit Hours		Credit Hours	Prerequisite or Co-requisite
		Lecture	Practical		
110402303	Numerical Analysis	3	-	3	110108112 and 110101203
110405331	Automatic Control	3	-	3	110101203
110405332	Automatic Control Lab	-	3	1	110405331
110406260	Applied Mathematics	3	0	3	110101203
110408220	Digital Logic	3	-	3	110101102 or 110101152
110408221	Digital Logic Lab.	-	3	1	110408220
110408332	Assembly Language and Microprocessors	3	-	3	112408220 and 110409240
110408333	Microprocessors Lab	-	3	1	110408221and 110408332
110408530	Microprocessors Based Systems	3	-	3	110408332

110409201	Electrical Circuits (1)	3	-	3	110101102and 110102102
110409203	Electrical Circuits (2)	3	-	3	110409201
110409221	Electromagnetic (1)	3	-	3	110101201 and 110102102
110409240	Electronics (1)	3	-	3	110409201or 110406229
110409300	Electrical Circuits Lab	-	3	1	110102103 and (110409203 or 110406229)
110409321	Probability and Random Processes	3	-	3	110101102
110409322	Signals and Systems	3	-	3	110406260 or (110101152 and 110101203)
110409324	Electromagnetic (2)	3	-	3	110409221
110409325	Analog Communications	3	-	3	110409322
110409341	Electronics (2)	3	-	3	110409240
110409342	Electronics Lab	-	3	1	110409300 and (110409341 or 110406320)
110409343	Digital Electronics	3	-	3	110409240 and 110408220
110409361	Electrical Machines (1)	3	-	3	110409221
110409400	Practical Training	-	-	0	The Completion of (112) Credit Hours at least including 110400203 without the Courses from outside the curriculum
110409421	Communication Lab	-	3	1	110409432
110409422	Digital Signal Processing	3	-	3	110409322 or 110406370
110409432	Digital Communications	3	-	3	110409325and 110409321
110409433	Wireless Communications Systems	3	-	3	110409432
110409461	Electrical Power Systems	3	-	3	110409361
110409470	Electrical Machines and Electrical Power Systems Lab	-	3	1	110409461
110409520	Communications Electronics	3	-	3	110409325and 110409341
110409560	Power Electronics	3	-	3	110409341
110409561	Renewable Power Generation	3	-	3	110409461
110409581	Graduation Project (1)	-	3	1	The Completion of (120) Credit

					Hours at least without the Courses from outside the curriculum and Department consent
110409582	Graduation Project (2)	-	6	2	110409581

Table 8: Selective-elective courses for Power Engineering field.

Course No.	Course Title	Detailed Distribution of Credit Hours		Credit Hours	Prerequisite or Co-requisite
		Lecture	Practical		
110409464	Electrical Machines (2)	3	-	3	110409361
110409466	Power System Analysis	3	-	3	110409461
110409562	Power System Reliability	3	-	3	110409461
110405531	Advanced Control	3	-	3	110405331 and (110405426 or 110409322)
110409563	Smart Grid Technology	3	-	3	110409561
110409564	Power System Stability	3	-	3	110409461
110409565	Special Topics in Power Engineering	3	-	3	Dept. Consent
110409566	Advanced Smart Grid Technology	3	-	3	110409561 and 110409433
110409567	Power System Protection	3	-	3	110409461
110409568	Electric Drive	3	-	3	110409361 and 110409560

Table 9: Selective-elective courses for Communication Engineering field.

Course No.	Course Title	Detailed Distribution of Credit Hours		Credit Hours	Prerequisite or Co-requisite
		Lecture	Practical		
110409424	Digital Communication Networks	3	-	3	110409432

110409425	Optical Communications	3	-	3	110409325 and 110409324
110409428	Satellite Communications	3	-	3	110409432
110409429	Antennas and Wave Propagation	3	-	3	110409324
110409431	Special Topics in Communications and Electronics Engineering	*3*	-	*3*	Dept. Consent
110409444	Analog Filter Design	3	-	*3*	*110*409341
110409445	Electronics (3)	3	-	3	*110*409341
110409448	Microwave Electronics Systems	3	-	3	110409341 and *110409324*
110409521	Advanced Wireless Communications	*3*	-	*3*	110409433
110409540	Opto-Electronics	3	-	3	110409341
110409541	Solid State Electronics	*3*	-	*3*	*110*409341

4) Practical Training

As listed in Table 7, Practical or Engineering training is a department compulsory, and counts for (0) CH. Usually students finish this requirement in the summer semester before their last year of study. That is, after the end of the fourth year.

The purpose of student training is to introduce students to work experience amongst professionals in different local (private or government) sites like companies and institutes that require electrical engineering background. Such an experience will allow students to gain knowledge of the atmosphere of real life work. Students are required to submit reports during their training, as well as presenting a seminar that describes their experience by the end of the training. The trainee's supervisor at the site will also fill a report that evaluates the student's performance.

5) Graduation Project

Senior students are required to work on a final project in their last year of study, which will be covered by two courses, the first one which is Graduation Project one (GP1) weighs (1) CH and students register for it in the first semester of the last year. In GP1, students describe the purpose of their project, their plan of work, a time table, a budget list and literature review. They also submit a report that follows ABET guidelines at the end of the semester. The other course is Graduation Project two (GP2), where students execute their work and present it at the end of their last year last year in front of an examination committee, which also will receive a final report. Students' graduation will be on hold if the final report is not submitted. The committee will also participate in grading the project.

While the department's graduates are qualified to work on any site that requires electrical engineering background, the students are given the opportunity to specialize in one of two fields where they chose five selective elective courses from one of two tables, either table 5.5 or table 5.6. Once a student chooses a field of study, he/she must finish (15) CH from that field. That is, if he/she chooses Power Engineering for example, all courses must be from table 5.5. Also, students can't register for SE courses until they finish at least (100) CH of course work.

6) Free Elective

(3) CH where students are free to choose any course provided by any faculty of the University after the Department's consent.

7) Communication Skills and Ethics

During their first year of study, students take a few courses that help them improve their communication skills such as language courses and some university compulsory elective courses that strengthen communication skills. In later years and in different courses, students are asked to work on electrical engineering assignments. Reports must be submitted and work must be presented in front the course's lecturer and the students' class mates. This will help in building students' character. Also writing reports and following IEEE standards improves the students' writing skills and language. Evaluation of these projects is based on strength of language, technical content, organization of report and communication style. Courses that require students to work on different projects are Ethics and Communication Skills, several advanced courses such as Electronics 2, Digital Electronics, Fiber optics, Machine systems, Communication Electronics, etc. Other courses are the two Graduation Project classes and Field Training, were students receive guidance from their advisors and supervisors on how to right technical reports according to IEEE standards, and on how to present their talk.

In addition to improving communication skills and eloquence in technical writing, the experience of writing reports teaches students the significance of ethical principles, and the importance of following a certain code of conduct when writing a report or executing a project. This experience also teaches students how to cite other researchers' work and how to avoid plagiarism.

8) Design in Electrical Engineering Courses

Some of the courses that are offered by the department contain design problems which are integrating elements of most of electrical engineering subjects. Classes that focus on design and in different levels are: Electromagnetic 1&2, Electronics 1&2, Electronics lab, Digital Electronics, Digital Signal Processing, Wireless Communications Systems, Electrical power Systems, Renewable Power, Power System Analysis, Digital Logic and Microprocessor Systems, and the majority the selective elective courses. These design problems are related to sub-disciplines of Electrical Engineering, like design of electronic systems, power system, communication systems and microprocessor systems. In addition to the mentioned courses, the two Graduate Project courses are an example of how design is an important component of the department's curriculum.

Course Description

110409201 Electrical Circuits (1)

3 C.H (3and0) Prereq. 110101102 and 110102102

Units, definitions, independent sources, dependent sources, Ohm's law, Kirchoffe's laws, division rule. Nodal analysis, Mesh Analysis, Linearity and Superposition, Thevenin's and Norton's theorems. Inductance and capacitance, source free RL and RC circuits, unit-step forcing function, and RLC circuits.

110409203 Electrical Circuits (2)

3 C.H(3and0) Prereq. 110409201

Sinusoidal steady-state response, phasor concept, A.C power analysis. Three phase circuits, magnetically coupled circuits, complex frequency, circuit analysis in s-domain, Bode plot, one-port and two-port networks, and passive filters.

110409221 Electromagnetic (1)

3 C.H(3and0) PrePreq. 110101201 and 110102102

Gradient , curl differential operators, vector analysis, Divergence and Stokes's theorem, electrostatic fields, Coulomb's law, unbound electric fields, electrostatic boundary-value problems, Magnetostatic fields, Maxwell's equations for static EM fields. Magnetic force,

Torque, and Moment. Magnetic materials, magnetic devices. Faraday's law, Displacement current, Time varying potentials, and Maxwell's equations for time varying fields.

110409240 Electronics (1)

3 C.H(3and0) Prereq. 110409201or 110406229

Introduction to semiconductor materials, pn- junction diode, DC analysis and models, zener diods, Schottky diods, diode circuits: rectifiers, regulators, clippers, clampers, and multiple diode circuits; BJT transistors: DC analysis, biasing, configurations, applications, The field-effect transistor: DC analysis, and JFET MOSFET, configurations, and applications. Simulation of some circuits using P-Spice.

110409300 Electrical Circuits Lab

1 C.H(0and3) Prereq. 110102103 and (110409203 or 110406229)

Equipment familiarization. Measurements and DC circuits. Techniques of circuit analysis. Basic laws on AC circuits. Step response of first and second order circuits. Voltage and current relationship in R, L, C circuits. Passive filters. Delta-star three phase measurements, and RLC response.

110409321 Probability and Random Processes

3 C.H(3and0) Prereq. 110101102

Probability axioms, random variables, operations on one random variable, multiple random variables, operations on multiple random variables, random processes: temporal characteristics, and spectral characteristics, linear systems with random inputs, Markov chains, and queuing theory.

110409322 Signals and Systems

3 C.H(3and0) Prereq. 110406260 or (110101152 and 110101203)

Classification of signals and systems, time-domain representations of continuous time signals, time-domain analysis of continuous LTI systems, frequency-domain representations of continuous time signals, frequency-domain analysis of continuous LTI systems, system analysis, time domain representation of discrete time signals, time domain analysis of discrete LTI systems.

110409324 Electromagnetic (2)

3 C.H(3and0) Prereq. 110409221

Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane waves in free space, power and poynting vector, reflection of plane waves at normal incidence, reflection of plane waves at oblique incidence, transmission lines: parameters, equations, and applications. Smith chart. Waveguides: rectangular waveguides, TE and TM modes. Introduction to antennas.

110409325 Analog Communication

3 C.H(3and0) Prereq. 110409322

Review of continuous-time signals and systems, AM modulation and demodulation schemes, angle modulation (FM and PM) and demodulation, performance of analog communication systems under noise, sampling theorem, quantization, PCM and delta modulation systems, introduction to digital transmission, and scrambling techniques.

110409326 Applied Electromagnetic

3 C.H(3and0) Prereq.110101201 and 110102102

Review of vector analysis, coordinate systems, Divergence and Stokes's theorem - electrostatic fields, Coulomb's law, unbound electric fields, electrostatic boundary-conditions problems, Magnetostatic fields, Maxwell's equations for static EM fields. Magnetic force, Torque, and Moment. Magnetic materials, magnetic devices.

Faraday's law, Displacement current, Time varying potentials, and Maxwell's equations for time varying fields. Boundary conditions , reflection and transmission of waves.

110409341 Electronics (2)

3 C.H(3and0) Prereq.110409240

Basic BJT amplifiers: amplifier configurations, multistage amplifiers, basic FET- amplifiers: amplifier configurations, multistage amplifiers; Frequency response of transistor amplifiers; Operational amplifier: characteristics, application; Differential amplifiers. Simulation of some circuits using P-Spice.

110409342 Electronics Lab

1 C.H(0and3) Prereq. 110409300 and (110409341 or 110406320)

Diode characteristics, diode applications, zener diode as a voltage regulator, BJT characteristics and DC biasing, operational amplifier characteristics, and applications, amplifier frequency response, multistage amplifier, and JFET amplifier.

110409343 Digital Electronics

3 C.H(3and0) Prereq. 110409240and 110408220

Diode and transistor models (Ebers-Moll model), Resistor-Transistor Logic (RTL), Diode-Transistor Logic (DTL), Transistor-Transistor Logic (TTL), Schottky TTL, Emitter-Coupled Logic (ECL), MOSFET digital circuits, resistor-loaded NMOS logic, CMOS logic, PLA and memory devices: ROM, PROM, EPROM, SRAM, and DRAM, waveform generation: monostable, a stable, and Schmitt trigger circuits, analog-to-digital and digital-to-analog conversion. Modeling and simulation using P-Spice.

110409344 Electronics Fundamentals Lab

1 C.H (0and3) Prereq. 110409300 and 110409240

Diode characteristics, diode applications, zener diode as voltage regulator, transistor characteristics and DC biasing, JFET, MOSFET characteristics, and multistage transistors.

110409348 Introduction to Electronics

2 C.H(2and0) Prereq. 110406229

Introduction to semiconductor materials, pn-junction diode, DC analysis and models, zener diode, schottky diode, diode rectifier, clipper, clampers, BJ Transistors, DC analysis.

110409361 Electrical Machines (1)

3 C.H(3and0) Prereq. 110409221

Introduction to machinery principles, magnetic field, Induced emf, transformers: Equivalent circuit, transformer tests, current transformer; DC machines: construction, armature windings, armature reaction. DC generators, DC motors, and three-phase induction motor.

110409363 Principles of Electrical Machines

2 C.H(2and0) Prereq. 110406229

Introduction to machinery principles, magnetic field, induced emf, transformers, equivalent circuits, DC-machines, construction, armature windings, and armature reaction.

110409470 Electrical Machines and Electrical Power Systems Lab

1 C.H(0and3) Prereq. 110409461

Transformers: open circuit test, short circuit test, autotransformers, three phase transformers and load characteristics. DC motors: shunt and series motors. DC generators: DC shunt generator. Induction motor: no-load test, locked-rotor test and load characteristics. Transmission line simulation and transmission line performance.

110409400 Practical Training

Prereq. The Completion of (112) Credit Hours at least including 110400203 without the Courses from outside the curriculum

The BSc degree in EE, requires 8 weeks of continuous training inside or outside Jordan. The training must be conducted within private or public sectors working in the EE fields, which requires the approval of the department. A final report and presentation are required.

110409421 Communication Lab

1 C.H(0and3) Prereq. 110409432

Introduction to spectrum analyzer operation. AM modulation/demodulation. FM modulation/demodulation. PM modulation/demodulation, Noise effect on AM, FM, and PM. Sample and hold, aliasing effect, pulse code modulation, delta modulation, signal to noise ratio, and signaling techniques: PSK, FSK, DPSK, QPSK, and MSK.

110409422 Digital Signal Processing

3 C.H(3and0) Prereq. 110409322 or 110406370

Analog to digital conversion and sampling theorem, Discrete-time signals and systems, z-transform, Fourier analysis, Discrete Fourier Transform (DFT) , Fast Fourier Transform (FFT), design of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters. Applications to speech, audio processing and image processing.

110409424 Digital Communication Networks

3 C.H(3and0) Prereq. 110409432

Review of digital data transmission, OSI model, TCP/IP model, switched networks (circuit, packet, frame relays, ATM), Local Area Networks (LAN): architecture and topologies, Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Optical Networks (SONET), Integrated Service Digital Networks (ISDN), wireless LANS, and performance analysis of a communication network. Assignments, projects design will be covered in this course.

110409425 Optical Communication

3 C.H(3and0) Prereq. 110409325 and 110409324

Review of wave propagation in medium space, wave guides and resonators, optical fiber, components of optical communication systems. Introduction to SONET and DWDM systems.

110409428 Satellite Communications

3 C.H(3and0) Prereq. 110409432

Orbits and related issues, baseband signals and quality of service, up/down link, intersatellite link and overall link performance, multiple access, Earth stations, and reliability of satellite communications.

110409429 Antennas and Wave Propagation

3 C.H(3and0) Prereq 110409324

Review of electromagnetic fundamentals, antennas and radio wave propagation. Antenna fundamentals, antenna radiation characteristics, Hertizian or short dipole, half wavelength dipole, monopole antenna, loop antenna, horn Antenna, patch antenna, antenna arrays, aperture antenna, friis transmission formula. Electromagnetic waves and its properties, propagation of waves, modes of propagation, waves attenuation and absorption, ground waves, sky waves space wave, radio VHF/UHF and microwave wave propagation, Wave guides. Terrestrial fixed links, and link budgets.

110409431 Special Topics in Communication and Electronics Engineering

3 C.H(3and0) Prereq. Dept. Consent

Recent topics in communication and Electronics engineering covered by a visiting professor or a department faculty member. Assignments, projects design will be covered in this course.

110409432 Digital Communications

3 C.H(3and0) Prereq. 110409325and 110409321

Review of signals. Source coding techniques: Huffman coding, Shanon-Fano algorithm, Lembel-Ziv algorithm. Digital bandpass modulation: Amplitude Shift-Keying (ASK), Frequency Shift-Keying (FSK), Phase Shift-Keying (PSK), Quadrature Amplitude Modulation (QAM). Introduction to information theory, channel capacity and channel coding.

110409433 Wireless Communication Systems

3 C.H(3and0) Prereq. 110409432

Introduction to wireless communication systems and standards, principles of wireless communications, cellular concept, North American cellular system, GSM, spread spectrum, system design fundamentals (grade of service, channel capacity), mobile radio propagation (path loss models), fading and multipath, equalization and diversity, modulation performance in fading and multipath channels. A term project including a final report and a presentation are required. Assignments, projects design will be covered in this course.

110409444 Analog Filter Design

3 C.H(3and0) Prereq. 110409341

Filter Fundamentals, classification of filters according to frequency range, order, characteristics, active-and passive- filters, active-filters using op-amps, second-order and high-order filter realizations, Effect of op-amp, Characteristics on the performance of active-Filters, Active-filters using other types of active elements: OTA-C filters, CC-Based Active filters MOSFET-C active filters.

110409445 Electronics (3)

3 C.H(3and0) Prereq. 110409341

Power amplifiers: classifications, operation, and conversion efficiencies; Feedback amplifiers. Oscillators, timing circuits, active filters: low-pass filters, high-pass filter, band-pass filters and band-stop filters. Simulation of some circuits using P-Spice.

110409448 Microwave Electronics Systems

3 C.H(3and0) Prereq. 110409341 and 110409324

Waveguides: modes and cutoff frequency, group and phase velocity, impedance matching, power coupling, striplines and microstrips. Passive components: Microwave solid state devices: Transistors, Gun devices, IMPATT diodes, PIN diodes, Varactor diodes, Yttrium-Iron Garnet, dielectric resonators. Microwave tubes, Microwave antennas, Radar, Doppler radar, and Transponders.

110409461 Electrical Power Systems

3 C.H(3and0) Prereq. 110409361

Fundamentals of power systems generation, transmission, and distribution. Transformer principles, synchronous machines, transmission line parameters and calculations. Types of conductors, series resistance, series inductance of three-phase transmission lines and capacitances. Short, medium and long models of transmission lines. Introduction to the Jordanian code of practice for construction in terms of internal lighting and electrical wiring and constructions will also be covered.

110409464 Electrical Machines (2)

3 C.H(3and0) Prereq. 110409361

Poly-phase rotating machines, A.C winding, induction machines, gage winding, slip-rotor winding, motor starting, torque, motor speed, synchronous generator, synchronous motor, speed control.

110409466 Power System Analysis

3 C.H(3and0) Prereq. 110409461

Admittance model and network calculations, Y-bus build up and modification, power flow solutions: Gauss Seidel, Newton Raphason, fast decoupled method, power flow studies and analysis in design and operation and short circuit calculations. Simulation assignments are required. Introduction to the Jordanian code of practice for construction in terms of internal lighting and electrical wiring and constructions will also be covered.

110409470 Electrical Machines and Electrical Power Systems Lab

1 C.H(0and3) Prereq. 110409461

Transformers: open circuit test, short circuit test, autotransformers, three phase transformers and load characteristics. DC motors: shunt and series motors. DC generators:

DC shunt generator. Induction motor: no-load test, locked-rotor test and load characteristics. Transmission line simulation and transmission line performance.

110409520 Communications Electronics

3 C.H(3and0) Prereq: 110409325 and 110409341

Analysis and design of various analog and digital communication circuits including RF amplifiers, oscillators and mixers. AM transmitters and receivers, AM suppressed carrier circuits, FM transmitters and receivers, TV transceiver, A/D and D/A converters, sample and hold circuits, quantizers, and encoders.

110409521 Advanced Wireless Communications

3 C.H(3and0) Prereq. 110409433

Modulation performance in Cellular communication, diversity techniques in wireless communications , effects of interference in cellular communications , GSM in wireless communication , CDMA techniques in wireless communication, General capacity comparison of cellular systems , fixed and dynamic allocation , hard and soft handoffs.

110409540 Opto-Electronics

3 C.H(3and0) Prereq. 110409341

Interaction of optics, lasers, mechanics, electronics, and programming. Design methodology; team dynamics. Review of optical detection, modulation, light sources, and detectors. Selected optoelectronic devices and applications such as CD-players, DVD, display systems, laser printers, barcode scanners, digital cameras. A term project including a final report and presentation are required. Assignments, projects design will be covered in this course.

110409541 Solid State Electronics

3 C.H(3and0) Prereq. 110409341

Energy bands and carrier transport in semiconductors. Generation and-recombination. Breakdown. Physical principles of p-n junction devices. Bipolar junction and MOS transistors. FETs. Gunn diodes, and Light emitting diodes. Semiconductor lasers. Device modeling.

110409560 Power Electronics

3 C.H(3and0) Prereq. 110409341

Power semiconductor devices: Diodes, Thyristors, Controllable switches such as GTO, MOSFETS, protection of devices and circuits, single–phase and three-phase uncontrolled and phase-controlled rectifiers, dc-dc switch mode convertor, and dc-ac inverters.

110409561 Renewable Power Generation

3 C.H(3and0) Prereq. 110409461

Power and energy units and energy carriers, power and energy sources, renewable energy sources and solar spectrum, direct sun power. Major topics spans: photovoltaic Power (potential of solar radiation, pn-junction, pn junction solar cell under illumination , current voltage characteristics of solar cells, equivalent circuit of solar cell , technologies of solar cells, modules, photovoltaic system and Hybrid systems); Solar thermal power (solar collectors, pipes, thermal storage, and solar thermal systems); Indirect sun power (wind power utilization , various wind energy systems, wind turbine generator technology, electrical power systems concepts and grid integration techniques).

110409562 Power System Reliability

3 C.H(3and0) Prereq. 110409561

Reliability definition and measures. Probability concepts and Markov chains. Failure models and availability models. Generator system reliability. Loss of load probability method. Evaluation of transmission network reliability.

110409563 Smart Grid Technology

3 C.H(3and0) Prereq . 110409561

Modernizing electric power transmission and distribution; energy independence, storage and security; Improving electrical grid efficiency, communications, reliability, and

resiliency; integrating new and renewable energy sources. Applications involve remote power, district power and critical loads protection.

110409564 Power System Stability

3 C.H(3and0) Prereq. 110409461

Small- and large- signal stability problem of power systems, synchronous generator rotor dynamics, swing equation and its solution (analytical and numerical), park's transformation, d-q decomposition of synchronous generator, detailed dynamical model of synchronous generator for stability studies, AVR and TG models and their effects on power system stability.

110409565 Special Topics in Power Engineering

3 C.H(3and0) Prereq. Dept. Consent

Recent topics in power engineering covered by a visiting professor or a department faculty member. Assignments, projects design will be covered in this course.

110409566 Advanced Smart Grid Technology

3 C.H(3and0) Prereq. 110409561 and 110409433

The aim of this course is to study advanced topics in the subject of smart grid technology. This course includes: Fundamentals of power line communications, communication technologies enabling a smart grid, Integration of communications, control and protection with a smart grid, improving electrical grid efficiency and reliability, integrating renewable energy resources with existing grid infrastructure, and more applications on loads protection devices.

110409567 Power System Protection

3 C.H(3and0) Prereq.110409461

Protection principles relays; directional power protection, differential, distance and pilot protection. Protection of power system elements including: generator transformer, bus, motors, and. Earth fault zero sequence, capacitors, reactors, and fuses. System grounding, low impedance grounding protection principles, and synchronization principles. Assignments, projects design will be covered in this course.

110409568 Electric Drive

3 C.H(3and0) Prereq. 110409361 and 110409560

Introduction, element of a drive system, electric power supply, DC-drive, system model, speed control, motor mechanism dynamics, closed loop speed control, single-phase rectifier with DC-motor, and AC-drive system.

110409581 Graduation Project (1)

1 C.H(0and3) Prereq. The Completion of (120) Credit Hours Successfully without the Courses from outside the curriculum and Department Consent

A group of students apply their theoretical knowledge gained throughout their study to design and build a certain circuit/device to perform a specific function under the supervision of one of the instructors at the department. A final report and presentation are required.

110409582 Graduation Project (2)

2 C.H(0and6) Prereq. 110409581

Continuation of project (1), the student has to interpret the application in real time, design and simulation to examine the project design. Project (2) is applied to various applications to electrical engineering options.

5-Years Guidance Study Plan

First Year

First Semester				Second semester			
Course No.	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**	**Course No.**	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**
110102101	General Physics (1)	3	-	110101102	Calculus 2	3	110108101
110103107	Engineering Chemistry	3	-	110102102	General Physics (2)	3	110102101
110108101	Calculus 1	3	-	110102103	General Physics Lab (1)	1	110102101 -Co-requisite
110400201	Manual Engineering Drawing	2	-	110103108	Engineering Chemistry Lab	1	110103107 -Co-requisite
111405101	Arabic Language	3	Level test in Arabic language or 1405098	110108112	Computer Programming	3	Computer skills level test or 110108099
111405110	English Language	3	Level test in English language or 111405099	110400101	Engineering Workshop	1	-
				110400202	Computer Aided Engineering Drawing	1	110400201
				111404117	Military Science	3	-
Total		**17**		**Total**		**16**	

Note: The student can commence in Practical Training in one of the summer semesters after passing 112 CH at least Including "Ethics and Communication Skills -0400203" without the Courses from outside the curriculum.

Second Year

First Semester				Second semester			
Course No.	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**	**Course No.**	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**
110101201	Calculus (3)	3	110101102	110400203	Ethics and Communication Skills	3	111405110
110101203	Ordinary Differential Equations (1)	3	110101102	110402303	Numerical Analysis	3	110108112 and 110101203
110406260	Applied Mathematics	3	110101203	110409203	Electrical Circuits (2)	3	110409201
110408220	Digital Logic	3	110101102 or 111001141	110409221	Electromagnetic (1)	3	110101201 and 110102102
110409201	Electrical Circuits (1)	3	110101102 and 110102102	110409240	Electronics (1)	3	110406229 or 110409201
111404118	Citizenship Education	3	-				
Total		**18**		**Total**		**15**	

Third Year

First Semester				Second semester			
Course No.	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**	**Course No.**	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**
-	University Elective	3	-	110409325	Analog Communications	3	110409322
110408221	Digital Logic Lab	1	110408220	110409324	Electromagnetic (2)	3	110409221
110408332	Assembly Language and Microprocessors	3	110408220 and 110409240	110409342	Electronics Lab	1	110409300 and (110409341 or 110406320)
110409300	Electrical Circuits Lab	1	110102103 and (110409203 or 110406229)	110409343	Digital Electronics	3	110409240 and 110408220
110409321	Probability and Random Processes	3	110101102	110409361	Electrical Machines (1)	3	110409221
110409322	Signals and Systems	3	110406260 or (110101152 and 110101203)	-	University Elective	3	-
110409341	Electronics (2)	3	110409240				
Total		**17**		**Total**		**16**	

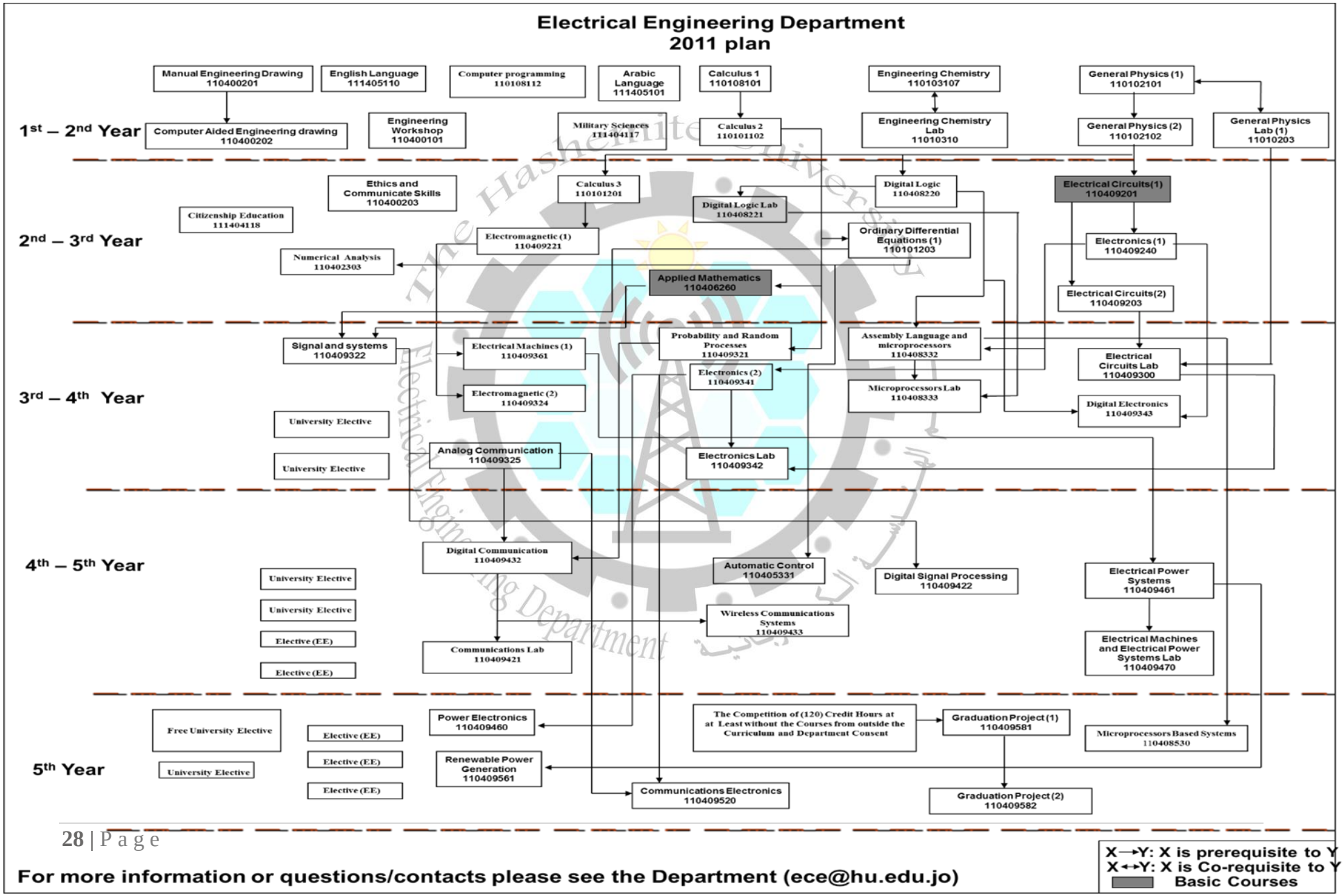
Fourth Year

First Semester				Second semester			
Course No.	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**	**Course No.**	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**
-	University Elective	3	-	-	University Elective	3	-
-	Elective (EE)	3	-	-	Elective (EE)	3	-
110405331	Automatic Control	3	110101203	110405332	Automatic Control Lab	1	110405331
110408333	Microprocessors Lab	1	110408221 and 110408332	110409421	Communications Lab	1	110409432
110409432	Digital Communications	3	110409325 and 11409321	110409422	Digital Signal Processing	3	110409322 or 110406370
110409461	Electrical Power System	3	110409361	110409433	Wireless Communications Systems	3	110409432
				110409470	Electrical Machines and Electrical Power systems Lab	1	110409461
Total		**16**		**Total**		**15**	

Fifth Year

First Semester				Second semester			
Course No.	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**	**Course No.**	**Course Title**	**Credit Hours**	**Prerequisite or Co-Requisite**
-	Elective (EE)	3	-	-	Elective (EE)	3	-
-	University Elective	3	-	-	Elective (EE)	3	-
110408530	Microprocessors Based Systems	3	110408332	-	Free University Elective	3	-
110409560	Power Electronics	3	110409341	110409520	Communications Electronics	3	110409325 and 110409341
110409561	Renewable Power Generation	3	110409461				
110409581	Graduation Project (1)	1	The Completion of (120) Credit Hours at least without the courses from outside the curriculum and department consent	110409582	Graduation Project (2)	2	110409581
Total		**16**		**Total**		**14**	

EE courses and their pre-requisites flow chart



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