KING SAUD UNIVERSITY

COLLEGE OF ENGINEERING

ELECTRICAL ENGINEERING DEPARTMENT

ACADEMIC PLAN

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING PROGRAM

1439 H

2018 G

Approved by: Chairman: …… Dean: ……

KING SAUD UNIVERSITY
COLLEGE OF ENGINEERING
ELECTRICAL ENGINEERING DEPARTMENT

ACADEMIC PLAN
BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING PROGRAM

1 INTRODUCTION

The Electrical Engineering Department has been in the forefront of the educational development process at King Saud University up to this year as it celebrates its 50th anniversary. Since its establishment, the Electrical Engineering Department has effectively contributed to the rapid development of the educational system in the Kingdom by striving to offer graduates who are qualified to play a vital role in all development plans of the country and hold key positions in all governmental and private sectors. As is understood by its faculty and staff members, the main objective of the Electrical Engineering Department is to educate highly specialized and qualified electrical engineers in different fields of electrical engineering who are capable of enhancing the rapid industrial, economic and social development that takes place in Saudi Arabia.

Accordingly, the Electrical Engineering Program prepares engineers to work in electrical power engineering stations, substations and high voltage transmission networks. The program also teaches students the issues pertaining to the design, development, and analysis of different types of electrical generators and motors in addition to their operation, maintenance, and control through extensive knowledge of power electronics. In addition, the program qualifies engineers to be capable of designing, developing, operating, and maintaining networks including antenna systems, satellite, microwave, and digital communications, in addition to signal processing. On the other hand, the program also prepares engineers to design, manufacture, and maintain the electronic systems used various civilian or military fields. Moreover, the Department prepares system engineers to design and manage automation, artificial intelligence and control systems of various industrial processes.

The Electrical Engineering Department is continuously updating the curricula of undergraduate and graduate programs to keep pace with the national and international norms. In this regard, the Department is fully equipped with advanced facilities and high-quality laboratories that cover all aspects of electrical engineering. These facilities are subject to continuous upgrades and improvements in order to keep pace with the latest technology requirements. Graduates of Electrical Engineering Program are thus equipped with experience to excel in notable job opportunities in various specialties related to electrical engineering. The Electrical Engineering Program is also accredited on both national level by "*Education Evaluation Commission-National Center for Academic Accreditation"* and internationally by *"Accreditation Board for Engineering and Technology, Inc. (ABET)"*

Approved by: Chairman: …… Dean: ……

2 BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING PROGRAM

Graduates of the Electrical Engineering program earn Bachelor of Science in Electrical Engineering Degree. The curriculum is covered in five-years (ten-semesters).

With the availability of various elective courses, the program prepares a student with adequate depth and breadth experience in various specialization areas including Electronics, Communication Systems, Electrical Power Engineering, and Automation and Intelligent Systems.

This program plan is carefully designed this program to provide more opportunities and less restrictions by allowing students to have breadth of knowledge in important areas of modern electrical engineering and simultaneously ensure that the graduates have sufficient depth to begin professional work.

2.1 Course Requirements

Students need to successfully pass 165 credit hours with minimum GPA of (2.75 of 5) to complete graduation requirements. This includes the following

- 32 credit hours of first common year (Table 2)
- 8 credit hours of University requirements (Table 3), which includes:
  - Compulsory course (2 credit hours) (Table 3A)
  - Elective courses: student chooses 3 courses (6 credit hours) (Table 3B).
- 48 credit hours of College requirements (Table 4) of which:
  - 40 credit hours are common courses for all programs (Table 4A)
  - 6 credit hours of additional courses for Electrical Engineering Program (Table 4B)
  - 2 credit hours of free elective courses to be taken by student from any college but not from his department (Table 4C).
- 77 credit hours of departmental requirements (Table 5) of which:
  - 42 credit hours are core courses (Table 5A).
  - 4 credit hours of capstone design projects (Table 5B).
  - 30 credit hours of elective courses (Table 5C).
  - One credit hour of practical training with no-grade (Table 5D).

- The 30 credit hour elective courses are divided into the following groups:
    - Elective Laboratory Courses (3 cr. hr.): (Table 5E)
    - Electrical Engineering Elective Courses (27 cr. hr.): (Table 5F)
    - Students are allowed to register for an optional course on principles of scientific research (Table 5G)
- Student chooses a depth area from one of various specialization areas that are declared to students in the beginning of their study in the 7th level.
- The academic advisor of each depth area helps the student to choose the elective courses that equip the student with adequate depth and breadth experience.
- The elective courses focus on design aspects and they assist the student in his capstone design projects.
- The student teams for capstone design project are arranged during the 8th level of study. Students work on their design projects during the 9th and 10th levels.

2.2 Senior Graduation Project Requirements

The design project is divided into two parts (2 credit hours each). The student is eligible to register for Senior Design Project-1 if he completes successfully at least 129 credit hours of the plan, and completing all courses of the 7th level, and other earlier levels. Senior Design Projects (1 and 2) can be taken during the first and second semesters only (not during the summer semester).

2.3 Practical Training Requirements

Program students must complete 10 week Practical Training in an area related to electrical engineering**,** prior to graduation. Prior to undertaking the practical training program, the student must obtain the approval of the department and he must have completed at least 110 credit hours. The student's performance is evaluated by the coordinators of both the training company and the department. Students enrolling in the practical training program are not allowed to take simultaneously any course or the graduation project.

A typical plan of study for a B. S. in Electrical Engineering for the ten levels is presented in Table 6.

Table 1: SUMMARY OF B.S. DEGREE REQUIREMENTS IN ELECTRICAL ENGINEERING

Requirements	Cr. Hr.	Description
Common First Year	**32**	General Chemistry (4) Differential Calculus (3) Statistics (3) English (12) Writing Skills (2) University Skills (3) IT Skills (3) Entrepreneurship (1) Health and Fitness (1)
University	**8**	**Islamic Studies**: Compulsory (2) Complementary (6)
College	**48**	Common (40) Additional (6) Free Elective Course (2)
Department	**77**	Core (42) Electrical Electives (30) Projects (4) Practical Training (1,NP) Research Project (0, NP)
Total	**165**	

Table 2: Common First Year (32 credit hours)

Level 1			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
ENGS 100	English language	6(6,9,0)	
MATH 101	Differential Calculus	3(3,1,0)	
ENT 101	Entrepreneurship	1(1,0,0)	
CHEM 101	General Chemistry	4(3,0,2)	
ARAB 100	Writing Skills	2(2,0,0)	
Total		**16**	

Level 2			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
ENGS 110	English	6(6,9,0)	
CUR 101	University Skills	3(3,0,0)	
CT 101	IT skills	3(0,0,6)	
STAT 101	Introduction to Statistics	3(2,2,0)	
EPH 101	Health Education & Fitness	1(1,1,0)	
Total		**16**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Approved by: Chairman: …… Dean: ……

Table 3: UNIVERSITY REQUIREMENTS (TOTAL 8 CREDIT HOURS)

Table 3A: Compulsory University Requirements (2 Credit Hours)

Course Code	Course Title	Cr. Hr.	Nature
IC 107	Ethics of the Profession	2	Compulsory
	Total	**2**	

Table 3B: Elective University Requirements

Student chooses 6 credit hours from this table

Course Code	Course Title	Cr. Hr.	Nature
IC 100	Studies in Prophet Biography	2	Elective
IC 101	Origins of Islamic Culture	2	Elective
IC 102	Family in Islam	2	Elective
IC 103	The Economic System in Islam	2	Elective
IC 104	The Political System in Islam	2	Elective
IC 105	Human Rights	2	Elective
IC 106	Medical Jurisprudence	2	Elective
IC 108	Contemporary Issues	2	Elective
IC 109	Role of Women in Development	2	Elective
QURN 100	Quran Kareem	2	Elective
	Total	**6**	

Approved by: Chairman: …… Dean: ……

Table 4: COLLEGE REQUIREMENTS

Table 4A: COLLEGE COMPULSORY COURSES (40 CREDIT HOURS)

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
MATH 106	Integral Calculus	3 (3,2,0)	MATH 101
MATH 107	Vectors and Matrices	3 (3,2,0)	MATH 101
MATH 203	Differential & Integral Calculus	3 (3,2,0)	MATH 106; MATH 107
MATH 204	Differential Equations	3 (3,2,0)	MATH 203
PHYS 103	General Physics (1)	4 (3,0,2)	
PHYS 104	General Physics (2)	4 (3,0,2)	PHYS 103
ENGL 109	Language & Communication	2 (2,1,0)	
ENGL 110	Technical Writing	2 (2,1,0)	ENGL 109
GE 201	Statics	3 (3,1,0)	MATH 106; MATH 107
GE 104	Basics of Engineering Drawing	3 (2,0,2)	
GE 106	Introduction to Engineering Design	3 (2,1,2)	GE 104
GE 203	Engineering and Environment	2 (2,0,0)	CHEM 101; MATH 101
GE 402	Engineering Projects Management	3 (3,1,0)	
GE 403	Engineering Economy	2 (2,1,0)	
Total		**40**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Table 4B : COLLEGE ADDITIONAL COURSES FOR ELECTRICAL ENGINEERING PROGRAM (6 CREDIT HOURS)

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
GE 211	Computer Programming in "C++"	3(2,0,2)	
MATH 254	Numerical Methods	3(3,2,0)	*MATH 107*
	Total	**6**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Table 4C: COLLEGE FREE COURSE (2 CREDIT HOURS)

Course Code	Course Title	Cr. Hr.	Prerequisites
XXX	Free Elective Course	2	
	Total	**2**	

Approved by: Chairman: …… Dean: ……

Table 5: ELECTRICAL ENGINEERING REQUIREMENTS

Table 5A: CORE COURSES

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
EE 201	Fundamentals of Electric Circuits	3(3,1,0)	*MATH 106*	
EE 202	Electric Circuit Analysis	3(3,1,0)	*EE 201* *MATH 107*	
EE 203	Engineering Electromagnetics (1)	3(3,1,0)	*MATH 203* *PHYS 104*	
EE 204	Engineering Electromagnetics (2)	3(3,1,0)	*EE 203*	
EE 205	Electric Circuits Laboratory	1(0,0,2)		*EE 202*
EE 208	Logic Design	3(3,1,0)		
EE 210	Logic Design Laboratory	1(0,0,2)		*EE 208*
EE 301	Signals and Systems Analysis	3(3,1,0)	*EE 201*	
EE 302	Modeling and Simulation Laboratory	1(0,0,2)	*EE 301*	
EE 310	Microelectronic Devices and Circuits	3(3,1,0)	*EE 201*	
EE 312	Basic Electronics Laboratory	1(0,0,2)		*EE 310*
EE 320	Communications Principles	3(3,1,0)	*EE 301*	
EE 330	Electromechanical Energy Conversion (1)	3(3,1,0)	*EE 202* *EE 203*	
EE 340	Fundamentals of Power Systems	3(3,1,0)	*EE 202*	
EE 351	Automatic Control	3(3,1,0)	*EE 301*	
EE 353	Introduction to Microprocessors	3(3,1,0)	*EE 208*	
EE 356	Control and Instrumentation Laboratory	1(0,0,2)		*EE 351*
EE 357	Microprocessor and Microcontroller Laboratory	1(0,0,2)		*EE 353*
	Total	**42**		

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab. NP= No grade (Pass or Fail)

Table 5B: SENIOR DESIGN PROJECTS (4 CREDIT HOURS)

Course Code	Course Title	Cr. Hr. (X,Y,L)	Prerequisites
EE 496	Graduation Project -1	2(2,0,0)	Complete successfully 129 credits hours and pass all courses in levels 1-7.
EE 497	Graduation Project -2	2(2,0,0)	EE 496
	Total	**4**	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Approved by: Chairman: …… Dean: ……

Table 5C: ELECTIVE COURSES REQUIREMENTS

Elective Module	Cr. Hr.	Notes
Elective Laboratories	3	Table 5E
Electrical Engineering Elective Courses	27	Table 5F
Optional Elective Course	0	Table 5G
Total	**30**	

Table 5D: PRACTICAL TRAINING

Course Code	Course Title	Cr. Hr.	Prerequisites
EE 999	Practical Training	1 (NP)	Successful Completion of 110 credit hours
	Total	**1**	

(NP): No grade-Pass

Table 5E: ELECTIVE LABORATORIES

Student chooses 3 credit hours from the following table

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
EE 402	Electronic Circuits Laboratory	1(0,0,2)		*EE 400*
EE 406	VLSI Design Laboratory	1(0,0,2)		*EE405*
EE 421	Communications Laboratory	2(0,0,4)	*EE 320*	*EE 423*
EE 433	Electromechanical Energy Conversion Laboratory	1(0,0,2)		*EE 430*
EE 445	Electrical Power Laboratory	2(0,0,4)		*EE 441*
EE 457	Applied Control Laboratory	1(0,0,2)		*EE 456*
EE 459	Advanced Logic Design Laboratory	1(0,0,2)		*EE 458*
Total		*3*		

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Approved by: Chairman: …… Dean: ……

Table 5F: ELECTRICAL ENGINEERING ELECTIVE COURSES

Student chooses 27 credit hours from the following table. Student can also choose the course EE 998 as an optional course

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
EE 400	Digital and Analog Electronic Circuits	3(3,1,0)	*EE 310*	
EE 403	Semiconductor Devices	3(3,1,0)	*EE 310*	
EE 404	Solar Cells and Photovoltaic Systems	3(3,1,0)	*EE 310*	
EE 405	VLSI Circuit Design	3(3,1,0)	*EE 310*	
EE 407	Electronic Communication Circuits	3(3,1,0)	*EE 310* *EE 320*	
EE 408	VLSI Technology and Fabrication	3(3,1,0)	*EE 310*	
EE 409	Electronic Instrumentation	3(3,1,0)	*EE 310*	
EE 410	Optoelectronic Devices and Systems	3(3,1,0)	*EE 310*	
EE 412	Low Power VLSI Design	3(3,1,0)	*EE 405*	
EE 415	Principles of Nanoelectronics	3(3,1,0)	*EE 310*	
EE 419	Introduction to Electronic Warfare	3(3,1,0)	*EE 310*	
EE 420	Digital Signal Processing	3(3,1,0)	*EE 301*	
EE 422	Digital Communications	3(3,1,0)	*EE 320*	
EE 423	Wave Propagation and Antennas	3(3,1,0)	*EE 204*	
EE 425	Satellite Communications	3(3,1,0)	*EE 423*	
EE 426	Microwave Engineering	3(3,1,0)	*EE 204*	
EE 430	Electromechanical Energy Conversion (2)	3(3,1,0)	*EE 330*	
EE 432	Power Electronics	3(3,1,0)	*EE 310*	
EE 435	Electric Drives	3(3,1,0)	*EE 330* *EE 432*	
EE 436	Electrical Machine Dynamics and Stability	3(3,1,0)	*EE 330*	
EE 441	Power System Analysis	3(3,1,0)	*EE 340*	
EE 443	Power System Operation and Control	3(3,1,0)	*EE 441*	
EE 444	Power System Planning	3(3,1,0)	*EE 340*	
EE 446	High Voltage Engineering	3(3,1,0)	*EE 340*	
EE 448	Power Distribution Systems	3(3,1,0)	*EE 340*	
EE 449	Power System Protection	3(3,1,0)	*EE 441*	
EE 450	Computer Architecture Organization	3(3,1,0)	*EE 353*	
EE 453	Microprocessor and Embedded System Design	3(3,1,0)	*EE 353*	
EE 454	Advanced Control Systems	3(3,1,0)	*EE 351*	
EE 456	Automatic Control Applications	3(3,1,0)	*EE 351*	
EE 458	Advanced Logic Design	3(3,1,0)	*EE 210*	
EE 463	Wireless Communications	3(3,1,0)	*EE 422*	
EE 464	Optical Communications	3(3,1,0)	EE 204, *EE 310, EE 320*	
EE 465	Probability Theory with Engineering Applications	3(3,1,0)	*STAT 101*	
EE 466	Cryptography and Network Security	3(3,1,0)	*EE320*	
EE 468	Selected Topics in Communications and Signal Processing	3(3,1,0)	*EE 301* *EE 320*	
EE 469	Selected Topics in Engineering Electromagnetics	3(3,1,0)	*EE 204*	
EE 470	Renewable Energy Engineering	3(3,1,0)	*EE 310* *EE 340*	
EE 479	Selected Topics in Electrical Power Engineering	3(3,1,0)	*EE 340*	
EE 480	Introduction to Artificial Intelligence	3(3,1,0)	*EE 351*	
EE 481	Real Time System Design	3(3,1,0)	*EE 353*	
EE 482	Communication Networks	3(3,1,0)	*EE 320*	
EE 483	Digital Control Systems	3(3,1,0)	*EE 351*	
Total Elected		**27**		

Approved by: Chairman: …… Dean: ……

Table 5G: ELECTIVE DEPARTMENT OPTIONAL COURSES WITHOUT CREDIT HOURS

Course Code	Course Title	Cr. Hr. (X,Y,L)	Requisites	
			Pre-	Co-
EE 998	Research Project	0 (NP)	Successful completion of 129 cr. hr.	

(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.
NP=No grade (Pass or Fail)

Approved by: Chairman: …… Dean: ……

Table 6: RECOMMENDED SEMESTER SCHEDULE – ELECTRICAL ENGINEERING PROGRAM*

Level 1			
Course Code	**Course Title**	**Cr. Hr.(X,Y,L)**	**Pre-requisite**
ENGS 100	English language	6(6,9,0)	
MATH 101	Differential Calculus	3(3,1,0)	
ENT 101	Entrepreneurship	1(1,0,0)	
CHEM 101	General Chemistry	4(3,0,2)	
ARAB 100	Writing Skills	2(2,0,0)	
Total		**16**	

Level 2			
Course Code	**Course Title**	**Cr. Hr.(X,Y,L)**	**Pre-requisite**
ENGS 110	English	6(6,9,0)	
CUR 101	University Skills	3(3,0,0)	
CT 101	IT skills	3(0,0,6)	
STAT 101	Introduction to Statistics	3(2,2,0)	
EPH 101	Health Education & Fitness	1(1,1,0)	
Total		**16**	

Level 3			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
IC 1xx	Optional IC course	2(2,0,0)	
PHYS 103	General Physics (1)	4(3,0,2)	
MATH 106	Integral Calculus	3(3,2,0)	MATH 101
MATH 107	Vectors & Matrices	3(3,2,0)	MATH 101
ENGL 109	Language & Communication	2(2,1,0)	
GE 104	Basics of Engineering Drawing	3(2,0,2)	
Total		**17**	

Level 4			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
PHYS 104	General Physics (2)	4(3,0,2)	PHYS 103
ENGL 110	Technical Writing	2(2,1,0)	ENGL 109
MATH 203	Differential and Integral Calculus	3(3,2,0)	MATH 106 MATH 107
GE 106	Introduction to Engineering Design	3(2,1,2)	GE 104
GE 201	Statics	3(3,1,0)	MATH 106 MATH 107
GE 203	Engineering and Environment	2(2,0,0)	CHEM 101 MATH 101
Total		**17**	

Level 5			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre- (Co-) requisite**
EE 201	Fundamentals of Electric Circuits	3(3,1,0)	*MATH 106*
EE 203	Engineering Electromagnetics (1)	3(3,1,0)	*MATH 203* *PHYS 104*
GE 211	Computer Programming in C++	3(2,0,2)	
MATH 204	Differential Equations	3(3,2,0)	*MATH 203*
EE 208	Logic Design	3(3,1,0)	
EE 210	Logic Design Laboratory	1(0,0,2)	EE 208 [C]
Total		**16**	

Level 6			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre- (Co-) requisite**
EE 202	Electric Circuit Analysis	3(3,1,0)	*EE 201* *MATH 107*
EE 204	Engineering Electromagnetics (2)	3(3,1,0)	*EE 203*
EE 205	Electric Circuits Laboratory	1(0,0,2)	*EE 202* [C]
EE 301	Signals and Systems Analysis	3(3,1,0)	*EE 201*
EE 310	Microelectronic Devices and Circuits	3(3,1,0)	EE 201
EE 312	Basic Electronics Laboratory	1(0,0,2)	EE 310 [C]
IC xx	2nd Elective Islamic Culture Course	2(2,0,0)	
Total		16	

Approved by: Chairman: …… Dean: ……

Level 7			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre- (Co-) requisite**
Math 254	Numerical Techniques	3(3,2,0)	MATH 107
EE 302	Modeling and Simulation Lab	1(0,0,2)	*EE301*
EE 320	Communications Principles	3(3,1,0)	*EE 301*
EE 330	Electromechanical Energy Conversion (1)	3(3,1,0)	*EE 202* *EE 203*
EE 340	Fundamentals of Power Systems	3(3,1,0)	*EE 202*
EE 353	Introduction to Microprocessors	3(3,1,0)	*EE 208*
EE 357	Microprocessor and Microcontroller Lab	1(0,0,2)	*EE 353* [C]
Total		**17**	

Level 8			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre- (Co-) requisite**
EE 351	Automatic Control	3(3,1,0)	*EE 301*
EE 356	Control and Instrumentation Laboratory	1(0,0,2)	*EE 351* [C]
EE4xx	EE Specialized Elective Course	10 (10,0,0)	*Refer to Table 5*
IC 107	Ethics of the Profession	2(2,0,0)	
	Free Elective Course	2(2,0,0)	
Total		**18**	

Level 9			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
EE 4xx	Specialized Elective Courses	11(11,0,0)	*Refer to Table 5*
EE 496	Graduation Project (1)	2(2,0,0)	Complete successfully 129 credits hours and pass all courses in levels 1-7.
GE 403	Engineering Economy	2(2,1,0)	
IC 1xx	3rd Elective Islamic Culture Course	2(2,0,0)	
Total		**17**	

Level 10			
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**
EE 4xx	EE Specialized Elective Course	9(9,0,0)	*Refer to Table 5*
EE 497	Graduation Project (2)	2(2,0,0)	*EE 496*
GE 402	Engineering Projects Management	3(3,1,0)	
EE 998	Research Project	0 (NP)	Complete successfully 129 credit hours
EE 999	Practical Training	1 (NP)	Successful completion of 110 credit hours
Total		**15**	

** CO-REQUISITE , NP: No grade (Pass or Fail)
(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

Approved by: Chairman: …… Dean: ……

3 COURSE DESCRIPTION

3.1 First Common Year

ENGS 100: English language ***6(6,9,0)***

This initial stage of the course is designed to give the students a strong foundation in the language, improving their command of English as well as improving their vocabulary, reading, writing and communication skills. In the process of improving these skills, students will also develop their confidence in the language and also their presentation skills. These all contribute to the life skills of the student and help to prepare them for their future studies and careers beyond KSU. As the course progresses and students reach a higher level of English, the focus will switch to the academic side of the language. This will involve preparing students for the style of language they will need for their future studies.
Pre-requisites: None.

MATH 101: Differential Calculus ***3(3,1,0)***

Limits and Continuity: The Concept of Limit, Computation of Limits, Continuity and its Consequences, Limits Involving Infinity, Formal Definition of the Limit. Differentiation: The Concept of Derivative, Computation of Derivatives (The Power Rule, Higher Order Derivatives, and Acceleration), the Product and Quotient Rules, The Chain Rule, Derivatives of Exponential and Logarithmic Functions, Implicit Differentiation and Inverse Trigonometric Functions, the Mean Value Theorem. Applications of Differentiation: Indeterminate Forms and L'Hopital's rule, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity and the Second Derivative Test, Optimization, Related Rates.

Textbook: Robert T. Smith, and Roland R. Minton, "Calculus, early Transcendental functions", Third Edition, 2007.
Pre-requisite: None

ENT 101 Entrepreneurship ***1(1,0,0)***

Pre-requisites: None.

CHEM 101: General Chemistry ***4(3,0,2)***

Stoichiometry: SI Units, chemical formulas, the mole, methods of expressing concentration, Calculations based on chemical equations. Gases: laws, kinetic theory, deviation and van der Waals equation. Thermochemistry: Types of enthalpy changes, Hess Law and its applications,, first law of thermodynamics. Solutions: Type of solutions and laws related , colligative properties. Chemical kinetics: Law of reaction rate, reaction order, factors affecting the rates. Chemical Equilibrium : Relation between Kc & Kp, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: Acid and base concepts, pH calculations of acid, base and buffer solutions. Atomic Structure: emission spectrum, Bohr's theory de Broglre's hypothesis, quantum numbers, electronic configuration of elements, consequences of the periodic table.
Pre-requisites: None.

ARAB 100: Writing Skills ***2(2,0,0)***

ENGS 110: English ***6(6,9,0)***

The final assessment for the course is the highly regarded International English Language Testing System (IELTS), which is used as a qualifying test for students wishing to attend university in many countries including the UK and Australia. Specialist material will be used to prepare students for this test with the aim of reaching an IELTS score of 5.0 by the end of the year.

Pre-requisites: None.

CUR 101: University skills ***3(3,0,0)***

Learning skills**:** Self management for learning, Learning tools, Reading strategies, Second language learning skills, Test administration.

Thinking skills: Theory Of Inventive Problem Solving (TRIZ), Rounding Thinking, Expanding perception, Creative thinking. Research skills: Problem determining, Search for information strategies, Sites of sources, access this information, Using thin formation, Information construction, Information evaluation.

Pre-requisites: None.

CT 101: IT skills ***3(0,0,6)***

Basic Concepts of Information Technology, Using a computer and Managing Files, Word Processing, Spreadsheets, Databases, Presentation.

Pre-requisites: None.

STAT 101: Introduction to Statistics ***3(3,0,0)***

Descriptive statistics; Probability; Random variables and probability distribution functions; Statistical inference; Correlation and simple linear regression.

Pre-requisites: None.

EPH 101: Health Education and Fitness ***1(1-1-0)***

Subjects about general health and body and brain fitness.

Pre-requisites: None.

3.2 University Requirements

A. University Compulsory Courses

IC 107 - Ethics of the Profession in Islam **2(2,0,0)**

B. University Elective Courses

IC 100 - Studies in Prophet Biography **2(2,0,0)**

IC 101 - Origins of Islamic Culture **2(2,0,0)**

IC 102 – Islam and Society Development **2(2,0,0)**

IC 103 - The Economic System in Islam **2(2,0,0)**

IC 104 –Basics of Political System in Islam **2(2,0,0)**

IC 105 - Human Rights **2(2,0,0)**

IC 106 - Medical Jurisprudence **2(2,0,0)**

IC 108 - Contemporary Issues **2(2,0,0)**

IC 109 -Woman and Her Developmental Role **2(2,0,0)**

3.3 College Requirements

A. Compulsory College Requirements for All Programs

MATH 106: Integral Calculus ***3(3,2,0)***

The definite integral, fundamental theorem of calculus, the indefinite integral, change of variable, numerical integration. Area, volume of revolution, work, arc length. Differentiation and integration of inverse trigonometric functions. The logarithmic, exponential, hyperbolic and inverse hyperbolic functions. Techniques of integration: substitution, by parts, trigonometric substitutions, partial fractions, miscellaneous substitutions. Indeterminate forms, improper integrals. Polar coordinates.

Textbooks: 1- Robert T. Smith, and Roland R. Minton, "Calculus, early Transcendental functions", 3rd Edition.
2- Earl W. Swokowski, Michael Olinick, Dennis Pence, and Jeffery A. Cole "Calculus", 6th Edition.

Pre-requisite: MATH 101

MATH 107: Vectors and Matrices ***3(3,2,0)***

Vectors in two and three dimensions, scalar and vector products, equations of lines and planes in space, surfaces, cylindrical and spherical coordinates. Vector valued functions, their limits, continuity, derivatives and integrals. Motion of a particle in space, tangential and normal components of acceleration. Functions in two or three variables, their limits, continuity, partial derivatives, differentials, chain rule, directional derivatives, tangent planes and normal lines to surfaces. Extrema of functions of several variables, Lagrange multipliers. Systems of linear equations, matrices, determinants, inverse of a matrix, Cramer's rule.

Textbook: Edward and Penny, "Calculus", international edition.

Pre-requisite: MATH 101

MATH 203: Differential & Integral Calculus ***3(3,2,0)***

Infinite series, convergence and divergence of infinite series, integral test, ratio test, root test and comparison test. Conditional convergence and absolute convergence, alternating series test. Power series, Taylor and Maclaurin series. Double integral and its applications to area, volume, moments and center of mass. Double integrals in polar coordinates. Triple integral in rectangular, cylindrical and spherical coordinates and applications to volume moment and

center of mass. Vector fields, line integrals, surface integrals, Green's theorem, the divergence theorem, Stoke' theorem.

Textbook: 1- Robert T. Smith, and Roland R. Minton, "Calculus, early Transcendental functions", 3rd Edition.
2- Earl W. Swokowski, Michael Olinick, Dennis Pence, and Jeffery A. Cole "Calculus", 6th Edition.

Pre-requisite: MATH 106 and MATH 107

MATH 204: Differential Equations ***3(3,2,0)***

Various types of first order equations and their applications. Linear equations of higher order. Systems of linear equations with constant coefficients, reduction of order. Power series methods for solving second order equations with polynomial coefficients. Fourier series, Fourier series for even and odd functions. Complex Fourier series. The Fourier integral.

Textbook: Dennis G. Zill and Michael R Cullen, "Differential equations with boundary value problems", 6th edition

Pre-requisite: MATH 203

PHYS 103: General Physics (1) ***4(3,0,2)***

Introduction (Vectors), Motion in one dimension with constant acceleration, Motion in two dimensions with application to projectile motion and circular motion, Newton's Laws of Motion, Work and Energy, Potential Energy and law of conservation of Energy, Linear Momentum and Collisions, Rotation of rigid object about a fixed axis.

Pre-requisites: None.

PHYS 104: General Physics (2) ***4(3,0,2)***

Electricity and Magnetism: Coulomb's law, electric fields, Gauss' Law, electric potential, potential energy, capacitance and dielectric, currents and resistance, electrical energy and power, direct current circuits, Kirchhoffs rules, magnetic fields, motion of charged particle in a magnetic field, sources of the magnetic field, Ampere's law, Faraday's law of induction, self inductance, energy in a magnetic field, mutual inductance, alternating current circuits, the RLC series circuit, power in an A.C. circuit, resonance in RLC services circuit.

Pre-requisites: PHYS 103.

ENGL 109 – Language and Communication ***2(2,1,0)***

ENGL 109 includes *English for Specific Purpose* (ESP) units that cover terminology and expressions, in various engineering disciplines. The course is designed to improve the communication and reading skills of engineering students. It equips the student with essential linguistic expertise for his engineering study and prospective professional career.

Textbook: Eric H. Glendinning & Norman Glendinning, "Oxford English for Electrical and mechanical Engineering", Oxford University Press (2000).

Pre-requisites: None.

ENGL 110 – Technical Writing ***2(2,1,0)***

English 110 is intended to enhance technical writing skills. It equips students with writing basics and techniques required for constructing clear and persuasive presentation of their ideas, on various forms including reports, presentations, worksheets, CVs' and memos. The course

highlights effective writing features including: focus, organization, support & elaboration, style, and conventions. It emphasizes on observing ethical norms in writing.
Textbook: Daphne Mackey, "Send me a Message: *A step-by-step approach to business and professional writing*", McGraw Hill (2006)
Pre-requisites: ENGL 109.

GE 104: Basics of Engineering Drawing ***3(2,0,2)***
The course includes the drawing of Orthographic and isometric projections. Other topics include scaling, sectioning, dimensioning and blue print reading. The course is taught using free hand, AutoCAD and AutoDesk Invetor

Textbook: Fundamentals of Graphics Communication, Bertoline, G.R., And Weibe, E.N., Mc Grew-Hill Inc., New York, 5th edition, 2007
References: A Manual of Engineering Drawing Practice, C.H. Simons and D.E. Maguire, Hodder & Stoughton.
Engineering Drawing and Graphic Technology, French T. E., Charles J. V. and Foster R.J., 14th Edition, McGraw-Hill,1993.

Pre-requisites: None.

GE 106: Introduction to Engineering Design ***3(2,1,2)***
Engineering profession, jobs, and disciplines; Elements of engineering analysis; Introduction to engineering design and team formation; Engineering problem definition; Engineering system Architecture and physical function decomposition; human factor, environment, and safety issues in design; Generation of alternative concepts; Evaluation of alternatives and selection of a concept, Design defense, performance evaluation, and reporting; Engineering ethics.
Textbook: Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, Exploring Engineering: An Introduction to Engineering and design, 4th ed.
Pre-requisite: GE 104

GE 201: Statics ***3(3,1,0)***
Force systems; vector analysis, moments and couples in 2D and 3D. Equilibrium of force systems. Analysis of structures; plane trusses and frames. Distributed force system; centroid of simple and composite bodies. Area moments of inertia. Analysis of beams. Friction.

Textbook: Meriam, J. L. and Kraige, L. G. "Engineering Mechanics, Volume 1, Statics", SI units Version
Pre-requisite: MATH 106 & MATH 107

GE 203: Engineering and Environment ***2(2,0,0)***
This course introduces the impact of engineering and industrial activities on the environment. The lectures cover basics of ecosystems, environmental balance, types of pollution, and types, sources, and limits of pollutants; in addition to fundamentals of Environmental Impact Assessment (EIA). Pollution control technologies and examples of pollution from various engineering and industrial sectors are also covered.

Textbook: G. Tyler Miller, Scott Spoolman. Living in the Environment, 17th edition. Cengage Learning (2014)

Approved by: Chairman: …… Dean: ……

Jerry A. Nathanson, Richard A. Schneider. Basic Environmental Technology: Water Supply, Waste Management, and Pollution Control, 6th edition. Pearson Education, Limited (2014)

Pre-requisite: CHEM 101, MATH 101

GE 402: Engineering Projects Management ***3(3,1,0)***

This course introduces techniques that provide rational solutions to a range of project management decisions encountered in engineering projects. Students are expected to gain a detailed understanding of some of the techniques, tools and processes available and their application in starting, planning, managing and finishing engineering projects; The course covers project management fundamentals including projects life cycle, project planning and scheduling techniques, cash flow forecasting, performance evaluations, estimating and cost control; project organizations; Introduction to risk management.

Textbook: Meredith, J. R., Mantel Jr, S. J., & Shafer, S. M. (2013). Project management in practice. Wiley Global Education

Prerequisite:

GE 403: Engineering Economy ***2(2,1,0)***

This course is being offered to the students who enroll in the College of Engineering to give them fundamental knowledge and understandings on Cost concepts, Time value of money operations, Measuring the worth of investments, Comparison of alternatives, Depreciation, and Economic analysis of public projects

Textbook: John A. White, Kenneth E. Case and David B. Pratt, "Principles of engineering economic analyses", 5th edition.

Pre-requisites: None.

B. Complementary College Requirements for Electrical Engineering Program

GE 211 - Computer Programming in "C++" **3(2,0,2)**

Introduction to computing and C++ programming. C++ basics, variables, assignment, standard library functions, and Interactive I/O. Control structures, selection, and repetition using "while" and "for" loops. Modular programming using functions. One-dimensional and multi-dimensional array declaration and manipulation. I/O Streams and data file processing. Development of C++ programs to solve engineering problems.

Textbook: Gary J. Bronson, "C++ for Engineers and Scientists", Cengage, 4th edition, 2013.

Pre-requisites: None

MATH 254 – Numerical Methods **3(3,2,0)**

Various numerical methods for solving nonlinear equations. Direct and iterative methods for solving systems of linear equations along with error estimate. Polynomial interpolation with error formula. Numerical differentiation and integration with error terms. An introduction to numerical solution of ordinary differential equations.

Textbook: Rizwan Butt and Yacine Benhadid, "An Introduction to Numerical Analysis"

Prerequisite: MATH 107

Approved by: Chairman: …… Dean: ……

3.4 Electrical Engineering Core Courses

EE 201 - Fundamentals of Electric Circuits **3(3,1,0)**

The concepts of independent and dependent voltage and current sources. Circuit theorems: Superposition principle. Thevenin and Norton theorems. Maximum power transfer theorem. Analysis techniques of circuit containing independent and dependent voltage and current sources: Nodal and mesh analysis. Sinusoidal sources and the concept of phasors in circuit analysis. Introduction to the concept of average, reactive and complex power, power factor.

Textbook: Boylestad, "Introductory Circuit Analysis", Prentice Hall, latest edition.

Pre-requisites: MATH 106

EE 202 - Electric Circuit Analysis **3(3,1,0)**

The ideal operational amplifier circuits. Energy storage elements. The complete response of *RL*, *RC*, and *RLC* Circuits. Magnetically coupled circuits. Ideal transformer. Three-Phase circuits. Frequency response and resonance. Laplace transform of circuits. Introduction to filter circuits. Two-Port networks.

Textbook: Dorf and Svoboda, "Introduction to Electric Circuits", John Wiley & Sons, latest edition.

Pre-requisite: EE 201 & MATH 107

EE 203 Engineering Electromagnetics (1) **3(3,1,0)**

Review: Vector calculus. *Electrostatic fields*: Coulomb's law and field intensity. Gauss's law. Energy and potential. Electric field in material space: Conductors and dielectrics. Electrostatic boundary-value problem: Poisson's and Laplace's equations. Uniqueness theorem. Resistance and capacitance. Method of Images. Applications on electrostatics. *Magnetostatic fields*: Biot-Savart's Law. Ampere's law. Magnetic energy and potentials. Magnetic force. Magnetic torque. Magnetic materials. Magnetic circuits. Inductance and inductors. Applications on magnetostatics. Introduction to computational modeling of electrostatic and magnetostatic problems.

Textbook: Elements of Electromagnetics, Matthew Sadiku, Oxford University Press**,** 6th Edition, 2014 (Chapters 1-8).

Reference: Fundamentals of Applied Electromagnetics, by Fawwaz T. Ulaby, Eric Michielssen, and Umberto Ravaioli, Prentice Hall, 7th Edition, 2014.

Pre-requisites: PHYS 104 & MATH 203

EE 204 – Engineering Electromagnetics (2) **3(3,1,0)**

Maxwell's equations: Faraday's law; Transformer and motional electromotive forces; Time-varying potentials; Time-harmonic fields. *EM wave propagation*: Wave propagation in lossy dielectrics; Plane wave in free space; Wave polarization; Poynting vector; Normal & oblique transmission and reflection of plane wave. *Transmission lines*: TL equations; Smith chart; Rectangular waveguides; Waveguide resonators. *Antenna basics*: Hertzian dipole; Half-wave

Approved by: Chairman: …… Dean: ……

dipole; Small-loop; Antenna characteristics; Notes on antenna arrays and radar equation. *Introduction*: Numerical methods of engineering electromagnetic applications.

Textbook: Elements of Electromagnetics, Matthew Sadiku, Oxford University Press**,** 6th Edition, 2014 (Chapters 9-14).

Reference: Fundamentals of Applied Electromagnetics, by Fawwaz T. Ulaby, Eric Michielssen, and Umberto Ravaioli, Prentice Hall, 7th Edition, 2014.

Pre-requisite: EE 203

EE 205 - Electric Circuits Laboratory **1(0,0,2)**

General introduction to the laboratory; Voltage, current, and power in DC circuits using KVL and KCL; Superposition; Thevenin's and maximum power transfer theorems in DC circuits; Series and parallel AC circuits; Resonance in series and parallel circuit. Maximum power transfer theorem; Power factor improvement in AC circuits; Transients in DC circuits; Magnetically coupled circuits; Three-phase circuits.

Textbook: Boylestad, "Introductory to Circuit Analysis", Prentice Hall, Latest Edition.

Co-requisite: EE 202

EE 208 - Logic Design **3(3,1,0)**

Number systems; Boolean algebra and logic gates; Simplification of Boolean functions; Combinational logic circuits design and analysis; MSI and PLD components; Introduction to synchronous sequential logic; Flip flops; Analysis of clocked sequential circuits; State reduction and assignment; Design of synchronous sequential circuits and PLA's.

Textbook: Moris, "Digital Design", Prentice Hall, Latest Edition.

Pre-requisite: None

EE 210 - Logic Design Laboratory **1(0,0,2)**

Familiarization with logic circuits laboratory; Introduction to logic gates; Implementation of Boolean functions using 'AND' and 'OR' gates; 'NAND' and 'NOR' implementation; 'XOR' and adders; Design of combinational circuits; Flip-flops; Design of sequential circuits; Sequential PLA's.

Textbook: Lab-Notes

Co-requisite: EE 208

EE 301 - Signals and Systems Analysis **3(3,1,0)**

Motivation and applications; Signal classifications; Signal operations; Singularity functions; Linear time-invariant systems and convolution; Correlation; Fourier series and transform for continuous and discrete time signals; Frequency response; Laplace transform and applications.

Textbook: Alan V. Oppenheim , Alan S. Willsky, and S. Hamid Nawab, "Signals & Systems", Prentice Hall, Latest Edition.

Pre-requisite: EE 201

EE 302 Modeling and Simulation Laboratory **1(0,0,2)**

Approved by: Chairman: …… Dean: ……

Introduction to modeling and simulation techniques; Continuous-time and discrete-time systems; Simulation of differential equations; Dynamic system modeling; Optimization Techniques; Dynamic errors; Simulation acceleration and real-time simulation; Modeling and simulation applications of electrical engineering systems; The lab prepares the students to the capstone design project, by working on a lab project on modeling and simulation.

Textbooks:

- Harold Klee, and Randal Allen "Simulation of Dynamic Systems with MATLAB and Simulink", Latest Edition.
- Dingyu Xue and YangQuan Chen, "System Simulation Techniques with MATLAB and Simulink", Latest Edition.

Pre-requisite: EE 301

EE 310- Microelectronic Devices and Circuits **3(3,1,0)**

Introduction: Semiconductor material properties; *Semiconductor diodes*: Structure, operation, circuit applications; *Special diodes*: Zener, LED, Solar cell and photodiode; *Metal Oxide Field Effect Transistors (MOSFETs)*: Structure, operation, and circuit applications; *Bipolar Junction Transistor*: Structure operation and circuit applications; *Thyristors*: Structure and I-V characteristics.

Textbook: "Microelectronic Circuit Design", 3rd ed., Jaeger and Balock, McGraw-Hill, Latest Edition.

Pre-requisite: EE 201

EE 312– Basic Electronics Laboratory **1(0,0,2)**

Introduction to the lab tools, I-V characteristics of diode, clipping circuits using diodes, rectification using diodes, Zener diode and regulators, BJT DC biasing, CE BJT amplifier. MOSFET DC biasing, CS MOSFET amplifier, simple AM receiver circuit.

Textbook: Sedra and Smith, "Microelectronic Circuits", 5th Edition, Oxford University Press, Latest Edition.

Co-requisite: EE 310

EE 320 - Communications Principles **3(3,1,0)**

Overview and Basic elements of Communication Systems; Transmission through Systems and Channels; Modulation; AM; Frequency Conversion; FM and PM; Superhetrodyne Receiver; FDM; Stereo Broadcasting; Sampling; Pulse Modulation (PAM, PWM, PPM); TDM; Pulse Code Modulation (PCM); DPCM and DM; Regenerative Repeaters; Advantages of Digital Communication; Line Coding (Binary Signaling); Introduction to Digital Modulation (ASK, FSK, PSK).

Textbook: Simon Haykin and Michael Moher, "An Introduction to Digital and Analog Communications", John Wiley & Sons, Latest Edition.

Pre-requisite: EE 301

EE 330 - Electromechanical Energy Conversion (1) **3(3,1,0)**

Approved by: Chairman: …… Dean: ……

Transformers (construction, operation of single-phase transformers, equivalent circuit, voltage regulation and efficiency, auto-transformer, three-phase transformers), AC machinery fundamentals, three-phase induction machines (construction, operation, equivalent circuit, performance, calculations, starting of induction motors, speed control), small AC motors (single-phase induction motors, reluctance and hysteresis motors, universal motors, servo motors, stepper motors).

Textbook: Chapman, "Fundamentals of Electric Machinery", McGraw Hill, Latest Edition.

Pre-requisite: EE 202 & EE 203

EE 340 – Fundamentals of Power System **3(3,1,0)**

Power system components and representation, Transmission line and cable parameters, Per Unit calculations, Analysis of transmission and distribution lines, Electric insulators, Grounding systems, High voltage surges, Protection system.

Textbook: A. A. Al-Arainy, N. H. Malik and S. M. Al-Ghuwainem, "Fundamentals of Electrical Power Engineering", King Saud University Press, Latest Edition.

Pre-requisite: EE 202

EE 351 - Automatic Control **3(3,1,0)**

Review of mathematical background (complex variables, Laplace, Diff. Equations); System representation (block diagram, transfer functions, signal flow graph) Modeling of electric and mechanical systems; State variable analysis; Stability; Time domain analysis; Root locus; Frequency domain analysis; Introduction to PID control.

Textbook: K. Ogata, "Modern Control Engineering", Prentice Hall, Latest Edition.

Pre-requisite: EE 301

EE 353 - Introduction to Microprocessors **3(3,1,0)**

PIC24 Assembly Language Introduction, 8/16-bit Operations , Extended Precision and Signed Operations , Pointers and Subroutines, Fixed point and floating point representation, PIC24 hardware, Parallel Port I/O, Interrupts and Timers,

Textbook: Reese, R. B. and Bruce, J. W. and Jones, B. A., "Microcontrollers: From Assembly Language to C using the Pic24 Family", Course Technology/Cengage Learning, 2009.

Pre-requisite: EE 208

EE 356 - Control and Instrumentation Laboratory **1(0,0,2)**

Experiments to support control theory using physical processes (e.g. water level, temperature control, light intensity control, etc); Control system simulation using Matlab; Modeling of physical (experimental) equipment; Static performance; Transient analysis; Measuring devices; Two-position control; Proportional control; PID control; Introduction to Electrical instrumentation and Measurements.

Textbook: Dorf and R. Bishop, "Modern Control Systems", Addison-Wesley, Latest Edition

Co-requisite: EE 351

Approved by: Chairman: …… Dean: ……

EE 357 - Microprocessor and Microcontroller Laboratory **1(0,0,2)**

MPLAB Introduction, 8/16-Bit Unsigned Operations, 16/32-Bit Signed Operations, Pointers, Subroutines, PIC24 System Startup, LED/Switch I/O, Interrupts and Timers, Serial Asynchronous IO and I2C, ADC, DAC Experiments, PWM experiments.

Textbook: Reese, R. B. and Bruce, J. W. and Jones, B. A., "Microcontrollers: From Assembly Language to C Using the Pic24 Family", Course Technology/Cengage Learning, Latest Edition.

Co-requisite: EE 353

3.5 Electrical Engineering Graduation Project Courses

EE 496 – Graduation Project-1 **2**

This is the first part of the capstone design project.

Prerequisite: Successful completion of 129 credit hours of the plan and completion of first to 7th levels.

EE 497 – Graduation Project-2 **2**

This is the second part of the capstone design project.

Prerequisite: EE 496

3.6 Practical Training

EE 999 – Practical Training **1 (NP)**

Students in the department are required to complete a 10 weeks summer training requirement in an area related to Electrical Engineering. Prior to undertaking the summer training program, the student must obtain the approval of the department and he must have completed, successfully, at least 110 credit hours including the CFY (or 78 credit hours excluding the CFY). Students enrolling in the summer training program are not allowed to take simultaneously any course or projects.

Prerequisite: Successful completion of 110 credit hours.

Approved by: Chairman: …… Dean: ……

3.7 Electrical Engineering Elective Courses

3.7.1 Elective Labs

EE 402 - Electronic Circuits Laboratory **1(0,0,2)**

PSPICE simulation of electronic circuits; Linear applications of op-amp; Wein-bridge oscillator; Active filters: LPF, and HPF. Schmitt trigger and astable multivibrator. Differential amplifier using BJT; CMOS and TTL inverters.

Textbook: "Microelectronic Circuits", 5th or latest edition, Sedra and Smith, Oxford University Press.

Co-requisite: EE 400

EE 406 - VLSI Design Laboratory **1(0,0,2)**

Low level and high level design and implementation of digital circuits targeted to FPGAs: Design entry using schematic editor, functional simulation, design entry using VHDL editor, VHDL Synthesis, Functional simulation, Compilation of design, design verification and study of reports; CMOS inverter layout (Step by step process), Layout design of digital circuits using layout tools, Lab. Project.

Textbook: Yalamanchili, "Introductory VHDL", Prentice Hall, Latest edition.

Co-requisite: EE 405

EE 421 - Communications Laboratory **2(0,0,4)**

AM and FM modulation and detection; PCM and delta modulation; Bit error rate measurements; TDM; ASK; FSK; Optical fiber parameter measurements; RF impedance measurements and matching; Basic propagation and antenna measurements.

Textbook: Lab-Notes

Pre-requisite: EE 320
Co-requisite: EE 423

EE 433 - Electromechanical Energy Conversion Laboratory **1(0,0,2)**

Equivalent circuit of transformers; Three-phase connections and harmonic problems; Equivalent circuit of three-phase and single-phase induction motors; Load testing of induction motors; Starting of single-phase induction motors; Equivalent circuit of synchronous machine: Performance of synchronous motors; Performance of dc machines.

Textbook: Chapman, "Fundamentals of Electric Machinery", McGraw Hill, Latest Edition.

Co-requisite: EE 430

EE 445 - Electrical Power Laboratory **2(0,0,4)**

Breakdown and dielectric strength of different insulating materials; Flashover tests on insulators; Over-voltage protection and insulation coordination; Corona and its effects; Grounding resistance measurements; Power System Simulator familiarization; Characteristics

of isolated and interconnected systems; Transmission line characteristics; Load Flow Study; Faults, characteristics and coordination of over-current relays; Power Quality issues.

Textbook: J.D. Glover & M Sarma, "Power System Analysis and Design", 3rd or latest edition, PWS Publishing.

Co-requisite: EE 441

EE 457 - Applied Control Laboratory **1(0,0,2)**

This laboratory is equipped with basic instruments and real time experiments that are necessary to familiarize the students with the advanced concepts and updated technology in the control field. The undergraduate experiments are designed to reinforce and expand many concepts covered in the advanced control course EE 454 and digital control course EE 483. Experiments are organized in several groups of real time applications, such as:

- Data Acquisition and system modeling
- Computer control system using MATLAB
- Digital Control using PLC

Textbooks: LAB Notes are prepared including a complete set of experiments.

Co-requisite: EE 456

EE 459 - Advanced Logic Design Laboratory **1(0,0,2)**

Arithmetic Logic Unit (ALU); Magnitude Comparators; ROM-Based Design; Synchronous and Asynchronous counters and their applications; Digital clock Design; State Machine Design; PLD and FPGA based designs; Project.

Textbook: Michael D. Ciletti, "Advanced Digital Design," Prentice Hall, Latest Edition.

Co-requisite: EE 458

3.7.2 Electrical Engineering Elective Courses

EE 400 – Digital and Analog Electronic Circuits **3(3,1,0)**

Operational Amplifiers and their applications; BJT differential and multistage amplifiers; IC Biasing; BJT current mirrors and current sources; MOS amplifiers; MOS current sources and current mirrors; Cascade amplifiers; Feedback amplifiers; Digital logic circuits; CMOS and pseudo NMOS logic circuits.

Textbook: Sedra and Smith, "Microelectronic Circuits", Oxford University Press, Latest Edition.

Pre-requisite: EE 310

EE 403 –Semiconductor Devices **3(3,1,0)**

Fundamentals of semiconductor Physics: Energy bands, Fermi-Dirac and Boltzmann statistics: carrier concentrations at thermal equilibrium, mass action law. Carrier transport mechanisms: Drift and diffusion. Basic Equations for semiconductor Device Operation: excess carriers, current continuity equations, Poison`s equation. PN and Special junction devices: Schottky barrier, microwave devices, Hetero-junction. MOS capacitor and MOSFET, Bipolar transistor.

Textbook: Paul H. Young, "Electronic Communication Techniques", 5th or Latest Edition, Prentice Hall.

Pre-requisite: EE 310

EE 404 – Solar Cells and Photovoltaic Systems **3(3,1,0)**

Solar Insolation (radiation); Generation, recombination, and basic equations of semiconductor-device physics; P-N junction Diode solar cells: Operation and construction; Solar cell parameters; Design of Silicon solar Cells; Photovoltaic Modules, Arrays, and Systems; Balance of the System (BOS); Design of Stand-alone PV Systems; Other Devices Structure; Other Semiconductor Materials.

Textbook: Jaeger and Balock, "Microelectronic Circuit Design", 3rd or Latest Edition, McGraw-Hill.

Pre-requisite: EE 310

EE 405 - VLSI Circuit Design **3(3,1,0)**

Basic fabrication sequence of NMOS and CMOS ICs. Design rules and layout. Combinational and sequential circuits. Memories and registers. Introduction to full custom and semi-custom ICs, standard cells, gate arrays, FPGAs and PLDs etc. CAD tools for design of ICs. Introduction to high-level design of ICs using VHDL. Introduction to low power IC design.

Textbook: Pucknell and Eshraghian, Pucknell, "Basic VLSI Design", Prentice Hall, Latest Edition.

Pre-requisite: EE 310

EE 407 – Electronic Communication Circuits **3(3,1,0)**

Radio frequency tuned amplifiers. Power amplifiers. Tuned LC oscillators. Crystal oscillators. Automatic gain control. Mixers. High frequency models of BJT. S-parameters. Introduction to Microwave devices: HBT and MESFET.

Textbook: Paul H. Young, "Electronic Communication Techniques", 5th or Latest Edition, Prentice Hall.

Pre-requisite: EE 310 and EE 320

EE 408 - VLSI Technology and Fabrication **3(3,1,0)**

Introduction to semiconductor devices; crystal growth and wafer preparation; chemical and physical vapor deposition; oxidation; diffusion; ion implantation; lithography; etching; metallization; process integration of CMOS and bipolar technologies; diagnostic techniques and measurements; packaging; yield and reliability

Textbook: James D. Plummer, Michael Deal, Peter D. Griffin, "Silicon VLSI Technology", 2nd or Latest Edition, Prentice Hall.

Pre-requisite: EE 310

EE 409 - Electronic Instrumentation **3(3,1,0)**

555 Timer and its applications. Analog switches. Analog multipliers. Operational trans-conductance amplifier (OTA). Current conveyor. Switched capacitor circuits. Phase-locked-

loop (PLL) with applications. Data conversion: digital-to-analog and analog-to-digital converters. Digital PLL.

Textbook: Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd or Latest Edition, McGraw Hill.

Pre-requisite: EE 310

EE 410 - Optoelectronic Devices and Systems **3(3,1,0)**

Photonic Semiconductor Materials. Optical sources: light-emitting diode, laser diode. Photo-detectors: PIN diode, APD. Optical waveguide basics. Optical fiber principles. Optical amplifiers. Introduction to Optoelectronic Systems with applications.

Textbook: Kasap, "Optoelectronics and Photonics: Principles and Practices", Prentice Hall, Latest Edition.

Pre-requisite: EE 310

EE 412 – Low Power VLSI Design **3(3,1,0)**

Introduction to low-power design, low- voltage process technology, low- voltage device model, low- voltage low- power CMOS circuit design, low- power CMOS RAM circuits, CMOS subsystem design, low- power VLSI design methodology.

Textbook: Bellaouar and Elmasry, "Low-power Digital VLSI Design: Circuits and Systems", Kluwer Academic, Latest Edition.

Pre-requisite: EE 405

EE 415 – Principles of Nanoelectronics **3(3,1,0)**

Introduction to fundamentals of nanoscience for electronics nanosystems. Principles of fundamental quantities: electron charge, effective mass, Bohr magnetron, and spin, as well as theoretical approaches. From these nanoscale components, discussion of basic behaviors of nanosystems such as analysis of dynamics, variability, and noise, contrasted with those of scaled CMOS.

Textbook: Mircea Dragoman and Daniela Dragoman, "Nanoelectronics: Principles and Devices" Artech House Publishers; Latest Edition.

Pre-requisite: EE 310

EE 419 – Introduction to Electronic Warfare **3(3,1,0)**

Introduction to Electronic Warfare (EW) principles, Electronic support measures (ESM) receivers, Electronic countermeasures (ECM), Electronic counter-countermeasures (ECCM), Command Control and Communications (C^3) Systems, ECM Jamming, Electronic Warfare technology.

Textbook: David Adamy, "Introduction to electronic Warfare: EW 102: A Second Course in Electronic Warfare" Artech House Publishers, Latest Edition.

Pre-requisite: EE 310

Approved by: Chairman: …… Dean: ……

EE 420 - Digital Signal Processing **3(3,1,0)**

Characterization and classification of discrete-time (DT) signals and systems; Typical DT signal processing operations; Linear time-invariant (LTI) - DT systems; Linear constant-coefficient difference equations; Frequency-domain representation of discrete-time signals and systems; The discrete Fourier transform (DFT); The fast Fourier transform (FFT); The *z*-transform; Linear phase transfer functions; Digital Filter Structures; Finite-impulse response (FIR) digital filter design; Infinite-impulse response (IIR) digital filter design; Digital processing of continuous-time signals; Fundamentals of multirate digital signal processing; Applications.

Textbook: Sanjit K. Mitra ,"Digital Signal Processing-A computer Based Approach", McGraw Hill, 2005 or Latest Edition.

Pre-requisite: EE 301

EE 422 - Digital Communications *3(3,1,0)*

Basic elements of communications systems; Review of probability theory; Base-band pulse transmission (matched filters, inter-symbol interference); Eye pattern, Nyquist criteria; Equalization; Digital Pass-band transmission: Coherent PSK, FSK, QPSK, MSK, M-ary frequency & phase modulations, MQAM; Non-coherent orthogonal modulation; Power spectra and bandwidth efficiency of binary and quaternary modulation schemes; Channel capacity; Source coding; Error control coding (channel coding).

Textbook: Simon Haykin, "Communication systems", John Wiley, Latest Edition.

Pre-requisite: EE 320

EE 423 - Wave Propagation and Antennas **3(3,1,0)**

Radiation and antennas; Antenna parameters; electrically small antennas, resonant antennas, traveling wave antennas; Aperture and patch antennas; Linear and planar antenna arrays; Basic propagation modes; Free-space propagation (direct terrestrial); Ground wave propagation; Sky wave propagation; Terrestrial wave propagation (mixed direct and indirect); Propagation models in mobile radio systems; Introduction to computational tools in wave propagation and antenna design.

Textbooks:

1. Constantine A. Balanis, "Antenna Theory, Analysis and Design", Wiley-Inter-science, 3rd Edition, 2005.
2. Christopher Haslett, “Essentials of Radio Wave Propagation”, Cambridge University Press, New York, 2008.

Pre-requisite: EE 204

EE 425 -Satellite Communications **3(3,1,0)**

Introduction to satellite communication; Basic orbit maneuver; Satellite orbit geometry and types (LEO, MEO and GEOs); Orbit characteristics; Telemetry, Tracking and Command; Propagation characteristics with the outer space; Frequency bands; Channel modeling, Satellite antennas and patterns; Earth stations; Modulation and multiple Access techniques; Satellite uplink and downlink: analysis and design; Frequency plan; Carrier and transponder capacity, Single-carrier and multi-carrier transponder; VSATs; Modern satellite systems and applications.

Approved by: Chairman: …… Dean: ……

Textbook: Pratt, Bostian, and Allnutt, "Satellite Communication Systems", John Wiley & Sons, Latest Edition.

Prerequisite: EE 423

EE 426- Microwave Engineering **3(3 ,1,0)**

Basics of Microwave Engineering, RF Behavior of Passive Components, Chip Components and Circuit Board Considerations, Stripline and Microstrip circuits, Microwave network analysis, Impedance matching, Power dividers and directional couplers, Microwave filters, Active microwave components, amplifiers, oscillators and mixers.

Textbook: David Pozar, "Microwave Engineering," Wiley, Latest Edition.

Pre-requisite: EE 204

EE 430 - Electromechanical Energy Conversion (2) **3(3,1,0)**

Synchronous machines (construction, internal voltage, equivalent circuit, phasor diagram, alternator: operation, excitation, performance, operating alone, parallel operation, synchronization). Synchronous motor (steady-state operation, starting, speed control, applications). DC machines (construction, classification, performance, motor types, characteristics, starting, speed control). Self-excited induction generators (theory, operation, magnetizing curves and self-excitation, equivalent circuit, performance, applications). Introduction to solid-state electronics in speed control of dc and ac motors

Textbook: Chapman, "Fundamentals of Electric Machinery," McGraw Hill, Latest Edition.

Pre-requisite: EE 330

EE 432 - Power Electronics **3(3,1,0)**

Classification of power electronics converters, Power semiconductor devices: terminal characteristics; Power converters: ac-ac converters, rectifiers, inverters, dc-dc converters and resonant converters; Applications in power systems.

Textbook: D. W. Hart, "Introduction to Power Electronics", Prentice-Hall, Latest Edition.

Pre-requisite: EE 310

EE 435 - Electric Drives **3(3,1,0)**

Principles of electric drive; Definitions; Electrical considerations: running, starting, braking; Mechanical considerations: type of enclosure, noise, drive transmission, motor selection; Electric traction; DC & AC solid-state drives.

Textbook: Krishnan, "Electric Motor Drives", Prentice Hall, Latest Edition.

Pre-requisite: EE 330 and *EE 432*

EE 436 – Electrical Machine Dynamics and Stability **3(3,1,0)**

Basic dynamic equations; DC machine dynamics: dynamic models, dynamic analysis; Synchronous machine transients and dynamics: transformation to direct-and quadrature-axis variables, Dynamic model of AC transmission line in d-p-o domain; Dynamic stability; Induction machine dynamics and transients: starting transients, sudden load changes, 3-phase faults.

Approved by: Chairman: …… Dean: ……

Textbook: Sarma, "Electric Machines: Steady State Theory and Dynamics Performance", West Publishing Co., Latest Edition.

Pre-requisite: EE 330

EE 441 –Power System Analysis **3(3,1,0)**

Concepts of power system modeling: Bus admittance and Bus Impedance matrices. Load flow analysis: Gauss-Seidel, Newton-Raphson and Fast-Decoupled methods. Symmetrical fault calculations: Thevenin equivalent and Bus impedance matrix methods. Symmetrical components. Transient stability: swing equation, equal-area criterion, Euler and modified Euler methods.

Textbook: J.D. Glover & M Sarma, "Power System Analysis and Design", 3rd edition, PWS Publishing, or Latest Edition.

Pre-requisite: EE 340

EE 443 - Power System Operation and Control **3(3,1,0)**

Concepts of power system operation; Network topology and incidence matrices formation of bus impedance matrix; Unit commitment; Optimal power flow; Automatic generation control; Energy management systems and control center operation; State estimation; Dynamic security assessment.

Textbook: Wood and Wollenberg, "Power Generation, Operation and Control", John Wiley, Latest Edition.

Pre-requisite: EE 441

EE 444 – Power System Planning **3(3,1,0)**

Basic load forecast methodologies; Electric loads characteristics; consumer categories; Power system generation; Transmission and distribution reliability evaluation; System cost assessment; Load management and energy conservation strategies.

Textbook: R. N. Allan, R. Billinton, "Reliability Evaluation of Power Systems", John Wiley, Latest Edition.

Pre-requisite: EE 340

EE 446 - High Voltage Engineering **3(3,1,0)**

Generation and measurements of high DC, AC and impulse voltages; Conduction and breakdown processes in gaseous, liquid, and solid insulating media; High voltage test techniques; Grounding and safety consideration.

Textbook: Naidu and Kamaraju, "High Voltage Engineering", 2nd or Latest Edition, Tata McGraw Hill.

Pre-requisite: EE 340

EE 448 - Power Distribution Systems **3(3,1,0)**

Components of Distribution system: substations, switchgear, feeders, sub-transmission lines and primary and secondary systems; planning and load forecasting of Distribution system;

"DAS" Distribution Automation Systems; Voltage drop and power loss considerations; Application of capacitors in distribution systems; Distribution service restoration and network reconfiguration; Power quality issues: causes, assessment and mitigation techniques

Textbook: Turan Gonen, " Electric Power Distribution System Engineering", Mc Graw-Hill Publishing Co., Latest Edition.

Pre-requisite: EE 340

EE 449 - Power System Protection **3(3,1,0)**

Protection Principles and Components; Fault Calculations; Protective Transformers; Over-current Protection; Distance Systems; Power Frequency and Carrier Systems; Protection of Generators, Motors, Bus bars, Reactors, and Capacitors; Transformers; Application of Protection to Distribution Systems; Station Layout and Configuration; Disturbance Monitoring; System Restoration; Microprocessor-Based Relaying.

Textbook: Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, Latest Edition.

Pre-requisite: EE 441

EE 450 - Computer Architecture Organization **3(3,1,0)**

Introduction to computer components and structure; Data representation; Processor structure and organization; Instruction sets and microprogramming; Memory structure and organization; Input-output structure and organization; Parallel computer structure and organization; Recent development on the subject; Applications: projects and discussions.

Textbook: Andrew S. Tanenbaum, "Structure Computer Organization", 5th or Latest Edition, Prentice-Hall, Pearson.

Pre-requisite: EE 353

EE 453 - Microprocessor and Embedded System Design **3(3,1,0)**

This course provides an introduction to the design of embedded microprocessor systems with emphasis on real-time nature of embedded systems, such as cost and design tradeoffs. Topics include: Memory devices; Interrupts and DMA; Timers and counters; Serial communication and parallel I/O interface; Keyboards; LCD; VGA interfaces; Transducers and sensors interface; A/D and D/A converters; Instruction execution cycle and timing; Buses timing and protocols; Practical projects that involve students in the design of an embedded microprocessor systems from initial concepts to the debugging of a final product.

Textbook: Stuart Ball, "Embedded Microprocessor Systems, Real World Design", 3rd or Latest Edition, Elsevier Science.

Pre-requisite: EE 353

EE 454 - Advanced Control Systems **3(3,1,0)**

Introducing real time considerations in the control design. Nonlinear systems are studied with different approaches. Multivariable systems and decoupling techniques are emphasized. Optimal control design is introduced. Adaptive and robust control design is covered in details. Students acquire the basic skills of how to approach and deal with different requirements to analyze and design real time applications.

Approved by: Chairman: …… Dean: ……

Textbook: Roland S. Burns, "Advanced Control Engineering," Latest Edition.
Pre-requisite: EE 351

EE456: Automatic Control Application **3(3,1,0)**

Introducing and practicing the engineering standards in control components selection and design. Fundamentals of industrial transducers and actuators are given. Problem definition and techniques for stimulation of ideas are given. Students learn the analysis and design of different control problems with special emphasis on concepts and design creativity. They acquire the basic skills of how to approach and deal with different requirements to analyze and to design real time applications**.**

Textbooks:

1. Clarence W. de Silva, "Sensors and Actuators: Control System Instrumentation", CRC Press, Latest Edition.
2. Richard C. Dorf and Robert H. Bishop "Modern Control Systems", Prentice Hall Inc., Latest Edition.

Pre-requisite: EE 351

EE 458 - Advanced Logic Design **3(3,1,0)**

Combinational and sequential logic design techniques, Algorithms and tools review. Structured design concept, Design strategies, Design decomposition, Design tools. Introduction to hardware languages, Basic Features. Simulation and Synthesis, Basic VHDL modeling techniques, Algorithmic level design, Register Transfer Level Design, Sequential (Synchronous and Asynchronous) Circuits Design, Programmable Logic and Storage Devices and Design Case Study.

Textbooks:

1. James R. Armstrong and F. Gail Gray, "VHDL Design Representation and Synthesis", Prentice Hall, Latest Edition.
2. Michael D. Ciletti, "Advanced Digital Design", Prentice Hall, Latest Edition.

Pre-requisite: EE 210

EE 463 -Wireless Communications **3(3,1,0)**

Basic concepts of wireless communications; The cellular concept; Cell splitting & sectoring; Cell coverage**;** Mobile radio propagation; Path loss models**;** Shadowing; Statistical fading models; Capacity of fading channels**;** Digital modulation Performance in fading channels**;** Equalization**,** diversity and channel coding**;** Speech coding; Multiple access techniques; Wireless networking; Modern wireless systems and standards.

Textbook: Theodore Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall, Latest Edition.

Prerequisites: EE 422

EE464 - Optical Communications **3(3,1,0)**

Approved by: Chairman: …… Dean: ……

Optical propagation; Optical waveguides; Optical fibers: structure, attenuation, dispersion; Light sources; Light detectors; Optical Amplifiers; Optical Modulators; Digital optical communication systems: analysis and design; WDM and DWDM system and its components; Optical Switching; Optical networking: SONET, SDH, Wavelength routed networks; Ultrahigh capacity networks; Nonlinear effects; Optical Measurements: OTDR; eye patterns, optical spectrum analyzer.

Textbook: Gerd Keiser, "Optical Fiber Communications Approach", McGraw Hill, Latest Edition.

Pre-requisite: EE 204, EE 310, and EE 320

EE 465 Probability Theory with Engineering Applications **3(3,1,0)**

Mathematical Modeling: deterministic and probability models. **Basics of probability:**, random experiments, discrete and continuous sample space, conditional probability, Baye's rule, independence of events, synthesizing randomness. **Single random variable:** distribution and density functions, function of random variable, Markov and Chebyshev Inequality, important types of discrete and continuous random variables, computer generation of random variables. **Characterization of random variable:** mean, variance and moments, transform methods, characteristic function, moment generating theorem. **Sum of random variables:** central limit theorem. **Electrical engineering applications of random variables. Random Process:** definition and characterization of random process. Auto-correlation and auto-covariance of random process. Gaussian random process. **Linear systems with random inputs:** Spectral characteristics of system response. **Engineering applications of random processes.**

Textbook: Leon-Garcia, "Probability, Statistics, and Random Processes for Electrical Engineering," Third Edition, Prentice-Hall, 2008
Prerequisite: STAT 101

EE 466 Cryptography and Network Security **3(3,1,0)**

Information Security: Principles; services; mechanisms; techniques; attacks. Fundamentals of cryptography; Secret-key cryptography, Encryption algorithms, Hash functions, Message authentication code (MAC), DES, AES; Public-key key cryptography, The discrete log problem, the integer factorization problem, Diffie-Helman key exchange, RSA and Elgamal encryption and digital signatures; Cryptographic protocols and their application to network and information security. Security in computer networks: TCP/IP security; Network attacks including port scanning, DDoS attacks, Botnets; Counter measures and best practices for cyber security; Intrusion detection/prevention systems (IDS/IPS): Anomaly vs. signature, network vs. host, IDS/IPS evasion techniques; Firewalls and proxies.

Textbook: B. Forouzan, "Cryptography and Network Security", McGraw-Hill, Latest Ed.

Pre-requisite: EE 320

EE 468 - Selected Topics in Communications and Signal processing **3(3,1,0)**

Topics of current interest will be offered.

Pre-requisites: EE 301 & EE 320

Approved by: Chairman: …… Dean: ……

EE 469 - Selected Topics in Engineering Electromagnetics **3(3,1,0)**

Topics of current interest will be offered.

Pre-requisites: EE 204

EE 470 - Renewable Energy Engineering **3(3,1,0)**

Understanding human energy needs, Alternative generating systems, Current sources of coal, oil, and nuclear power. Renewable energy sources including solar, wind, biomass, bio-fuel, fuel cells, hybrid systems, ocean, and geothermal. Renewable energy in a sustainable future. The nature and availability of solar radiation. Low-temperature solar energy applications. Solar thermal engines and electricity generation. Introducing photovoltaics. PV basis principles. Electrical characteristics of PV cells and modules. PV systems for remote power. Grid-connected PV systems. Cost of energy form PV. Biomass as a fuel. Bioenergy sources. Combustion of solid biomass. Production of gaseous fuels from biomass. Production of liquid fuels from biomass. Hydro: The resource. Stored energy and available power. Type of the hydroelectric plant. Small scale hydroelectricity. Wind turbines. Aerodynamics of wind turbines. Power and energy from wind turbines. Offshore energy. Environmental consequences and considerations of energy conversion and renewable sources. Socioeconomic implications of sustainable energy.

Textbooks:

1. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 2nd or Latest Ed. (ISBN 0199261784), Oxford: Oxford Univ. Press.
2. Aldo Da Rosa, "Fundamentals of Renewable Energy Processes", 1st or Latest Edition (ISBN 0120885107), Elsevier Academic Press.

Pre-requisite: EE 310 and *EE 340*

EE 479 - Selected Topics in Electrical Power Engineering **3(3,1,0)**

Topics of current interest will be offered.

Pre-requisites: EE 340

EE 480 – Introduction to Artificial Intelligence **3(3,1,0)**

Introduction to artificial intelligence, Intelligent agents, Solving problems by searching, Game playing, logical agents and first order logic, Learning from observations, Learning in neural and belief networks, Practical language processing, Fuzzy logic and reasoning, Perception and pattern recognition, Artificial neural networks. Applications in image processing, Robotics, projects.

Textbook: Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd or Latest Edition, Prentice Hall.

Pre-requisite: EE 351

EE 481 - Real Time System Design **3(3,1,0)**

Basic issues in Real Time System Design, Conceptual models that can be used in capturing behavior and its implementation. Real Time operating System RTOS. Scheduling and Practical Implementation of Embedded Systems having a real time constraints. Translation of system specifications into a computation models and mapping these formal models into RTL level.

Approved by: Chairman: …… Dean: ……

Case Study on the Quartus II – Stratix II Environment integrating the NIOS Processor with FPGA.

Textbooks:

1. D. Gajski, F. Vahid, S. Narayan, J. Gong, "Specification and Design of Embedded Systems, Prentice Hall, 2008.
2. Volnei A. Pedroni, "Circuit design with VHDL", MIT Press, London England, Latest Edition.

Pre-requisite: EE 353

EE482 - Communication Networks **3(3,1,0)**

Introduction to communications networks; Circuit switching and packet switching; Computer networks protocols: OSI layers; Traffic flow control: Reliable data transfer; Medium access control methods; Local area networks (LANs): Ethernet and Wi-Fi; Routing algorithms; IP addressing; Overview of several protocols used in the Internet; TCP and UDP; Discussion of recent development in the subject.

Textbook: Alberto Leon-Garcia and Indra Widjaja, "Communication Networks", Latest Edition McGraw Hill.

Pre-requisite: EE 320

EE 483 - Digital Control Systems **3(3,1,0)**

Introduction to digital systems; Sampling process; Z-transform techniques; Difference equations and state space representation; Simulation of discrete systems; Solution via Z-transform; Stability, controllability and observability of discrete systems; Discretization methods; Introduction to computer controlled systems.

Textbooks:

1. Charles, Phillips and Nagle "Digital Control System Analysis and Design", Prentice-Hall, Latest Edition.
2. K. Ogata, "Discrete-Time Control Systems," 2nd or Latest Edition, Prentice Hall.

Pre-requisite: EE 351

3.7.3 Optional Elective Courses

EE 998 - Research Project **0 (NP)**

The course is designed to serve the research needs of the students. The course is not required for graduation; so students may opt to register it or otherwise. The consent of the faculty member with whom the student might work is essential.

Prerequisite: Successful completion of 129 credit hours