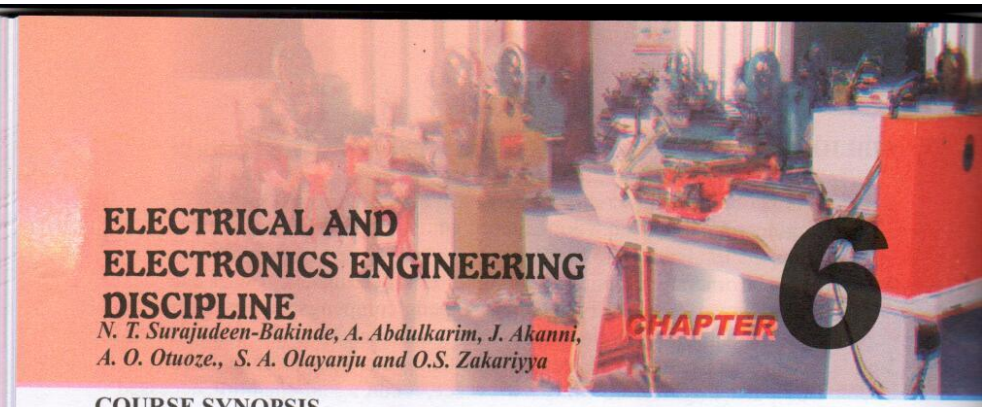

ELECTRICAL AND ELECTRONICS ENGINEERING DISCIPLINE

CHAPTER 6

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COURSE SYNOPSIS

Electrical and Electronics Engineering
Introduction to Electrical and Electronics Engineering discipline: Definition of Electrical and Electronics Engineering. Specializations/Options in Electrical and Electronics Engineering. Use of different equipment in Electrical and Electronics Engineering for various operations/processes. Prospects and job opportunities in Electrical and Electronics Engineering as a Profession. Relevant regulatory bodies and societies in Electrical and Electronics Engineering. The role of Electrical and Electronics Engineers in advancement of humanity.

6.1 INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING DISCIPLINE

6.2 DEFINITION

Electrical Engineering is the historical name for what is now called Electrical and Electronics Engineering and/or Electrical, Electronic and Computer Engineering. The discipline originates in the 19th century with the development of electric power and the advent of telephone and wireless communications. Electrical and Electronics Engineering continues to have lasting impact not only on engineering and technology profession, but on all aspects of societal developments. Recent advances such as integrated computing and communications systems and the proliferation of microchips and microelectronic hardware have revolutionized the present day existence in terms of life; work as well as how the society interacts and even on the social life.

The National Broadcasting Commission is a parastatal of the Federal Government of Nigeria established by Section 1 of the National Broadcasting Commission Act, Cap. NII; laws of the Federation, 2004 and vested with the responsibilities of, amongst other things, regulating and controlling the broadcasting Industry in Nigeria.

The Nigerian Communications Commission is the independent National Regulatory Authority for the telecommunications industry in Nigeria. The Commission is responsible for creating an enabling environment for competition among operators in the industry as well as ensuring the provision of qualitative and efficient telecommunications services throughout the country.

Electrical and Electronics Engineering is an application of science, technology, and problem-solving skills to conduct research, design, develop (or construct), test, and oversee the manufacture of electrical and electronic equipment and devices as well as maintain products, services and information systems.

Electrical and Electronics Engineers (EEE) design, develop, test, and supervise the manufacture of electrical and electronic equipment. Some of these equipment include broadcast and communications systems; computers; electric motors; machinery controls; lighting; wiring in buildings; automation systems; automobiles, aircraft, radar and navigation systems as well as power generating, controlling, and transmission devices used by electric utilities. Electrical Engineers also engage in the design and development of new technologies to generate, store, transmit, control and convert energy and information. From the global positioning systems (GPS) that can continuously provide the location of a vehicle to giant electric power generators, electrical and electronics engineers are responsible for a wide range of technologies.

Much of the advanced equipment found at home or workplace such as entertainment systems, domestic appliances, personal computers, data processing equipment, robots and machine tools are made possible by Electrical and Electronics Engineering.

6.3 SPECIALIZATIONS/OPTIONS IN ELECTRICAL AND ELECTRONICS ENGINEERING

There are several areas of specialization available in Electrical and Electronics Engineering. Candidates may study/work in design, research and development, production or management positions at government agencies or private corporations where they specialize in any of the underlisted areas. The following are available options but not limited to the specialization in Electrical and Electronics Engineering:

6.3.1 Electronics and Telecommunications Engineering

Electronics and Telecommunications Engineering, is an electrical engineering discipline that brings together electrical engineering with computer science in order to enhance telecommunication systems. Telecommunication engineering links heavily with what is generally grouped as broadcast engineering. A telecommunication engineer is responsible for designing, monitoring and installation of telecommunications equipment and facilities, such as complex electronic switching systems, wired and wireless telephone facilities, and fiber optics. Telecommunication is a diverse field of engineering which is connected to electronics, civil, structural, and electrical engineering. Ultimately, telecom engineers are responsible for providing the method for customers to have telephone and high-speed data services. The understanding of telecommunications engineering helps people who are closely working in political and social fields, as well as accounting and project managements.

Telecom engineers use a variety of equipment and transport media available fron multitude of manufacturers to design the telecom network infrastructure. The m common media, often referred to as plant in the telecom industry, used telecommunications companies today are copper, coaxial cable, fiber, and radio.

Telecom engineers are often expected, as most engineers are, to provide the b solution possible at the lowest cost to the company. This often leads to creat solutions to problems that often would have been designed differently without budget constraints dictated by modern society. In the earlier days of the telec industry, massive amounts of cable were placed that were never used or have b replaced by modern technology such as fiber optic cable and digital multiplex techniques.

In schools, it is taken as an option in Electrical and Electronics Engineering or ru a department under general Engineering faculty depending on the capacity of institution. Students wishing to establish themselves in this field must be soun basic science courses, general engineering mathematics, electron Communication theory, software designs; installation and operations, elementary and sophisticated Computer programming.

Some of the courses taken under this option in include Communication Enginee Principles, Satellite Communications, Mobile and Personal Communicati Digital Signal Processing, Broadcasting and Internet Technology etc.

6.3.2 Computer and Control Systems Engineering

Control Engineering or Control Systems Engineering popularly referred t Computer and Control Systems Engineering is the engineering discipline applies control theory to the designing of systems with expected or des behaviours. The practice uses sensors to measure the output performance of device being controlled and those measurements can be used to give feedback t input actuators that can make corrections toward desired performance. Wh device is designed to perform without the need of human inputs for correction, called automatic control. Being multi-disciplinary in nature, control syst engineering activities focus on implementation of control systems mainly derive mathematical modeling of systems of a diverse range. It also involves writi comprehensive algorithm from the mathematical models for translation int appropriate computer programming for the desired performance.

In schools, this is also taken as either an option in Electrical Engineering or department on its own under general engineering faculty. Students who wis establish themselves in the area must be solid in general engineering mathem computer programming, electronics, electrical machines, control theory etc. S of the courses taught under this option include Control Engineering, Microproc

Hardware and Software Techniques, Digital System Design and VHDL programming, Digital Control Engineering etc.

6.3.3 Power and Machines Engineering

Power and Machine Engineering also known as Power and Energy Systems studies electric power generation, transmission and distribution systems as well as renewable energy technologies by utilising well defined techniques and available potential energy sources including its economic implications. World primary energy resources such as fossil fuels, renewable energies, nuclear energy are utilised to prescribe solutions to present situation, trends, and future developments in the areas of power systems. Sustainable energy system and environmental impact of energy conversion and use have become the order of the present day world as it largely affects the economy and so is given priority in the present day energy systems studies. Power and energy systems research emphasizes all aspects of electrical energy, innovation in energy generation and delivery, alternative resources, and efficient devices, conversion, delivery and use of energy in electrical form. The activity ranges from controls for large utility systems to energy harvesting devices for micro-sensors. The growth of solar energy, wind energy, and other resources, combined with trends such as electric and hybrid vehicles will have profound impact on global society.

Largely, Power and Machines or Power and Energy systems as been called in some cases, focus on three major subdivisions that include Power Systems, Power Electronics and Electrical Machines. Power systems is the area concerned with the most economic, most reliable ways to assemble and operate a large electric power network, given its inherent nonlinearities and uncertainties; Power electronics deals with a developing a better, more reliable ways to design, analyze, and control switching power converters; while Electrical Machines deals with the design, modeling, simulations, application as well as protection of Electrical Machines.

Though power and machines is run as an option in some institutions, each of the subdivision is run as a department (for wider syllabus) or in some other cases taken as an option in the department of Electrical and Electronics Engineering. Students wishing to establish themselves in this area of electrical engineering must be sound in basic science courses, general engineering mathematics, electronics, Control theory, electrical machines and power systems theories. Some of the courses taught under this option include Electric Power principles, Electric Power Systems Engineering, Power Systems Communication and Control, Electrical Machines, Electrical Energy Conversion and Storage, Computer Application in Power Systems, Electrical Machines Design.

Other areas in electrical and electronics engineering include Energy Systems Engineering, Microprocessors and microcomputers, Analog and Digital Electronics Engineering, Optoelectronics, Electronic Circuit Design Engineering, Bioelectronics Engineering, Measurements, Instrumentation, Remote Sensing, Microelectronic Design and fabrication, Robotics and Automation Engineering, Microwaves, Radar Technologies, Antennas etc

6.4 USE OF VARIOUS INSTRUMENTS, EQUIPMENT AND APPARATUS IN ELECTRICAL AND ELECTRONICS ENGINEERING

In the field of Electrical and Electronics Engineering, there are myriads of instruments, equipment and apparatus used in measuring and testing of circuit elements and parameters as well as determining the circuit behaviours usually displayed in form of waveforms. These instruments, equipment and apparatus could be categorized into analogue or digital device. They could also be basically grouped into software or hardware. A very interesting thing is that all physical circuits and their elements exist in digital form and can also be designed, measured and simulated in digital modes. Various digital laboratories exist which will immensely assist students' practical understanding. It is therefore strongly recommended for students to acquaint themselves with the use of the laboratories. Such laboratories include Livewires, proteus, NL5 Circuit Simulator, MATLAB, iCircuits, xCircuits, CEDAR Logic Simulator to mention but a few. There are numerous software available online and more are still being released by the day.

Testing and measurements of values of circuit elements such as resistors, capacitors, inductors and diodes can be determined simply by using an instrument known as multimeter (A hybrid of basically Ohmmeter, Voltmeter, Ammeter). Instruments such as spectrum analyzer, motor drive analyzer, Mixed Signal Oscilloscope, instrument transformers etc are also often used.

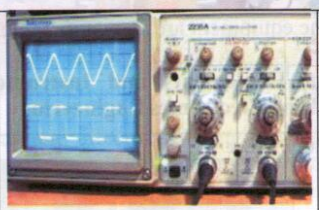
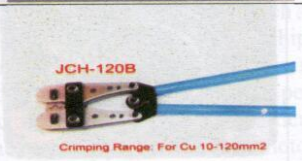
Equipment could be some complex machines like transformers, Hand Tools such as Soldering iron, set of screw drivers, cutters, or complete electrical tool kit to be precise; it could be PCB based tools such as Trace Resistance, Impedance calculator; it could be RF tools e.g RF Unit converter, filter circuit tracer etc; it could be schematic tools such as schematic capture tools; Circuit Simulators for drawing circuits as well as simulating them e.g Livewire, NL5 Circuit Simulator, iCircuits, xCircuits, CEDAR Logic Simulator etc passive tools such as Resistor Value Table or even digital toolbox

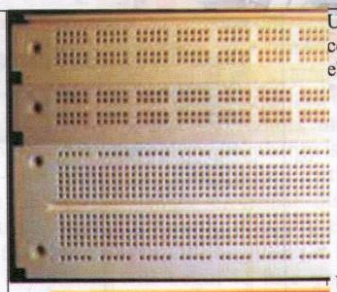
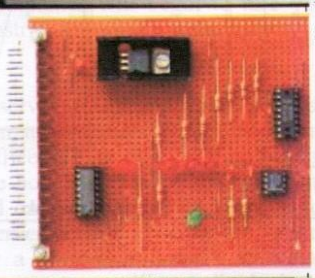
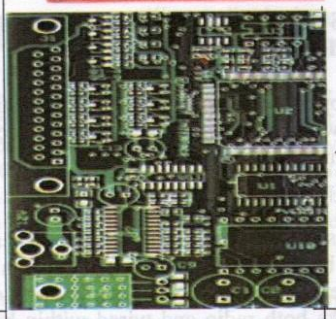
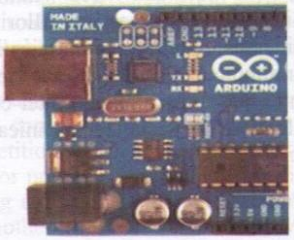
Apparatus here refers to any flexible-circuit set-up which allows for accommodation of some number of experiments called modules. Microchip Based Standard Modules which are designed to accommodate several experiments, measurements and Testing such as 'Skill G', Arduino boards and Galileo boards are perfect examples. Also, they could be in form of machines set up for some particular experiments such as Transformers (open and short circuit tests), Induction motors Since advancement has been made in the areas of automation, use of predesigned flexible circuit board.

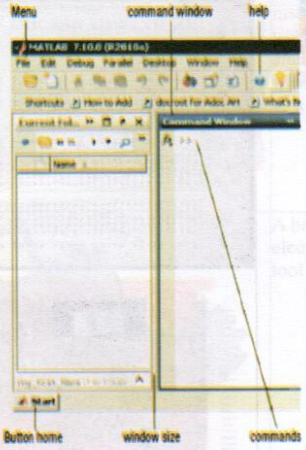
Some of the images of the equipment are shown in Table 6.1.

Table 6.1: Equipment, Implements and Instruments Used for Various Operations in Electrical and Electronics Engineering

S/N	Name of Equipment	Picture	Uses
1	Multimeters	  (A) DIGITAL MULTIMETERS  (B) ANALOG MULTIMETER	Is a multi-function meter basically used for measuring current, voltage and resistance. It can be analog or digital.

2	Oscilloscope		It is a laboratory instrument commonly used for displaying and analyzing the waveform of electronic as a function of time.
3	Electrical/Electronic Toolbox		A basic electrical/electronic tool
4	Soldering Iron		A hand tool used for joining component to component and to Vero boards.
5	A Roll of Soldering Lead		This is melted with the use of soldering iron to form joint between components, component and board
6	Crimping Tool		It is used for joining two pieces of Cu wires.

7	Breadboard		Used for temporary construction of electronic circuits
	Vero Board		Used as a mount for soldered components
	A Printed Circuit Board		A layout containing connections for ease of mounting components.
8			**Arduino Board:** A module which basically allows for control of appliances

9	A Printed Circuit Board	 MATLAB Software outlook.	Software are used mainly for analysis. They help in interpreting signals and systems behavior.

6.5 PROSPECTS AND JOB OPPORTUNITIES IN ELECTRICAL AND ELECTRONICS ENGINEERING.

There are unlimited opportunities for Electrical and Electronics Engineers to fit well into the society. Below are some of the key industry sectors where the services of Electrical and Electronics Engineers are needed.

Telecommunications

Telecommunications is a prime growth area for Electrical and Electronics Engineers. The growth is spurred by the worldwide deregulation, which has led to more players trying to make it on the field. The number of employers is expanding in such services as Local area networks both radio and wired within buildings and campuses as evident in some higher institutions University of Ilorin inclusive, Wire and optical links to homes and businesses, Satellite communications in unwired Third World countries, Satellite communications for mobile telephone users everywhere, Satellite, microwave, and fiber-optic trunks for inter-city traffic, Databases ranging from internet sites to collections of specialized technical information, Digitization of broadcasting stations etc.

Energy and Electric Power Sector

Power engineers deal with energy generation by a variety of methods -- turbine, hydro, fuel cell, solar, geothermal, and wind, for example. They also deal with electrical power distribution from source to consumer and within factories, offices, hospitals, laboratories, and they design electric motors and batteries. In industry, power engineers are employed wherever electrical energy is used to manufacture or produce an end product -- petrochemicals, pulp, paper, textiles, metals, and rubber, for example. They are needed to design electrical distribution systems and instrumentation and control systems for the safe, effective, efficient operation of the production facilities. As the average age of the engineers in this job area approaches the mid-to-late forties, companies will begin to hire young engineers in large numbers. Jobs in these industries are usually in abundance.

Computers

The computer industry serves many industrial sectors, including aerospace, transportation, construction, telecommunications, power, medicine, and automated manufacturing and even offices. The industry is strong and growing, in part because of the desire of corporate bodies to reduce its dependence on large, expensive centralized systems based on mainframes, and instead to opt for more flexible architectures like client/server networks, or private "intranets" based on Internet technology, separated by a protective firewall to maintain local security for proprietary materials. Even more compelling, individuals and companies alike have embraced the World Wide Web as an information source, communication medium and market for goods, creating a seemingly insatiable demand for advanced software, high-speed modems, and more powerful PCs are well appreciated in the applications of computers. Many employers in the computer industry find it difficult to fill the positions created by growth. Demand is especially strong for those whose knowledge and skills integrate hardware and software, as hardware/software co-design gains in popularity thereby giving Electrical and Electronics Engineers a large variety of options in this field regarding their future career.

Semiconductors

The chief enabling technology at the heart of the electronic components booming computer industry is semiconductor technology, in particular the development and manufacture of integrated circuits. As integrated circuits companies strive to search for faster and more powerful chips, they seek engineers to investigate new materials and improved packaging -- engineers who can handle the challenge of competitive pressure and ever-shorter development time. Manufacturers of microprocessors and memory chips for example, continuously improve existing products and introduce new ones to beat the competition and meet customers' expectations of ever-higher performance. Semiconductor products include not just digital ICs but also analog chips, mixed-signal (analog and digital) integrated circuits, and radio-frequency (RF) integrated circuits. Another important sector deals with power semiconductor devices for power control in manufacturing, transportation, and electrical distribution.

Aerospace

Electrical and electronics engineers in the aerospace field, design and develop electronics and power equipment for aircraft, helicopters, and spacecraft. Displays, controls, communications, and navigation are important aspects of the field, as are simulators for training and development. Military systems for land, sea, and air also come under the aerospace category.

Defence and aerospace companies still employ hundreds of thousands of Electrical and Electronics Engineers, even though the aerospace industry has faced some hard times in recent years. Prospects in the two major branches of the industry are looking brighter. Defence systems are a major priority for most nations especially; Nigeria which is currently facing seemingly unending terror attacks. Interests in space exploration and travel will be an added advantage. Hence, new satellites are needed to meet swelling demand for global communications. Electrical Engineers are therefore needed to be on deck in the design, operations and maintenance of satellites.

Bioengineering

This wide-ranging field, alternatively referred to as biomedical engineering, was created some 30years ago by the merging interests of engineering and the biological /medical sciences. Some of the representative bioengineering activities include the design of diagnostic and therapeutic devices for clinical use, the design of prosthetic devices, the development of biologically compatible materials, and the application of state-of-the-art technology to biological research. This field has grown tremendously since its inception; now more than 100 universities offer training programs that are funded by hundreds of millions of dollars across the globe. Bioengineering is an interdisciplinary field with employers in many sectors but more of Electrical and Electronics Engineers. Bioengineers work with other health care professionals as members of a team.

The Biomedical Engineer must learn to think of biology in new ways in order to develop new tools for diagnosing disease and to repair or replace diseased organs. Many of the major advances in this field now seem almost common place: pacemakers, blood analyzers, cochlear implants, medical imaging, lasers, prosthetic implants, and life support systems are just a few of the results of the team efforts of biomedical engineers and health professionals.

Manufacturing

Manufacturing technology has become more important in recent years as global economic reality has forced companies to re-evaluate basic manufacturing techniques in order to remain competitive. In pursuit of increased productivity, companies have introduced such innovations as just-in-time parts supply, six-sigma quality goals, statistical process control, and robotic assembly cells. Even small companies have transformed their ad hoc approach to process development into rigidly controlled and monitored systems, well understood in terms of mathematical models, where the effects of random events can be quickly detected and corrected.

Thus there is a widespread application of the manufacturing sciences in the workplace today, from automation on the production line to management techniques to environmentally friendly methods of manufacturing. Electrical Engineers are therefore needed in the machineries design and operation, computer monitoring and control, general automation of various manufacturing processes as well as repairs and troubleshooting of the machineries.

Services and Other Professions

Many electrical and computer engineers and computer scientists find that their technical background makes them well suited for a variety of work in other industries. For example, the service industry has become a major employer of engineers and computer professionals.

Some find work that directly corresponds to their professional training. The entertainment industry hires engineers for a variety of projects; in the entertainment industries, for example, electrical and computer engineers are recruited to handle their Imagineering tools and to help create animated films. The banking and finance industry has many computer-related positions that need engineers to manage rapid-trading activities like the Internet Banking, ATM design and operations, electronic queuing managing systems etc. Many organizations use the talents of computer professionals to create, store, and transmit data and to create and manage systems for operation. Although individually, these industries do not employ a large number of engineers, in combination they add up to a large whole. Engineering majors can thus look to industries where they can apply their technical knowledge and skills in fields that may not be high-tech in themselves.

Education and Research

Many electrical engineers, computer engineers, and computer scientists interact with educational and research institutions or industrial labs. Some go straight into college and university teaching and research after completing their PhD degrees. Others, including those with master's degrees, may teach on a part-time basis while holding a full-time job with another organization or on a full time basis and/or as an independent consultant.

Opportunities also abound in continuing professional education, such as short courses designed to update engineers. Taught by faculty as well as consultants with industrial experience, these courses are offered to employees on site as well as off site. Engineers with expertise in timely subjects can also give papers and publish articles and books that bring them recognition and put them in line for consulting work.

Transportation and Automotive

This industry spans many areas. Transportation can include railroads, shipbuilding, and traffic management. What these disparate areas have in common is that employers rely on increased use of electronics merged with other engineering disciplines. It includes electronics for internal and external communication,

navigation, failure detection, and displays of many types. Many vehicles are directed and accelerated by fault-tolerant electronics. Electric power is generated and distributed within most vehicles. Ships are wired like small cities for power and information. The domain of mechanical and civil engineering, transportation and automotive areas have many job opportunities for electrical engineers from various technical specialties, including communications, computers, and control systems.

6.6 RELEVANT PROFESSIONAL BODIES IN ELECTRICAL AND ELECTRONICS ENGINEERING

There are various schools responsible for the tutoring of various engineering courses at tertiary levels and are often accredited to ensure compliance with the laid-down curriculum towards ensuring standard program. In Nigeria, the National University Commission (NUC) and the Council for the Regulation of Engineering in Nigeria (COREN) are responsible for carrying out the accreditation of the program from time to time. The purpose of this program is to help attract a diversified pool of talented students into research careers in the various fields, and to help ensure that they receive the best education possible.

Institute of Electrical and Electronics Engineers (IEEE) is a professional organization with its corporate office in New York City and its operations center in Piscataway, New Jersey in United States of America. It is an international, non-profit, professional organization for the advancement of technology related to electricity. IEEE develops global standards in a broad range of industries, including: power and energy, biomedical and health care, information technology and robotics, telecommunication and home automation.

The Nigerian Society of Engineers (NSE) is the umbrella organization for the Engineering Profession in Nigeria. The Society looks after the professional needs of members through well-structured programmes and regular interactions among the different cadre of membership, enhancing high professional standard and ethical practices

6.7 THE ROLE OF ELECTRICAL AND ELECTRONICS ENGINEERS IN ADVANCEMENT OF HUMANITY.

The technical-know-how of Electrical and Electronics Engineers (EEE) is required to drive through any meaningful development in any society. Some notable roles of EEE in the advancement of humanity include;

1. Ensuring growth in Telecommunications industry by research inputs, technical supports in terms of workmanship and consultancy
2. Developing and repairing electronic and electrical health facilities for managing health risks
3. They are responsible (with other relevant engineers) for power generation, transmission and distribution for both homes and industries.
4. They assist in transportations which include railroads, shipbuilding and control and general traffic management.
5. In the areas of security, electrical engineers develop various automation systems for verification and access as well as alert in case of security breach.
6. In economic growth, electrical engineers develop systems that not only lead to job creation but seeing to faster execution rate of jobs through systems hardware and software designs for industries and organizations.

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