**KING SAUD UNIVERSITY**
**COLLEGE OF ENGINEERING**
**ELECTRICAL ENGINEERING DEPARTMENT**

# 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, economical and social development taking place in Saudi Arabia. Accordingly, the Department educates and prepares engineers on electrical power and the responsibilities associated in electrical power engineering stations, substations and high voltage transmission networks. The Electrical Engineering Department 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 Department qualifies electrical communication engineers 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 Department also teaches electronics in order to design, and maintain the electronic circuits and systems used in the fields of communication, automatic control and computers along with other systems of civilian or military nature. Moreover, the Department prepares system engineers who are trained in the design and management of control systems using computers to operate and maintain various processes and fulfill other applications.

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 subjected to a continuous upgrades and improvements in order to keep pace with the latest technology requirements. The diverse areas of specialty associated with electrical engineering provide the graduates with very good job opportunities both in the governmental and in the private sectors throughout the Kingdom.

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# 2. BACHELOR OF SCIENCE PROGRAM

## 2.1 General

The undergraduate Electrical Engineering program leads to the Bachelor of Science Degree with a Major in Electrical Engineering (EE). It has four distinct specialized areas:

1. Electronics,
2. Communication Systems,
3. Electrical Power Engineering,
4. Automation and Intelligent Systems.

This program was approved by the EE faculty on March 23, 2008. It was carefully designed to provide more opportunities and less restriction by allowing students to have breadth of knowledge in important areas of modern electrical engineering and at the same time ensure that the graduates have sufficient depth to begin professional work with confidence in at least one of the above disciplines. The B.S. program is a four-year/eight-semesters program, preceded by a two-semester preparatory year.

## 2.2 Preparatory Year

The preparatory year aims at enhancing the skills of the student through intense English courses and courses that improve their communication and computer skills. The table below illustrates the modules studied during the preparatory year.

| **Level 1** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Hr.** |
| MATH 140 | Introduction to Mathematics | 2(2-1-0) |
| ENGL 140 | English Language (1) | 8(20-0-0) |
| Health 150 | Health & Fitness | 1(1-1-0) |
| CI 140 | Learning, Thinking and Research Skills | 3(3-1-0) |
| ENT 101 | Entrepreneurship | 1(1-1-0) |
| | | **15** |

| **Level 2** | | |
|---|---|---|
| **Course Code** | **Course Title** | **Hr.** |
| MATH 150 | Differential Calculus | 3(3-1-0) |
| ENGL 150 | English Language (2) | 8(20-0-0) |
| IT 140 | Computer Skills | 3(0-0-6) |
| SCS 140 | Communication Skills | 2(2-1-0) |
| | | |
| | | **16** |

## 2.3 Course Requirements

After successfully passing the preparatory year and to complete the graduation requirements for a B.S. in Electrical Engineering, the students are required to successfully pass a total of 132 credit hours (Table 1). The program is divided into:

- 12 credit hours of University requirements (Table 2)
- 51 credit hours of College requirements (Table 3) of which 38 credit hours are compulsory courses for all departments (Table 3A) and 13 credit hours of complementary courses (Table 3B)

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- 69 credit hours of departmental requirements (Table 4) of which 42 credit hours are core courses (Table 4A), 4 credit hours of graduation project (Table 4B) and 23 credit hours of elective courses (Table 4C).
- The 23 cr. hr. elective courses are divided into two groups: Depth courses (17 cr. hr.) that are to be selected from one of the specialized areas offered by the department and Breadth courses (6 cr. hr.) that are to be selected from two areas other than the student's area of specialization (Tables 5A to 5D inclusive).

### 2.4 Senior Capstone Design 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 if he completes successfully at least 128 credit hours and completing all courses of the 7$^{th}$ level, and other earlier levels. Senior Design Project -2 can be taken during the first and second semesters only (not during summer semester).

### 2.5 Summer Training Requirements

Prior to graduation, each Electrical Engineering major must complete an approved Engineering Summer Training Program, after completion of at least at least 110 Cr. Hr. and completing the registration requirements of all courses in the 8$^{th}$ level. Summer training extends over a period of 10 weeks excluding weekends and official holidays, and must be undertaken in companies or establishments accepted by the college. The student's performance is evaluated by the training company and by both the Department and College coordinators.

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

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

| Requirements | Cr. Hr. | Description |
|---|---|---|
| University | 12 | Islamic (8) and Arabic (4) Studies |
| College | 51 | Compulsory (41), Complementary (10) |
| Department | 69 | Core (42), Projects (4) and Electives (23) |
| **Total** | **132** | |

**Table 2 UNIVERSITY REQUIREMENTS**

| Course Code | Course Title | Cr. Hr. | Notes |
|---|---|---|---|
| ARAB 101 | Language Skills | 2(2,0,0) | Compulsory |
| ARAB 103 | Arabic Basic Writing | 2(2,0,0) | Compulsory |
| IC 107 | Ethics of the Profession in Islam | 2(2,0,0) | Compulsory |
| IC 100 | Studies in Prophet Biography | 2(2,0,0) | Optional |
| IC 101 | Origins of Islamic Culture | 2(2,0,0) | Optional |
| IC 102 | Islam and Society Development | 2(2,0,0) | Optional |
| IC 103 | The Economic System in Islam | 2(2,0,0) | Optional |
| IC 104 | Basics of Political System in Islam | 2(2,0,0) | Optional |
| IC 105 | Human Rights | 2(2,0,0) | Optional |
| IC 106 | Medical Jurisprudence | 2(2,0,0) | Optional |
| IC 108 | Contemporary Issues | 2(2,0,0) | Optional |
| IC 109 | Woman and Her Developmental Role | 2(2,0,0) | Optional |
| | **Total** | **12** | |

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## Table 3 COLLEGE REQUIREMENTS

### Table 3A COMPULSORY COURSES

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | |
|---|---|---|---|---|
| | | | Pre- | Co- |
| MATH 106 | Integral Calculus | 3(3,2,0) | *MATH 150* | |
| MATH 107 | Vectors and Matrices | 3(3,2,0) | *MATH 150* | |
| MATH 203 | Differential and Integral Calculus | 3(3,2,0) | *MATH 106*<br>*MATH 107* | |
| MATH 204 | Differential Equations | 3(3,2,0) | *MATH 203* | |
| STAT 324 | Engineering Probability and Statistics | 3(2,2,0) | | |
| PHYS 103 | General Physics (1) | 4(3,0,2) | | |
| PHYS 104 | General Physics (2) | 4(3,0,2) | | |
| CHEM 101 | General Chemistry (1) | 4(3,0,2) | | |
| ENGL 107 | Technical Writing | 3(3,0,0) | | |
| ENGL 108 | Communication Skills for Engineers | 3(3,0,0) | | |
| GE 104 | Basics of Engineering Drawing | 3(2,0,2) | | |
| GE 201 | Statics | 3(3,1,0) | *MATH 106*<br>*MATH 107* | |
| GE 404 | Engineering Management | 2(2,1,0) | | |
| | **Total** | **41** | | |

### Table 3B COMPLEMENTARY COURSES

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | |
|---|---|---|---|---|
| | | | Pre- | Co- |
| GE 105 | Introduction to Engineering Design | 2(1,1,2) | *GE 104* | |
| GE 211 | Computer Programming in "C++" | 3(2,0,2) | | |
| GE 403 | Engineering Economy | 2(2,1,0) | | |
| MATH 244 | Linear Algebra | 3(3,2,0) | *MATH 107* | |
| | **Total** | **10** | | |

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

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## Table 4: ELECTRICAL ENGINEERING REQUIREMENTS

### Table 4A: 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 205 | Electric Circuits Laboratory | 1(0,0,2) | | *EE 212* |
| EE 208 | Logic Design | 3(3,1,0) | | |
| EE 210 | Logic Design Laboratory | 1(0,0,2) | *EE 208* | |
| EE 211 | Computational Techniques in Electrical Eng. | 3(2,0,2) | *GE 211* | *MATH 244* |
| EE 212 | Electric Circuit Analysis | 2(2,1,0) | *EE 201*<br>*MATH 107* | |
| EE 213 | Engineering Electromagnetics (1) | 3(3,1,0) | *MATH 203*<br>*PHYS 104* | |
| EE 214 | Engineering Electromagnetics (2) | 2(2,1,0) | *EE 213* | |
| 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* |
| EE 320 | Communications Principles | 3(3,1,0) | *EE 301* | |
| EE 330 | Electromechanical Energy Conversion (1) | 3(3,1,0) | *EE 212*<br>*EE 213* | |
| EE 340 | Fundamentals of Power Systems | 3(3,1,0) | *EE 212* | |
| 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.

### Table 4B: SENIOR DESIGN PROJECTS

| Course Code | Course Title | Cr. Hr. | Requisites | |
|---|---|---|---|---|
| | | | Pre- | Co- |
| EE 496 | Graduation Project -1 | 2 | Complete 131 credits | |
| EE 497 | Graduation Project -2 | 2 | *EE 496* | |
| | **Total** | **4** | | |

### Table 4C: ELECTIVE COURSES

*Each student is required to take 17 cr. hr. from ONE of the four Specialized Areas (Depth) in addition to 6 cr. hr. from TWO other areas (Breadth)*

| Elective Module | Cr. Hr. |
|---|---|
| Specialized Area Elective Module (Depth) | 17 |
| Other Areas Elective Courses (Breadth) | 6 |
| **Total** | **23** |

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## Table 5: ELECTIVE COURSES OF SPECIALIZED AREAS

*Each student is required to take 17 cr. hr. from ONE of the four Specialized Areas (Depth) in addition to 6 cr. hr. from TWO other areas (Breadth)*

### Table 5A: ELECTRONICS

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | | Notes |
|---|---|---|---|---|---|
| | | | Pre- | Co- | |
| EE 401 | Introduction to Electronic Circuits | 3(3,1,0) | *EE 310* | | *Compulsory for Depth Students* |
| EE 402 | Electronic Circuits Laboratory | 1(0,0,2) | | *EE 401* | *Compulsory for Depth Students* |
| 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* | | *Compulsory for Depth Students* |
| EE 406 | VLSI Design Laboratory | 1(0,0,2) | | *EE405* | *Compulsory for Depth Students* |
| EE 407 | Electronic Communication Circuits | 3(3,1,0) | *EE 401* | | |
| EE 408 | VLSI Technology and Fabrication | 3(3,1,0) | *EE 310* | | |
| EE 409 | Electronic Instrumentation | 3(3,1,0) | *EE 401* | | |
| 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 403* | | |
| EE 419 | Introduction to Electronic Warfare | 3(3,1,0) | *EE 401* | | |

### Table 5B: COMMUNICATION SYSTEMS

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | | Notes |
|---|---|---|---|---|---|
| | | | Pre- | Co- | |
| EE 420 | Digital Signal Processing | 3(3,1,0) | *EE 301* | | |
| EE 421 | Communications Laboratory | 2(0,0,4) | *EE 214 EE 320* | | *Compulsory for Depth Students* |
| EE 422 | Digital Communications | 3(3,1,0) | *EE 320* | | *Compulsory for Depth Students* |
| EE 423 | Wave Propagation and Antennas | 3(3,1,0) | *EE 214* | | *Compulsory for Depth Students* |
| EE 425 | Satellite Communications | 3(3,1,0) | *EE 423* | | |
| EE 426 | Microwave Engineering | 3(3,1,0) | *EE 214* | | |
| EE 427 | Information Theory | 3(3,1,0) | *STAT 324* | | |
| EE 428 | Error Correcting Coding for Communication Systems | 3(3,1,0) | *EE 422* | | |
| EE 463 | Wireless Communications | 3(3,1,0) | *EE 422 EE 423* | | |
| EE 464 | Optical Communications | 3(3,1,0) | *EE 423* | | |
| EE 468 | Selected Topics in Communications and Signal Processing | 3(3,1,0) | *Instructor and Department Approval* | | |
| EE 469 | Selected Topics in Engineering Electromagnetics | 3(3,1,0) | *Instructor and Department Approval* | | |

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

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**Table 5C: ELECTRICAL POWER ENGINEERING**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | | Notes |
|---|---|---|---|---|---|
| | | | Pre- | Co- | |
| EE 431 | Electromechanical Energy Conversion (2) | 2(2,1,0) | *EE 330* | | *Compulsory for Depth Students* |
| EE 432 | Power Electronics | 3(3,1,0) | *EE 310* | | |
| EE 433 | Electromechanical Energy Conversion Laboratory | 1(0,0,2) | | *EE 431* | *Compulsory for Depth Students* |
| EE 435 | Electric Drives | 3(3,1,0) | *EE 330*<br>*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* | | *Compulsory for Depth Students* |
| 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 445 | Electrical Power Laboratory | 2(0,0,4) | | *EE 441* | *Compulsory for Depth Students* |
| EE 446 | High Voltage Engineering | 3(3,1,0) | *EE 340* | | |
| EE 447 | Electricity Market and Energy Transactions | 3(3,1,0) | *EE 441* | | |
| EE 448 | Power Distribution Systems | 3(3,1,0) | *EE 340* | | |
| EE 449 | Power System Protection | 3(3,1,0) | *EE 441* | | |
| EE 470 | Renewable Energy Engineering | 3(3,1,0) | *EE 310*<br>*EE 340* | | |
| EE 475 | Power System Grounding | 3(3,1,0) | *EE 340* | | |
| EE 479 | Selected Topics in Electrical Power Engineering | 3(3,1,0) | *Instructor and Department Approval* | | |

**Table 5D: AUTOMATION AND INTELLIGENT SYSTEMS**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Requisites | | |
|---|---|---|---|---|---|
| | | | Pre- | Co- | |
| EE 450 | Computer Architecture Organization | 3(3,1,0) | *EE 357* | | |
| EE 453 | Microprocessor and Embedded System Design | 3(3,1,0) | *EE 357* | | |
| EE 454 | Advanced Control Systems | 3(3,1,0) | *EE 351* | | |
| EE 456 | Automatic Control Applications | 3(3,1,0) | *EE 351* | | *Compulsory for Depth Students* |
| EE 457 | Applied Control Laboratory | 1(0,0,2) | | *EE 456* | *Compulsory for Depth Students* |
| EE 458 | Advanced Logic Design | 3(3,1,0) | *EE 210* | | *Compulsory for Depth Students* |
| EE 459 | Advanced Logic Design Laboratory | 1(0,0,2) | | *EE 458* | *Compulsory for Depth Students* |
| EE 480 | Introduction to Artificial Intelligence | 3(3,1,0) | *EE 351* | | |
| EE 481 | Real Time System Design | 3(3,1,0) | *EE 357* | | |
| EE 482 | Communication Networks | 3(3,1,0) | *EE 320* | | |
| EE 483 | Digital Control Systems | 3(3,1,0) | *EE 351* | | |

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

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## Table 6: RECOMMENDED SEMESTER SCHEDULE - ELECTRICAL ENGINEERING PROGRAM*

| Level 3* | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| CHEM 101 | General Chemistry (1) | 4(3,0,2) | |
| ENGL 107 | Technical Writing | 3(3,0,0) | |
| MATH 106 | Integral Calculus | 3(3,2,0) | *MATH 150* |
| MATH 107 | Vectors and Matrices | 3(3,2,0) | *MATH 150* |
| PHYS 103 | General Physics (1) | 4(3,0,2) | |
| **Total** | | **17** | |

| Level 4 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| ARAB 101 | Language Skills | 2(2,0,0) | |
| ENGL 108 | Communication Skills for Engineers | 3(3,0,0) | |
| GE 104 | Basics of Engineering Drawing | 3(2,0,2) | |
| IC 107 | Ethics of the Profession in | 2(2,0,0) | |
| MATH 203 | Differential and Integral Calculus | 3(3,2,0) | *MATH 106 MATH 107* |
| PHYS 104 | General Physics (2) | 4(3,0,2) | |
| **Total** | | **17** | |

| Level 5 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| EE 201 | Fundamentals of Electric Circuits | 3(3,1,0) | *MATH 106* |
| EE 213 | Engineering Electromagnetics (1) | 3(3,1,0) | *MATH 203 PHYS 104* |
| GE 105 | Introduction to Engineering Design | 2(1,1,2) | *GE 104* |
| GE 201 | Statics | 3(3,1,0) | *MATH 106 MATH 107* |
| GE 211 | Computer Programming in "C++" | 3(2,0,2) | |
| MATH 204 | Differential Equations | 3(3,2,0) | *MATH 203* |
| **Total** | | **17** | |

| Level 6 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| EE 205 | Electric Circuits Laboratory | 1(0,0,2) | *EE 212* [c] |
| EE 208 | Logic Design | 3(3,1,0) | |
| EE 211 | Computational Techniques in EE | 3(2,0,2) | *GE 211 MATH 244*[c] |
| EE 212 | Electric Circuit Analysis | 2(2,1,0) | *EE 201 MATH 107* |
| EE 214 | Engineering Electromagnetics (2) | 2(2,1,0) | *EE 213* |
| IC 1xx | Optional Islamic Course | 2(2,0,0) | |
| MATH 244 | Linear Algebra | 3(3,2,0) | *MATH 107* |
| **Total** | | **16** | |

| Level 7 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| ARAB 103 | Expository Writing | 2(2,0,0) | |
| EE 210 | Logic Design Laboratory | 1(0,0,2) | *EE 208* |
| EE 301 | Signals and Systems Analysis | 3(3,1,0) | *EE 201* |
| EE 310 | Microelectronic Devices and Circuits | 3(3,1,0) | *EE 201* |
| EE 312 | Basic Electronics Laboratory | 1(0,0,2) | *EE 310* [c] |
| EE 330 | Electromechanical Energy Conversion (1) | 3(3,1,0) | *EE 212 EE 213* |
| EE 353 | Introduction to Microprocessors | 3(3,1,0) | *EE 208* |
| **Total** | | **16** | |

| Level 8 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| EE 320 | Communications Principles | 3(3,1,0) | *EE 301* |
| EE 340 | Fundamentals of Power Systems | 3(3,1,0) | *EE 212* |
| EE 351 | Automatic Control | 3(3,1,0) | *EE 301* |
| EE 356 | Control and Instrumentation Laboratory | 1(0,0,2) | *EE 351* [c] |
| EE 357 | Microprocessor and Microcontroller Lab | 1(0,0,2) | *EE 353* |
| IC 1xx | Optional Islamic Course | 2(2,0,0) | |
| STAT 324 | Engineering Probability and Statistics | 3(2,2,0) | |
| **Total** | | **16** | |

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| Level 9 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| EE 496 | Graduation Project-1 | 2 | Comp. 131 credits |
| EE 4xx | Specialized Elective Courses | 13 | *Refer to Table 5* |
| GE 403 | Engineering Economy | 2(2,1,0) | |
| **Total** | | **17** | |

| Level 10 | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **Cr. Hr. (X,Y,L)** | **Pre-requisite** |
| EE 497 | Graduation Project-2 | 2 | *EE 496* |
| EE 4xx | EE Specialized Elective Course | 10 | *Refer to Table 5* |
| GE 404 | Engineering Management | 2(2,1,0) | |
| IC 1xx | Optional Islamic Course | 2(2,0,0) | |
| EE 999 | Summer Training | 0 | Complete 96 credits |
| **Total** | | **16** | |

**c** Co-requisite

* This program is preceded by a two-semester preparatory year
(X,Y,L) X = Lectures; Y = Tutorials; L = Lab.

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# 3. COURSE DESCRIPTION

## 3.1 Preparatory Year

**ENGL 140 - English Language -1-** *8(20-0-0)*

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.

**ENGL 150 - English Language -2-** *8(20-0-0)*

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.

**Math 140 - Introductory Mathematics** *2(2-1-0)*

Basic Algebraic Operations, Equations and Inequalities, Graphs, Functions, Polynomials and Rational Functions, Exponential and Logarithmic Functions, Trigonometric Functions, Trigonometric Identities and Conditional Equations, Systems of Equations and Inequalities; Matrices, Sequences and Series.

Pre-requisites: None.

**Math 150 - 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.

Pre-requisites: None.

**IT 140 - Computer Skills** *3(0-0-6)*

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

Pre-requisites: None.

**CI 140 - Learning , Thinking and Research Skills** *3(3-1-0)*

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.

**SCS 140 - Communication Skills** *2(2-1-0)*

This course deals with communication kills as a tool for achieving personal psychological and social adaptability. It is one of the key skills in matrix of (self development skills) this course covers skills related to communication sufficiency comprised of a wide array of major matrix of knowledge, skills and approaches comprised in four main sufficiency: Knowledge sufficiency, Social sufficiency, Comprehension sufficiency, Productive sufficiency.

Pre-requisites: None.

**Health 150 - Health & Fitness** 1*(1-1-0)*

Subjects about general health and body and brain fitness.

Pre-requisites: None.

**ENT 101 – Entrepreneurship** 1*(1-1-0)*

Pre-requisites: None.

### 3.2 University Requirements

**ARAB 101 - Language Skills** *2(2-0-0)*

The original and secondary parsing, the dual, the five verbs, masculine and feminine, (the weak letter), etymology and the semantic evolution, nunation of accusative, diptote the original and secondary parsing, apocopate and jussive, dative/ genitive, verbal sentences, the signification of tenses, the passive verb (its signification and its forms in present and past verbs), the nominal sentences, the pronouns, the neglected letters, the conjunctions, numbers (how to write them).

**Pre-requisite: ---**

**ARAB 103 - Expository Writing** *2(2-0-0)*

Applications in reading and speaking skills, the adverb of time and the adverb of place, accusative of explanation (specification), Punctuations, computer-based writing, dictionaries and E-dictionaries, applications to reading and writing skills, accusative of cause or reason, denotative of state (circumstantial accusative or accusative of the state or condition), writing a paragraph and essay, application to reading and writing skills, appositions (adjective/ corroboration/ substitute/ explanatory apposition and syndetic explicative, diminutive (nomen deminutivum), applications in reading and writing skills, relation quiescence (pause), completion fifth text's exercises, and writing formal and informal letters.

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

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

***Approved by*:** Chairman: …… Dean: ……

**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 107 - Ethics of the Profession in Islam** 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

**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.

Pre-requisite: *MATH 150***.**

**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.

Pre-requisite: *MATH 150***.**

**MATH 203 - Differential and 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 centre of mass. Double integrals in polar coordinates. Triple integral in rectangular, cylindrical and spherical coordinates and applications to volume moment and centre of mass. Vector fields, line integrals, surface integrals, Green's theorem, the divergence theorem, Stoke' theorem.

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.

Pre-requisite: *MATH 203*.

**MATH 244 – Linear Algebra** *3(3,2,0)*

Matrices and their operations., types of matrices. Elementary transformations. Determinants, elementary properties. Inverse of a matrix. Linear systems of equations. Vector spaces, linear independence, finite dimensional spaces, linear subspaces. Inner product spaces. Linear transformations, kernel and image of a liner transformation. Eigen values and Eigen vectors of a matrix and of a linear operator.

Prerequisite: *MATH 107*.

**STAT 324 - Engineering Probability and Statistics** *3(2,2,0)*

Probability and probability distribution - Mathematical expectations of random variables. Discrete and continuous distributions. Sampling distributions - Estimation, testing of hypothesis - Regression and correlation.

Pre-requisites: *None*.

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

Introduction (Vectors), Motion in one dimension with constant acceleration, Motion in two dimension with application to projectile motion and circular motion, Newton’s Laws of Motion, Work and Energy, Potential Energy and 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 series circuit.

Pre-requisites: *None*.

**CHEM 101 - General Chemistry (1)** *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*.

**ENGL 107 - Technical Writing** *3(3,0,0)*

Types of documents. Principles of organizing, developing and writing technical information. Report structure and components. Report forms and rhetorical patterns common to scientific and technical Disciplines. Technical writing conversions including headings, illustrations, style and tone. Extensive writing assignments for various report and document types.

Pre-requisites: *None*.

**ENGL 108 - Communication Skills for Engineers** *3(3,0,0)*

Searching, compiling, referencing and writing ethics. Guidelines for good written communication. Guidelines for slide preparation and good oral presentation. Delivering successful speeches. Writing memos and business letters. Introduction to academic and business proposals. Guidelines for writing CV's, successful interviews and job search skills. Group dynamics, effective meetings, team-work, leadership and management skills. Engineering ethics and professional conduct.

Pre-requisites: *None*.

**GE 104 - Basics of Engineering Drawing** *3(2,0,2)*

Constructional geometry and basics of lettering; Sketching; Orthographic projection; Sectional and auxiliary views; Dimensioning; Introduction to computer graphics; Engineering applications.

Pre-requisites: *None*.

**GE 105 - Introduction to Engineering Design** *2(1,1,2)*

Introduction and practicing the engineering professional culture and ethics. Enhancing on personal skills such as teamwork, leadership, written and oral presentation. Problem solving strategies. Problem definition and techniques for stimulation of ideas. Decision making in design. Mathematical and computer modeling techniques.

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; centroids 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* and *MATH 107*.

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

Introduction to computers and programming. Compilers and numbers systems. Program structures, comments, and printing. Formatting output, Escape sequence, and program debugging. Variables, arithmetic operators, and expressions. Access of input/output files. Program control using: if-else statement, switch commands, for loops, and while loops. User-defined functions. One and two dimensional Arrays. Multidimensional arrays. Strings and Pointers. Structure data types. Introduction to classes. Engineering Applications.

Textbook: Delores M. Etter and Jeanine A. Ingber, "Engineering Problem Solving with C++", McGraw-Hill, Pearson international edition, 2nd edition 2008.

Pre-requisites: *None*.

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

Cost concepts. Time value of money operations. Measuring the worth of investments. Comparison of alternaives.Depreciation.Economic analysis of public projects.

Textbook: White, Case, Pratt and Agee, "Principles of Engineering Economic Analysis", 4th Edition.

Pre-requisites: *None*.

**GE 404 –Engineering Management** *2(2,1,0)*

This course is in an introductory course on project management. The course covers the project management process from the beginning to the end, focusing on practical skills that make students able to immediately complete projects on time and on budget, while achieving their targets.

Textbook: Harold Kerzner, " Project Management: A system Approach to Planning, Scheduling, and Control", Sixth edition, Wiley.

Pre-requisites: *None*.

### 3.4 Electrical Engineering Core Courses

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

Circuit theorems: superposition principle, Thevenin and Norton theorems, maximum power transfer theorem. Techniques of circuit analysis: Nodal and mesh analysis, Sinusoidal sources and the concept of phasors in circuit analysis. Introduction to the concept of average, reactive and complex power, and power factor. Three phase circuits.

Textbook: Boylestad, "Introductory Circuit Analysis", Prentice Hall, 2007.

Pre-requisites: *MATH 106*.

**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 and power factor improvement in AC circuits; Transients in DC circuits; Magnetically-coupled circuits; Three phase circuits.

Textbook: Boylestad, "Introductory Circuit Analysis", Prentice Hall, 2007.

Co-requisite: *EE 212*.

**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, 1998.

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

Pre-requisite: *EE 208*.

**EE 211 - Computational Techniques in Electrical Engineering** *3(2,0,2)*

Introduction to Numerical Analysis, Taylor Polynomials and Error in Taylor's Polynomial, Concept of Error, Root-finding (Bisection, Newton and Secant Method), Interpolation and Approximation, Lagrange Interpolating Polynomial, Newton's Polynomial, Numerical Integration and Differentiation, Systems of linear equations, Least Square method, Numerical Solution of Ordinary Differential Equation (ODE)

***Approved by*:** Chairman: …… Dean: ……

Textbook: K. Atkinson and W. Han, "Elementary Numerical Analysis, John Wiley & Sons, *L.E.*3rd ed., 2004.

Pre-requisite: *GE 211.* Co-requisite: *MATH 244.*

**EE 212 - Electric Circuit Analysis** *2(2,1,0)*

Introduction to the Laplace Transform. The Laplace Transform in Circuit Analysis. Frequency response of RLC and selective circuit: concept of transfer function, resonance, bode plots, introduction to filters; Two-Port networks; Mutual inductance and transformers; Transient analysis of first and second order circuits.

Textbook: Nilsson, "Electric Circuits", Addision Wesley, 2007.

Pre-requisite: *EE 201* and *MATH 107.*

**EE 213 – Engineering Electromagnetics (1)** *3(3,1,0)*

Review to vector calculus; Electrostatic fields; Columb's law ;Gauss's law and divergence; Electric potential; Dielectrics and capacitance; Poisson's and Laplace's equations; Charge images; Current density and conductors; Magnetostatic fields; Biot-Savart and Ampere's laws; Curl and Stoke's theorem; Magnetic materials and circuits; Self and mutual inductances; Energy in static Fields.

Textbook: Engineering Electromagnetics , William H. Hayt, Jr. and Johan A. Buck, McGraw Hill, 2012.

Pre-requisites: *PHYS 104* and *MATH 203.*

**EE 214 – Engineering Electromagnetics (2)** *2(2,1,0)*

Time varying fields; Faraday's law. Transformer and motional emfs; Displacement current; Maxwell's equations and time harmonic fields; Wave equation; Power transfer and Poynting vector; Plane wave propagation in free space, in lossy dielectrics and in good conductors; Polarization; Reflection of plane wave at normal and oblique incidence; Transmission line Theory; Impedance matching.

Textbook: Engineering Electromagnetics , William H. Hayt, Jr. and Johan A. Buck, McGraw Hill, 2012.

Pre-requisite: *EE 213.*

**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, 1996.

Pre-requisite: *EE 201.*

***Approved by*:** Chairman: …… Dean: ……

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

Introduction to semiconductor material properties; semiconductor diodes: structure, operation, and 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.

Text book: "Microelectronic Circuit Design", 3rd ed., Jaeger and Balock, McGraw-Hill, 2008.

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, 2004.

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, 2006.

Pre-requisite: *EE 301.*

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

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, 1998.

Pre-requisite: *EE 212* and *EE 213*.

**EE 340 – Fundamental 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.

***Approved by*:** Chairman: …… Dean: ……

Textbook: A.A. Al-Arainy, N.H. Malik and S.M. Al-Ghuwainem, "Fundamentals of Electrical Power Engineering", King Saud University Press, 2007.

Pre-requisite: *EE 212*.

**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, (Fourth edition and more), 2002.

Pre-requisite: *EE 301*.

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

Microprocessors architecture; Addressing modes and techniques; Instruction set; Assembly language programming; Interrupt systems; Input/output devices and timing; Memory devices; Future trends in microprocessors.

Textbook: Triebel and Singh, "The 8088 and 8085 Microprocessors", Prentice Hall, 2000.

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: "Modern Control Systems", Dorf and R. Bishop, Addison-Wesley, 1998.

Co-requisite: *EE 351*.

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

Introduction to microprocessors and their architecture; Microprocessor C/Assembly programming and machine code generation; RAM and EPROM; RS-232C; SCI and serial port interface; Parallel I/O interface and DMA; Programmable I/O interfaces and UART; DAC and ADC converters; Real time implementation; Project. Introduction.

Textbook: Triebel and Singh, "The 8088 and 8085 Microprocessors", Prentice Hall, 2000.

Pre-requisite: *EE 353*.

## 3.5 Electrical Engineering Elective Courses

### A. Electronics Elective Courses

**EE 401 – Introduction to Electronic Circuits** *3(3,1,0)*

Op-amp applications: inverting and non-inverting amplifiers, integrator, difference amplifier. Differential amplifier. Current Mirror. Negative and positive feedback. NMOS and CMOS inverters, CMOS and pseudo NMOS logic gates, pass-transistor logic, dynamic logic. BJT digital circuits: TTL, and ECL logic.

Textbook: Sedra and Smith, "Microelectronic Circuits", 5th Edition, Oxford University Press, 2004.

Pre-requisite: *EE 310.*

**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.

Text book: "Microelectronic Circuits", 5th Edition, Sedra and Smith, Oxford University Press, 2004.

Co-requisite: *EE 401*.

**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: "Electronic Communication Techniques", Paul H. Young, 5th Edition, Prentice Hall, 2003.

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.

Text book: "Microelectronic Circuit Design", 3rd ed., Jaeger and Balock, McGraw-Hill, 2008.

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: "Basic VLSI Design", Pucknell and Eshraghian, Pucknell, Prentice Hall, 1994.

Pre-requisite: *EE 310*.

**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, 2001.

Co-requisite: *EE 405*.

**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 Edition, Prentice Hall, 2003.

Pre-requisite: *EE 401*.

**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: "Silicon VLSI Technology", James D. Plummer, Michael Deal, Peter D. Griffin, 2nd Edition, Prentice Hall, 2008.

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: "Design with Operational Amplifiers and Analog Integrated Circuits", Franco, 3rd Edition, McGraw Hill, 2001.

Pre-requisite: *EE 401*.

***Approved by*:** Chairman: …… Dean: ……

**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: "Optoelectronics and Photonics: Principles and Practices", Kasap, Prentice Hall, 2001.

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, 1995.

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; 2 edition , 2008.

Pre-requisite: *EE 403*.

**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, 2004.

Pre-requisite: *EE 401*.

## B. Communication Systems Elective Courses

**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.

Pre-requisite: *EE 301*.

**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 214* and *EE 320.*

**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, 2009.

Pre-requisite: *EE 320.*

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

Wave-guides and cavities; Radiation and antennas; Antenna parameters; dipoles and loop antennas; traveling wave antennas; Aperture and patch antennas; Linear and planar antenna arrays; Basic propagation modes; Free-space propagation; Ground wave propagation; Sky wave propagation; Space (terrestrial) wave propagation; Introduction to Propagation models in mobile radio systems.

Textbook: [1] Constantine A. Balanis, "Antenna Theory, Analysis and Design", Wiley-Interscience, 2005.

[2]: Christopher Haslett, "Essentials of Radio Wave Propagation", Cambridge University Press, New York, 2008.

***Approved by*:** Chairman: …… Dean: ……

Pre-requisite: *EE 214*.

**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; 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; VSAT; Modern satellite systems and applications.

Textbook: Pratt, Bostian, and Allnutt, " Satellite Communication Systems", John Wiley & Sons, 2003.

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, Wiley, " Microwave Engineering", 2004.

Pre-requisite: *EE 214*.

**EE 427 - Information Theory** *3(3 ,1,0)*

Information theory measures: Entropy, relative entropy and mutual information; Entropy rate of a stochastic process: Memoryless sources and sources with memory; Data compression: source coding theorem, variable length codes, arithmetic codes; Characterization of transmission and storage channel: channel capacity, the channel coding theorem and its converse, Gaussian channel, capacity of band-limited channels; Introduction to error control codes.

Textbook: Thomas M. Cover and Joy A. Thomas, " Elements of Information Theory", Wiley, 2006.

Prerequisite: *STAT 324*.

**EE428 - Error Correcting Coding for Communication Systems** *3(3,1,0)*

Linear block codes, Galois fields; polynomials over GF(q); cyclic codes; BCH and Reed-Solomon codes; Block codes performance in AWGN channels; convolutional codes and Viterbi decoding; bit error rate bounds for convolutional codes; Trellis coded Modulation (TCM); Interleavers; concatenated codes; Error control for channel with feedback; application of ECC in different communication systems and in storage media.

Textbook: Robert H. Morelos-Zaragoza, " The Art of Error Correcting Codes", John Wiley & Sons, 2006.

Pre-requisite: *EE 422*.

***Approved by*:** Chairman: …… Dean: ……

**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, 2002.

Prerequisites: *EE 422* and *EE 423*.

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

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, 2000.

Pre-requisite: *EE 423*.

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

Topics of current interest will be offered.

Pre-requisites: Instructor and Department Approval.

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

Topics of current interest will be offered.

Pre-requisites: Instructor and Department Approval.

## C. Electrical Power Engineering Elective Courses

**EE 431 - Electromechanical Energy Conversion (2)** *2(2,1,0)*

Synchronous machines (construction, internal voltage, equivalent circuit, phasor diagram, performance of turbo-alternator, generator operating alone, parallel operation of AC generators, synchronous motor, steady-state operation, starting), DC machines (construction, classification, performance, motor characteristics, starting of DC motors, speed control of DC motors).

Textbook: Chapman, "Fundamentals of Electric Machinery", McGraw Hill, 1998.

Pre-requisite: *EE 330*.

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

***Approved by*:** Chairman: …… Dean: ……

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, 2008.

Pre-requisite: *EE 310*.

**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, 1998.

Co-requisite: *EE 431*.

**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, 2001.

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.

Textbook: Sarma, "Electric Machines: Steady State Theory and Dynamics Performance", West Publishing Co., 1998.

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, 2002.

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, 1984.

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, 1984

Pre-requisite: *EE 340*.

**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 and characteristics and coordination of overcurrent relays. Power Quality issues.

Textbook: J.D. Glover & M Sarma, "Power System Analysis and Design", 3rd edition, PWS Publishing, 2002.

Co-requisite: *EE 441*.

**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 Edition, Tata McGraw Hill 2005.

Pre-requisite: *EE 340*.

**EE447 - Electricity Market and Energy Transactions** *3(3,1,0)*

Basic concepts of market economics; electricity market driving forces; competitive electricity market structure: single and multiple sellers and buyers, pool market, bilateral market, spot market; DCOPF, ACOPF, SCOPF; electricity rate structure and pricing: marginal price, market clearing price, pool price, spot price; forward, future, options, swap and hedging contracts; security: costs, Value of loss load, LOLP, ancillary services; transmission and electricity markets; system charges: infrastructure, use of system, connections, and wheeling models and fees; regulatory models; Investing: in generation, in transmission.

***Approved by*:** Chairman: …… Dean: ……

Pre-requisite: *EE 441*.

**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., 1986.

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, Busbars, 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, 1997.

Pre-requisite: *EE 441*.

**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, 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.

Textbook: [1] Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Second Ed. Oxford: Oxford Univ. Press, 2004, ISBN 0199261784.

[2] Aldo Da Rosa, Fundamentals of Renewable Energy Processes, First Ed., Elsevier Academic Press, 2005, ISBN 0120885107.

Pre-requisite: *EE 310* and *EE 340*.

***Approved by*:** Chairman: …… Dean: ……

**EE 475 - Power System Grounding** *3(3,1,0)*

Basics of reasons, types and uses of grounding and bonding; step and touch voltages, Methods of grounding of power system neutrals; Equipment grounding; Lightning protection grounding; Static electricity protection grounding: Ground electrodes systems; Measurements of grounding system parameters; Electric safety hazards and preventive measures; Surge protection and noise mitigation techniques

Textbooks: G. Vijayaraghavan, Mark Brown and Malcolm Barnes, "Practical grounding, bonding, shielding and surge protection", Elsevier Press, 2004.

Pre-requisites: EE340.

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

Topics of current interest will be offered.

Pre-requisites: Instructor and Department Approval.

## D. Automation and Intelligent Systems Elective Courses

**EE450: 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 Edition, Prentice-Hall, Pearson, 2005.

Pre-requisite: *EE 357*.

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

The 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 edition, Elsevier Science, 2002.

Pre-requisite: *EE 357*.

**EE454: 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 to design real time applications.

Textbook: Roland S. Burns, "Advanced Control Engineering", 2001

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, 2007.
2- Richard C. Dorf and Robert H. Bishop "Modern Control Systems**"**, 11th edition Prentice Hall Inc., 2008

Pre-requisite: *EE 351*.

**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 EE483. 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 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, 2008.
2- Michael D. Ciletti, "Advanced Digital Design", Prentice Hall, 2008.

Pre-requisite: *EE 210*.

**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, 2008.

Co-requisite: *EE 458*.

**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, and projects.

Textbooks: Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall, 2002.

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. 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, 2008.

Pre-requisite: *EE 357*.

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

Introduction to communication networks; Computer networks protocols: ISO-OSI, TCP-IP, ATM, LANs; Sharing of resources techniques: circuit switching and store and forward techniques; Network traffic sources; Network traffic flow: link level and network level; Recent development on the subject; Applications: projects and discussions.

Textbooks: Alberto Leon-Garcia and Indra Widjaja, "Communication Networks", 2nd Edition McGraw-Hill, 2004.

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.

Textbook: [1] Charles, Phillips and Nagle “Digital Control System Analysis and Design”, Prentice-Hall, 2000.

[2] K. Ogata, “Discrete-Time Control Systems,” Second Edition, Prentice Hall, 1995

Pre-requisite: *EE 351*.

***Approved by*:** Chairman: …… Dean: ……