ONLINE **COURSE DESCRIPTION** CATALOG

EPCE

ENERGY PROVIDERS COALITION FOR EDUCATION

Premier Resource for Industry-Driven Online

ENERGY EDUCATION

This course description catalog serves as a reference for courses, certificates, degrees and programs offered by the EPCE education partner institutions.

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Bismarck State College (BSC)

INTRODUCTORY COURSES

Orientation to the Electrical Industry

This online, non-college credit course will familiarize students with today's electrical industry. The course will begin looking at the history of the industry and at those who played major roles in its creation, development and structure. The course will familiarize students with the three sectors of the industry and the roles of each. Lastly, the course will touch on deregulation, new technology and what the future appears to hold.

Industrial Aptitude Test Prep Course

This online, non-college credit course will expose students to variety types of lessons and questions focusing on reading comprehension, mechanical aptitude, spatial aptitude and general mathematics that they will face in an Industrial Aptitude test. The course is designed to help the student discover their strengths as well as their weaknesses. Once the students are able to identify the subjects they are weak in, they can concentrate on those areas. This self-paced course will result in maximum test result by building the students self-confidence as they proceed and help them avoid "test anxiety" that causes low test scores.

ELECTRIC POWER TECHNOLOGY PROGRAM (ELPW)

Course requirements for Certificate in Electric Power Technology:

- Complete 41 semester credits of technical core courses and 12 semester hours in a specialization area of Electric Power Technology
- Complete 4 semester credits of general education from any two areas of study

Course requirements for AAS degree in Electric Power Technology:

- Complete 41 semester credits of technical core courses and 12 semester hours in a specialization area of Electric Power Technology
- Complete 15 semester credits of general education

For more information on certificate/degree plans and tuition, or to contact the ELPW advisor, please visit: **http://epceonline.org/electric-power-technology-details**

The Electric Power Technology program is available online in a convenient schedule that provides the best learning environment. Courses can be taken individually or per the recommended semester schedule.

Semester 1 Courses

Introduction to the Electrical Industry & Power Grid - ELPW 111 - 3 Credits

This course will begin with a basic introduction to the systems and components that make up a basic electrical system, including generation, transmission and distribution. Students then study the history behind electrical utility industry, how the electrical system in the United States was established and how Thomas Edison and George Westinghouse influenced the development of electrical systems. They learn how the electrical industry was first regulated and how regulation of the industry has changed. Students learn how the electrical industry is currently being re-regulated to encourage competition. Students will also gain knowledge of the system operations and marketing of electricity. Finally, they study how the electrical industry is segmented into utility sectors, such as investor-owned, federally owned, publicly owned and cooperatively owned utilities.

Applied Math - ENRT 103 - 3 Credits

This course will teach basic math skills and apply them to energy industry situations. Students will learn the metric system, basic volume and area calculations as well as algebra and trigonometry and how they apply to industry specific situations.

DC Fundamentals - ENRT 106 - 2 Credits

Recommended prerequisite: ENRT 103
This course covers basic direct current theory and application. Students will study methods of producing direct current voltage, including batteries, and magnetic fields. Students will learn to calculate voltage, current, resistance, and power in series, parallel, and combination DC circuits. The construction and operation of rotating DC machines including DC generators and DC motors will also be covered.

AC Fundamentals - ENRT 108 - 3 Credits

Recommended prerequisite: ENRT 103 & ENRT 106
This course covers basic alternating current theories and applies those theories to electrical systems and related equipment. Students will also study basic generator and motor design, construction and operation principles.

Industrial Composition - ENRT 115 - 2 Credits

In this course, students learn the proper writing techniques used within the industry through practical industrial writing scenarios such as filling out work request orders, equipment logs and electrical switching orders.

Semester 2 Courses

Electrical System Fundamentals - ELPW 105 - 3 Credits
This course will discuss the basic electrical power grid system from the electrical generation facility to your home usage. Students will study the different types of electrical power production including: fossil fired, hydroelectric, gas turbine, combine cycle, nuclear power and renewable energy sources such as wind, solar, and geothermal. The course will also cover what the future of the electrical system might look like using fuel cell and smart grid technology.

Electrical Industry Safety - ELPW 109 - 3 Credits
This course covers the general safety practices and information employees need while working in any segment of the electrical industry, and the Federal Agencies responsible for insuring a safe working environment. Students will also gain an understanding of the Workers Right to Know regulations and gain an awareness of Public Safety issues.

Basic Print Reading - ELPW 110 - 3 Credits
This course gives students an introduction to the different schematics used in power plant operations and electrical transmission and distribution systems. Students will gain an understanding of the standard symbols used in the various systems schematics and how to read them. Students learn how to read basic piping and instrumentation diagrams and how to interpret single line electrical diagrams. Students finish the course by studying electrical system diagrams beginning at the generator and following through to the distribution system.

Electrical System Components - ELPW 112 - 3 Credits
This course provides in-depth look into the components used in the transmission of electricity. Students begin with an introduction to the generation of electric power. Students will then learn how switchyards, substations, overhead transmission systems, and underground transmission systems transmit that power at the proper voltage levels and provide system protection. Components such as transformers, circuit breakers, regulators, capacitor banks, tap changers, disconnects, current and potential transformers, relays, and lightning arrestors will be examined in detail. Students will also study the various types of electrical conductors, structures, and insulators used to transmit electricity.

Industrial Communications - ELPW 118 - 2 Credits
In this course, students will study the appropriate interpersonal skills needed to communicate effectively with co-workers and customers including resolving on-the-job conflicts and establishing positive working relationships. Students will also learn what is considered acceptable behavior in the workplace and how to recognize unacceptable behaviors.

Semester 3 Courses

Advanced Print Reading - ELPW 200 - 3 Credits
This course covers advanced electrical prints used to navigate complex electrical systems and feeder maps. Students also study schematics that are used when working with electronic systems and system instrumentation that is used to control and monitor the flow of electricity through the electrical system. Students also learn to use the diagrams to troubleshoot system problems and to safely isolate sections of the electrical system.

Advanced Industrial Safety - ELPW 202 - 3 Credits
This course focuses on specific safety practices used within the industry. Students begin by studying general practices, such as confined space entry, lock-out tag out procedures, fall protection, fire safety and working with hazardous materials. Students also learn some specific safety procedures used by linemen, such as proper bucket truck operation and some techniques used when working with electrical conductors. Finally, students learn some of the specific considerations that must be adhered to as an electrical system dispatcher to ensure the safety of line crews and technicians working on the electrical system.

Advanced Electrical Systems - ELPW 204 - 4 credits
This course provides students with a complete understanding of the design and operation of electrical transmission and distribution systems. Students begin by studying the basic principles of transmission and distribution circuits, including the advantages and disadvantages of AC and DC transmission. Students will also learn some of the procedures used by system operators and line crews to maintain the safe and effective delivery of power during adverse conditions and the steps necessary to restore power after outages. An introduction to distribution system automation is also provided.

Electrical System Protection - ELPW 206 - 4 credits
This course covers philosophies and principles used to protect the electrical system from abnormal and fault conditions, beginning with the generator. Instrument transformers, protective relays, and system grounding principles are covered.

Semester 4 - Choose one specialization area or 12 total credits from the areas below

Line Construction Specialization

Transformers - ELPW 250 - 4 Credits
This course begins by reviewing basic transformer design and operation. The course also covers 3-phase transformers, single-phase loads for 3-phase transformers, and the connections used in such transformers. The course introduces students to installation procedures and maintenance procedures.

Underground Line Construction - ELPW 230 - 4 Credits
This course covers the two basic categories of underground line construction, such as direct burial and those found in vaults and ducts. Students learn the design, conductors and the transformers used in residential direct burial and the factors that affect it. The course includes underground line construction design and the factors that affect this type of installation.

Overhead Transmission & Distribution Line Construction - ELPW 210 - 4 Credits
This course covers the design and construction of transmission and distribution overhead lines. This includes structures, conductors, insulators and the factors that influence particular use for both transmission and distribution systems. The course covers guidelines for working safely with poles, conductors, switchgear, transformers, rigging, grounds and more. Students will be introduced to high and low voltage troubleshooting procedures, stringing procedures and guidelines for live line work. Maintaining good voltage to the customer and street lighting issues also will be discussed.

Substation Specialization

Classes offered in the Spring semesters

Substation Construction & Maintenance - ELPW 251 - 4 Credits
This course begins with a review of hand and power tools used during the construction and maintenance of substations and continues with safety procedures and equipment put in place to protect workers within a substation. Students learn the basic construction of a substation, including electrical equipment rigging and installation, cable tray and conduit installation, cable controls and panel wiring, as well as a wide variety of installation procedures for electrical components and protection equipment.

Substation Relays - ELPW 211 - 4 Credits
This course focuses on testing and calibrating substation equipment, including voltage testing on equipment feeder relays, and circuit breaker relays. Students also learn the various tests that need to be conducted on protective relays, such as overcurrent and voltage relays, directional and line relays, as well as ground and test device testing.

Substation Operations - ELPW 231 - 4 Credits
This course will detail the specifics of power electronics as applied in substations for power transmission. It will describe typical functions provided in utility substation automation systems and some important considerations in the interface between substation equipment and the automation system components. Students will look at the availability of information, the analysis of this information, and the subsequent decision making to optimize system operation in a competitive environment. Oil containment, animal issues and security will also be discussed and the requirements necessary to qualify a substation to withstand seismic events. The operation of substation fire protection and substation communications systems such as the SCADA system and SCADA security will be examined system design specialization.

System Design Specialization *

** Students need the ability to apply geometry, trigonometry, and algebra throughout the courses in this specialization.*

Advanced Math - ELPW 208 - 4 Credits
This course covers algebra, geometry and trigonometry needed for energy technicians working in the electrical system design and metering specialization areas. The course covers the fundamental concepts of algebra, equations, functions and graphs. The course also covers trigonometric functions, laws of sines and cosines, vectors and analytic geometry.

System Design Basics - ELPW 212 - 3 Credits
In this course, students study the basic principles and applications of components that comprise an electric power distribution system. It focuses on quantitative approaches to analyze systems including ideal transformers and line parameters. Customer requirements, design layout considerations, tariffs and new construction permitting requirements for overhead and underground distribution systems are studied.

System Design Analysis - ELPW 232 - 3 Credits

In this course students study the process calculations involved with distribution system design. Included is a brief review of fundamental principles and relationships, followed by exercises using phasors in complex coordinate planes, power transformer equivalent circuits, per unit notation, transmission line parameters and steady state operation, symmetrical faults and symmetrical components, unsymmetrical faults and system protection. The course winds up with an overview of system protection principles and settings calculations for various types of protective relays.

Civil Design - ELPW 252 - 2 Credits

In this course students study the basic principles of civil design in electrical distribution system facilities. It includes site selection and surveying, soils testing and compaction, grounding, grading, drainage and oil catchment requirements, step potential protection, design layouts, line plan and profile development, foundations, trenching and raceway design, and underground distribution cable direct burial, duct bank, manhole and vault design considerations.

Metering Specialization *

** Students need the ability to apply geometry, trigonometry, and algebra throughout the courses in this specialization track.*

Advanced Math - ELPW 208 - 4 Credits

This course covers algebra, geometry and trigonometry needed for energy technicians working in the electrical system design and metering specialization areas. The course covers the fundamental concepts of algebra, equations, functions and graphs. The course also covers trigonometric functions, laws of sines and cosines, vectors and analytic geometry.

Fundamentals of Metering - ELPW 213 - 3 Credits

This course introduces students to the fundamentals of metering, such as terminology and basic principles of meters. Students learn basic math needed in metering, and review basic electricity and magnetism principles. They are introduced to meter testing equipment, meter diagrams and standards, and learn technical data and how to read watt hour and demand meters.

Single-Phase & Polyphase Metering - ELPW 233 - 3 Credits

In this course students learn about single-phase metering and polyphase metering, including meter design, adjustments and compensations, and applications. They also learn about power factor analyzers, high amperage CT cabinets, meter demand theory, demand registers, and testing and maintenance of thermal demands.

Advanced Metering Technology - ELPW 253 - 2 Credits

This course introduces students to various metering system designs and application options. The students study the metering system components, associated wiring configurations and instrument transformer variations. Topics include ratio, burden, and correction factor calculations; functional testing, and calibration procedures as well as safe installation procedures. Also included are cogeneration metering, and principles of load management and associated equipment.

ELECTRICAL TRANSMISSION SYSTEMS TECHNOLOGY PROGRAM (ETST)

Course requirements for Certificate in Electrical Transmission Systems Technology:

- Complete 51 semester credits of technical core courses in Electrical Transmission Systems Technology
- Complete at least 4 semester credits of general education from two areas of study

Course requirements for AAS in Electrical Transmission Systems Technology:

- Complete 51 semester credits of technical core courses in Electrical Transmission Systems Technology
- Complete at least 15 semester credits of general education from two areas of study

For more information on certificate/degree plans and tuition, or to contact the ETST advisor, please visit: **http://epceonline.org/electrical-transmission-systems-technology-details**

The Electrical Transmission Systems Technology program is available online in a convenient schedule that provides the best learning environment. Courses can be taken individually or per the recommended semester schedule.

Semester 1 Courses

Power Industry Concepts - ETST 240 - 3 Credits

This course covers the basic role system operators and electrical dispatchers play in the electric power industry. In addition, students will study the history, development and evolution of the electric industry since inception. This course also explores the effects of deregulation of modern day electrical markets. This course concludes with the working environment of system operators, including some of the challenges they face, such as shift work, certification and the tremendous amount of responsibility operating in a real-time market.

Applied Mathematics for System Operators - ETST 242 - 2 Credits

This course provides a review of basic mathematical concepts required for work as an electrical transmission systems operator. In addition to basic mathematics, students study basic trigonometry, vectors and phasors and the relationship these mathematical functions have to work as a system operator.

DC Fundamentals - ENRT 106 - 2 Credits- 32 CEHs

This course covers basic direct current theory and application. Students will study methods of producing direct current voltage, including batteries, and magnetic fields. Students will learn to calculate voltage, current, resistance, and power in series, parallel, and combination DC circuits. The construction and operation of rotating DC machines including DC generators and DC motors will also be covered.

AC Fundamentals - ENRT 108 - 3 Credits - 33 CEHs

This course covers basic alternating current theories and applies those theories to electrical systems and related equipment. Students will also study basic generator and motor design, construction and operation principles.

Electrical Diagram Interpretation - ETST 260 - 2 Credits - 17 CEHs

This course covers electrical diagrams including single line diagrams, schematic diagrams and logic diagrams. This course focuses on the system operators perspective and the role diagram comprehension plays in an operators job performance.

Semester 2 Courses

Electrical Generation Theory - ETST 250 - 4 Credits - 32 CEHs

This course covers the design and construction of large electrical generators. Students study the sources of voltage and the design and types of A.C. and D.C. generators and related auxiliary equipment. Students also study the design and operation of A.C. and D.C. motors.

System Elements I - Substations - ETST 254 - 3 Credits - 31 CEHs

This course covers the basic equipment found in switchyards and substations. Also included are the function and types of substations, related transmission and distribution systems and how each system is tied to one another.

System Elements II - Transformers - ETST 256 - 3 Credits - 31 CEHs

This course builds upon System Elements I by introducing basic diagrams, transformers, switching and basic substation safety and inspection. Topics covered in this course will include interpreting one-line diagrams, exploring power and specialty transformers, the six basic steps of switching and lock-out/tag-out (LOTO) procedures.

System Elements III - Protective Relaying - ETST 258 - 3 credits - 35 CEHs

As the last of the System Elements courses, this course focuses on protective relaying of substation equipment and transmission lines. Details found in this course include practical understanding and identification of protective and control equipment, zones of protection, protection schemes, and relay communication systems.

Semester 3 Courses

Power System Operations - ETST 262 - 3 Credits - 29 CEHs

This course covers the basic roles and responsibilities of system operators including transmission operations, market operations, reliability, balance and interchange and scheduling. The goal of this course is to introduce the multitude of positions found in a typical transmission control center.

Interconnected System Operations - ETST 266 - 3 Credits - 31 CEHs

This course covers the operation of power pools, regional reliability organizations and independent system operators and the role of each. In addition, this course covers interconnected switching procedures between utilities.

Power Flow - ETST 268 - 3 Credits - 29 CEHs

In this course, students study the control of power flow through interconnected systems and the operation of parallel power systems. The topics include generator synchronization, phase angle, VAR control and line voltage regulation. Procedures for controlling electrical power flows to maintain steady state conditions across the power grid are also a focus of this course.

System Operator Work Practices - ETST 270 - 3 Credits - 33 CEHs

In this course students will learn the role a system operator plays in the delivery of power and the operation and maintenance of the transmission system. Students will learn what is expected of a system operator including desired personal characteristics, working environment, employer's expectations/qualifications, educational and training requirements, certification requirements, role in performing reliability functions, tasks and duties and behavior required under code of conduct and other regulatory and legislative orders.

Semester 4 Courses

Power System Safety - ETST 272 - 3 Credits - 23 CEHs
This course covers the safe operating practices, system isolation procedures, and accident prevention procedures used in the transmission and distribution of power. Emphasis will be placed on electrical system lock out and safety procedures.

Communication & Control Technology - ETST 274 - 2 Credits - 23 CEHs
This course covers the theory and application of various communications technologies used in the electric industry.

Power System Economics - ETST 276 - 3 Credits - 33 CEHs
This course covers economic factors governing electrical system operations. Costs of generation, transmission and distribution are explained. The organization of markets for electrical energy and how this structure affects participating companies' operational and investment decisions are discussed. The effects of congestion, transmission losses and penalty factors are studied. Load management, scheduling and pricing are a focus as well.

Power System Emergency Concepts - ETST 278 - 3 Credits - 30 CEHs
This course concentrates on the concepts involved in the emergency operations of the interconnected power system. Learners will study all of the NERC Emergency Preparedness and Operations Standards (EOP) that govern those operations. Topics include emergency planning, recognition of, and reaction to, power system emergencies and abnormal conditions, as well as system restoration and the implementation and coordination of the proper procedure to restore the electrical system to a safe operating condition.

Reliability Policies & Procedures - ETST 280 - 3 Credits - 29 CEHs
This course familiarizes and helps students understand the policies and procedures that ensure the reliability of the power system. North American Electric Reliability Corporation (NERC) standards, as well as other regulatory agency policies, are explained and discussed. Government agencies, reliability regions, and state reliability concerns also are defined and discussed.

ENERGY SERVICES & RENEWABLE TECHNICIAN PROGRAM (ESRE)

Course requirements for Certificate in Energy Services & Renewable Technician:
- Complete 54 semester credits of technical core courses in Renewable Generation Technology
- Complete at least 4 semester credits of general education from two areas of study
- Complete the Practical Applications course that includes "hands on" work at the BSC lab

Course requirements for AAS in Energy Services & Renewable Technician:
- Complete 54 semester credits of technical core courses in Renewable Generation Technology
- Complete at least 15 semester credits of general education
- Complete the Practical Applications course that includes "hands on" work at the BSC lab*

For more information on certificate/degree plans and tuition, or to contact the ESRE advisor, please visit: **http://epceonline.org/energy-services-renewable-technician-details**

The Energy Services & Renewable Technician program is available online in a convenient schedule (with a 'hands on" lab) that provides the best learning environment. Courses can be taken individually or per the recommended semester schedule.

Semester 1 Courses

Electrical & Safe Work Practices - ESRE 210 - 3 credits
This course covers specific work practices in the areas of basic electrical safety, principles of electricity, basic process controls, elevated work and rigging. OSHA standards and safe permitting practices are components of this course.

Mechanical Drive Systems - ESRE 216 - 4 credits
Introducing the fundamentals of mechanical drives and the application of mechanical skills and knowledge to the industrial setting. Topics covered will include couplings, chain drives, pulley drives, motor leveling and alignment, bearings, gaskets and gear drives. Demonstration by the student in the areas of torqueing, measurements, gap adjustments and shaft alignments is included.

Hydraulic Fundamentals - ESRE 213 - 3 credits
This course covers principles and operation of hydraulic systems. Hydraulic system analysis and troubleshooting in the lab setting is part of this course.

Solar & Distributed Grid Systems - ESRE 218- 4 credits
This course includes an in-depth study of grid-direct solar arrays, small wind systems and other distributed grid systems. Curriculum also includes sizing and installation of systems.

Semester 2 Courses

Automation & Control - ESRE 224 - 3 credits
Students learn the control devices used to operate motors and generators in an industrial or renewable power generation facility. Some of the equipment covered: relays, contactors, motor starters, PLCs and variable frequency drives.

Applied Electronics - ESRE 221 - 3 credits
This course focuses on the electronic components and devices that are critical in the operation of renewable energy facilities. Students will understand their function and how to troubleshoot them.

Commercial Wind Systems - ESRE 226 - 3 credits
Commercial wind turbine systems are the focus of this course. The interoperation of the subsystems in a commercial wind turbine, the tracking and data acquisition using SCADA systems and the distribution of the generated power are covered in this course. The technician's role in the successful operation of the facility is another component of this course.

Energy Technician Applications & Troubleshooting - *ESRE 228 - 5 credits
This course, primarily a hands-on course, takes the core technician skills learned and integrates them into practice. Lab systems included are hydraulic, mechanical, electric motors/ motor control, PLCs, and other control systems. This course will develop and test the students troubleshooting skills and prepare them to work safely and effectively in an industrial or renewable power generation facility. Students enrolling in the online option will be required to complete two weeks of lab activities on the BSC Campus.

Semester 3 Courses

Industrial Composition & Communication - ENRT 122 - 4 credits
In this course, students will learn the proper writing techniques used within the industry through practical industrial writing scenarios such as filling out work request orders, equipment logs and electrical switching orders. In addition, students will study the appropriate interpersonal skills needed to communicate effectively with co-workers and customers including resolving on-the-job conflicts and establishing positive working relationships. Students will also learn what is considered acceptable behavior in the workplace and how to recognize unacceptable behaviors.

Safety, Health & Environment - ENRT 105 - 3 credits
This course covers the personal protective equipment and proper safe work practices and procedures commonly used in the energy industry. Students will also gain a working knowledge of standard safety, health and environmental practices and regulations set by various government entities.

Mechanical Fundamentals - ENRT 107 - 2 credits
This course introduces mechanical concepts commonly found in a plant setting. Topics covered include hand tools, piping, valves, steam traps and strainers. In addition, pumps, compressors, drivers, fans and rotating equipment are covered. Bearings, seals and lubrication are a focus in this course, as well as heat exchanger designs. Plant terminology and operator expectations are covered also.

Plant Equipment & Systems - ENRT 110 - 4 credits
This course introduces equipment used in the power, process and renewable industries. Valves, piping, pumps, compressors, generators, turbines, motors, lubrication systems, heat exchangers, furnaces, boilers, cooling towers, separators, reactors, and distillation columns are covered. The utilization of this equipment within systems will be covered.

Semester 4 Courses

Print Reading- ENRT 112 - 3 credits
This course covers schematics, prints, and piping and instrument diagrams used in the energy industry. Students will learn how to read and interpret block and single-line diagrams, which will prepare them for the logic and electrical schematics included in this course.

Applied Math - ENRT 103 - 3 credits
This course will teach basic math skills and apply them to energy industry situations. Students will learn the metric system, basic volume and area calculations as well as algebra and trigonometry and how they apply to industry specific situations.

Power Generation, Components & Protection - PWRP 224 - 3 credits
Students enrolled in this course will study the design and construction of large industrial generators used in the production of electricity. Students will study the various exciter designs and operation and the various auxiliary equipment that supports generator operation. Students enrolled in this course will study the electrical systems from the main generator through the switchyard.

Instrumentation & Control - ENRT 116 - 4 credits
This course provides a comprehensive study of instrumentation components, control theory, control systems and typical controllers associated with the operation of energy facilities.

Smart Grid Courses

Smart Grid, Smart Customer: The online, non-college credit course is designed to provide customer service representatives and other industry employees with a brief, non-technical overview of what the smart grid is and what enhancements it will provide both the consumer and the electric power industry. The course begins with an overview of traditional and renewable generation sources, the advantages and disadvantages of each, and the integration of renewable power on the grid. Basic difference will be reviewed between the design and operation of the traditional grid compared to today's much improved, evolving smarter grid. Lastly, the importance of consumer education and the changes that companies may experience from the spectrum of stakeholders will be discussed.

Renewable Energy Sources and the Smart Grid:
This online, non-college credit course examines electricity production from various forms of renewable energy, and provides a survey of the function, operation and vision of the smart grid. Renewable energy sources including solar, wind, tidal, geothermal and others are studied in detail, covering availability, dispersion, methods of recovery, utilization and integration into the Smart Grid.

Operation Considerations for the Smart Grid: This online, non-college credit course examines the operation considerations for the Smart Grid and will focus on understanding the operational considerations for technicians who will install, control, monitor, and maintain the smart grid. The course is designed to ensure that technicians working on the smart grid have a balanced understanding of why and how the smart grid will be operated, both from the utility perspective as well as the customer perspective. The course will cover technologies and systems utilized. It will also cover the skills needed to maintain the smart grid, along with addressing safety precautions needed. This course is divided into the following six modules:

1. Smart Grid: The Big Picture
2. Communications and Data of the Smart Grid
3. The Customer Side of the Smart Grid
4. The Utility Side of the Smart Grid
5. Controlling, Operating, and Monitoring the Smart Grid
6. Maintenance Needs of the Smart Grid

Impact of the Smart Grid: This online, non-college credit course examines the business impacts of the Smart Grid. The course is focused on providing a comprehensive understanding of the overall business impacts to those that will be making decisions surrounding implementation of the smart grid and to those that will be governing and operating the smart grid itself. Some of the business impacts discussed will include: financial implications; emissions implications; assessing, weighing, and managing risk; customer knowledge and perspective regarding the smart grid; utility employee knowledge requirement changes; and methods to produce a quality business plan for a smart grid project.

This course is divided into the following five units:

- National and Societal Impacts
- Impacts on the Environment
- Impacts on Employees
- Impacts on Utilities
- Building the Smart Grid Business Case

NUCLEAR POWER TECHNOLOGY PROGRAM (NUPT)

Course requirements for Certificate in Nuclear Power Technology:

- Complete 52 semester credits of technical core courses in Nuclear Power Technology
- Complete 4 semester credits of general education from any two areas of study

Course requirements for AAS in Nuclear Power Technology:

- Complete either 52 semester credits of technical core courses in Nuclear Power Technology- Non-licensed Operator Track OR 57 semester credits of technical core courses in Nuclear Power Technology- Instrumentation and Control Track.
- Complete 15 semester credits of general education

The Associates of Applied Science degree in Nuclear Power Technology, offered by Bismarck State College's National Energy Center for Excellence, is approved by the Nuclear Uniform Curriculum Program (NUCP), managed by the Nuclear Energy Institute (NEI). For more information, please visit: **http://epceonline.org/nucp**

For more information on certificate/degree plans and tuition, or to contact the NUPT advisor, please visit: **http://epceonline.org/Cert-AAS-Nuclear-Power-Technology-details**

Semester 1 Courses

Non-licensed Operator AND Instrumentation & Control Tracks

Overview of Nuclear Energy - NUPT 101 - 2 Credits
In this course the student will study the history of nuclear power, the basic principles of reactor design and operation at commercial nuclear electrical generating facilities. It includes an examination of nuclear waste issues, a study of important events which occurred at commercial nuclear plants, and a look towards the future of the electrical generating industry.

Nuclear Mathematical Fundamentals - NUPT 103 - 3 Credits
This course will review basic math, including basic arithmetic functions, fractions and decimals. The course will continue by covering scientific notation, dimensional analysis, algebra, basic geometry and trigonometry. Control charts and graphs, logarithms and exponential functions, and rate concepts will also be covered.

Classical Physics - NUPT 105 - 4 Credits
Recommended prerequisite: NUPT 103
This course is designed to introduce students to classical physics. Topics covered include: units of measurement, kinetics, force, energy, momentum, work, fluids, and mechanical principles.

Engineering Drawings, Diagrams and Schematics - NUPT 107 - 3 Credits
This course will introduce students to engineering drawings, diagrams, and schematics that are used in nuclear operations. Students will learn how to read and decipher the various nuclear symbols, components, systems, and legends found on diagrams, drawings, and schematics.

Semester 2 Courses

Non-licensed Operator AND Instrumentation & Control Tracks

Courses offered in Spring semesters

Mechanical Science - NUPT 113 - 3 credits
This course will cover the basic function, design, and operation of mechanical components and equipment which are an integral part of nuclear facilities. Pumps, heat exchangers, valves, diesel engines, compressors, and filters will be included as well as some mechanical systems such as cooling towers and refrigeration.

Nuclear Plant Chemistry - NUPT 215 - 3 Credits
Recommended prerequisite: NUPT 103
This course covers basic chemistry fundamentals relating to maintaining water purity in primary and secondary systems. This course also covers chemistry concepts for both pressurized water reactors and boiling water reactors. Principles of water treatment, hazards and safety requirements will also be contained in the course.

Electrical Science - NUPT 109 - 4 Credits
Recommended prerequisite: NUPT 103
This course begins with the study of basic electrical fundamentals, theory, laws, and magnetism. Direct current and alternating current electrical circuits, generators, motors, and other components along with their applications will be covered. Single-phase AC circuits and three-phase AC circuits will be discussed. Inductance, capacitance, impedance, and resonance will be covered along with construction of conductors, insulators, and relays.

Nuclear Physics - NUPT 213 - 3 Credits
Recommended prerequisite: NUPT 105
This course will tour the topics that comprise the fundamentals of nuclear science, giving the students an appreciation of theory and principles that govern nuclear processes involved in an operating reactor. This course covers the fundamental atomic structures, nuclear nomenclature, binding energy and nuclear decay reactions. Other topics such as the famous E=mc2 equation, neutron interaction with matter, the fission process and decay heat will be related to the everyday operation of a nuclear power plant.

Non-licensed Operator Track

Semester 3 Courses

Heat Transfer, Fluid Flow & Thermodynamics - NUPT 217 - 4 Credits
Recommended prerequisite: NUPT 105
This course covers heat transfer, fluid flow fundamentals, and the basics of thermodynamics. It begins with a discussion of temperature and heat, and progresses into heat capacities, sensible and latent heats. The laws of thermodynamics and related terms are introduced. The student will learn to perform energy balances, and understand thermodynamic processes and cycles. Properties of fluids and descriptions of their behavior are discussed. Topics covered include density, static head, hydraulics, buoyancy, and fluid flow. Centrifugal pumps are studied as well as closed system operation.

Instrumentation & Control - NUPT 111 - 4 Credits
Recommended prerequisites: NUPT 109 & NUPT 217
This course will cover the construction, operation, and failure modes of basic sensors and detectors used in nuclear generation. Included in this are gamma and neutron core power detector construction, operation and effects. Various control systems will be covered including failure symptoms and troubleshooting techniques from an operational perspective.

Science of Radiological Protection - NUPT 221 - 3 Credits
This course will provide the student with a broad, in-depth knowledge of radiological protection principles.

Material Science - NUPT 219 - 3 Credits
This course provides the student with a basic understanding of the structure of metals and how those structures are affected by various processes. The properties of metals and their applications are also covered along with thermal stress and shock. Ductile and brittle fractures will also be covered along with selecting materials for specific use in the industry. Lastly, students will discuss how important pressure and temperature curves are and why they are used when heating up and cooling down plant equipment.

Semester 4 Courses

Reactor Theory - NUPT 220 - 2 Credits
Recommended prerequisite: NUPT 213
This course will tour the topics that comprise the fundamentals of how reactors are built and operated, giving the student understanding and appreciation of the theory and principles that govern control room operation and activities outside the control room and how they/could they affect the reactor. This course starts with classification of the types of neutrons, and the neutron life cycle. Other topics include reactivity which provides an understanding of what criticality means in terms of reactor operation. Lastly, a discussion of reactor shutdown operation and decay heat removal and significant reactor events.

Nuclear Plant System Component Design and Function - NUPT 225 - 4 Credits
This course will provide the student with a broad, in-depth knowledge of nuclear plant Reactor, Reactor Auxiliaries, Secondary Plant and Electrical Systems.

Reactor Safety Design - NUPT 223 - 3 Credits
This course will provide the student with a broad, in-depth knowledge of reactor safety design and protection principles.

Conduct of Facility Operations - NUPT 227 - 4 Credits
This course will provide the student with a broad-brush knowledge of the Conduct of Operations as set forth by the Department of Energy (DOE Order 5480.19, Conduct of Operations). This document contains best operating practices found in the commercial nuclear fleet, and as such can be looked at as a summary document for candidate utility workers.

Instrumentation & Control Track

Semester 3 Courses

Instrument Drawings and Documentation - ICTL 215 - 4 credits
Topics covered in this course include plant terminology, piping and industrial diagrams (P&ID), electrical and wiring diagrams, graphs, charts, documentation of settings and records keeping, calibration practices and standards, flow, pressure, position, level, temperature and analytical measurements. The use and care of test equipment is also covered.

Heat Transfer, Fluid Flow & Thermodynamics - NUPT 217 - 4 Credits
Recommended prerequisite: NUPT 105
This course covers heat transfer, fluid flow fundamentals, and the basics of thermodynamics. It begins with a discussion of temperature and heat, and progresses into heat capacities, sensible and latent heats. The laws of thermodynamics and related terms are introduced. The student will learn to perform energy balances, and understand thermodynamic processes and cycles. Properties of fluids and descriptions of their behavior are discussed. Topics covered include density, static head, hydraulics, buoyancy, and fluid flow. Centrifugal pumps are studied as well as closed system operation.

Instrumentation & Control - NUPT 111 - 4 Credits
Recommended prerequisites: NUPT 109 & NUPT 217
This course will cover the construction, operation, and failure modes of basic sensors and detectors used in nuclear generation. Included in this are gamma and neutron core power detector construction, operation and effects. Various control systems will be covered including failure symptoms and troubleshooting techniques from an operational perspective.

Input and Output Devices - ICTL 225 - 4 credits
In this course students will study measurement sensors such as proximity sensors and switches, motion detectors, analog and smart transmitters, and temperature devices. Other topics include valves and their types, valve positioners, current to pneumatic (I/P) converters, electric drives and motor starters, dampers and linkages.

Semester 4 Courses

Motors and Controllers - ICTL 235 - 4 credits
Topics of study include types of AC and DC motors, stepper motors, motor theory, types of motor controls, three phase power, Y and delta configurations, variable speed drives (variable frequency and variable DC), motor and other electrical equipment protection (breakers and overloads).

Nuclear Plant System Component Design and Function - NUPT 225 - 4 Credits
This course will provide the student with a broad, in-depth knowledge of nuclear plant Reactor, Reactor Auxiliaries, Secondary Plant and Electrical Systems.

Reactor Safety Design - NUPT 223 - 3 Credits
This course will provide the student with a broad, in-depth knowledge of reactor safety design and protection principles.

Instrumentation & Control II - NUPT 229 - 4 Credits
In this course, the student will be exposed to advanced instrumentation and control concepts pertinent to technicians working in the nuclear industry. The course will delve into the theory of operation for a number of digital components and systems, and explain important systems common to all nuclear power plants that employ these concepts. The course will also delve into the certain mechanical and electrical processes to demonstrate how these relate to the instrumentation and control systems governing them.

Please note: Upon completion of the Nuclear Power Technology program, BSC has articulation agreements with Excelsior College so you can seamlessly continue your education and move to the next level of degree.

POWER PLANT TECHNOLOGY PROGRAM (PWRP)

Course requirements for Certificate in Power Plant Technology:

- Complete 52 semester credits of technical core courses in Power Plant Technology
- Complete at least 4 semester credits of general education from two areas of study
- Complete the ENRT 220 Practical Applications course that includes "hands on" work at either a Power Generating Plant or at the BSC lab.

Course requirements for AAS in Power Plant Technology:

- Complete 52 semester credits of technical core courses in Power Plant Technology
- Complete at least 15 semester credits of general education
- *Complete the ENRT 220 Practical Applications course that includes "hands on" work at either a Power Generating Plant or at the BSC lab.

The Power Plant Technology program is available online in a convenient schedule (with a 'hands on" lab) that provides the best learning environment. Courses can be taken individually or per the recommended semester schedule.

For more information on certificate/degree plans and tuition, or to contact the PWRP advisor, please visit: **http://epceonline.org/power-plant-technology-details**

Semester 1 Courses

Introduction to Energy Technology - ENRT 101 - 4 credits
An introduction to the expanding energy industry. Students will learn about a variety of energy facilities from traditional to renewable, including but not limited to fossil fuel power plants, petroleum refineries, ethanol and biodiesel facilities, gasification plants, wind farms, geothermal and hydro power production facilities, natural gas processing facilities, petroleum production, water and wastewater treatment and others. The role of the technician in these facilities will be a focus, as will be the expectations and culture of the industry.

Safety, Health & Environment - ENRT 105 - 3 credits
This course covers the personal protective equipment and proper safe work practices and procedures commonly used in the energy industry. Students will also gain a working knowledge of standard safety, health and environmental practices and regulations set by various government entities.

Mechanical Fundamentals - ENRT 107 - 2 credits
This course provides an introduction to mechanical concepts commonly found in a plant setting. Topics covered include hand tools, piping, valves, steam traps and strainers. In addition, pumps, compressors, drivers, fans and rotating equipment are covered. Bearings, seals and lubrication are a focus in this course, as well as heat exchanger designs. Plant terminology and operator expectations are covered also.

Plant Equipment & Systems - ENRT 110 - 4 credits
This course provides an introduction to equipment used in the power, process and renewable industries. Valves, piping, pumps, compressors, generators, turbines, motors, lubrication systems, heat exchangers, furnaces, boilers, cooling towers, separators, reactors, and distillation columns are covered. The utilization of this equipment within systems will be covered.

Semester 2 Courses

Print Reading -ENRT 112 - 3 credits
This course covers schematics, prints, and piping and instrument diagrams used in the energy industry. Students will learn how to read and interpret block and single-line diagrams, which will prepare them for the logic and electrical schematics included in this course.

Applied Math - ENRT 103 - 3 credits
This course will teach basic math skills and apply them to energy industry situations. Students will learn the metric system, basic volume and area calculations as well as algebra and trigonometry and how they apply to industry specific situations.

Electrical Fundamentals - ENRT 104 - 3 credits
This course covers basic direct current theories and applies those to the electrical system and related equipment. Students will also study basic DC circuit calculations. This course will also cover basic alternating current theories and apply those theories to electrical systems and related equipment. Students will study various methods of producing a voltage. Students will also study essential generator and motor design, construction and operating principles.

Instrumentation & Control - ENRT 116 - 4 credits
This course provides a comprehensive study of instrumentation components, control theory, control systems and typical controllers associated with the operation of energy facilities.

Semester 3 Courses

Heat Transfer, Fluid Flow & Thermodynamics - ENRT 118 - 3 credits
Students enrolled in this course will study heat transfer, fluid flow and the conservation of energy. Specific equipment design considerations based on thermodynamic principles will be covered.

Water Purification & Treatment - ENRT 120 - 3 credits
This course covers industrial water treatment processes. Students will study boiler water treatment, raw water treatment and the design and operation of ion exchangers. The course also covers cooling water treatment equipment and waste water treatment equipment and systems.

Steam Generation - NRT 205 - 3 credits
In this course the various types of boilers, systems, components and auxiliary systems associated with steam generators are covered. Different designs of boilers will be covered including low/high pressure, fire tube/water tube, negative/positive draft, drum type and others. Boiler operation, combustion, safety and emission control equipment will be covered along with efficiency measures.

Operations, Troubleshooting & Communication - ENRT 215 - 3 credits
Students will gain the knowledge necessary to comprehend overall plant operations and respond to abnormal operating conditions. Students also will participate in root cause analysis exercises while troubleshooting different operating scenarios. This course provides instruction in the different types of troubleshooting techniques, procedures, and methods used to solve process problems. Students will use existing knowledge of equipment, systems and instrumentation to understand the operation of an entire unit in a facility. Students study concepts related to commissioning, normal startup, normal operations, normal shutdown, turnarounds, and abnormal situations, as well as the process technician's individual and team role in performing tasks associated with these concepts within an operating unit.

Semester 4 Courses

Energy Sources & Conversions - PWRP 203 - 3 credits
Students enrolled in this course will study the various forms of energy and the processes used to convert chemical and potential energy into thermal, mechanical and in some instances electrical energy. Energy sources that will be studied include fossil fuels (coal, oil and natural gas), hydro, wind, fuel cells, solar, derived fuel, geothermal and nuclear. Combustion and reaction will be discussed in detail for those energy sources that require combustion to convert from one energy form to another.

Boilers & Environmental Protection - PWRP 207 - 3 credits
Recommended prerequisite: ENRT 205
In this course, students will gain a more thorough understanding of the various types of boilers, systems, components and auxiliary systems associated with steam generation. Topics covered include low/high pressure, fire tube/water tube, negative/positive draft, drum type, supercritical and fluidized bed boilers. Boiler operation, combustion, safety and emission control equipment will be covered along with efficiency measures.

Turbines & Combined Cycle - PWRP 210 - 3 credits

Students enrolled in this course will study all the elements that make up a gas turbine and a combined cycle unit. This course also covers the safe and efficient operation of gas turbines and heat recovery steam generators and their different applications as used in combine cycle and cogeneration configurations. Coal gasification is also studied. This course covers basic steam turbine construction and design and associated auxiliary systems. Students will learn how thermal energy is converted to mechanical energy as the steam passes through a typical industry steam turbine. Students will also study the auxiliary systems associated with steam turbine operation, including extraction steam systems, gland steam sealing systems, turbine lube oil systems, seal oil systems, instrumentation and control devices and protective schemes used during abnormal operating conditions. Steam turbine start-up and shut-down procedures will also be studied.

Power Generation, Components & Protection - PWRP 224 - 3 credits

Students enrolled in this course will study the design and construction of large industrial generators used in the production of electricity. Students will study the various exciter designs and operation and the various auxiliary equipment that supports generator operation. Students enrolled in this course will study the electrical systems from the main generator through the switchyard.

Practical Applications - *ENRT 220 - 2 credits

Online students are required to contact their advisor prior to registering. Students will participate in hands-on lab activities, internships or industry job shadowing to gain entry-level job competencies. Students may not complete this course before their final semester at BSC.

Water and Wastewater Technology Program (WATR)

Course requirements for Certificate in Water and Wastewater Technology:

- Complete 30 semester credits of technical core courses in Water and Wastewater Technology

For more information on certificate/degree plans and tuition, or to contact the WATR advisor, please visit: **http://epceonline.org/Water-and-Wastewater-Technology-Details**

The Water and Wastewater Technology program is available online in a convenient schedule (with a 'hands on" internship/job shadow experience) that provides the best learning environment. Courses can be taken individually or per the recommended semester schedule.

Semester 1 Courses

Introduction to the Water Industry - WATR 101 - 3 credits

This course provides an overview of the water treatment program and the water treatment industry. It introduces students to water and wastewater treatment occupations and processes. Students study operator roles, industry requirements, common terminology and basic equipment as well as water use and characteristics.

Safety, Health & Environment - ENRT 105 - 3 credits

This course covers the personal protective equipment and proper safe work practices and procedures commonly used in the energy industry. Students will also gain a working knowledge of standard safety, health and environmental practices and regulations set by various government entities.

Mechanical Fundamentals - ENRT 107 - 2 credits

This course provides an introduction to mechanical concepts commonly found in a plant setting. Topics covered include hand tools, piping, valves, steam traps and strainers. In addition, pumps, compressors, drivers, fans and rotating equipment are covered. Bearings, seals and lubrication are a focus in this course, as well as heat exchanger designs. Plant terminology and operator expectations are covered also.

Applied Math - ENRT 103 - 3 credits

This course will teach basic math skills and apply them to energy industry situations. Students will learn the metric system, basic volume and area calculations as well as algebra and trigonometry and how they apply to industry specific situations.

Print Reading -ENRT 112 - 3 credits
This course covers schematics, prints, and piping and instrument diagrams used in the energy industry. Students will learn how to read and interpret block and single-line diagrams, which will prepare them for the logic and electrical schematics included in this course.

Control Systems - WATR 116 - 2 credits
This course provides a comprehensive study of instrumentation components, control theory, control systems and typical controllers associated with the operation of water and wastewater treatment facilities.

Semester 2 Courses

Laboratory Procedures - WATR 105 - 2 credits
Students will be introduced to the chemical makeup of water and the impurities that must be removed for purification processes. Common procedures for testing and monitoring water and wastewater quality will be studied along with the calculation of chemical dosages and feed rates.

Water Treatment I - WATR 110 - 3 credits
This course will cover water sources and protection with a focus on pre-and primary methods and equipment. Filtration, clarification and basic softening methods will also be studied along with pump types and applications. An emphasis will be placed on operating procedures and troubleshooting for each type of process.

Water Treatment II - WATR 115 - 3 credits
This course will instruct students on secondary and final treatment methods, processes and equipment. Disinfection methods and distribution systems will be covered in detail along with sampling, monitoring and reporting based on governmental regulations. Routine operator duties along with problem solving methods will be identified.

Wastewater Treatment - WATR 120 - 3 credits
This course is designed to assist students in understanding the processes and equipment used in a wastewater treatment plant. The concepts used for biological treatment and troubleshooting the various processes will be emphasized. Collection systems operation and maintenance will also be covered.

Practical Applications - WATR 220 - 3 credits
Online students are required to contact their advisor prior to registering.
In addition to coursework students will complete an internship/ job shadow experience at a water treatment facility or hands-on lab activities at BSC's National Energy Center of Excellence. This experience will require students to observe and assist in the daily operations of a functional water or wastewater treatment facility. The hands-on training is expected to include lab testing, process checks, basic problem solving and routine maintenance activities. Students may not complete this course before their final semester at BSC.

Excelsior College

BACHELOR OF PROFESSIONAL STUDIES IN TECHNOLOGY MANAGEMENT

Course requirements for Bachelor of Professional Studies in Technology Management:

- Professional component: 45 credit hours (including 15 upper level and 15 in the area of focus)
- Additional credit component: 45 credit hours (including information literacy and 6 upper-level credits)
- Arts and sciences: 30 credit hours (including 9 upper level)

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/bachelor-professional-studies-technology-management-details**

Financial Accounting ACC211 – 3 credits

Develops skills of basic financial accounting principles in the pursuit of organizational goals and strategies. Topics covered include financial statement analysis, accounting information systems, operating decisions, and financing.

Management Costs and Applications BUS 341 – 3 credits

A study of fundamental management theories, examining the manager's role in today's global business environment. Topics include the role of managers in the business environment, strategies for planning and decision making, organization and controls, leadership, motivation, staffing, and managing change.

Business Leadership – BUS 452 – 3 credits

Focuses on research findings about leadership, leadership practice, and leadership skill development. Explores and evaluates leadership practices, behaviors, and personal attributes of leaders and includes case studies of leaders and organizations. The course balances theory with real-world applications for a practical, skill-building approach to leadership.

Introduction to Computers – IT 221 – 3 credits

This course provides students with a fundamental knowledge of the computer system and its components, including computer hardware and architecture, application software, operating systems, networks, and the Internet. Advanced topics such as information privacy and security, database and data warehouse, data mining, and legal, ethical, and privacy issues in the information technology field will also be introduced in this course. Additionally, students will participate in learning activities to develop the needed skills to work with Microsoft Office suite.

Project Management – IT 390 – 3 credits

Explores system development life cycle (SDLC) and project life cycle to enhance skills in budget and timeline management. Use of project management software to design project schedules, using bar charts, PERT and critical path method.

Technology and Society – TECH 230 – 3 credits

Considers technological change from historical, artistic, and philosophical perspectives and its effect on human needs and concerns. Emphasis is placed on the causes and consequences of technological change and the evaluation of the implications of technology.

Economic Analysis for Technologists – TECH 330 – 3 credits

The application of economics and decision theory to the evaluation of engineering alternatives in planning, developing, constructing, and managing engineering projects.

Introduction to Energy Utilization – TECH 340 – 3 credits

Introduction to current and potential energy sources, the link between energy and wealth, and the consequences of action or inaction concerning energy and the environment.

Technology Management Capstone: Integrated Technology Assessment – TECH 490 – 3 credits

An online portfolio development experience that requires students to reflect on their past academic and professional experiences and use the information gained from this reflective exercise to develop learning statements related to the Bachelor of Professional Studies in Technology Management degree outcomes. The learning statements must be supported by documented evidence that demonstrates that the outcomes have been met. Students learn how to develop an online portfolio during the first module of the course and then work under the guidance of a faculty mentor during the remainder of the semester to compose learning statements, compile appropriate evidence, and create the Integrated Technology Management Assessment report.

Electrical Technology Concentration

A concentration in electrical technology focuses on training and preparing the students with the knowledge and practical skills in electrical technology along with electrical circuits, electrical systems, and electrical equipment. It is centered on design, assembly, testing, maintenance, repairing, and upgrading of electrical circuits, components, and equipment. The electrical technology outcomes are geared towards providing students with fundamental as well as applied knowledge in electrical systems, electrical equipment, and processes. These will prepare the students for positions in operating, repairing, and upgrading of electrical circuits, electrical systems, and electrical equipment.

Upon successful completion of the Excelsior College Bachelors of Professional Studies with an Electrical Technology concentration, the student will be able to:

1. Identify, formulate, and present solutions to a variety of technical problems in the area of electrical technology.
2. Demonstrate competency in the analysis, interpretation, and application of data in the area of electrical technology.

Information Technology Concentration

A concentration in information technology focuses on training and preparing students to stay up-to-date with the rapidly changing technical environment. The information technology concentration is a technical discipline centered on the design, assembly, testing, and maintenance of computer circuitry and peripheral hardware. The concentration also emphasizes the information system concepts, principles, and practices, and problem solving of information technology domains. The information technology outcomes are geared toward providing students with a foundational knowledge of information technology in a wide variety of subject areas and preparing students for positions including information technicians, database management systems, software management, data communications, information security, and network management. Upon successful completion of the Excelsior College Bachelors of Professional Studies with an information technology concentration, the student will be able to:

1. Analyze and apply a range of information system concepts, principles, and practices in the context of solving problems across a spectrum of information technology domains.
2. Develop computer-based applications using appropriate information technology concepts and principles.

Nuclear Technology Concentration

A concentration in information technology focuses on training and preparing students to stay up-to-date with the rapidly changing technical environment. The information technology concentration is a technical discipline centered on the design, assembly, testing, and maintenance of computer circuitry and peripheral hardware. The concentration also emphasizes the information system concepts, principles, and practices, and problem solving of information technology domains. The information technology outcomes are geared toward providing students with a foundational knowledge of information technology in a wide variety of subject areas and preparing students for positions including information technicians, database management systems, software management, data communications, information security, and network management. Upon successful completion of the Excelsior College Bachelors of Professional Studies with an information technology concentration, the student will be able to:

1. Analyze and apply a range of information system concepts, principles, and practices in the context of solving problems across a spectrum of information technology domains.
2. Develop computer-based applications using appropriate information technology concepts and principles.

Renewable Energy Technology Concentration

A concentration in renewable energy technology focuses on training and preparing students to stay current with the renewable energy industry. The renewable energy technology concentration is a technical discipline centered on renewable energies such as solar, wind, water, and geothermal. The concentration also emphasizes the political and economic influences on the renewable energy business. The renewable energy technology outcomes are geared toward providing students with a foundational knowledge of renewable energy in a wide variety of subject areas and preparing students for positions in the renewable energy industry including an understanding of economics and politics associated with renewable energy. Upon successful completion of the Excelsior College Bachelors of Professional Studies with a renewable energy technology concentration, the student will be able to:

1. Identify and discuss renewable energy technologies being used commercially and residentially
2. Perform an analysis of political and economic influences on the renewable energy business

Electrical Theory – NUC 255 – 3 credits

Introduction to the fundamentals of charge, AC and DC current, voltage, capacitance, inductance, energy, power, Kirchhoff's laws, loop and nodal analysis, and linear voltage-current characteristics.

Applied Instrumentation and Control – TECH 225 – 3 credits

This course focuses on instrumentation, temperature, pressure, and flow measurements, transducers, pneumatic and hydraulic systems, programmable logic controllers, and process control. In this course the students will have the opportunities to explore the characteristics and operations of different types of transducers and measuring instruments. The importance of system models as well as its relationship between process control will also be covered.

Electrical Power Distribution – TECH 233 – 3 credits
Design, operation, and technical details of modern power distribution systems including generating equipment, transmission lines, plant distribution, and protective devices Includes calculations of fault current, system load analysis, rates, and power economics.

Renewable Energy Overview I: Solar and Geothermal – TECH 250 – 3 credits
Overview of Solar (Photovoltaic) energy, Solar Thermal energy, and Geothermal energy. Also describes green building technologies (sustainable systems design). Political, economic, and environmental impact will also be discussed.

Renewable Energy Overview II: Wind and Water – TECH 251 – 3 credits
Overview of wind energy and water energy in both commercial and noncommercial applications. Continued discussion from TECH*250 regarding sustainable system design regarding green building technologies. Political, economic, and environmental impact will also be discussed.

BACHELOR OF SCIENCE IN TECHNOLOGY

Course requirements for Bachelor of Science in Technology:
- Technology component: 48 credit hours
- Arts and Sciences: 60 credit hours
- Free electives: 12 credit hours

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/bachelor-science-technology-details**

The following are the concentration options for the BS in Technology:
- **Electronic/Instrumentation Technologies Concentration**
- **Nuclear Technologies Concentration**
- **Power Plant Technologies Concentration**
- **Computer Technologies Concentration**
- **Electromechanical Technologies Concentration**

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

Course requirements for Bachelor of Science in Information Technology:
- Technical component (including concentration requirements): 48 credit hours
- Arts and Sciences: 60 credit hours
- Free electives (including information literacy): 12 credit hours

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/bachelor-science-information-technology-details**

Object Oriented Programming – IT 210 – 3 credits
Covers problem solving and algorithm development using the object-oriented programming language Java. Introduction to object-oriented features including encapsulation, inheritance, and polymorphism. Examines the development of processes of design, coding, debugging, and documentation. Focuses on techniques of good programming style.

Business Data Communications – IT 250 – 3 credits
This course provides overview and application of the concepts and practices of data communications and networking within a business environment. Topics of this course include data communications models, protocols, standards, and services; networking technologies and communication media; network topology, design and architecture; network management; wireless technologies; network security; and cryptography. Students will practice their knowledge and skills through hands-on labs and assignments, which is based on real-world business case scenarios.

Computer Systems Architecture – IT 321 – 3 credits
This course is an introduction to the basic components and structure of the computer. The course covers in detail basic Boolean algebra, fundamentals of computer design, instruction set principles, RISC/CISC processors, instruction and processor level parallelism, memory hierarchy, pipelining, assembly language, and parallel computer architectures. The course will also address the architecture and microprogramming of the processor.

Operating Systems – IT 360 – 3 credits
Introduction to the basic components and structure of a generic operating system. Considers in detail processes, process management and synchronization, threads, interrupts and interrupt handling, memory management, virtual memory management, resource allocation, and an introduction to file systems, protection, and security.

Database Management Systems – IT 370 – 3 credits
Examines the technology and impact of the design of database systems on the organization. Covers the application, design, and implementation of database systems. Topics include an introduction to basic database concepts, database design principles including E-R diagrams and database normalization, SQL queries, transaction management, distributed databases, data warehousing, and database administration. Course focuses on the relational model.

Web Design and Development – IT 371 – 3 credits
This course will provide practical instruction on the design, creation and maintenance of web pages. The course will cover the fundamental principles of web programming and formatting. This will include learning the difference between client side and server side scripting technologies, effective use of web authoring tools and code development. The course will also cover web design standards and the need for integrating human computer interaction principles in web design. The final project in the course will enable learners to apply current development and production practices to design web pages.

Human-Computer Interactive Design – IT 375 – 3 credits
"Interaction design is heavily focused on satisfying the needs and desires of the people who will use the product." This course examines human-computer interaction (HCI) and focuses on all aspects of user interface (UI) + user experience (UX) design. Students will explore the fundamental concepts and methods involved in designing digital products, mobile applications, and websites. Students will be challenged to create a startup digital product in the form of a phone app, tablet app, or Web app/website. The course will be broken down into 8 stages (modules) which will break down the entire process that professional designers use every day to design the apps and/or websites that we love using today. Students will begin with the product brief (description, problem, audience, platform, etc.) and end with a high fidelity prototype of their newly designed mobile app or website. Each module will include assignments, discussions, and other activities related directly to that module.

Overview of Computer Security – IT 380 – 3 credits
Offers an in-depth look at operating system security concepts and techniques. Examines theoretical concepts of computer security. Explores security strategies, the advancement of security implementation, and timeless problem-solving strategies.

Project Management – IT 390 – 3 credits
Explores system development life cycle (SDLC) and project life cycle to enhance skills in budget and timeline management. Use of project management software to design project schedules, using bar charts, PERT and critical path method.

System Administration – IT 460 – 3 credits
This course provides learners with the knowledge and hands-on skills necessary to administer systems and its resources. Topics covered include directory services, user account management, file and print services, load balancing, security and user/client administration. Students will setup and manage a fully functioning computer network of systems. Furthermore, through hands-on (labs) assignments, students deal with challenges designed to help them install, configure and manage servers.

Integrated Technology Assessment Bix – IT 495 – 3 credits
A capstone course for the B.S. Information Technology program. It requires students to reflect on their past academic and professional experiences and use the information gained from this reflective exercise to develop learning statements related to the Information Technology degree outcomes. The learning statements must be supported by documented evidence that demonstrate that the outcomes have been met. Students learn how to develop an online portfolio during the first four weeks of this 15-week course, and then work under the guidance of a faculty mentor during the remainder of the semester to compose learning statements, compile appropriate evidence, and create the Integrated Technology Assessment portfolio.

Cybersecurity Technology Concentration

Computer Forensics – IT 406 – 3 credits
Emphasizes the technical and legal aspects of electronic evidence and the computer forensic investigative process. Topics include the discovery and recovery of electronic evidence stored on or transmitted by computers, networks, and cellular devices.

Cyber Attacks and Defenses – CYS 426 – 3 credits
This course investigates security issues, vulnerabilities, and mechanisms to identify, respond to and prevent cyberattacks and to build active defense systems. The course will follow the formal ethical hacking methodology including reconnaissance, scanning and enumeration, gaining access, escalation of privilege, maintain access and reporting. Ethical Hackers are computer and network experts who attack security systems on behalf of its owners, seeking vulnerabilities that a malicious hacker could exploit.

Business Continuity – CYS 455 – 3 credits
A course designed to provide a broad coverage of topics related to security in the business environment. Coverage of methods for physical security in addition to the security measures involving hardware, software, secure and unsecure protocols, authentication, and processes used to prevent access. Emphasis on the development of a business continuity plan and disaster recovery plan will provide essential details to mitigate the effect of a breach in security or in the event of a disaster.

Network and Application Security – CYS 403 – 3 credits
This course covers the main concepts and models of network and application security, which includes: security models and threats, access control, secure routing and switching, cryptography and secure communication, and how to mitigate security threats. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term.

Information Security Concentration

Network Security – IT 402 – 3 credits
Covers principles, procedures, hardware, and software related to network security. Topics include malicious code, intrusion detection, prevention and response, cryptographic protocols for privacy and integrity. Explores trade-offs between risk of misuse, cost of prevention, and societal issues.

Web Security – IT 404 – 3 credits
Focuses on key concepts of web security from both client-side and server-side perspectives. Client-side concepts include intrusion, detection, and recovery and secure online transactions. Server-side concepts include Web server security log analysis, Web servers, and firewalls. Additional topics include cryptology, digital identification, encryption, and privacy and security for users.

Computer Forensics – IT 406 – 3 credits
Emphasizes the technical and legal aspects of electronic evidence and the computer forensic investigative process. Topics include the discovery and recovery of electronic evidence stored on or transmitted by computers, networks, and cellular devices.

Information Assurance Management – IT 408 – 3 credits
Focuses on the protection of information systems against unauthorized access to or modification of information whether in storage, processing or transit, and against the denial of service to authorized users, including those measures necessary to detect, document, and counter such threats. Emphasizes importance of sensitivity to threats and vulnerabilities of information systems and the recognition of the need to protect data.

Fundamentals of Cryptography – IT 410 – 3 credits
In this course students will learn the history of cryptography and its role in information assurance. Students will examine the inner workings of various cryptographic models and techniques, and will be able to identify the appropriate uses of symmetric and asymmetric encryption. Students will also examine the common pitfalls and weaknesses associated with the implementation of cryptographic techniques, and will understand the challenges and limitations of various key management systems.

Network Operations Concentration

Advanced Networking – IT 422 – 3 credits
A study of the architecture, implementation and related protocols of (1) Broadband technologies such as ISDN, SMDS, DSL, Cable, WDM, DWDM and SONET, (2) Packet Switching Technologies such as switching methodologies, X.25, Frame Relay, and ATM, (3) TCP/IP topics such as IP protocol, TCP protocol, IP addressing and routing, ARP, and routing protocols. Other topics include the basic structure of the global Internet, and network security issues such as intrusion detection, firewalls, encryption, and digital signatures, the basics of VPNs (Virtual Private Networks) and their advantages and disadvantages.

Network Operating Systems – IT 424 – 3 credits
Identifies the main functions of operating systems and network operating systems, and distinguishes between the two. Examines and compares the basic features of common network operating systems such as Novell NetWare, all versions of Windows, Unix, and Linux. Discusses the common examples of network utility software and Internet software, software licensing agreements, and network security and backup/recovery issues.

Wireless Technology – IT 426 – 3 credits
Describes the infrastructures, components and protocols of a wide range of wireless technologies. The course commences with a brief review of networking fundamentals including software and hardware used for interconnection of traditional wired networks. Examines existing wireless technologies such as global positioning satellite (GPS), cellular digital packet data (CDPD), general packet radio service (GPRS), infra-red (IR), the operation and protocols for simplex tone and data paging systems, and local multi-point communication systems (LMCS). Addresses future technologies such as Bluetooth, digital audio broadcast (DAB) and IMT2000.

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING TECHNOLOGY

Course requirements for Bachelor of Science in Electrical Engineering Technology:

- Technical component (including concentration requirements): 57 credit hours
- Arts and Sciences: 60 credit hours
- Free electives (including information literacy): 7 credit hours

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/bseet-details**

Circuit Theory I – ELEC 152 – 4 credits

DC circuits. Introduction to the basic principles of electricity. Topics covered include: current, voltage, resistance (both linear and non-linear), Ohms Law, work and power, series and parallel resistance, resistance networks, Kirchhoff's Law, network theorems (Norton's, Thevenin's, superposition, and Millman's), mesh and nodal analysis, inductance, capacitance, and time constants. This course contains a lab component.

Circuit Theory II – ELEC 153 – 4 credits

Principles and applications of alternating current circuits, the sine wave, reactance, complex algebra and phasors, impedance, power in AC circuits, series and parallel impedances, impedance networks, and resonance. This course contains a lab component.

Electronics I – ELEC 160 – 4 credits

An introduction to the study of semiconductor devices such as PN-junction diodes, bipolar junction transistors (BJT), field-effect transistors (FETs,) Metal-Oxide Semiconductor field-effect transistors (MOSFET), which will enable the students to perform analysis of DC transistors biasing, small-signal single and multi-stage amplifiers using BJTs , FETs and MOSFETs, and frequency response of transistor single and multi-stage amplifiers. This course contains a lab component.

Electronics II – ELEC 161 – 4 credits

Analysis and application of advanced electronic circuits. Topics include differential amplifiers, stage gain in decibels, input and output impedances, linear IC operational amplifiers, frequency response, Bode plots, active filters, D/A and A/D circuits, oscillators and high frequency amplifiers. Emphasis is in troubleshooting of test circuits, and analysis based on computer simulation. This course contains a lab component.

Digital Electronics – ELEC 201 – 4 credits

Principles and applications of digital circuits. Topics include number systems, binary arithmetic, logic gates and Boolean algebra, logic families, combinational and synchronous logic circuit design, logic minimization techniques (Karnaugh maps, Quine-McCluskey), counters, shift registers, encoders and decoders, multiplexors and demultiplexors, and interfacing. This course contains a lab component.

Microprocessors – ELEC 202 – 4 credits

Principles and applications of microprocessors, including hardware and software, interfacing, assembly language programming, and microprocessor-based systems. Eight, 16, and 32-bit microprocessor technology and features are presented. This course contains a lab component.

Object Oriented Programming – IT 210 – 3 credits

Covers problem solving and algorithm development using the object-oriented programming language Java. Introduction to object-oriented features including encapsulation, inheritance, and polymorphism. Examines the development of processes of design, coding, debugging, and documentation. Focuses on techniques of good programming style.

Project Management – IT 390 – 3 credits

Explores system development life cycle (SDLC) and project life cycle to enhance skills in budget and timeline management. Use of project management software to design project schedules, using bar charts, PERT and critical path method.

Electronics Concentration

Digital and Analog Communications – ELEC 331 – 3 credits

Principles and applications of communication circuits, RF circuit theory (transmitters, receivers), modulation (AM, FM), transmission lines and media, wave propagation, analog versus digital communication techniques, protocols, and communication networks. This course contains a lab component.

Advanced Digital Design – ELEC 306 – 3 credits

Systematic design methods for sequential state machines. Specification and modeling of sequential systems. Design implementation using programmable logic devices. This course contains a lab component.

Business Data Communications – IT 250 – 3 credits
This course provides overview and application of the concepts and practices of data communications and networking within a business environment. Topics of this course include data communications models, protocols, standards, and services; networking technologies and communication media; network topology, design and architecture; network management; wireless technologies; network security; and cryptography. Students will practice their knowledge and skills through hands-on labs and assignments, which is based on real-world business case scenarios.

Control Systems – ELEC 321- 3 credits
Emphasizes the practical applications of control systems. Covers the terminology, concepts, principles, procedures, and computations used by engineers and technicians to analyze, select, specify, design, and maintain all parts of a control system. Emphasizes the application of established methodology with the aid of examples, calculators, and computer programs. Derivatives and integrals are introduced and explained as they are used. Emphasis is on developing an intuitive grasp of how derivatives and integrals relate to physical systems.

Microcontrollers – ELEC 307 – 3 credits
Design of microprocessor based systems. A detailed study of Microprocessor/ microcontroller applications in data acquisition and process control systems. This course contains a lab component.

Nanotechnology Concentration

Introduction to Nanotechnology – ELEC 305 – 3 credits
Introduction to the underlying principles of nanotechnology, nanoscience, and nanoengineering. Introduces scientific principles and laws relevant on the nanoscale. Discusses applications in engineering physics, chemistry, and biology.

Basic Nanofabrication Process – ELEC 310 – 3 credits
An introduction to the basic principles and methods of nanofabrication and the associated metrology/characterization methods used in industrial and research applications of nanotechnology. Discusses the grand challenges of nanofabrication with respect to industrial scaling of nanofabrication techniques and showcases examples of specific industrial applications in electronics, photonics, chemistry, biology, medicine, defense, energy, etc.

Nanotechnology Process Equipment – ELEC 410 – 3 credits
This course presents the equipment used in nanofabrication processes at the manufacturing level as well as research and development stages. It covers nanotechnology, 300-mm wafer processing, green processes and devices, new fabrication advances and non-vacuum processing tools. Examples of equipment used in applications for micro/nanoelectronics and photovoltaics will be presented, including equipment for doping, layer deposition, device evaluation, and packaging. This course contains a lab component.

Introduction to Nanofabrication Manufacturing Technology – ELEC 415 – 3 credits
This course is an introduction to the fundamentals and applications of nanofabrication manufacturing technology. Topics include etching and micromachining, nanogrinding, laser-based nanofabrication, pulse water drop micromachining, diamond nanogrinding, and commercialization issues of nanotechnology. This course contains a lab component.

Micro-electrical Mechanical Systems – ELEC 420 – 3 credits
This course focuses on Micro Electromechanical Systems (MEMS) and Nano Electromechanical Systems (NEMS). Topics include MEMS and NEMS architecture, synthesis, modeling, and control. Micro-sensors, micro-actuators, micro-engines, and optical MEMS applications are explored. Electronic applications of MEMS, such as in data storage and bio-medical sensors, are also covered. This course contains a lab component.

Power Systems Concentration

Programmable Logic Controllers – ELEC 210 – 3 credits
This course introduces students to programmable logic controllers (PLCs). Topics covered include PLC programming, troubleshooting, networking, and industrial applications.

Generation and Transmission of Electric Power – ELEC 360 – 3 credits
This course will examine electric power generation and transmission systems; power flow; economic scheduling of electric power generation; transmission operations; and power system faults.

Power Electronics – ELEC 350 – 3 credits
This course covers principles of operation of power semiconductor devices such as Thyristors and IGBTs. Also covers fundamentals of power converter circuits including switching power supplies, DC/DC converters, phase controlled AC/DC rectifiers, and DC/AC inverters.

Electric Machines – ELEC 345 – 3 credits
Principles and applications of DC motors and generators, ideal transformers and three-phase transformers, three-phase induction machines, equivalent circuit of the induction motor, synchronous generators and motors.

Instrumentation and Data Acquisition – ELEC 370 – 3 credits
This course provides and introduction to virtual instrumentation and data acquisition. Topics covered include virtual instruments, sub virtual instruments, structures, and data acquisition.

BACHELOR OF SCIENCE IN NUCLEAR ENGINEERING TECHNOLOGY

Course requirements for Bachelor of Science in Nuclear Engineering Technology:

- Technical component: 48 credit hours
- Arts and Sciences: 60 credit hours
- Free electives (including information literacy): 16 credit hours

For more information on tuition, or to contact an advisor, please visit **http://epceonline.org/bs-nuclear-engineering-technology**

Circuit Theory I – ELEC 152 – 4 credits
DC circuits. Introduction to the basic principles of electricity. Topics covered include: current, voltage, resistance (both linear and non-linear), Ohms Law, work and power, series and parallel resistance, resistance networks, Kirchhoff's Law, network theorems (Norton's, Thevenin's, superposition, and Millman's), mesh and nodal analysis, inductance, capacitance, and time constants. This course contains a lab component.

AND

Circuit Theory II – ELEC 153 – 4 credits
Principles and applications of alternating current circuits, the sine wave, reactance, complex algebra and phasors, impedance, power in AC circuits, series and parallel impedances, impedance networks, and resonance. This course contains a lab component.

(both courses must be completed)

OR

Electrical Theory – NUC 255 – 3 credits
Introduction to the fundamentals of charge, AC and DC current, voltage, capacitance, inductance, energy, power, Kirchhoff's laws, loop and nodal analysis, and linear voltage-current characteristics.

Introduction to Computers – IT 221 – 3 credits
This course provides students with a fundamental knowledge of the computer system and its components, including computer hardware and architecture, application software, operating systems, networks, and the Internet. Advanced topics such as information privacy and security, database and data warehouse, data mining, and legal, ethical, and privacy issues in the information technology field will also be introduced in this course. Additionally, students will participate in learning activities to develop the needed skills to work with Microsoft Office suite.

Fundamentals of Reactor Safety – NUC 271 – 3 credits
The course will provide you with an overview of nuclear reactor plant safety design topics, including basic concepts relating to regulatory requirements, reactor plant safety analysis, reactor protection systems, plant procedural structure, and emergency planning. Additionally, the course will explore significant industry events, including those at Three Mile Island, Chernobyl, and Fukushima, as well as the impact of the 9/11 terrorism event. Course subject matter will reference the Pressurized Water Reactor nuclear plant design.

Material Science – NUC 323 – 3 credits
Material Science is a study of how materials are used in nuclear engineering applications. Topics studied in the course include basic nuclear plant operation overview, atomic bonding, crystalline and noncrystalline structures, diffusion, mechanical and thermal behavior, failure analysis and prevention, structural materials, ceramics, corrosion, radiation effects on materials, material commonly used in reactor core and nuclear plant design, and material problems associated with reactor core operation.

Health Physics and Radiation Protection – NUC 210 – 3 credits
This course provides a fundamental grounding in the theory a nd principles of radiation protection relevant to nuclear power plant operations.

Radiation Measurement Lab – NUC 211 – 3 credits
This course provides a fundamental rounding in practical aspects of detection and measurement of radiation and radioactive contamination relevant to nuclear power plant operations.

Plant Systems Overview – NUC 350– 3 credits
Overview of the basic aspects of design, layout and function of all major systems associated with nuclear power plant designs typically used for U.S. power production. The approach to the course is to build a power plant system by system. Covers major system components, controls and their design features. Emphasizes the systems' interconnection and functions. Systems are grouped/classified regarding their use and characteristics, e.g. production vs. safety, primary (nuclear interface) vs. balance of plant, active vs. passive.

Reactor Core Fundamentals – NUC 330 – 3 credits
Reactor Core Fundamentals – NUC 330 – 3 credits
A study of the basics of neutron chain reaction systems. Topics include neutron cross sections, flux, reaction rates, fission processes, neutron production, neutron multiplication, six-factor formula, reactivity, subcritical multiplication, prompt and delayed neutron fractions, reactor period, reactivity coefficients, control rod worth, and fission product poisons.

Introduction to Heat Transfer and Fluid Mechanics – NUC 250 – 3 credits
This course provides a fundamental grounding in the principles of heat, heat transfer, and fluid mechanics, as they apply to power plant operation. While designed to meet the requirements of the Nuclear Uniform Curriculum Program, specifically Section 1.1.5 Heat Transfer and Fluid Flow of ACAD 08-006 for Non-Licensed Nuclear Operators, this course has broad applicability for anyone interested in power plant technology, regardless the heat source used. The course covers the following broad topics: Temperature, its measurement, and pressure-temperature relationships in power plant steam and water systems; Heat, its various forms, mechanisms and mechanics of heat transfer, and the related power plant components used to transfer heat; Fluid mechanics as they relate to heat and heat transport in power plant steam systems; Fluid mechanics as they relate to power plant water systems

Integrated Technology Assessment – NUC 495 – 3 credits
The Nuclear Engineering Technology Capstone is an in-depth, student-centered course that requires the integration of theory and practical experience. Students will integrate and apply the theory, technical skills, and professional skills they have learned to offer solutions a specific nuclear industry event. The project will analyze the Fukushima Nuclear Accident event from an engineering technical problem, potential consequences if the primary containment failed, and provide a recommendation for a design that would mitigate or prevent future events in which the student will conduct research by exploring, evaluating, and theorizing a solution in a final paper. The capstone course is designed to develop the technical and non-technical competencies of students in an integrated fashion.

Nuclear Cybersecurity Concentration

Overview of Computer Security – IT 380 – 3 credits
Offers an in-depth look at operating system security concepts and techniques. Examines theoretical concepts of computer security. Explores security strategies, the advancement of security implementation, and timeless problem-solving strategies.

Governance, Legal, and Compliance – CYS 260 – 3 credits
To minimize liabilities and reduce risks from cyber security threats and reduce the losses from legal action, the information security practitioner must understand governance, compliance, and the legal environment and stay informed of emerging laws and regulations. This course will introduce you to the challenges of governance, ethics, legal, and regulatory compliance through the eyes of information security professionals. We will examine compliance requirements in response to key mandates and laws, including Sarbanes-Oxley, HIPAA, Privacy, Gramm-Leach-Bliley, the Foreign Corrupt Practices Act (FCA), and the Payment Card Industry Data Security Standards (PCI DSS). Lastly, we will examine some of the challenges of compliance and ethics in the practice of Information Security.

This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

Cybersecurity Defense in Depth for the Nuclear Industry – CYS 350 – 3 credits
The course examines the world of cybersecurity risks and defenses which poses significant threats to the nuclear industry infrastructure. This course will provide knowledge, skills, and techniques to identify and address the many cybersecurity threats facing the nuclear industry today. This course will provide a framework for current and future cybersecurity threats by first examining the history of cybersecurity. The course will then apply lessons learned in the past to current cybersecurity risks and defenses. Lastly, the course will attempt to predict future cybersecurity concerns and the necessary preparations needed to defend against them. This course will examine how IT security threats are constantly evolving and provide insight into cybersecurity defenses from a nuclear industry perspective using real-world scenarios to demonstrate actual cybersecurity threats and the strategies used to defend against those threats.

Business Continuity – CYS 455 – 3 credits
A course designed to provide a broad coverage of topics related to security in the business environment. Coverage of methods for physical security in addition to the security measures involving hardware, software, secure and unsecure protocols, authentication, and processes used to prevent access. Emphasis on the development of a business continuity plan and disaster recovery plan will provide essential details to mitigate the effect of a breach in security or in the event of a disaster.

Cybersecurity Investigation and Case Studies for the Nuclear Industry – CYS 465 – 3 credits
This course provides a comprehensive analysis of the methods, tools, and best practices for responding to cyber security incidents and product vulnerabilities in the nuclear industry. It covers building a computer security incident response team (CSIRT) and a product security team (PST) for security vulnerability handling. It includes a discussion of the best practices on conducting a cybersecurity investigation, which minimizes potential damage while ensuring proper handling of electronic data collection. Students review legal issues from a variety of national perspectives and consider the practical aspects of coordination with other organizations.

Information Literacy – INL 102 – 1 credit
An online self-paced course providing a broad overview of information literacy concepts. Introduces skills for locating, using, and evaluating various information resources, as well as discussing the legal and ethical uses of information. Students take five quizzes to help learn course content, and a Pass/Fail grade is determined by the final examination.

Nuclear Leadership Concentration

Organizational Behavior – BUS 311 – 3 credits
An overview of human behavior in work organizations. Examines theoretical, empirical, and applications issues from individual, interpersonal, group, and organizational perspectives. Topics include the overview and history of the field, perceptions, attitudes, learning processes, personality, motivation, stress, performance appraisal, group dynamics, leadership, communication, decision making, job design, organizational structure and design, organizational change, and development.

Business Leadership – BUS 452 – 3 credits
Focuses on research findings about leadership, leadership practice, and leadership skill development. Explores and evaluates leadership practices, behaviors, and personal attributes of leaders and includes case studies of leaders and organizations. The course balances theory with real-world applications for a practical, skill-building approach to leadership.

Leading Change in the Nuclear Industry – NUC 280 – 3 credits
Primary focus is preparation of future leaders in the nuclear industry on concepts concerning effective change management associated with the nuclear industry.

Leadership Communications in the Nuclear Industry – NUC 285 – 3 credits
Primary focus is preparation of future leaders in the nuclear industry on concepts concerning effective leadership communications associated with the nuclear industry

Nuclear Leadership – Leadership Courage/Risk Management – NUC 360 – 3 credits
This course details the necessary leadership styles for the nuclear industry. The course focuses on concepts associated with effective leadership, teamwork, ethical decision making, leadership challenges, risk management, organizational structure, and business acumen. Students will develop strategies to transition current nuclear industry styles to transformational and situational leadership styles to meet the challenges facing the nuclear industry.

Information Literacy – INL 102 – 1 credit
An online self-paced course providing a broad overview of information literacy concepts. Introduces skills for locating, using, and evaluating various information resources, as well as discussing the legal and ethical uses of information. Students take five quizzes to help learn course content, and a Pass/Fail grade is determined by the final examination.

UNDERGRADUATE CERTIFICATE IN CYBERSECURITY

The Undergraduate Certificate in Cybersecurity r
equires 18 credits.

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/certificate-bachelor-in-cybersecurity-details**

Governance, Legal, and Compliance – CYS 260 – 3 credits
To minimize liabilities and reduce risks from cyber security threats and reduce the losses from legal action, the information security practitioner must understand governance, compliance, and the legal environment and stay informed of emerging laws and regulations. This course will introduce you to the challenges of governance, ethics, legal, and regulatory compliance through the eyes of information security professionals. We will examine compliance requirements in response to key mandates and laws, including Sarbanes-Oxley, HIPAA, Privacy, Gramm-Leach-Bliley, the Foreign Corrupt Practices Act (FCA), and the Payment Card Industry Data Security Standards (PCI DSS). Lastly, we will examine some of the challenges of compliance and ethics in the practice of Information Security. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments

Computer Systems Security Fundamentals – CYS 300 – 3 credits This course provides an introduction to all aspects of computer security. It describes threats and types of attacks against computers to enable students to understand and analyze security requirements and define security policies. In the course, we will discuss major models in computer security such as Bell-La Padula, Biba and Clark-Wilson, and compare their properties and roles in implementation. Security mechanisms and enforcement issues will be introduced and security features of major application systems will be discussed as practical examples. Other topics include, cryptography. Planning for security, risk management, security standards, law and ethics.

Security Focused Risk Management – CYS 450 – 3 credits
This course will focus on providing you with insights, guidance and best practices in security focused risk management. Students will review the fundamental principles of security focused risk management. Students will utilize a disciplined and standard approach to risk management including risk identification, risk assessment, risk prioritization, and risk prevention or mitigation. Students will learn to identify classes of possible vulnerabilities, threats, attack vectors, consequences and mitigation strategies.

Large Scale Cybercrime and Terrorism – CYS 475 – 3 credits
This course will examine Cyber Crime and Terrorism in global context and focus on large scale incidents that effect international security. The foundation of the course will emphasize the evolution of Cyber Crime and Terrorism within the context of globalization and the increasing complexity of Cyber Crime and international, nation-less decentralized terror networks. The course will discuss the relationship of cybercrime and uses of information technology that cultivated and sustained current international terror networks. The course will also discuss emerging trends and potential threats such as Electromagnetic Pulse Attacks (EMPs) and methods (and limitations) to confront Large Scale Cyber Crime and terrorism such as advanced data mining techniques by the Intelligence Community and use of Fusion Centers.

Cybersecurity Investigations and Case Studies – CYS 460 – 3 credits
This course is a comprehensive analysis of the methods, tools, and best practices for handling, responding, and investigating cybersecurity incidents and product vulnerabilities. Covers building a security incidence response Team (IRT) and a Product Security Team for security vulnerability handling. Students review legal issues from a variety of national perspectives, and consider practical aspects of coordination with other organizations.

BACHELOR OF SCIENCE IN CYBERSECURITY

Course requirements for Bachelor of Science in Cybersecurity:
- Technical Component (52 credit hours)
- Arts and Sciences (60 credit hours)
- Free Electives (including information literacy) (8 credit hours)

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/certificate-bachelor-in-cybersecurity-details**

Introduction to Microprocessors – CYS 203 – 3 credits
The course introduces the fundamental principles, operations and applications of microprocessors. The architecture and organization of microprocessors including hardware, software and peripheral interfacing will be covered. In addition, the basic organization and function of microcontrollers will also be covered. Principles and applications of microprocessors, including hardware and software, interfacing, assembly language programming, and microprocessor-based systems. Eight, 16, and 32-bit microprocessor technology and features are presented. This course contains a lab component

OR

Computer Systems Architecture – IT 321 – 3 credits
This course is an introduction to the basic components and structure of the computer. The course covers in detail basic Boolean algebra, fundamentals of computer design, instruction set principles, RISC/CISC processors, instruction and processor level parallelism, memory hierarchy, pipelining, assembly language, and parallel computer architectures. The course will also address the architecture and microprogramming of the processor.

Introduction to Cybersecurity – CYS 245 – 1 credit
The course provides students with an introduction to the basic and fundamental concepts of cyber security from both a technical and managerial perspective. Students will gain insight on common cyber-attacks and the techniques for identifying, detecting and defending against cyber security threats. The course will cover the basics of physical, network and web security as well as standards and laws in Cybersecurity. The knowledge gained in this course will provide students with a concrete foundation to further master the concepts of Cybersecurity.

Governance, Legal, and Compliance – CYS 260 – 3 credits
To minimize liabilities and reduce risks from cyber security threats and reduce the losses from legal action, the information security practitioner must understand governance, compliance, and the legal environment and stay informed of emerging laws and regulations. This course will introduce you to the challenges of governance, ethics, legal, and regulatory compliance through the eyes of information security professionals. We will examine compliance requirements in response to key mandates and laws, including Sarbanes-Oxley, HIPAA, Privacy, Gramm-Leach-Bliley, the Foreign Corrupt Practices Act (FCA), and the Payment Card Industry Data Security Standards (PCI DSS). Lastly, we will examine some of the challenges of compliance and ethics in the practice of Information Security. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

Cybersecurity Defense in Depth – CYS 345 – 3 credits
The course examines the world of cybersecurity risks and defenses which poses significant threats to governments and businesses. This course will provide knowledge, skills, and techniques to identify and address the many cybersecurity threats facing our world today. This course will provide a framework for current and future cybersecurity threats by first examining the history of cybersecurity. The course will then apply lessons learned in the past to current cybersecurity risks and defenses. Lastly, the course will attempt to predict future cybersecurity concerns and the necessary preparations needed to defend against them. This course will examine how IT security threats are constantly evolving and provide insight into cybersecurity defenses from business and government perspective using real-world scenarios to demonstrate actual cybersecurity threats and the strategies used to defend against those threats.

Cyber Attacks and Defense – CYS 426 – 3 credits
This course investigates security issues, vulnerabilities, and mechanisms to identify, respond to and prevent cyberattacks and to build active defense systems. The course will follow the formal ethical hacking methodology including reconnaissance, scanning and enumeration, gaining access, escalation of privilege, maintain access and reporting. Ethical Hackers are computer and network experts who attack security systems on behalf of its owners, seeking vulnerabilities that a malicious hacker could exploit.

Security Focused Risk Management – CYS 450 – 3 credits
This course will focus on providing you with insights, guidance and best practices in security focused risk management. Students will review the fundamental principles of security focused risk management. Students will utilize a disciplined and standard approach to risk management including risk identification, risk assessment, risk prioritization, and risk prevention or mitigation. Students will learn to identify classes of possible vulnerabilities, threats, attack vectors, consequences and mitigation strategies.

Business Data Communications – IT 250 – 3 credits
This course provides overview and application of the concepts and practices of data communications and networking within a business environment. Topics of this course include data communications models, protocols, standards, and services; networking technologies and communication media; network topology, design and architecture; network management; wireless technologies; network security; and cryptography. Students will practice their knowledge and skills through hands-on labs and assignments, which is based on real-world business case scenarios.

Operating Systems – IT 360 – 3 credits
Introduction to the basic components and structure of a generic operating system. Considers in detail processes, process management and synchronization, threads, interrupts and interrupt handling, memory management, virtual memory management, resource allocation, and an introduction to file systems, protection, and security.

Overview of Computer Security – IT 380 – 3 credits
Offers an in-depth look at operating system security concepts and techniques. Examines theoretical concepts of computer security. Explores security strategies, the advancement of security implementation, and timeless problem-solving strategies.

Computer Forensics – IT 406 – 3 credits
Emphasizes the technical and legal aspects of electronic evidence and the computer forensic investigative process. Topics include the discovery and recovery of electronic evidence stored on or transmitted by computers, networks, and cellular devices.

System Administration – IT 460 – 3 credits
This course provides learners with the knowledge and hands-on skills necessary to administer systems and its resources. Topics covered include directory services, user account management, file and print services, load balancing, security and user/client administration. Students will setup and manage a fully functioning computer network of systems. Furthermore, through hands-on (labs) assignments, students deal with challenges designed to help them install, configure and manage servers.

Cyber Operations Concentration

Object Oriented Programming – IT 210 – 3 credits
Covers problem solving and algorithm development using the object-oriented programming language Java. Introduction to object-oriented features including encapsulation, inheritance, and polymorphism. Examines the development of processes of design, coding, debugging, and documentation. Focuses on techniques of good programming style.

OR

Introduction to Programming – IT 240 – 3 credits
This course is an introduction to the C++ programming language through a study of the concepts of program specification and design, algorithm development, and coding and testing using a modern software development environment. The student will grasp the basics of both procedural and non-procedural (Object Oriented) Programming. Topics covered include fundamentals of algorithms, problem solving, programming concepts, classes and methods, control structures, arrays, and strings. This course will serve not only as an introduction to programming in C++ but also as a preparation for a more advanced C++ course involving data structures and algorithmic development.

Introduction to Homeland Security – CJ 125 – 3 credits
This course provides an overview of the concept of Homeland Security, and how it has evolved since the September 11th terrorist attacks in New York City. Also covered is the need to balance terrorism threats, natural disasters, and other hazards; the critical role of communications and social media; intelligence and counterterrorism, border security and immigration, transportation safety and security, communications, cybersecurity, and critical infrastructure protection; identification of vulnerabilities, mitigation, prevention, and preparedness; all-hazards response and recovery; statutory actions, critical guidance documents, directives, and legislation; the hierarchical organizational structure of the Department of Homeland Security (DHS), and the various programs and actions undertaken by government agencies, community organizations, and the private sector in support of homeland security concept.

Reverse Engineering – CYS 400 – 3 credits
This course will focus on providing students the knowledge, skills, and hands-on experience in using reverse engineering to deduce the design of a software component to determine how it accomplishes its goals. Specific topics include reverse engineering software tools and techniques for software recovery such as malware analysis, decompilation of code, intellectual property protections such as digital rights management, and communication protocols utilizing static and dynamic techniques.

Secure Software Development – CYS 470 – 3 credits
In today's environment, perimeter and infrastructure security is not enough to mitigate security attacks against data and information stored, transmitted, and processed by computer systems. In order to design and build secure IT systems, all elements of the system need to be secure. Unfortunately, more and more security vulnerabilities are exploited due to insecure software systems. This course gives insight, guidance, and best practices in the design, development, and testing of secure software systems.

Large Scale Cybercrime and Terrorism – CYS 475 – 3 credits
This course will examine Cyber Crime and Terrorism in global context and focus on large scale incidents that effect international security. The foundation of the course will emphasize the evolution of Cyber Crime and Terrorism within the context of globalization and the increasing complexity of Cyber Crime and international, nation-less decentralized terror networks. The course will discuss the relationship of cybercrime and uses of information technology that cultivated and sustained current international terror networks. The course will also discuss emerging trends and potential threats such as Electromagnetic Pulse Attacks (EMPs) and methods (and limitations) to confront Large Scale Cyber Crime and terrorism such as advanced data mining techniques by the Intelligence Community and use of Fusion Centers.

Graduate Certificate in Cybersecurity Management

The Graduate Certificate in Cybersecurity requires 18 credits.

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/cybersecurity-graduate-certificate-and-masters-details**

Foundations of Cybersecurity – CYS 500 – 3 credits

This course provides students with knowledge and tools necessary to research cybersecurity threats, identify threats and take action to minimize, mitigate, or eliminate the threats. Additionally, the concepts of continuous training within the organization, and the company-wide impact of cybersecurity are addressed.

Network and Communication Security – CYS 504 – 3 credits

This course is an introduction to network security fundamentals. It is organized in four parts. The first part covers the basics of private key and public key cryptography, including the common encryption algorithms AES, RC4, and RSA. The second part builds on cryptography to design secure protocols for confidentiality, authentication, and data integrity. Examples will include IPSec, SSL/TLS, and VPNs. The third part covers how cyber-attacks proceed from reconnaissance to exploits and intrusions. Particular emphasis is given on web attacks (such as phishing, SQL injection, drive-by downloads) and malware. The last part of the course will describe focus on intrusion prevention, detection, and response. Specific topics include firewalls, spam filters, intrusion detection systems, and risk management. Students will learn about protocols to communicate securely over unsecure networks, and about modern technologies for protecting computers from a wide range of threats. Throughout the course, real world cases are discussed, and students will gain hands-on experience in labs.

Ethics, Legal, and Compliance Issues in Cybersecurity – CYS 541 – 3 credits

Coursework examines the ethical, legal, and regulatory compliance issues related to the practice of cyber security. Focuses on the requirements, challenges, and dilemmas of data protection, due diligence, privacy laws, fraud and risk management, intellectual property, and ethical corporate codes of conduct. Covers key mandates and laws, including the Foreign Corrupt Practices Act (FCA) and the Payment Card Industry Data Security Standards (PCI DSS). To minimize liabilities and reduce risks from electronic, physical threats and reduce the losses from legal action, the information security practitioner must understand the current legal environment and stay informed of emerging laws and regulations.

Leadership and Communications in Cybersecurity – CYS 550 – 3 credits

This course will develop the knowledge and skills necessary to design a cybersecurity strategy, including people, process, and technology, in a complex organization. The role of leaders in cybersecurity becomes critical to business success. The course will cover global issues; emphasis will be placed on individual's roles within organizations and how they communicate their ideals to the teams of individuals performing cybersecurity tasks and other stakeholders who provide oversight.

Information Assurance – CYS 560 – 3 credits

This course will provide awareness, guidance, best practices and assessments on the principles of information systems security. We will examine the foundations of information systems security as defined by industry experts and the International Information Systems Security Certification Consortium, or (ISC)2, which is considered a definitive source for information security domain definitions and a premier certification authority. As such, this course will examine information systems security concepts according to the consortium s newly redesigned "eight domains of knowledge" model for their Certified Information Systems Security Professional (CISSP) certification. We will use course textbooks, open educational resources, current cybersecurity events, research and case studies to support our lectures, discussions and assessments. We will learn to apply some of the information systems security knowledge and skills through individual activities and practice exams. The course will provide you with an opportunity to apply the course subjects to a project that encompasses several of the major topics.
This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook). Course engagement includes such activities as discussions, reading, study time, and assignments.

MASTER OF SCIENCE IN CYBERSECURITY

The Master of Science in Cybersecurity requires 30 total credits, including those in the area of focus.

For information on tuition, or to contact an advisor, please visit: **http://epceonline.org/cybersecurity-graduate-certificate-and-masters-details**

Foundations of Cybersecurity – CYS 500 – 3 credits

This course provides students with knowledge and tools necessary to research cybersecurity threats, identify threats and take action to minimize, mitigate, or eliminate the threats. Additionally, the concepts of continuous training within the organization, and the company-wide impact of cybersecurity are addressed.

Network and Communication Security – CYS 504 – 3 credits

This course is an introduction to network security fundamentals. It is organized in four parts. The first part covers the basics of private key and public key cryptography, including the common encryption algorithms AES, RC4, and RSA. The second part builds on cryptography to design secure protocols for confidentiality, authentication, and data integrity. Examples will include IPSec, SSL/TLS, and VPNs. The third part covers how cyber-attacks proceed from reconnaissance to exploits and intrusions. Particular emphasis is given on web attacks (such as phishing, SQL injection, drive-by downloads) and malware. The last part of the course will describe focus on intrusion prevention, detection, and response. Specific topics include firewalls, spam filters, intrusion detection systems, and risk management. Students will learn about protocols to communicate securely over unsecure networks, and about modern technologies for protecting computers from a wide range of threats. Throughout the course, real world cases are discussed, and students will gain hands-on experience in labs.

Project Management Principles and Application – BUS 530 – 3 credits

This course provides the theoretical framework and practical tools to develop comprehensive understanding of the managerial process in project management. The curriculum is built for the business leaders, professionals, or administrators who are involved in completing special projects and desire to competently utilize professional project management methods and techniques. Throughout its duration, this course will offer numerous examples on how to apply project management strategies and tools to real world projects and situations as well as provide the students with opportunities to practice their learned skills. Available supporting project management technology will be described and the students will receive high-level hands-on training on Microsoft Office Project 2007. In a nutshell, the students will gain a thorough understanding of project management process and techniques which will enable them to optimize the process of their projects and place them onto a path towards successful project completion.

Ethics, Legal, and Compliance Issues in Cybersecurity – CYS 541 – 3 credits

Coursework examines the ethical, legal, and regulatory compliance issues related to the practice of cyber security. Focuses on the requirements, challenges, and dilemmas of data protection, due diligence, privacy laws, fraud and risk management, intellectual property, and ethical corporate codes of conduct. Covers key mandates and laws, including the Foreign Corrupt Practices Act (FCA) and the Payment Card Industry Data Security Standards (PCI DSS). To minimize liabilities and reduce risks from electronic, physical threats and reduce the losses from legal action, the information security practitioner must understand the current legal environment and, stay informed of emerging laws and regulations.

Leadership and Communications in Cybersecurity – CYS 550 – 3 credits

This course will develop the knowledge and skills necessary to design a cybersecurity strategy, including people, process, and technology, in a complex organization. The role of leaders in cybersecurity becomes critical to business success. The course will cover global issues; emphasis will be placed on individual's roles within organizations and how they communicate their ideals to the teams of individuals performing cybersecurity tasks and other stakeholders who provide oversight.

Information Assurance – CYS 560 – 3 credits

This course will provide awareness, guidance, best practices and assessments on the principles of information systems security. We will examine the foundations of information systems security as defined by industry experts and the International Information Systems Security Certification Consortium, or (ISC)2, which is considered a definitive source for information security domain definitions and a premier certification authority. As such, this course will examine information systems security concepts according to the consortium s newly redesigned "eight domains of knowledge" model for their Certified Information Systems Security Professional (CISSP) certification. We will use course textbooks, open educational resources, current cybersecurity events, research and case studies to support our lectures, discussions and assessments. We will learn to apply some of the information systems security knowledge and skills through individual activities and practice exams. The course will provide you with an opportunity to apply the course subjects to a project that encompasses several of the major topics.

This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook). Course engagement includes such activities as discussions, reading, study time, and assignments.

Capstone Project in Cybersecurity – CYS 596 – 3 credits
This is a capstone course which examines computer security technologies and principles, including cryptography, authentication, access control, database and software security, management issues such as physical and infrastructure security, human factors, and security auditing. This course also covers IT security management, risk assessment, and legal and ethical considerations. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

Information Assurance Concentration

Software and Application Security – CYS 523 – 3 credits
The course teaches you secure programming techniques by focusing on foundational defensive techniques, cutting-edge protection, and security features you can use in your development process. The critical skills needed to succeed as a developer will include Identify security defects in your code, fix security bugs using secure coding techniques, incorporate security into your development process, the use of open source tools to test your applications. The course will also focus on design flaws in existing software packages. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook). Course engagement includes such activities as discussions, reading, study time, and assignments.

Cyber Attacks and Defense – CYS 526 – 3 credits
This course investigates security issues, vulnerabilities, and mechanisms to identify, respond to and prevent cyberattacks and to build active defense systems. The course will follow the formal ethical hacking methodology including reconnaissance, scanning and enumeration, gaining access, escalation of privilege, maintain access and reporting. Ethical Hackers are computer and network experts who attack security systems on behalf of its owners, seeking vulnerabilities that a malicious hacker could exploit.

Digital Forensics and Investigation – CYS 586 – 3 credits
This course provides an in-depth analysis of the digital defense planning, technologies, and methods to safeguard organizational networks, databases, and applications. It presents a plan-protect-respond framework of digital security; the interaction of policies, implementation, and oversight; and ways to perform a computer forensic investigation.

Policy Administration Concentration

Security Policy and Compliance – CYS 545 – 3 credits
This course will focus on security policy and compliance in the world of cybersecurity that encompass laws, ethics, privacy, and governance issues. Students will be exposed to national and international policies while understanding the importance of security policy as the beginning of any security program in organizations. The theory and principles behind the topics mentioned are explored in depth where policy documents are critiqued and compliance issues and frameworks are discussed. Students will learn the approach to writing security policies where compliance plays a role. This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

IT Risk Analysis and Management – CYS 575 – 3 credits
The course examines Information Security Risk Analysis and Management from a business perspective. The course will provide an overview of the key aspects of risk analysis and management including asset identification and associated risk identification, qualitative and quantitative risk assessment and prioritization, determination of risk mitigation strategies, budgeting for risk, and ongoing risk management. This course will provide knowledge, skills, and techniques to identify, prioritize and manage the many IT security risks facing businesses today. Students will also examine how IT Risk Management supports IT governance and decision making by businesses. The role of risk analysts, auditors, security personnel, and management will be discussed.

MASTER OF BUSINESS ADMINISTRATION (CYBERSECURITY MANAGEMENT)

Course requirements for Master of Business Administration with Cybersecurity Management concentration:

- Foundation component: 0-15 credit hours (waivable)
- Core component: 27 credit hours
- Concentration component: 9 credit hours

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/cybersecurity-graduate-certificate-and-masters-details**

Business Ethics for Managers – BUS 523 – 3 credits

The focus of this course is on the application of moral philosophy with regard to the social responsibility of business, corporate governance, and business/government relations. The course examines other issues as well, including the rights and obligations of employers and employees; hiring, firing and discrimination; gathering, concealing and gilding information; and issues in dealing with foreign cultures. Students will consider how organizations can be guided toward fulfilling their social responsibilities.

Managerial Economics – ECO 508 – 3 credits

This course provides students with the opportunity to apply economic analysis to practical managerial decision-making contexts. The fundamental focus is studying how managers direct scarce resources efficiently to achieve organizational goals. Students will develop strategies to respond to various market events within the context of a global business environment using a number of economic tools including pricing strategies, demand forecasting, competitive analysis, market structure analysis and game theory.

Marketing – BUS 506 – 3 credits

This course presents a systematic framework for understanding marketing management and strategy. It focuses on creating and executing marketing strategies and policies. IT examines the ethical, legal, social, and environmental issues relevant to the development of sound marketing strategies and policies.

Organizational Behavior – BUS 553 – 3 credits

Examines the application of behavioral science to organization behavior, formal and informal groups, structure and management processes, decision making and controlling processes, communication within the organization and organizational development. Covers: theories of organization and management; individual behavior; group dynamics; organizational change; organizational performance, efficiency, and effectiveness; and the impact of technology on the workplace and its constituents.

Quantitative Analysis – BUS 503 – 3 credits

This course prepares students to apply statistics and probability concepts to business decisions. Students learn important criteria for developing effective research questions, including the creation of appropriate sampling populations and instruments. Other topics include descriptive statistics, probability concepts, confidence intervals, sampling designs, data collection, and data analysis including parametric and nonparametric tests of hypothesis and regression analysis.

Accounting for Managers – BUS 500 – 3 credits

This course is intended to help the student understand how to analyze a company's basic financial statements and annual report. By the end of the course, you should be familiar with the four basic financial statements, some of the key accounts on the balance sheet as well as the overall accounting cycle. As a manager, you should be able to effectively analyze a company's financial statements and annual report. Additionally, managers should be able to conclude on a company's profitability, efficiency, liquidity and solvency.

Business Communications – BUS 501 – 3 credits

Focuses on the development of clear written communication and oral presentation skills. Examines a variety of communication techniques, formats, and processes for sharing organizational information. Explores the use of audiovisual and electronic media to enhance the quality of presentation and communication.

Global Business Environment – BUS 502 – 3 credits

This course examines the global business environment and its impact on an organization's business strategy and decision making. It focuses on the complexities and risk/reward assessments that arise due to highly diversified markets, cross cultural issues, globalization, international organizations (WTO, IMF, World Bank, etc.), nongovernmental organizations (NGOs), foreign direct investment, and currency risk challenges.

Human Resource Management – BUS 504 – 3 credits
This course will provide students with an understanding of the evolution and roles of human resource management in organizations, as well as an overview of the basic functions of HR management. These functions include: staff planning; recruitment and selection; job analysis and design; performance management; labor relations and laws; training and development; compensation and rewards; HR strategy; strategic, corporate, and HRM objectives; HRM policies, practices and leadership behavior; employee involvement; diverse workforces; the impact of globalization; and HR s role in change management and internal consulting.

This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

Change Management – BUS 554 – 3 credits
A study of the process of change and change management. Focuses on the types of changes that take place within organizations, identifying the key issues and challenges associated with each type of change. Uses macro and micro tools for working with change, including management skills and styles, communications patterns, and force-field and gap analysis. Covers the human and economic factors in organizational change and restructuring.

Leadership – BUS 552 – 3 credits
Focuses on the leadership process within the broad context of organizational dynamics. Explores leadership from four different perspectives: the leader; the follower; the situation; and leadership skills. Theories, concepts and models are applied to workplace situations.

Finance – BUS 505 – 3 credits
What projects should an organization invest in? Where will an organization obtain finance to pay for investments? How will an organization manage day-to-day financial activities such as cash collections and payments? These are some of the questions that you will be addressing in this course on Financial Management. The purpose of this course is to provide students with an overview of the problems facing financial managers in an uncertain world. It is intended to develop students critical thinking and problem-solving competencies in financial statement analysis, capital structure, and capital budgeting. The course is focused on applying financial theory to analyze real-life situations with students placed in the role of a financial manager making decisions in an uncertain environment with an incomplete data set.

This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook), Course engagement includes such activities as discussions, reading, study time, and assignments.

Information Technology – BUS 570 – 3 credits
Examines the strategic, operational, and ethical uses of information technology. Explores global and electronic markets and data management. Examines how IT can support customer and supply chain management.

Strategy and Policy – BUS 511 – 3 credits
This is the MBA Capstone course. It integrates previous study and various business disciplines to formulate, analyze, and implement effective business strategy. Students will analyze complex business situations to make strategic decisions under conditions of uncertainty.

Ethics, Legal, and Compliance Issues in Cybersecurity – CYS 541 – 3 credits
Coursework examines the ethical, legal, and regulatory compliance issues related to the practice of cyber security. Focuses on the requirements, challenges, and dilemmas of data protection, due diligence, privacy laws, fraud and risk management, intellectual property, and ethical corporate codes of conduct. Covers key mandates and laws, including the Foreign Corrupt Practices Act (FCA) and the Payment Card Industry Data Security Standards (PCI DSS). To minimize liabilities and reduce risks from electronic, physical threats and reduce the losses from legal action, the information security practitioner must understand the current legal environment and, stay informed of emerging laws and regulations.

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Information Assurance – CYS 560 – 3 credits

This course will provide awareness, guidance, best practices and assessments on the principles of information systems security. We will examine the foundations of information systems security as defined by industry experts and the International Information Systems Security Certification Consortium, or (ISC)2, which is considered a definitive source for information security domain definitions and a premier certification authority. As such, this course will examine information systems security concepts according to the consortium s newly redesigned "eight domains of knowledge" model for their Certified Information Systems Security Professional (CISSP) certification. We will use course textbooks, open educational resources, current cybersecurity events, research and case studies to support our lectures, discussions and assessments. We will learn to apply some of the information systems security knowledge and skills through individual activities and practice exams. The course will provide you with an opportunity to apply the course subjects to a project that encompasses several of the major topics.

This is a 3-credit course, requiring a minimum of 18 hours of course engagement each week in an 8-week term, or 9 hours per week in a 15-week term (refer to the Credit Hours Calculation Policy in the Student Handbook). Course engagement includes such activities as discussions, reading, study time, and assignments.

Worcester Polytechnic Institute (WPI)

GRADUATE CERTIFICATE IN POWER SYSTEMS ENGINEERING

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/graduate-certificate-power-systems-engineering-details**

Protection and Control Specialization

Four technical courses are required to complete the certificate.

Power Systems Analysis – ECE 5500

This graduate level course examines the principles of Power System Analysis. It will begin with a review of AC circuit analysis. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power systems stability. (Prerequisites: Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis and basic computer programming.)

Transients in Power Systems – ECE 5511

This graduate level course introduces the student to the effects of electromagnetic transients in distribution systems. Topics include transient analysis, lightning and switching surges, mechanisms of transient generation, insulation coordination, grounding, surge protection devices, and shielding. (Prerequisite: ECE 5500 Power System Analysis)

OR

Power System Dynamics – ECE 5523

This graduate level course is concerned with modeling, analyzing and mitigating power system stability and control problems. The course seeks to provide an understanding of the electromechanical dynamics of the interconnected electric power grid. This subject is presented from a theoretical viewpoint; however, many practical examples are included. The course begins with a description of the physics of the power system, frequency regulation during steady-state operation, dynamic characteristics of modern power systems, a review of feedback control systems, power system frequency regulation, and a review of protective relaying. This is followed by material on synchronous machine theory and modeling. Simulation of power system dynamic response, small signal stability, transient stability analysis using SIMULINK and effects of non-traditional power sources on systems dynamics will also be covered. Power system stabilizers, load modeling and under frequency load shedding are covered in the final lectures. (Prerequisite: Familiarity with the basics of Laplace Transforms, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis topics recommended. (ECE 5500 Power System Analysis and ECE 5511 Transients in Power Systems or equivalent background experience is suggested.)

Protective Relaying – ECE 5521

This graduate level course is the first of a two course sequence that covers both the principles and practices of power system protective relaying. The course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturers equipment. The course begins with a brief review of the nature of power system operation, power system faults and other abnormal conditions. The nature and objectives of protective relaying are covered next with emphasis on how the power system can be monitored to detect abnormal conditions. The computational tools needed to analyze system operation and apply protective relaying are covered next, including the per-unit system, phasors and symmetrical components. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation is included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. (Prerequisite: ECE 5500 Power System Analysis or equivalent background experience is suggested. Familiarity with phasors, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis or similar background is recommended. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Advanced Applications in Protective Relaying – ECE 5522

This graduate level course covers advanced topics in the principles and practices of power system protective relaying. The course seeks to provide an understanding of how protective relays are applied to protect power system components. While the subject is presented from a theoretical viewpoint, many practical examples are included. Examples specific to both new installations and existing, older facilities will be included. Course content is not specific to any manufacturer's equipment. The course begins with applications of protective devices to generators. This will include distributed generation as well as wind-turbine and inverter-connected sources. Transformer protection is covered next, including application procedures for older, electromechanical relays as well as modern numeric relay designs. A unit on bus protection is covered next, including all typical high-speed and time backup bus protection schemes. Transmission line and distribution feeder protection is covered in detail including both conventional and communications-assisted schemes. The course ends with a unit on other protection applications such as under frequency load shedding, reclosing and out-of-step relaying. (Prerequisite: ECE 5521 Protective Relaying. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Renewable and Distribution Concentration

Five to six technical courses are required to complete the certificate.

Power Systems Analysis – ECE 5500

This graduate level course examines the principles of Power System Analysis. It will begin with a review of AC circuit analysis. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power systems stability. (Prerequisites: Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis and basic computer programming.)

Transients in Power Systems – ECE 5511

This graduate level course introduces the student to the effects of electromagnetic transients in distribution systems. Topics include transient analysis, lightning and switching surges, mechanisms of transient generation, insulation coordination, grounding, surge protection devices, and shielding. (Prerequisite: ECE 5500 Power System Analysis)

Power Distribution – ECE 5530

This graduate level course introduces the fundamentals of power distribution systems, apparatus, and practices suited to new and experienced utility distribution engineers. Topics include distribution system designs, transformers and connections, practical aspects of apparatus and protection, principles of device coordination, grounding, voltage control, and power quality. (Prerequisites: Prior courses in magnetism and three-phase circuits. An electric machines course would be recommended.)

Power System Protection and Control – ECE 5520

This graduate level course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples and applications are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of power system operation, three-phase system calculations and the representation (modeling) of power system elements. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation are included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. The final course segments cover specific applications such as pilot protection of transmission lines, generator protection and transformer protection. (Prerequisite: ECE 5500 Power System Analysis)

OR

Protective Relaying – ECE 5521

This graduate level course is the first of a two course sequence that covers both the principles and practices of power system protective relaying. The course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of the nature of power system operation, power system faults and other abnormal conditions. The nature and objectives of protective relaying are covered next with emphasis on how the power system can be monitored to detect abnormal conditions. The computational tools needed to analyze system operation and apply protective relaying are covered next, including the per-unit system,

phasors and symmetrical components. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation is included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. (Prerequisite: ECE 5500 Power System Analysis or equivalent background experience is suggested. Familiarity with phasors, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis or similar background is recommended. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Distributed and Renewable Power Generation – ECE 5532

This course introduces the characteristics and challenges of interconnecting increasing numbers of Distributed Energy Resources (DERs) to the Electric Power System (EPS). Topics include: challenges to distribution and transmission system protection; local voltage control; ride through; optimal interconnection transformer configurations; and practical engineering approaches to maintain system reliability and protection. The current and evolving interconnection standard (IEEE 1547) is included. (Prerequisites: ECE 5500 Power System Analysis plus either ECE 5520 Power System Protection and Control or ECE 5521 Protective Relaying. ECE 5530 Power Distribution highly recommended.)

GRADUATE CERTIFICATE IN POWER SYSTEMS MANAGEMENT

Six courses are required to complete the certificate.

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/graduate-certificate-power-systems-management-details**

Power Systems Analysis – ECE 5500

This graduate level course examines the principles of Power System Analysis. It will begin with a review of AC circuit analysis. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power systems stability. (Prerequisites: Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis and basic computer programming.)

Choose 2 or 3 of the following Electrical and Computer Engineering courses:

Transients in Power Systems – ECE 5511

This graduate level course introduces the student to the effects of electromagnetic transients in distribution systems. Topics include transient analysis, lightning and switching surges, mechanisms of transient generation, insulation coordination, grounding, surge protection devices, and shielding. (Prerequisite: ECE 5500 Power System Analysis)

Electromechanical Energy Conversion – ECE 5512

This graduate level course will further explore alternating current circuits, three phase circuits, basics of electromagnetic field theory, magnetic circuits, inductance, and electromechanical energy conversion. Topics also include ideal transformer, iron-core transformer, voltage regulation, efficiency equivalent circuit, and three phase transformers. Induction machine construction, equivalent circuit, torque speed characteristics, and single-phase motors, synchronous machine construction, equivalent circuit, power relationships phasor diagrams, and synchronous motors will be covered. Direct current machine construction, types, efficiency, power flow diagram, and external characteristics will be discussed.

Power System Protection and Control – ECE 5520

This graduate level course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples and applications are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of power system operation, three-phase system calculations and the representation (modeling) of power system elements. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation are included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. The final course segments cover specific applications such as pilot protection of transmission lines, generator protection and transformer protection. (Prerequisite: ECE 5500 Power System Analysis)

Protective Relaying – ECE 5521

This graduate level course is the first of a two course sequence that covers both the principles and practices of power system protective relaying. The course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of the nature of power system operation, power system faults and other abnormal conditions. The nature and objectives of protective relaying are covered next with emphasis on how the power system can be monitored to detect abnormal conditions. The computational tools needed to analyze system operation and apply protective relaying are covered next, including the per-unit system, phasors and symmetrical components. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation is included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. (Prerequisite: ECE 5500 Power System Analysis or equivalent background experience is suggested. Familiarity with phasors, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis or similar background is recommended. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Advanced Applications in Protective Relaying – ECE 5522

This graduate level course covers advanced topics in the principles and practices of power system protective relaying. The course seeks to provide an understanding of how protective relays are applied to protect power system components. While the subject is presented from a theoretical viewpoint, many practical examples are included. Examples specific to both new installations and existing, older facilities will be included. Course content is not specific to any manufacturer's equipment. The course begins with applications of protective devices to generators. This will include distributed generation as well as wind-turbine and inverter-connected sources. Transformer protection is covered next, including application procedures for older, electromechanical relays as well as modern numeric relay designs. A unit on bus protection is covered next, including all typical high-speed and time backup bus protection schemes. Transmission line and distribution feeder protection is covered in detail including both conventional and communications-assisted schemes. The course ends with a unit on other protection applications such as under frequency load shedding, reclosing and out-of-step relaying. (Prerequisite: ECE 5521 Protective Relaying. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Power System Dynamics – ECE 5523

This graduate level course is concerned with modeling, analyzing and mitigating power system stability and control problems. The course seeks to provide an understanding of the electromechanical dynamics of the interconnected electric power grid. This subject is presented from a theoretical viewpoint; however, many practical examples are included. The course begins with a description of the physics of the power system, frequency regulation during steady-state operation, dynamic characteristics of modern power systems, a review of feedback control systems, power system frequency regulation, and a review of protective relaying. This is followed by material on synchronous machine theory and modeling. Simulation of power system dynamic response, small signal stability, transient stability analysis using SIMULINK and effects of non-traditional power sources on systems dynamics will also be covered. Power system stabilizers, load modeling and under frequency load shedding are covered in the final lectures. (Prerequisite: Familiarity with the basics of Laplace Transforms, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis topics recommended. (ECE 5500 Power System Analysis and ECE 5511 Transients in Power Systems or equivalent background experience is suggested.)

Power Distribution – ECE 5530

This graduate level course introduces the fundamentals of power distribution systems, apparatus, and practices suited to new and experienced utility distribution engineers. Topics include distribution system designs, transformers and connections, practical aspects of apparatus and protection, principles of device coordination, grounding, voltage control, and power quality. (Prerequisites: Prior courses in magnetism and three-phase circuits. An electric machines course would be recommended.)

Power System Operation and Planning – ECE 5531

This graduate-level course deals with modern operation, control and planning for power systems. Topics include: Characteristics of generating units; Economic Dispatch; Unit Commitment; Effects of the transmission system on power delivery; Optimal Power Flow and Location Marginal Pricing; Power System Security; State Estimation for Power Systems; Power System Reliability Evaluation. Software tools such as MATLAB and power system simulator software will be used both in the classroom and in some homework assignments.

Power Transmission – ECE 5540

This graduate level course focuses on the theory and current professional practice in problems of electric power transmission. It begins with a review of the theory of AC electric power transmission networks and addresses a range of challenges related to reactive power and voltage control as well as steady-state and transient's stability. Students will learn in detail the principles of traditional reactive power compensation (shunt reactors and capacitors); series compensation and modern static reactive compensation like SVC, STATCOM and other Flexible AC Transmission Systems (FACTS) devices. The effects of each of these types of compensation on static and dynamic voltage control, reactive power requirement and steady-state and transient stability problems are covered from theoretical as well as practical aspects. Particular attention is given to the mathematical models and principles of operation of many types of compensation systems. Basic principles of operation and control of High-Voltage DC (HVDC) systems and their impact on steady-state and dynamics of power system will be covered as well. (Prerequisite: ECE 5500 Power System Analysis.)

Power Electronics – ECE 523

The application of electronics to energy conversion and control. Electrical and thermal characteristics of power semiconductor devices' diodes, bipolar transistors and thyristors. Magnetic components. State-space averaging and sampled-data models. Emphasis is placed on circuit techniques. Application examples include dc-dc conversion, controlled rectifiers, high-frequency inverters, resonant converters and excitation of electric machines. (Prerequisites: ECE 3204 and undergraduate courses in modern signal theory and control theory; ECE 504 is recommended.)

Choose 2 or 3 of the following Business courses:

Project Management – MIS 576

This course presents the specific concepts, techniques and tools for managing projects effectively. The role of the project manager as team leader is examined, together with important techniques for controlling cost, schedules and performance parameters. Lectures, case studies and projects are combined to develop skills needed by project managers in today's environment.

Group and Interpersonal Dynamics in Complex Organizations – OBC 500

This practice-based course simulates a complex organization with critical interdependencies at interpersonal, group, and intergroup levels. Students will be asked to make sense of their experiences through class discussions, individual reflection and readings in organization studies. This course is intended to be a student's first course in organizational studies.

Operations Risk Management – OIE 541

Operations risk management deals with decision making under uncertainty. It is interdisciplinary, drawing upon management science and managerial decision-making, along with material from negotiation and cognitive psychology. Classic methods from decision analysis are first covered and then applied, from the perspective of business process improvement, to a broad set of applications in operations risk management and design including: quality assurance, supply chains, information security, fire protection engineering, environmental management, projects and new products. A course project is required (and chosen by the student according to his/her interest) to develop skills in integrating subjective and objective information in modeling and evaluating risk. (An introductory understanding of statistics is assumed.)

Optimization Methods for Business Analytics – OIE 598

This course covers mathematical optimization in greater detail beyond the foundational concepts of linear programming. A variety of optimization problem classes will be addressed, likely including integer programming, nonlinear programming, stochastic programming and global optimization. While ensuring an appropriate level of theory, the main emphasis will be the methodological and computational aspects of solving such problems arising in the operational, manufacturing, and service sectors. Recommended background: Previous course(s) in linear algebra, basic knowledge about optimization and linear programming, or consent of the instructor.

Special Topics in Energy Management – BUS 598

The student and faculty work together to develop a course focused on energy management from a business perspective.

MASTER OF ENGINEERING IN POWER SYSTEMS ENGINEERING

Course Requirements:

- At least 21 total credit hours in Electrical and Computer Engineering (ECE) with at least 12 credit hours in ECE Power Systems Engineering courses
- Must include ECE 5500. Power System Analysis
- Up to 9 credit hours from engineering, mathematics, science or business.

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/me-power-systems-engineering-details**

Power Systems Analysis – ECE 5500

This graduate level course examines the principles of Power System Analysis. It will begin with a review of AC circuit analysis. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power systems stability. (Prerequisites: Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis and basic computer programming.)

Choose up to 4 courses in Power Systems Engineering:

Transients in Power Systems – ECE 5511

This graduate level course introduces the student to the effects of electromagnetic transients in distribution systems. Topics include transient analysis, lightning and switching surges, mechanisms of transient generation, insulation coordination, grounding, surge protection devices, and shielding. (Prerequisite: ECE 5500 Power System Analysis)

Electromechanical Energy Conversion – ECE 5512

This graduate level course will further explore alternating current circuits, three phase circuits, basics of electromagnetic field theory, magnetic circuits, inductance, and electromechanical energy conversion. Topics also include ideal transformer, iron-core transformer, voltage regulation, efficiency equivalent circuit, and three phase transformers. Induction machine construction, equivalent circuit, torque speed characteristics, and single-phase motors, synchronous machine construction, equivalent circuit, power relationships phasor diagrams, and synchronous motors will be covered. Direct current machine construction, types, efficiency, power flow diagram, and external characteristics will be discussed.

Power System Protection and Control – ECE 5520

This graduate level course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint, however, many practical examples and applications are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of power system operation, three-phase system calculations and the representation (modeling) of power system elements. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation are included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. The final course segments cover specific applications such as pilot protection of transmission lines, generator protection and transformer protection. (Prerequisite: ECE 5500 Power System Analysis)

Protective Relaying – ECE 5521

This graduate level course is the first of a two course sequence that covers both the principles and practices of power system protective relaying. The course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of the nature of power system operation, power system faults and other abnormal conditions. The nature and objectives of protective relaying are covered next with emphasis on how the power system can be monitored to detect abnormal conditions. The computational tools needed to analyze system operation and apply protective relaying are covered next, including the per-unit system, phasors and symmetrical components. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation is included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. (Prerequisite: ECE 5500 Power System Analysis or equivalent background experience is suggested. Familiarity with phasors, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis or similar background is recommended. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Advanced Applications in Protective Relaying – ECE 5522

This graduate level course covers advanced topics in the principles and practices of power system protective relaying. The course seeks to provide an understanding of how protective relays are applied to protect power system components. While the subject is presented from a theoretical viewpoint, many practical examples are included. Examples specific to both new installations and existing, older facilities will be included. Course content is not specific to any manufacturer's equipment. The course begins with applications of protective devices to generators. This will include distributed generation as well as wind-turbine and inverter-connected sources. Transformer protection is covered next, including application procedures for older, electromechanical relays as well as modern numeric relay designs. A unit on bus protection is covered next, including all typical high-speed and time backup bus protection schemes. Transmission line and distribution feeder protection is covered in detail including both conventional and communications-assisted schemes. The course ends with a unit on other protection applications such as under frequency load shedding, reclosing and out-of-step relaying. (Prerequisite: ECE 5521 Protective Relaying. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Power System Dynamics – ECE 5523

This graduate level course is concerned with modeling, analyzing and mitigating power system stability and control problems. The course seeks to provide an understanding of the electromechanical dynamics of the interconnected electric power grid. This subject is presented from a theoretical viewpoint; however, many practical examples are included. The course begins with a description of the physics of the power system, frequency regulation during steady-state operation, dynamic characteristics of modern power systems, a review of feedback control systems, power system frequency regulation, and a review of protective relaying. This is followed by material on synchronous machine theory and modeling. Simulation of power system dynamic response, small signal stability, transient stability analysis using SIMULINK and effects of non-traditional power sources on systems dynamics will also be covered. Power system stabilizers, load modeling and under frequency load shedding are covered in the final lectures. (Prerequisite: Familiarity with the basics of Laplace Transforms, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis topics recommended. (ECE 5500 Power System Analysis and ECE 5511 Transients in Power Systems or equivalent background experience is suggested.)

Power Distribution – ECE 5530

This graduate level course introduces the fundamentals of power distribution systems, apparatus, and practices suited to new and experienced utility distribution engineers. Topics include distribution system designs, transformers and connections, practical aspects of apparatus and protection, principles of device coordination, grounding, voltage control, and power quality. (Prerequisites: Prior courses in magnetism and three-phase circuits. An electric machines course would be recommended.)

Power System Operation and Planning – ECE 5531

This graduate-level course deals with modern operation, control and planning for power systems. Topics include: Characteristics of generating units; Economic Dispatch; Unit Commitment; Effects of the transmission system on power delivery; Optimal Power Flow and Location Marginal Pricing; Power System Security; State Estimation for Power Systems; Power System Reliability Evaluation. Software tools such as MATLAB and power system simulator software will be used both in the classroom and in some homework assignments.

Distributed and Renewable Power Generation – ECE 5532

This course introduces the characteristics and challenges of interconnecting increasing numbers of Distributed Energy Resources (DERs) to the Electric Power System (EPS). Topics include: challenges to distribution and transmission system protection; local voltage control; ride through; optimal interconnection transformer configurations; and practical engineering approaches to maintain system reliability and protection. The current and evolving interconnection standard (IEEE 1547) is included. (Prerequisites: ECE 5500 Power System Analysis plus either ECE 5520 Power System Protection and Control or ECE 5521 Protective Relaying. ECE 5530 Power Distribution highly recommended.)

Power Transmission – ECE 5540

This graduate level course focuses on the theory and current professional practice in problems of electric power transmission. It begins with a review of the theory of AC electric power transmission networks and addresses a range of challenges related to reactive power and voltage control as well as steady-state and transient's stability. Students will learn in detail the principles of traditional reactive power compensation (shunt reactors and capacitors); series compensation and modern static reactive compensation like SVC, STATCOM and other Flexible AC Transmission Systems (FACTS) devices. The effects of each of these types of compensation on static and dynamic voltage control, reactive power requirement and steady-state and transient stability problems are covered from theoretical as well as practical aspects. Particular attention is given to the mathematical models and principles of operation of many types of compensation systems. Basic principles of operation and control of High-Voltage DC (HVDC) systems and their impact on steady-state and dynamics of power system will be covered as well. (Prerequisite: ECE 5500 Power System Analysis.)

Choose up to 6 additional credit hours from:

- any Electrical and Computer Engineering graduate course including any of the Power Systems Engineering courses listed above and:

Selected Topics In Computer Engineering – ECE 579

Courses in this group are devoted to the study of advanced topics in computer engineering such as real-time intelligent systems, VLSI design and high-level languages

MASTER OF SCIENCE IN POWER SYSTEMS MANAGEMENT

Course Requirements:

- Power System Analysis – ECE 5500
- At least 9 credits but no more than 12 credits in other ECE Power Systems Engineering courses.*
  **Credit cannot be awarded for ECE 5521 & 5522 if credit for ECE 5520 has been earned.*
- 12 credit hours of management classes.
- **Remaining credit hours may be taken in:**
  - Any graduate level course work in engineering, science, or system dynamics**
  - No more than 15 of the total degree credit hours may be in ECE.

For more information on tuition, or to contact an advisor, please visit: **http://epceonline.org/ms-power-systems-management-details**

Power Systems Analysis – ECE 5500

This graduate level course examines the principles of Power System Analysis. It will begin with a review of AC circuit analysis. The course will then cover the topics of transmission line parameter calculation, symmetrical component analysis, transformer and load modeling, symmetrical and unsymmetrical fault analysis, power flow, and power systems stability. (Prerequisites: Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis and basic computer programming.)

ECE Power Systems Engineering Courses:

Transients In Power Systems – ECE 5511

This graduate level course introduces the student to the effects of electromagnetic transients in distribution systems. Topics include transient analysis, lightning and switching surges, mechanisms of transient generation, insulation coordination, grounding, surge protection devices, and shielding. (Prerequisite: ECE 5500 Power System Analysis)

Electromechanical Energy Conversion – ECE 5512

This graduate level course will further explore alternating current circuits, three phase circuits, basics of electromagnetic field theory, magnetic circuits, inductance, and electromechanical energy conversion. Topics also include ideal transformer, iron-core transformer, voltage regulation, efficiency equivalent circuit, and three phase transformers. Induction machine construction, equivalent circuit, torque speed characteristics, and single-phase motors, synchronous machine construction, equivalent circuit, power relationships phasor diagrams, and synchronous motors will be covered. Direct current machine construction, types, efficiency, power flow diagram, and external characteristics will be discussed.

Power System Protection And Control – ECE 5520

This graduate level course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples and applications are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of power system operation, three-phase system calculations and the representation (modeling) of power system elements. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation are included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. The final course segments cover specific applications such as pilot protection of transmission lines, generator protection and transformer protection. (Prerequisite: ECE 5500 Power System Analysis)

Protective Relaying – ECE 5521

This graduate level course is the first of a two course sequence that covers both the principles and practices of power system protective relaying. The course seeks to provide an understanding of how interconnected power systems and their components are protected from abnormal events such as faults (short circuits), over-voltages, off-nominal frequency and unbalanced phase conditions. This subject is presented from a theoretical viewpoint; however, many practical examples are included that emphasize the limitations of existing protective equipment. Course content is not specific to any manufacturer's equipment. The course begins with a brief review of the nature of power system operation, power system faults and other abnormal conditions. The nature and objectives of protective relaying are covered next with emphasis on how the power system can be

monitored to detect abnormal conditions. The computational tools needed to analyze system operation and apply protective relaying are covered next, including the per-unit system, phasors and symmetrical components. The modeling of current transformers under steady-state and transient conditions is presented with emphasis on the impact on protective devices. A unit on system grounding and its impact on protective device operation is included. Course emphasis then shifts to protective devices and their principles of operation. Both electromechanical and numeric relay designs are covered. (Prerequisite: ECE 5500 Power System Analysis or equivalent background experience is suggested. Familiarity with phasors, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis or similar background is recommended. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Advanced Applications in Protective Relaying – ECE 5522

This graduate level course covers advanced topics in the principles and practices of power system protective relaying. The course seeks to provide an understanding of how protective relays are applied to protect power system components. While the subject is presented from a theoretical viewpoint, many practical examples are included. Examples specific to both new installations and existing, older facilities will be included. Course content is not specific to any manufacturer's equipment. The course begins with applications of protective devices to generators. This will include distributed generation as well as wind-turbine and inverter-connected sources. Transformer protection is covered next, including application procedures for older, electromechanical relays as well as modern numeric relay designs. A unit on bus protection is covered next, including all typical high-speed and time backup bus protection schemes. Transmission line and distribution feeder protection is covered in detail including both conventional and communications-assisted schemes. The course ends with a unit on other protection applications such as under frequency load shedding, reclosing and out-of-step relaying. (Prerequisite: ECE 5521 Protective Relaying. Note: Credit cannot be awarded for this course if credit has already been received for ECE 5520 Power System Protection and Control.)

Power System Dynamics – ECE 5523

This graduate level course is concerned with modeling, analyzing and mitigating power system stability and control problems. The course seeks to provide an understanding of the electromechanical dynamics of the interconnected electric power grid. This subject is presented from a theoretical viewpoint; however, many practical examples are included. The course begins with a description of the physics of the power system, frequency regulation during steady-state operation, dynamic characteristics of modern power systems, a review of feedback control systems, power system frequency regulation, and a review of protective relaying. This is followed by material on synchronous machine theory and modeling. Simulation of power system dynamic response, small signal stability, transient stability analysis using SIMULINK and effects of non-traditional power sources on systems dynamics will also be covered. Power system stabilizers, load modeling and under frequency load shedding are covered in the final lectures. (Prerequisite: Familiarity with the basics of Laplace Transforms, derivatives, transfer functions, poles and zeros, block diagram and the notion of feedback with basic understanding power system analysis topics recommended. (ECE 5500 Power System Analysis and ECE 5511 Transients in Power Systems or equivalent background experience is suggested.)

Power Distribution – ECE 5530

This graduate level course introduces the fundamentals of power distribution systems, apparatus, and practices suited to new and experienced utility distribution engineers. Topics include distribution system designs, transformers and connections, practical aspects of apparatus and protection, principles of device coordination, grounding, voltage control, and power quality. (Prerequisites: Prior courses in magnetism and three-phase circuits. An electric machines course would be recommended.)

Power System Operation and Planning – ECE 5531

This graduate-level course deals with modern operation, control and planning for power systems. Topics include: Characteristics of generating units; Economic Dispatch; Unit Commitment; Effects of the transmission system on power delivery; Optimal Power Flow and Location Marginal Pricing; Power System Security; State Estimation for Power Systems; Power System Reliability Evaluation. Software tools such as MATLAB and power system simulator software will be used both in the classroom and in some homework assignments.

Distributed and Renewable Power Generation – ECE 5532

This course introduces the characteristics and challenges of interconnecting increasing numbers of Distributed Energy Resources (DERs) to the Electric Power System (EPS). Topics include: challenges to distribution and transmission system protection; local voltage control; ride through; optimal interconnection transformer configurations; and practical engineering approaches to maintain system reliability and protection. The current and evolving interconnection standard (IEEE 1547) is included. (Prerequisites: ECE 5500 Power System Analysis plus either ECE 5520 Power System Protection and Control or ECE 5521 Protective Relaying. ECE 5530 Power Distribution highly recommended.)

Power Transmission – ECE 5540

This graduate level course focuses on the theory and current professional practice in problems of electric power transmission. It begins with a review of the theory of AC electric power transmission networks and addresses a range of challenges related to reactive power and voltage control as well as steady-state and transient's stability. Students will learn in detail the principles of traditional reactive power compensation (shunt reactors and capacitors); series compensation and modern static reactive compensation like SVC, STATCOM and other Flexible AC Transmission Systems (FACTS) devices. The effects of each of these types of compensation on static and dynamic voltage control, reactive power requirement and steady-state and transient stability problems are covered from theoretical as well as practical aspects. Particular attention is given to the mathematical models and principles of operation of many types of compensation systems. Basic principles of operation and control of High-Voltage DC (HVDC) systems and their impact on steady-state and dynamics of power system will be covered as well. (Prerequisite: ECE 5500 Power System Analysis.)

Choose 4 of the following School of Business Courses:

Project Management – MIS 576

This course presents the specific concepts, techniques and tools for managing projects effectively. The role of the project manager as team leader is examined, together with important techniques for controlling cost, schedules and performance parameters. Lectures, case studies and projects are combined to develop skills needed by project managers in today's environment.

Group and Interpersonal Dynamics in Complex Organizations – OBC 500

This practice-based course simulates a complex organization with critical interdependencies at interpersonal, group, and intergroup levels. Students will be asked to make sense of their experiences through class discussions, individual reflection and readings in organization studies. This course is intended to be a student's first course in organizational studies.

Operations Risk Management – OIE 541

Operations risk management deals with decision making under uncertainty. It is interdisciplinary, drawing upon management science and managerial decision-making, along with material from negotiation and cognitive psychology. Classic methods from decision analysis are first covered and then applied, from the perspective of business process improvement, to a broad set of applications in operations risk management and design including: quality assurance, supply chains, information security, fire protection engineering, environmental management, projects and new products. A course project is required (and chosen by the student according to his/her interest) to develop skills in integrating subjective and objective information in modeling and evaluating risk. (An introductory understanding of statistics is assumed.)

Optimization Methods For Business Analytics – OIE 598

This course covers mathematical optimization in greater detail beyond the foundational concepts of linear programming. A variety of optimization problem classes will be addressed, likely including integer programming, nonlinear programming, stochastic programming and global optimization. While ensuring an appropriate level of theory, the main emphasis will be the methodological and computational aspects of solving such problems arising in the operational, manufacturing, and service sectors. Recommended background: Previous course(s) in linear algebra, basic knowledge about optimization and linear programming, or consent of the instructor.

Special Topics in Energy Management – BUS 598

The student and faculty work together to develop a course focused on energy management from a business perspective.

Ask an Educational Consultant at: **epceonline.org/educational-consultant**

Clemson University

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING (BSEE)

Course Requirements:

- Courses on Preliminary Application form – 10 courses (36 credit hours)
- Required ECE courses, ECE Technical Electives, and ECE capstone design courses – 18 courses, (54 credit hours)
- ECE laboratories – 7 Laboratory Courses (7 credit hours)
- Other (General Education and Intro. To Engineering): – 13 courses (29 credit hours)

The Electrical Engineering (BSEE) Degree Completion program enables students to enroll in the Clemson University online electrical engineering degree after completing required prerequisite courses. Clemson University offers both the prerequisite and the core engineering online courses required for the BSEE degree online.

For more information on tuition and applying, or to contact an advisor, please visit: **http://epceonline.org/bs-electrical-engineering**

Prerequisite Courses - 36 credit hours

These courses are required to be completed before being accepted into the Engineering courses

- CH 1010 - Chemistry I (4)
- CH 1020 - Chemistry II (4)
- CPSC 1110 - Elem. Comp. Progr. in C/C++ (3)
- ENGL 1030 - Accelerated Composition (3)
- MTHSC 1060 - Calculus of One Variable I (4)
- MTHSC 1080 - Calculus of One Variable II (4)
- MTHSC 2060 - Calculus of Several Variables (4) - strongly recommend before applying
- MTHSC 2080 - Introduction to Ordinary Differential Equations (4) - strongly recommend before applying
- PHYS 1220 - Physics with Calculus I (3)
- PHYS 2210 - Physics with Calculus II (3)
- Other Engineering Courses - 5 credit hours
- Other Mathematics - 3 credit hours
- English and Communications - 6 credit hours
- Arts, Humanities, and Social Sciences - 15 credit hours

ENGR and ECE Courses:

Engineering Discipline and Skills I – ENGR 1050

Provides solid foundation of skills to solve engineering problems. Students demonstrate problem solving techniques with spreadsheets, dimensions and units. Introduces professional and societal issues appropriate to engineering. Includes Honors sections.

Engineering Discipline and Skills II – ENGR 1060

Continuation of topics introduced in ENGR 1050. Students demonstrate problem solving techniques using spreadsheet and modeling techniques, and by interpreting validity of experimental results. Students complete projects on multi-discipline teams. Various forms of technical communication are emphasized. Includes Honors sections.

Programming and Problem Solving I – ENGR 1070

Students formulate and solve engineering problems using MATLAB: estimate answers for comparison to computed solutions; read, interpret and write programs, instructions and output (both written and graphical); and debug. Includes Honors sections.

Programming and Problem Solving II – ENGR 1080

Continuation of topics introduced in ENGR 1070. Students formulate and solve engineering problems using MATLAB; read, interpret and write programs; utilize trendlines; iterate/loops; evaluate and compose conditional statements; and debug. Includes Honors sections.

Programming and Problem Solving Applications – ENGR 1090

Students formulate and solve engineering problems on multi-discipline teams using MATLAB. Various forms of technical communication are emphasized. Includes Honors sections.

Logic and Computing Devices – ECE 2010

Introduction to Boolean algebra and digital logic. Topics include number systems and representation of information; Boolean operators and algebra; expression minimization; combinational circuits, including adders, comparators, decoders and multiplexors; sequential logic, including flip-flops, shift registers, counters and memory. Includes Honors sections.

Electric Circuits I – ECE 2020

Study of DC resistive circuits, Kirchhoff's Laws, Nodal and Mesh emphasis, sources, Thevenin's and Norton's theorems, RC, RL, RCL circuit solutions with initial condition using homogenous or nonhomogenous ordinary differential equations having constant coefficients. Develop sinusoidal steady state solution. Includes Honors sections.

Logic and Computing Devices Laboratory – ECE 2090
Introduction to designing, building, simulating and testing digital logic circuits. Topics include SSI and MSI ICs; general combinational circuits; adders, decoders and multiplexors; general sequential circuits; shift registers, counters and memory. Includes Honors sections.

Electrical Engineering Laboratory I – ECE 2110
Principles of measurement and instruments used to measure parameters and dynamic variables in electric circuits, steady state and transient measurements in DC and AC circuits, and data analysis methods are included.

Electrical Engineering Laboratory II – ECE 2120
Emphasizes measurement techniques in AC steady-state circuits and comparison to theoretical predictions. Two-port network methodology and transfer functions are studied experimentally and related to analysis using transform techniques.

Electric Circuits II – ECE 2620
Continuation of the study of electric circuits, including three-phase circuits, complex frequency and network functions, frequency response, two-port parameters, magnetically-coupled circuits, Laplace transforms, and ideal op amps. Includes Honors sections.

Computer Organization – ECE 2720
Introductory course in computer organization and architecture. Topics include CPUs, memory, I/O, processor families, buses, peripherals, microarchitectures, and instruction sets. Includes Honors sections.

Computer Organization Laboratory – ECE 2730
Laboratory enhances students' understanding of computer organization via assignments involving assembly language programming. Topics include basic syntax, branching and loops, addressing modes, arrays and pointers, subroutines and stacks. Includes Honors sections.

Electrical Engineering Laboratory III – ECE 31130
Measurements and characteristics of electronic devices and circuits; use of manual and automated instruments to acquire data; oral and written engineering reports.

Electronics I – ECE 3200
Introduction to electronic materials and devices; principles of design; design of DC and AC circuits using diodes, bipolar junction transistors, field-effect transistors and use of transistors in digital circuits. Includes Honors sections.

Signals, Systems, and Transforms – ECE 3300
Study of systems models, analysis of signals, Fourier series and transforms, sampling and Z transforms, discrete Fourier transforms. Includes Honors sections.

Electric Power Engineering – ECE 3600
Presents the basic principles of power systems, energy conversion, electromagnetic induction and developed forces. Topics include power and energy concepts and analysis; the basics of electric power generation, transmission, and distribution; synchronous machines, induction motors, and DC motors.

Electromagnetics – ECE 3800
Topics in electrostatics include static electric charge, force, field (Coulomb's and Gauss's laws), flux, potential, energy, dielectrics, boundary conditions, and capacitance. Topics in magnetostatics include steady electric current, magnetic field (Biot-Savart and Ampere's law), force, flux, energy, boundary conditions, and inductance.

Electrical Engineering Laboratory – ECE 3120
Design and characterization of functional circuits using solid-state devices; use of manual and automated instruments for measurements; statistical analysis of data; preparation of engineering reports.

Random Signal Analysis – ECE 3170
Introduction to engineering problems of a probabilistic nature. Systems transformations, statistical averages, simulation, and estimation of system parameters. Includes Honors sections.

Electronics II – ECE 3210
Analysis and design of discrete amplifier circuits at low and high frequencies; operational amplifiers, frequency response, feedback, stability, and applications of analog integrated circuits.

Microcontroller Interfacing – ECE 3710
Discusses the programming and interfacing of microcontrollers in order to control their integrated devices and external peripherals. Topics include memory and I/O; interrupts, counters and timers; ADCs and DACs; PWMs; and parallel and serial communication.

Microcontroller Interfacing Laboratory – ECE 3720
Emphasizes microcontroller programming and interfacing for controlling various types of hardware. Topics include reading and writing to RAM, applications of a digital latch, keypad interfacing, interrupts, clock pulse generation, pulse width modulation, serial interfaces, and A-to-D and D-to-A conversion.

Fields, Waves, and Circuits – ECE 3810
Covers foundation of circuit theory, transmission lines and circuits, plane-wave propagation, radiation, and antennas.

Introduction to Linear Control Systems – ECE 4090
Introduction to classical linear control systems. Topics include continuous and discrete descriptions of systems, time and frequency response, stability, system specification, system design of continuous and discrete systems.

Communications Systems – ECE 4270
Study of communication systems design and analysis. Topics include signals and spectra, baseband signaling and detection in noise, digital and analog modulation and demodulation techniques, communications link budget analysis.

Integrated System Design I – ECE 4950
Considers engineering design of systems in a continuous process of project definition, planning, execution, and evaluation. This process includes consideration of both technical and non-technical factors in design. Strong emphasis is placed on the development of effective technical communications skills, particularly oral communications competency.

Integrated System Design II – ECE 4960
Project-oriented course which brings together electrical and computer engineering students of dissimilar training in teams or project groups. Group assignments are designed to develop an appreciation for individual and creative thinking, as well as team effort.

POWER SYSTEMS ENGINEERING CERTIFICATE

This certificate is for individuals who do not wish to pursue a BSEE degree and are not currently enrolled at another institution. There are three courses are required to complete the certificate.

For more information on tuition and applying, or to contact an advisor, please visit: **http://epceonline.org/power-systems-engineering-certificate**

Electric Power Engineering – ECE 3600
Presents the basic principles of power systems, energy conversion, electromagnetic induction and developed forces. Topics include power and energy concepts and analysis; the basics of electric power generation, transmission, and distribution; synchronous machines, induction motors, and DC motors.

Power System Analysis – ECE 4180
Study of power system planning and operational problems. Topics include load flow, economic dispatch, fault studies, transient stability, and control of problems. System modeling and computer solutions are emphasized through class projects.

Electric Machines and Drives – ECE 4190
Performance, characteristics, and modeling of AC and DC machines during steady-state and transient conditions. Introduction to power electronics devices and their use in adjustable speed motor drives.

RENEWABLE ENERGY CERTIFICATE

This certificate is for individuals who do not wish to pursue a BSEE degree and are not currently enrolled at another institution. There are three courses are required to complete the certificate.

For more information on tuition and applying, or to contact an advisor, please visit: **http://epceonline.org/renewable-energy-certificate**

Fundamentals of Wind Power – ECE 4570
Introduces wind turbine systems, including wind energy potential and application to power generation. Topics include wind energy principles, wind site assessment, wind turbine components, power generation machinery control systems, connection to the electric grid, and maintenance.

Fundamentals of Solar Energy – ECE 4610
Introduces solar energy conversion systems. Topics include environmental benefits of solar energy, solar thermal systems, concentration solar power, photovoltaic (PV) cell design and manufacturing, sizing of PV system, hybrid photovoltaic/thermal systems, energy storage, and urban/rural applications.

Renewable Energy Penetration on the Power Grid – ECE 4200
Introduces the basic definition of electrical power, interfacing primary sources, generator/load characteristics, and renewable energy resources. Topics include solar energy grid interfacing, wind energy grid interfacing, battery charging/management, harmonic distortion, voltage sags, and national standards.

Ask an Educational Consultant at: **epceonline.org/educational-consultant**

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