Jordan University of Science and Technology

Faculty of Engineering

Department of Electrical Engineering

Study Plan of Bachelor of Science Degree in Electrical Engineering

2019

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Vision:

The vision of the Department is to be well recognized regionally and internationally for excellence in its educational programs, pioneering research activities and in full compliance to the international standards of quality assurance.

Mission:

The mission of the Department is to provide high quality and effective education in the field of electrical engineering; Materialize the partnership with industry by meeting the ever changing needs of the market for future engineers; Immunize the students with knowledge and experience in their field of specialization to contribute in the making of professional leaders.

Educational Objectives

- **Objective 1: Technical Knowledge and Skills**

  Innovative problem solvers that utilize scientific and engineering knowledge to address contemporary real life issues.

- **Objective 2: Communications Skills**

  Leaders in both the public and private sectors, capable of serving international, national and regional entities, while inspiring their teams to excel.

- **Objective 3: Preparation for the Profession**

  Ethically and socially conscious professionals that function well in their communities, across multi-disciplinary teams.

- **Objective 4: Preparation for Further Study**

  Independent learners, who engage in lifelong learning, share their knowledge; successfully pursue graduate studies as well as engineering research and development.

Program Learning Outcomes

1- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3- An ability to communicate effectively with a range of audiences.

4- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

5- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

These constitute the new ABET 1-7 criteria.

Study Plan of Bachelor of Science Degree in Electrical Engineering

Numbering and coding system of courses of the study plan.

Course Coding

The following codes are used to designate courses:

Department			Level/year	Field	Sequence
A	**B**	**C**	**x**	**y**	**z**

The Department codes (A, B, C) are as follows:

Code	Department	Code	Department
AE	Aeronautical Engineering	**EE**	**Electrical Engineering**
BME	Biomedical Engineering	IE	Industrial Engineering
CHE	Chemical Engineering	ME	Mechanical Engineering
CE	Civil Engineering	NE	Nuclear Engineering

Course Numbering

- The electrical engineering courses are tabled and numbered in such a manner to recognize each course regarding its subject area, year or level, and semester offered.
- Example: EE xyz; the **EE** symbol in the course number denotes Electrical Engineering and (xyz) is a 3-digits number:

A. The first digit (x) denotes the year level of the course according to student's study plan as follows:

Code	Level/year
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year

B. The second digit (y) denotes the course field subject as follows:

Second number	Field
0	General Electrical Engineering, Electromagnetics
1	Electric Circuits
2	Electronics
3	Electromechanical Systems
4	Control, Measurements
5	Communications
6	Signal Processing
7	Networks, Computer
8	Power Systems
9	Engineering Training, Graduation Projects, Special Topics

C. The third digit (z) distinguishes different courses under the same subject.

Example: EE 452 (Communications Systems Lab) means

EE	4	5	2
Department of Electrical Engineering	Level (Fourth year)	Field (Communications)	

Specializations

The Department of Electrical Engineering at JUST offers the Bachelor of Science (B.Sc.) degree in Electrical Engineering in the following two specializations:

- Communications
- Power

Degree Requirements

A Bachelor of Science (B.Sc.) degree in Electrical Engineering at JUST is awarded in accordance with the statute stated by JUST regulations (adjusted) for B.Sc. awarding issued by the Deans' Council based on the 1987 law for awarding scientific degrees and certifications at JUST, and after the successful completion of 160 credit hours, distributed as indicated in the following table.

Classification		Credit hours		
		Compulsory	Elective	Total
University requirements		16	9	25
Faculty requirements		32	0	32
Department requirements	Department core	76	0	76
	Specialization requirements	21	6	27
Total		**145**	**15**	**160**

A. University Requirements (25 Credit Hours)

1. Compulsory courses (university requirements): (16 Credit Hours)

Course No.	Course title	Credit hours	Theoretical	Practical
MS 100 (1)	Military sciences	3	3	-
ARA 101	Arabic language	3	3	-
HSS 110	Social responsibility	3	3	-
HSS119(2)	Entrepreneurship and Innovation	2	2	-
LG 112	English language 2	3	3	-
HSS129	General skills	2	2	-

(1) This course is required from Jordanian students only; non-Jordanian students can take a substitute for this course from the university elective courses.
(2) Faculty of Engineering students must take "HSS119A" Introduction to Engineering Innovation and Entrepreneurship instead of "HSS119" Entrepreneurship and Innovation.

Notice: All non-Arabic speaking students in the university are required to study the following courses:

Course No.	Course title	Credit hours	Theoretical	Practical
ARB 101A	Fundamentals of Arabic Language for non-Arabic speaking students (as a substitute for the course ARB 101)	3	3	-
HSS 110A	Social responsibility (in English) (as a substitute for the course HSS 110)	3	3	3

2. Elective courses: (9) credit hours:

A total of 9 credit hours is required.

B. Faculty Requirements: (32 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
*NE 100	Introduction to engineering	1	1	-	----
MATH 101	Calculus I	3	3	-	----
MATH 102	Calculus II	3	3	-	MATH 101
MATH 201	Intermediate Analysis	3	3	-	MATH 102
MATH 203	Ordinary Differential Equations	3	3	-	MATH 102
PHYS 101	General Physics I	3	3	-	----
PHYS 102	General Physics II	3	3	-	PHYS 101
PHYS 107	General Physics Lab	1	-	3	PHYS 102 (or Co.)
CHEM 101	General Chemistry I	3	3	-	----
CHEM 102	General Chemistry II	3	3	-	CHEM 101
CHEM 107	General Chemistry Lab	1	-	3	CHEM 102 (or Co.)
NE 114	Programming for Engineers	3	2	2	-
ME 100	Engineering Workshops	1	-	3	---
ME 200	Engineering Drawing A	1	-	3	-
Total		**32**	**27**	**14**	

* online course.

C. Department Requirements: (103 Credit Hours) distributed as follows:

C-1. Department compulsory courses from the Department of Mechanical Engineering (3 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite
ME 215	Engineering Mechanics	3	3	-	PHYS 101
Total		**3**	**3**	**-**	

C-2. Department compulsory courses from the Department of Industrial Engineering (2 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite
IE 351	Economics and Engineering Management	2	2	-	MATH 201
Total		**2**	**2**	**-**	

C-3. Department compulsory courses from the Department of Computer Engineering (7 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
CPE 234	Digital Logic Design and Computer Architecture	3	3	-	-
CPE 235	Digital Logic Design Lab	1	-	3	CPE 234
CPE 353	Microprocessor Systems	3	3	-	CPE 234
Total		**7**	**6**	**3**	

C-4. Department compulsory courses from the Department of Electrical Engineering (64 credit hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
EE 204	Introduction to Linear Systems	3	3	-	MATH 201
EE 207	Electromagnetics I	3	3	-	PHYS 102, MATH 201, MATH 203 (or Co.)
EE 210	Electric Circuits I	3	3	-	PHYS 102, MATH 203 (or Co.)
EE 213	Electric Circuits Lab	1	-	3	Passing EE 210
EE 220	Introduction to Electronics	3	3	-	EE 210 (or Co.)
EE 260	Signals and Systems Analysis	3	3	-	Passing EE 210, EE 204 (or Co.)
EE 305	Numerical Methods for Engineers	3	3	-	NE 114, MATH 203
EE 307	Electromagnetics II	3	3	-	Passing EE 207, Passing EE 210
EE 310	Electric Circuits II	3	3	-	Passing EE 210, Passing EE 260
EE 320	Electronic Circuits	3	3	-	Passing EE 220
EE 324	Electronic Circuits Lab	1	-	3	EE 320, EE 213
EE 332	Electric Machines	3	3	-	Passing EE 207, Passing EE 310
EE 341	Measurement Systems and Sensors	3	3	-	EE 320, Passing EE 260
EE 360	Random Signal Analysis	3	3	-	Passing EE 260
EE 420	Digital Electronic Circuits	3	3	-	EE 320
EE 422	Digital Electronic Circuits Lab	1	-	3	EE 324, EE 420
EE 432	Electric Machines Lab	1	-	3	EE 213, EE 332
EE 440	Control Systems	3	3	-	Passing EE 260
EE 442	Instrumentation and Control Systems Lab	1	-	3	EE 324, EE 341, EE 440
EE 450	Communication Systems	3	3	-	Passing EE 360
EE 470	Microcontrollers and Embedded Systems	3	3	-	EE 341, CPE 353, Co. EE 472
EE 472	Microcontrollers and Embedded Systems Lab	1	-	2	CPE 235 or,EE 324,

EE 480	Power Systems	3	3	-	EE 332, EE 305
EE 490	Engineering Training	3	-	3	Completion of 117 Credit hours
EE 591	Graduation Project I	1	1	-	Completion of 117 Credit hours
EE 592	Graduation Project II	3	3	-	EE 591, EE490
	Total	**64**	**55**	**20**	

D. Communications Specialization:

D-1. Compulsory Courses (21 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
EE 407	Antennas and Radio Wave Propagation	3	3	-	EE 307
EE 452	Communication Systems Lab	1	-	3	EE 324, EE 450
EE 460	Digital Signal Processing	3	3	-	Passing EE 360
EE 506	Microwaves and Fiber Optics Lab	1	-	3	EE 407
EE 524	RF Communication Circuits	3	3	-	EE 450, EE 320
EE 551	Digital Communications	3	3	-	EE 450
EE 552	Digital Communications Lab	1	-	3	EE 452, EE 551 (or Co.)
EE 559	Wireless and Mobile Communications	3	3	-	EE 551
EE 575	Communication Networks	3	3	-	EE 450
	Total	**21**	**18**	**9**	

D-2. Elective Courses; students are required to choose 6 credit hours from the following table:

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
EE 507	Antennas	3	3	-	EE 407
EE 508	Introduction to Electromagnetic Compatibility	3	3	-	EE 307, EE 320
EE 509	Microwave Engineering	3	3	-	EE 307

EE 521	Solid State Electronics	3	3	-	EE 320
EE 522	Optoelectronics	3	3	-	EE 320
EE 525	Electronic Circuit Design	3	3	-	EE 320
EE 526	Semiconductor Devices	3	3	-	EE 320
EE 528	Microwave Electronics	3	3	-	EE 307, EE 320
EE 529	Integrated Circuits Design	3	3	-	EE 320
EE 555	Optical Fiber Communication Systems	3	3	-	EE 307, EE 551
EE 558	Satellite Communication Systems	3	3	-	EE 551
EE 565	Digital Speech Processing	3	3	-	EE 460
EE 566	Digital Image Processing	3	3	-	EE 460
EE 579	Cryptography and Network Security	3	3	-	CPE 353, EE 450
EE 595	Special Topics in Communications	3	3	-	Completion of 100 Credit Hours

E. Power Specialization:

E-1. Compulsory Courses (21 Credit Hours):

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
EE 435	Power Electronics	3	3	-	EE 320, EE 332
EE 447	Digital Control	3	3	-	EE 440
EE 485	Power Systems Analysis	3	3	-	EE 480
EE 531	Electric Drive Systems	3	3	-	EE 435, EE 440
EE 536	Power Electronics Lab	1	-	3	EE 324, EE 435
EE 581	Power Systems Integration Lab	1	-	3	EE 485, EE 531 (or Co.)
EE 582	Power Systems Lab	1	-	3	EE 485
EE 585	Power Systems Operation	3	3	-	EE 480
EE 586	Power Systems Protection	3	3	-	EE 485
	Total	**21**	**18**	**9**	

E-2. Elective Courses; students are required to choose 6 credit hours from the following table:

Course No.	Course title	Credit hours	Theoretical	Practical (LAB)	Pre-requisite or Co-requisite
EE 525	Electronic Circuit Design	3	3	-	EE 320
EE 526	Semiconductor Devices	3	3	-	EE 320
EE 532	Renewable Energy Systems	3	3	-	EE 435, EE 485
EE 535	Power Semiconductor Devices	3	3	-	EE 435
EE 537	Switched Mode Power Supplies	3	3	-	EE 435, EE 440
*EE 538	High Voltage Engineering	3	3	-	EE 480
EE 539	Advanced Electrical Machines	3	3	-	EE 332
EE 540	Robotics	3	3	-	EE 447
EE 541	Sensors and Actuators	3	3	-	EE 320, EE 332, EE 440
EE 542	Fuzzy Control	3	3	-	EE 447
*EE 546	Power Systems Control	3	3	-	EE 440, EE 480
EE 547	Computer Control	3	3	-	EE 447
EE 549	Mixed Signal Test Engineering	3	3	-	EE 420, EE 442
EE 583	Power Electronic Applications in Power Systems	3	3	-	EE 435, EE 485
EE 587	Power Systems Quality	3	3	-	EE 485
EE 596	Special Topics in Power	3	3	-	Completion of 100 Credit Hours
EE 597	Special Topics in Control	3	3	-	Completion of 100 Credit Hours

*This course could be offered online.

Study Plan

FIRST YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
NE 100	Introduction to Engineering	1	1	-	-	ME 100	Engineering Workshops	1	-	3	-
ME 200	Engineering Drawing A	1	-	3	-	NE 114	Programming For Engineers	3	2	2	-
HSS 119 A	Introduction to Engineering Innovation and Entrepreneurship	2	2	-	-	MATH 102	Calculus 2	3	3	-	MATH 101
MATH 101	Calculus 1	3	3	-	-	CHEM 102	General Chemistry 2	3	3	-	CHEM 101
PHYS 101	General physics 1	3	3	-	-	CHEM 107	General Chemistry lab.	1	-	3	CHEM 102 (or Co.)
CHEM 101	General Chemistry 1	3	3	-	-	PHYS 102	General Physics 2	3	3	-	PHYS 101
ARB 101	Arabic Language	3	3	-	-	PHYS 107	General Physics lab.	1	-	3	PHYS 102 (or Co.)
Total		**16**	**15**	**3**		**Total**		**15**	**11**	**11**	

SECOND YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
LG 112	English Language 2	3	3	-	Passing ENG 099	EE 204	Introduction to Linear Systems	3	3	-	MATH 201
MATH 201	Intermediate Analysis	3	3	-	MATH 102	EE 207	Electromagnetics I	3	3	-	PHYS 102, MATH 201, MATH 203 (or Co.)
MATH 203	Ordinary Differential Equations	3	3	-	MATH 102	EE 213	Electric Circuits Lab	1	-	3	Passing EE 210
EE 210	Electric Circuits I	3	3	-	PHYS 102, MATH 203 (or Co.)	EE 220	Introduction to Electronics	3	3	-	EE 210 (or Co.)
ME 215	Engineering Mechanics	3	3	-	PHYS 101	EE 260	Signals and Systems Analysis	3	3	-	Passing EE 210, EE 204 (or Co.)
HSS 110	Social Responsibility	3	3	-	----	HSS 129	General Skills	2	2	-	----
						MS100	MILITARY SCIENCES	3	3		
Total		**18**	**18**	**-**		**Total**		**18**	**17**	**3**	

THIRD YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
CPE 234	Digital Logic Design and Computer Architecture	3	3	-	----	EE 324	Electronic Circuits Lab	1	-	3	EE 213, EE 320
EE 305	Numerical Methods for Engineers	3	3	-	NE 114, MATH 203	EE 332	Electric Machines	3	3	-	Passing EE 207, Passing EE 310
EE 310	Electric Circuits II	3	3	-	Passing EE 210, Passing EE 260	EE 341	Measurement Systems and Sensors	3	3	-	Passing EE 260, EE 320
EE 307	Electromagnetics II	3	3	-	Passing EE 207, Passing EE 210	IE 351	Economics and Engineering Management	2	2	-	MATH 201
EE 320	Electronic Circuits	3	3	-	Passing EE 220	CPE 353	Microprocessor Systems	3	3	-	CPE 234 or EE 270
EE 360	Random Signal Analysis	3	3	-	Passing EE 260	CPE 235	Digital Logic Design Lab	1	-	3	CPE 234 or EE 270
							University Requirement Elective Course	3	3	-	----
Total		**18**	**18**	**-**		**Total**		**16**	**14**	**6**	

Communications Specialization:

FOURTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
EE 420	Digital Electronic Circuits	3	3	-	EE 320	EE 407	Antennas and Radiowave Propagation	3	3	-	EE 307
EE 432	Electric Machines Lab	1	-	3	EE 213, EE 332	EE 422	Digital Electronic Circuits Lab	1	-	3	EE 324, EE 420
EE 440	Control Systems	3	3	-	Passing EE 260	EE 442	Instrumentation and Control Systems Lab	1	-	3	EE 324, EE 341, EE 440
EE 450	Communication Systems	3	3	-	Passing EE 360	EE 452	Communication Systems Lab	1	-	3	EE 324, EE 450
EE 470	Microcontrollers and Embedded Systems	3	3	-	EE 341, CPE 353 or EE 370, Co. EE 472	EE 460	Digital Signal Processing	3	3	-	Passing EE 360
EE 472	Microcontrollers and Embedded Systems Lab	1	-	2	CPE 235 or EE 272, EE 324, Co. EE 470	EE 480	Power Systems	3	3	-	EE 305, EE 332
						----	University Requirement Elective Course	3	3	-	----
Total		**14**	**12**	**5**		**Total**		**15**	**12**	**9**	

Summer Semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab	
EE 490	Engineering training	3	-	-	Completion of 117 Credit Hours
Total		**3**		-	

FIFTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
EE 506	Microwaves and Fiber Optics Lab	1	-	3	EE 407	EE 552	Digital Communications Lab	1	-	3	EE 452, EE 551 (or Co.)
EE 524	RF Communication Circuits	3	3	-	EE 320 EE 450	EE 559	Wireless and Mobile Communications	3	3	-	EE 551
EE 551	Digital Communications	3	3	-	EE 450	EE 575	Communication Networks	3	3	-	EE 450
EE 591	Graduation Project I	1	-	-	Completion of 117 C.H.	EE 592	Graduation Project II	3	-	-	EE 591, EE490
---	Track Elective Course	3	3	-	Choice Dependent	---	Track Elective Course	3	3	-	Choice Dependent
---	University Requirement Elective Course	3	3	-	---						
Total		**14**	**12**	**3**		**Total**		**13**	**9**	**3**	

Power Specialization:

FOURTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
EE 420	Digital Electronic Circuits	3	3	-	EE 320	EE 422	Digital Electronic Circuits Lab.	1	-	3	EE 324, EE 420
EE 432	Electric Machines Lab.	1	-	3	EE 213, EE 332	EE 435	Power Electronics	3	3		EE 320, EE 332
EE 440	Control Systems	3	3	-	Passing EE 260	EE 442	Instrumentation and Control Systems Lab	1	-	3	EE 324, EE 341, EE 440
EE 470	Microcontrollers and Embedded Systems	3	3	-	EE 341, CPE 353 or EE 370, Co. EE 472	EE 447	Digital Control	3	3	-	EE 440
EE 472	Microcontrollers and Embedded Systems Lab.	1	-	2	CPE 235 or EE 272, EE 324, Co. EE 470	EE 450	Communication Systems	3	3	-	Passing EE 360
EE 480	Power Systems	3	3	-	EE 305, EE 332	EE 485	Power Systems Analysis	3	3	-	EE 480
Total		**14**	**12**	**5**		**Total**		**14**	**12**	**6**	

Summer Semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab	
EE 490	Engineering training	3	-	-	Completion of 117 Credit Hours
Total		**3**		-	

FIFTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credits	Weekly hours		Pre-requisite	Course No.	Course name	Total credits	Weekly hours		Pre-requisite
			Lecture	Lab					Lecture	Lab	
EE 531	Electric Drive Systems	3	3	-	EE 435, EE 440	EE 581	Power Systems Integration Lab	1	-	3	EE 485, EE 531 (or Co.)
EE 536	Power Electronics Lab	1	-	3	EE 324, EE 435	EE 586	Power Systems Protection	3	3	-	EE 485
EE 582	Power Systems Lab	1	-	3	EE 485	EE 592	Graduation Project II	3	-	-	EE 591, EE490
EE 585	Power Systems Operation	3	3	-	EE 480	---	Track Elective Course	3	3	-	Choice Dependent
EE 591	Graduation Project I	1	-	-	Completion of 117 C.H.	---	University Requirement Elective Course	3	3	-	---
---	Track Elective Course	3	3	-	Choice Dependent						
----	University Requirement Elective Course	3	3	-	----						
Total		**15**	**12**	**6**		**Total**		**13**	**9**	**3**	

Catalogue Description of Electrical Engineering Courses:

EE 204 Introduction to Linear Systems (3CH) (Pre-requisite: Math 201)
Gaussian elimination. Theory of simultaneous linear equations. Orthogonal projections and least squares. Determinants. Complex-valued vectors and matrices. Eigenvalues and eigenvectors. Singular value decomposition. Introduction to state-space modeling. Computer applications.

EE 207 Electromagnetics I (3CH) (Pre-requisite: Phys 102, Math 201, Math 203 (or Co.))
Vector analysis. Electrostatic fields. Magneto-static fields. Solution of Laplace's and Poisson's equations. Faraday's law and applications. Maxwell's equations.

EE 210 Electric Circuits I (3CH) (Pre-requisite: Phys 102, Math 203 (or Co.))
Units and definitions. Experimental laws and simple circuits. Useful techniques of circuit analysis. Inductance and capacitance. Source-free RL and RC circuits. Application of the unit step forcing function. RLC circuits. Sinusoidal forcing function. Phasor concept. Sinusoidal steady-state response.

EE 212 Electric Circuit Analysis (Non-EE students) (3CH) (Pre-requisite: Phys 102, Math 203 (or Co.))
Units and definitions. Experimental laws and simple circuits. Useful techniques of circuit analysis. Inductance and capacitance. Source-free RL and RC circuits. Application of the unit step forcing function. RLC circuits. Sinusoidal forcing function. Phasor concept. Sinusoidal steady-state response.

EE 213 Electric Circuits Lab (1CH, 3L) (Pre-requisite: PASSING EE 210)
Resistors and resistive circuits. Potentiometers. Superposition principle. Thevenin's theorem and maximum power transfer. RLC current and voltage characteristics. Frequency response of RL, RC and RLC circuits. Series and parallel resonant circuits. Lab project

EE 220 Introduction to Electronics (3CH) (Pre-requisite: EE 210 (or Co.))
Semiconductor materials. Intrinsic, N-type and P-type semiconductors. Carriers. Density of state and Fermi function. Distribution of carriers. Drift and diffusion currents. Einstein's relationship. p-n junctions: depletion region, forward and reverse biasing, I-V relationship. Diode circuits and applications. Bipolar junction and field-effect transistors: theory, dc biasing, dc and ac load lines, symmetrical swing. Small-signal transistor models.

EE 260 Signals and Systems Analysis (3CH) (Pre-requisite: PASSING EE 210, EE 204 (or Co.))
Discrete and continuous time systems: classifications, convolution and impulse response. Orthogonal expansions and Fourier series. Fourier transform. Laplace transform. Z-transform. System function. Computer applications

EE 270 Digital Logic Design (3CH) (Pre-requisite: NE 114, Equivalent: CPE 234)
Boolean algebra. Combinational logic. Synthesis methods of sequential circuits. Fundamentals of processor design. PLDs, memory, and I/O.

EE 272 Digital Logic Design Lab (1CH, 3L) (Pre-requisite: EE 270 or CPE 234, Equivalent: CPE 235)
Experiments in digital logic and computer design and implementation using TTL integrated circuits including SSI, MSI, and LSI. ALUs. Design and implementation of arithmetic and logic units and various sequential machines.

EE 303 Fundamentals of Electrical Engineering (Non-EE students) (3CH) (Pre-requisite: Math 102, Phys 102)
Electrical quantities. Circuit principles. Basics of DC and AC analysis. Polyphase circuits. Transformers. Semiconductor diodes. Bipolar transistors. Field effect transistors. Thyristors. Operational amplifiers.

EE 304 Electric Drives (3CH) (Non-EE students) (Pre-requisite: EE 303)
Introduction to electric drives. DC drives. AC drives: induction motors, synchronous motors, reluctance and stepping motors. Servomotor drives.

EE 305 Numerical Methods for Engineers (3CH) (Pre-requisite: NE 114, Math 203)
Machine epsilon. Round-off error. Linear systems of equations. Gauss elimination and iterative methods. Eigenvalue methods. Spline interpolation. Numerical integration. Ordinary and partial differential equations. Nonlinear equations. Zeros of polynomials. One dimensional optimization. Least squares data fitting. Singular value decomposition. Random number generators.

EE 306 Electrical Engineering Lab (Non-EE students) (1CH, 3L) (Pre-requisite: EE 304)
DC circuits. Diodes, transistors, thyristors and operational amplifiers. Transformers. DC motors. Synchronous motors. Single- and three-phase and induction motors.

EE 307 Electromagnetics II (3CH) (Pre-requisite: PASSING EE 207, PASSING EE 210)
Maxwell’s equations. Plane waves: propagation, reflection and refraction. Transmission lines. Waveguides and resonant cavities. Introduction to antennas.

EE 310 Electric Circuits II (3CH) (Pre-requisite: PASSING EE 210, PASSING EE 260)
Average power and RMS values. Polyphase circuits. Complex frequency. Frequency response. Magnetically coupled circuits. General two-port networks. Solving circuit problems using Laplace transform. Introduction to electric filters.

EE 320 Electronic Circuits (3CH) (Pre-requisite: PASSING EE 220)
Small signal analysis of BJT and FET amplifiers. Multistage amplifiers. Frequency response of single and multistage amplifiers. Darlington pair amplifiers Differential amplifiers. Operational amplifier theory and applications: summation, subtraction, integration and differentiation. Filters. Oscillators.

EE 321 Electronic Circuits for Non-EE Students (3CH) (Pre-requisite: EE 212 or EE 303)
Diode circuit analysis (DC & AC). Bipolar junction transistors: theory, circuits and applications. Field effect transistors: theory, circuits and application. Introduction to operational amplifiers and applications. Oscillators

EE 322 Electronic Circuits Lab for Non-EE Students (1CH, 3L) (Pre-requisite: EE 213, EE 321)
Diode circuits. DC and AC characteristics of BJT and FET amplifiers. Single- and multi-stage amplifiers and their frequency response. Operational amplifiers and applications. Oscillators. Lab project.

EE 324 Electronic Circuits Lab (1CH, 3L) (Pre-requisite: EE 213, EE 320)
Diode characteristics, Diode applications. DC and AC characteristics. Bipolar junction transistor and field effect transistor characteristics and Biasing. Single- and multi-stage amplifiers. Frequency response of amplifier circuits. Differential amplifier. Operational amplifiers characteristics and applications. Filters. Oscillators. Lab project.

EE 332 Electric Machines (3CH) (Pre-requisite: PASSING EE 207, PASSING EE 310)
Transformers: performance characteristics, three-phase connections, autotransformers. DC machines: performance equations, generator and motor characteristics, starting and speed control of motors. Synchronous machines: generator and motor operation. Three-phase induction motors: operation, performance calculations, starting and speed control. Single phase induction motors. Small synchronous motors. Universal motors.

EE 341 Measurement Systems and Sensors (3CH) (Pre-requisite: PASSING EE 260, EE 320)
Units, Dimensions, and standards. Measurement errors. Statistical analysis of experimental data. Operational amplifier circuits in instrumentation. Transducers: mechanical, thermal, optical. Measurements of basic electrical quantities: electromechanical indicating instruments, electronics multi-meters, digital multi-

meters, ac bridges. Digital-signal conditioning: analogue-to-digital convertors, digital-to-analogue converters, sample-and-hold circuits, data acquisition hardware, IEEE 488 instrumentation bus. Oscilloscopes: vertical deflection system, horizontal deflection system, digital storage oscilloscopes. Spectrum analyzers.

EE 360 Random Signal Analysis (3CH) (Pre-requisite: PASSING EE 260)
Probability principles and set theory. Random variables. Operations on random variables. Various distribution functions. Random processes: temporal and spectral characterization. Response of linear time-invariant systems to random inputs

EE 370 Microprocessor Systems (3CH) (Pre-requisite: EE 270 or CPE 234, Equivalent: CPE 353)
Microprocessor organization and assembly language. Parallel and serial interfaces and bus architecture. Memory organization and software for real time control design applications.

EE 407 Antennas and Radiowave Propagation (3CH) (Pre-requisite: EE 307)
Introduction (Radio spectrum, propagation schemes, radio services). Antenna principles and types. Antenna parameters (e.g., solid angle, field regions, directivity, gain, beamwidth, aperture, impedance, effective length, polarization mismatch loss). Ideal and practical dipoles. Antenna arrays. Friis transmission formula and radar equation. Plane earth propagation. Ionospheric propagation. Knife-edge diffraction. Biological effects of radiation. Free space path loss. Urban propagation. Effects of the earth's magnetic field.

EE 420 Digital Electronic Circuits (3CH) (Pre-requisite: EE 320)
Diodes and transistors as switches. Switching and speed limitations. RTL. DTL. TTL, ECL, and MOS logic gates. Interfacing and expansion of logic circuits. Comparators and Schmidtt triggers. Multivibrators. Timing circuits. A/D and D/A converters. Sample and hold circuits.

EE 422 Digital Electronic Circuits Lab (1CH, 3L) (Pre-requisite: EE 324, EE 420)
Transistor as a switch. TTL logic specifications. Interfacing of logic gates. Comparators and Schmidtt triggers. Monostable and astable multivibrators. 555 timers. A/D and D/A converters. Sweep voltage generators. Sample and hold circuits. Lab project.

EE 432 Electric Machines Lab (1CH, 3L) (Pre-requisite: EE 213, EE 332)
Transformers. Three-phase transformer methods of connection. DC motors. DC generators. Three-phase induction motors. Single-phase induction motors. Three-phase synchronous generator and motor. AC series motor. Lab project.

EE 435 Power Electronics (3CH) (Pre-requisite: EE 320, EE 332)
Power semiconductor devices: types, drive circuits, protection circuits, and power loss calculation. AC-DC converters: uncontrolled and fully-controlled single-phase and three-phase rectifiers, half-controlled rectifiers. AC-AC converters: cycloconverters, ac voltage controllers. DC-AC converters: single-phase and three-phase inverters. DC-DC converters: step-down, step-up, and step-down/up converters.

EE 440 Control Systems (3CH) (Pre-requisite: PASSING EE 260)
Transfer functions. Block diagrams. Signal flow graphs. State-space description. Mathematical modeling of physical systems. Time-domain analysis. Root locus techniques. Frequency-domain analysis and design.

EE 442 Control and Instrumentation Lab (1CH, 3L) (Pre-requisite: EE 324, EE 341, EE 440)
Measurement of motor characteristics: armature connection and field connection. Transient response of motors. Closed-loop position and speed control systems. Dead band and transient characteristics. Passive network compensation. Stabilization with tachogenerator feedback: frequency response measurement. Mechanical, thermal and light measurements.

EE 447 Digital Control (3CH) (Pre-requisite: EE 440)
Review of discrete-time systems and the Z-transform. Sampled data systems. Stability. Jury and Schure–Cohn criterion. Controllability and observability. Gain compensation. Direct design methods. Feedback control systems. Dynamic programming.

EE 450 Communication Systems (3CH) (Pre-requisite: PASSING EE 360)
Equivalent low-pass models. Amplitude modulation and demodulation. Angle modulation and demodulation. AWGN channels and noise and signal power calculations using the PSD. Sampling, quantization and pulse code modulation. Delta modulation. Noise analysis in PCM and DM systems. TDM and Pulse modulation techniques: PAM, PPM, PWM.

EE 452 Communication Systems Lab (1CH, 3L) (Pre-requisite: EE 324, EE 450)
Tuned circuits and crystals. AM modulators. AM demodulators. Super-heterodyne radio receiver. FM modulators. FM demodulators. Simulation using Matlab/Simulink. Lab project.

EE 460 Digital Signal Processing (3CH) (Pre-requisite: PASSING EE 360)

Review of discrete-time signals and systems prosperities and representations. Digital processing of continuous–time signals. Oversampling in A/D and D/A conversions. Review of the Z transform. Frequency response of discrete systems using zero-pole locations. All-pass systems, Minimum phase systems, and applications. Discrete FIR filters design using the Windowing, and PM methods. Design of discrete IIR filters using the Impulse invariance, and the bilinear transformation methods. Discrete Fourier series. Discrete Fourier Transform, and the FFT. Fourier analysis of continuous-time signals using the DFT.

EE 470 Microcontrollers and Embedded Systems (3CH) (Pre-requisite: EE 341, CPE 353 or EE 370, Co. EE 472)

Basic architecture and assembly language of a microcontroller. Principles of microprocessor serial and parallel interfacing covering PSP, USART, I2C and SPI. Timers, A/D and D/A relevant chips. Software and hardware interrupt handling routines. Application of top-down design to microcontroller software development in assembly language and in C-language. Evaluation of hardware and software trade-offs.

EE 472 Microcontrollers and Embedded Systems Lab (1CH, 2L) (Pre-requisite: CPE 235 or EE 272, EE 324, Co. EE 470)

Basic experiments on using Microcontrollers PIC18F4520 to interface LEDs, switches, keypads, LCDs, temperature sensors using the internal ports in assembly and C languages. Experiments on using the built-in timers, A/D converter, USART, I2C and SPI busses. A final individual design project will be carried out by students including analysis of the problem, design of the system hardware and software, simulation and implementation.

EE 480 Power Systems (3CH) (Pre-requisite: EE 305, EE 332)

Basic Concepts and Per Unit Impedances. Phase shift in transformers. Series impedance of transmission lines. Capacitance of transmission lines. Current and voltage relations of transmission lines. Admittance model and network calculations. Impedance model and network calculations. Power flow solutions. Symmetrical fault analysis.

EE 485 Power Systems Analysis (3CH) (Pre-requisite: EE 480)

Symmetrical Components. Unsymmetrical Faults. Power system economics. Load and energy forecasting. Computer based load flow calculations and control. Economic operation of power systems. Power system stability. Power system control. Power system planning and reliability calculations.

EE 490 Engineering Training (3CH) (Pre-requisite: Passing 117 Credit Hours)

The student has to spend at least 8 weeks of electrical engineering training at recognized companies and establishments during the summer semester.

EE 506 Microwaves and Fiber Optics Lab (1CH, 3L) (Pre-requisite: EE 407)

Microwave power measurement. Insertion loss and return loss measurement. Impedance measurement and matching. Basic antenna measurements. Experimentation with different antenna types. Microstrip and array antennas. Basic fiber optic measurements and transmission.

EE 507 Antennas (3CH) (Pre-requisite: EE 407)
Antenna parameters. Radiation integrals. Wire antennas. Arrays. Broadband and traveling wave antennas. Aperture antennas. Reflector antennas. Microstrip antennas.

EE 508 Introduction to Electromagnetic Compatibility (3CH) (Pre-requisite: EE 307, EE 320)
Basic concepts (e.g., emissions, susceptibility, radiation, conduction, electrostatic discharge, attenuation, shielding effectiveness, HEMP, TEMPEST, health hazards). EMI examples and demonstrations. Causes and effects of interference. Strategies for preventing interference. Electrical dimensions. EMC units and power loss in cables. Power source specifications. Military and commercial regulations. Non-ideal behavior of components including: wires, printed circuit boards, resistors, capacitors, inductors, and switches. PSPICE tutorial. PSPICE simulations of EMC tests and transients. Bio-electromagnetics (thermal and nonthermal effects).

EE 509 Microwave Engineering (3CH) (Pre-requisite: EE 307)
Review of Electromagnetics theory. Transmission lines and waveguides. Microwave network analysis. Impedance matching. Passive microwave devices. Stripline and microstrip line circuits. Microwave filters.

EE 521 Solid State Electronics (3CH) (Pre-requisite: EE 320)
Fundamentals of solid-state theory. Continuity equations. Steady state solution. p-n junction characteristics. p-n diode equations and ideality factor. Schottky junctions. Ohmic contacts. Physics of field effect transistors: MOSFET. Physics of bipolar junction transistors (BJT).

EE 522 Optoelectronics (3CH) (Pre-requisite: EE 320)
Materials. Electronic and optical properties in semiconductors. Absorption, spontaneous emission, and stimulated emission. Light emitting diodes. Lasers and laser applications. Optical amplifiers and SOA applications. Photodiodes. Responsivity. Solar cells. Optoelectronics integrated circuits.

EE 524 RF Communication Circuits (3CH) (Pre-requisite: EE 320, EE 450)
Large-signal analysis. Network noise analysis. Tuned amplifiers. Intermodulation distortion. RF oscillators. Super-heterodyne receivers. Phase-locked loops. Frequency synthesizers. Mixers, modulators and demodulators. RF power amplifiers.

EE 525 Electronic Circuit Design (3CH) (Pre-requisite: EE 320)
Feedback amplifiers. Oscillators. Power amplifiers. Current mirrors and active loads. Differential amplifiers. Active filters. Internal structure of operational amplifiers. Integrated analog circuits and applications.

EE 526 Semiconductor Devices (3CH) (Pre-requisite: EE 320)
Basic properties of semiconductor devices. Selected topics in semiconductor materials: statistics, and transport. Aspects of transport in homo- and hetero-junctions. Charge control in different FETs: transport, modeling. Bipolar transistor models (Ebers-Moll, Gummel-Poon): heterostructure bipolar transistors. Special devices.

EE 528 Microwave Electronics (3CH) (Pre-requisite: EE 307, EE 320)
Gunn diode, Tunneling diodes, Schottky barrier diode, microwave bipolar junction transistors and metal semiconductor field-effect transistors. Power added efficiency. Maximum oscillation frequency. Device parameters and optimization. Microwave integrated circuits.

EE 529 Integrated Circuit Design (3CH) (Pre-requisite: EE 320)
Analog design with MOS technology. Differential amplifiers. Wideband amplifiers. Frequency response in amplifiers. Stability and frequency compensation. Noise. Current mirrors. Bandgap references. Nonlinearity and mismatch. MOS operational amplifier.

EE 531 Electric Drive Systems (3CH) (Pre-requisite: EE 435, EE 440)
DC-motor drives using controlled AC-DC converters. DC-motor drives using DC-DC converters. Frequency-controlled Induction-motor drives. Slip energy recovery. Synchronous motor drives using inverters and cycloconverters. Variable reluctance drives: switched reluctance and stepper-motor drives using bridge inverters.

EE 532 Renewable Energy Systems (3CH) (Pre-requisite: EE 435, EE 485)
Passive and active solar systems. Fuel cells. Hydroelectric power. Geothermal heat transfer. Wind energy and system integration.

EE 535 Power Semiconductor Devices (3CH) (Pre-requisite: EE 435)
Carrier transport physics. Breakdown phenomenon in semiconductor devices. Power bipolar transistors. Thyristors. Power junction field-effect transistors. Power field-controlled diodes. Power metal-oxide-semiconductor field-effect transistors. Power MOS-bipolar devices.

EE 536 Power Electronics Lab (1CH, 3L) (Pre-requisite: EE 324, EE 435)
Single-phase fully-controlled bridge rectifier with static/rotating loads. Single-phase half-controlled bridge rectifier. Three-phase controlled bridge rectifier. Single-phase ac voltage controller. Frequency converter. Single-phase bridge inverter with static/rotating loads. Three-phase bridge inverter. Step-down converter. Step-up converter. Step down/up converter. Lab project.

EE 537 Switched-Mode Power Supplies (3CH) (Pre-requisite: EE 435, EE 440)
Types of switched-mode power electronic converters. Feedback control design of switched-mode power supplies. Pulse width modulation controllers. Modeling and simulation of switched-mode power supplies using PSpice and Matlab-Simulink.

EE 538 High Voltage Engineering (3CH) (Pre-requisite: EE 480) (This course could be offered online)
Generation and measurement of high voltage. Electrostatic field and field stress control. Electrical breakdown in gases, solids and liquids. Non-destructive insulation test techniques. Over-voltages and insulation coordination.

EE 539 Advanced Electric Machines (3CH) (Pre-requisite: EE 332)
Linear Electric machines: comparison with rotating machines. Linear induction motors: simplified electromagnetic field theory, force equation, characteristics. Superconducting ac generators and motors. Variable reluctance motors: performance and characteristics. Printed circuit motors.

EE 540 Robotics (3CH) (Pre-requisite: EE 447)
Introduction. Basic mathematics: transformation, position and orientation, rotation mathematics, Euler angles. Kinematics and inverse kinematics. Jacobians and inverse Jacobians relations. Dynamics of robots & manipulators. End effectors. Sensors with applications. Robot trajectory and task planning. Linear control of robots. Nonlinear control (feedback linearization). Robot programming and control software design.

EE 541 Sensors and Actuators (3CH) (Pre-requisite: EE 320, EE 332, EE 440)
Sensors performance terminology. Thermal sensors: metal temperature detectors, thermistors, thermocouples, bimetal switches, electronic temperature sensors. Mechanical sensors: potentiometric, capacitive, inductive, ultrasonic, piezoelectric, strain gauges, proximity and limit switches, digital encoders, Hall-effect sensors. Optical sensors: photoconductive cells, solar cells, photodiodes, spectral response. Actuators: electrical, pneumatic, and hydraulic. Application examples.

EE 542 Fuzzy Control (3CH) (Pre-requisite: EE 447)
Introduction. Conventional control system design, Fuzzy control system. Basics of fuzzy control: choosing fuzzy controller input and outputs, putting control knowledge into rule-bases, fuzzy quantification of knowledge, matching, inference step, converting decisions into actions, graphical depiction of fuzzy control making, visualizing the fuzzy controller's dynamical operation. General fuzzy systems: linguistic variables, fuzzy sets, fuzzification, inference mechanism, defuzzification, mathematical representation of fuzzy systems, Takagi-Sugeno fuzzy systems, simulation of fuzzy control systems, real-time implementation

issues. Adaptive fuzzy control, fuzzy supervisory control: fuzzy tuning of PID controller, fuzzy gain scheduling, fuzzy superposition of conventional controllers.

EE 546 Power Systems Control (3CH) (Pre-requisite: EE 440, EE 480) (This course could be offered online)
Flow of power in an AC system. Flexible AC transmission systems. Static VAR types and basic characteristics. Static VAR compensator applications to electric power systems: static shunt compensators and statcom. Application examples.

EE 547 Computer Control (3CH) (Pre-requisite: EE 447)
Computer role in processes. Digitization. Difference Equations. Discrete form of controllers and their applications in systems. Computer control configurations. Computer Interfacing. Computer instructions for program driven and interrupt driven high-level languages. Real-time operating systems. Interfacing sensors in computer control applications. Command generation in machines & processes. Applications for robot arm motion. Sequential control using programmable logic controller.

EE 549 Mixed Signal Test Engineering (3CH) (Pre-requisite: EE 420, EE 442)
Overview of mixed signal testing. The test specification process. DC and parametric measurements. Measurement accuracy. Tester hardware. Sampling theory. DSP-based testing. Analog channel testing. Digital channel testing. Design for test. Data analysis. Test economics.

EE 551 Digital Communications (3CH) (Pre-requisite: EE 450)
Digital modulation schemes: signal space representation, baseband and bandpass representation of digitally modulated signals, power spectra of digitally-modulated signals. Optimum receivers for AWGN channels: Detection principles for digital communication signals in noise, correlation and matched filter receivers, signal space concepts, maximum a posteriori receivers, maximum likelihood receivers, coherent and non-coherent detection, bit error rate analysis. Baseband and bandpass transmission through band-limited channels: Nyquist's criterion and ISI analysis. Introduction to information theory and source coding. Introduction to error control coding.

EE 552 Digital Communications Lab (1CH, 3L) (Pre-requisite: EE 452, EE 551 (or Co.))
Digital waveform generators. Waveform analysis. Pulse amplitude modulators and demodulators. Sample and hold circuits. Delta modulation. PCM. ASK, FSK, PSK, DPSK systems.

EE 555 Optical Fiber Communication Systems (3CH) (Pre-requisite: EE 307, EE 551)
Components, advantages and classifications of fiber communication systems. Dielectric slab wave-guide. Step index fiber. Graded index fiber. Attenuation and dispersion. Light sources. Optical modulation. Photodetectors. Optical detection. Noise in the optical receiver. Heterodyne detection. Bit error rate analysis of direct detection and heterodyne detection systems.

EE 558 Satellite Communication Systems (3CH) (Pre-requisite: EE 551)
Overview of satellite communication. Earth station technology. Earth-orbiting and geostationary satellites. Channel characterization and link budget calculations. Transponders and transponder model. Channelization. Frequency plans. Propagation and interference considerations. Satellite access techniques. Introduction to satellite networks.

EE 559 Wireless and Mobile Communications (3CH) (Pre-requisite: EE 551)
Overview of wireless communications. Cellular systems: principles, trunking, grade of service and traffic capacity, power control, and handovers. Characterization of wireless channels: large scale and small scale propagation mechanisms, path loss, multipath and fading. Digital modulation techniques for wireless channels. Power efficiency, nonlinear amplifiers, diversity. Performance in multipath fading channels. Multiple access: fixed (FDMA, TDMA, CDMA) and random (ALOHA, CSMA) access methods.

EE 565 Digital Speech Processing (3CH) (Pre-requisite: EE 460)
Production and classification of speech sounds. Acoustics of speech production. Analysis and synthesis of pole-zero speech models. Short-time Fourier transform analysis and synthesis. Filter-bank analysis and synthesis. Sinusoidal analysis/synthesis. Speech Coding. Speech enhancement.

EE 566 Digital Image Processing (3CH) (Pre-requisite: EE 460)
Introduction. Image digitization. Human vision system and color imaging. Image enhancement and histogram techniques. Image edge/line detection. Image transformations and filtering. Image denoising. Geometric operations. Image segmentation. Introduction to image compression.

EE 575 Communication Networks (3CH) (Pre-requisite: EE 450)
Introduction to queuing theory. Physical data link and network layers. Network topologies. Basic performance evaluation methods. Circuit and packet switching. Local area networks.

EE 579 Cryptography and Network Security (3CH) (Pre-requisite: CPE 353 or EE 370, EE 450)
Privacy and authentication; attacks, services, and mechanisms. Symmetric key crypto-systems: Caesar and Hill ciphers, modern techniques including stream ciphers and the Digital Encryption Standard DES. Triple and Double DES. Introduction to network layers. Placement of encryption function. Key distribution. Introduction to Number Theory: Prime and relatively prime numbers, modular arithmetic, Euler's Totient function, Fermat's and Euler's theorems, primality testing, factoring, Euclid's algorithm, the Chinese remainder theorem, and discrete logarithms. Public-Key crypto-systems (Asymmetric key): RSA and Diffie-Hellman. Message Authentication and Hash Functions. Digital Signatures and Authentication Protocols. Electronic Mail Security: privacy and authentication (Pretty Good Privacy PGP, Secure/Multipurpose Internet Mail Extension S/MIME). Web Security requirements.

EE 581 Power Systems Integration Lab (1CH, 3L) (Pre-requisite: EE 485, EE 531 (or Co.))
Application of computer packages and techniques on modern power systems. System modeling and simulation.

EE 582 Power Systems Lab (1CH, 3L) (Pre-requisite: EE 485)
Transmission line performance under different operating conditions. Real and reactive power flow and control for a transmission line. Characteristics of different types of relays. Power system protection using relays. Measurement of sequence components. Balanced and unbalanced faults. Power system transients and stability. Lab Project.

EE 583 Power Electronic Applications in Power Systems (3CH) (Pre-requisite: EE 435, EE 485)
Semiconductor devices for power engineering applications. Common power electronics circuits. Impact of power electronics loads on power quality. Hvdc: converter plant. Transmission plant. Control strategies. Flexible AC transmission: Conventional and advanced devices. Shunt compensation. Static var compensation. Series compensation. Angle compensation. Quadrature boosters. Unified power flow controller.

EE 585 Power Systems Operation (3CH) (Pre-requisite: EE 480)
Electric power generation, transmission and distribution. Overhead power lines and underground power cables. Substation design. Power system economics. Load and energy forecasting. Earthing.

EE 586 Power Systems Protection (3CH) (Pre-requisite: EE 485)
Relay operating principles. Current and voltage transformers. Generator protection. Motor protection. Transformer protection. Bus protection. Transmission line protection. Computerized protection of power systems.

EE 587 Power Systems Quality (3CH) (Pre-requisite: EE 485)
Introduction to power quality. Wiring and grounding issues. Voltage sags. Voltage variations. Transients. Harmonics. Longer duration voltage variation. Distributed generation and power electronics. Instrumentation and analyzers.

EE 591 Graduation Project I (1CH) (Pre-requisite: Completion of 117 Credit Hours)
Project preparation by forming teams supervised by a faculty member. Selecting the project's scope, understand the theory, background and application. Understand the ethical and professional issues in engineering practice. A final presentation and report are required.

EE 592 Graduation Project II (3CH) (Pre-requisite: EE490, EE 591)
Practical implementation of the project approved in the first portion of the graduation project sequence. A final report and presentation are required.

EE 595 Special Topics in Communications (3CH) (Pre-requisite: Department Council Approval)
Content has to be approved by the Electrical Engineering Department Council.

EE 596 Special Topics in Power (3CH) (Pre-requisite: Department Council Approval)
Content has to be approved by the Electrical Engineering Department Council.

EE 597 Special Topics in Control (3CH) (Pre-requisite: Department Council Approval)
Content has to be approved by the Electrical Engineering Department Council.